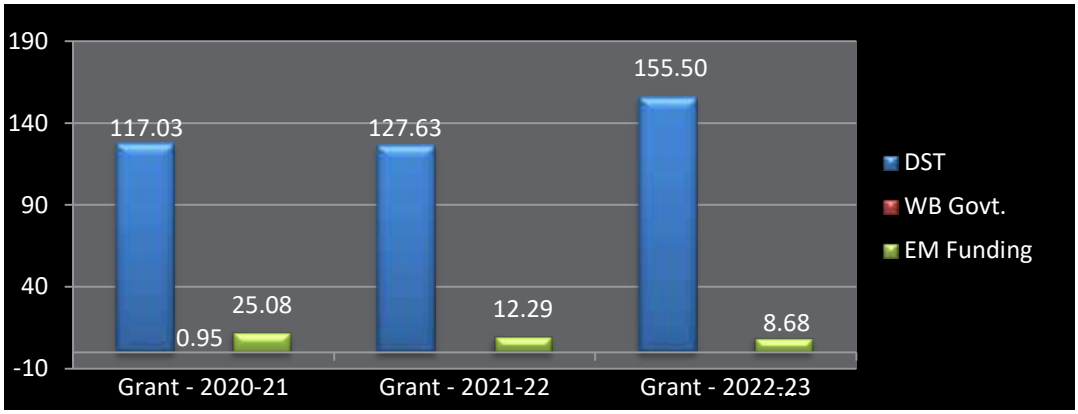
ANNUAL REPORT 2022-23

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

Deemed to be University under *de novo* Category

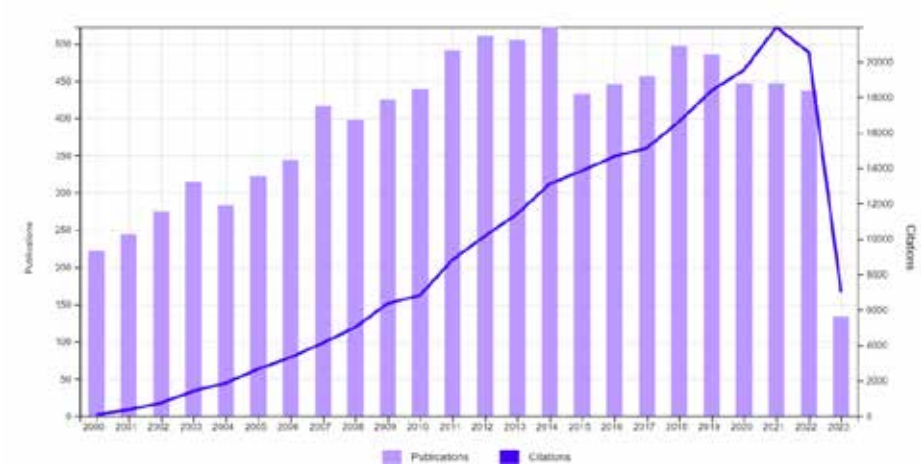
(An Autonomous Institute under Department of Science & Technology, Government of India)



Budget in 2022-2023: DST – 155.50 crores

Web of Science

Citation Report (On 26th May, 2023)



RESULT FOUND 2000-2023

No. of Publications	:	**9,495**
H Index	:	**149**
Sum of the times cited	:	**223,862**
Average citations per item	:	**23.58**
Average citations per year	:	**9327.58**

PERFORMANCE DURING THE YEAR (2022-23)

Publications in Journals	:	**380**
Publications in Book Chapter	:	**10**
Average Impact Factor	:	**7.16**
Ph.D. Degree Awarded	:	**58**
Patent Granted/Awarded	:	**03**
Patent Filed	:	**05**

ANNUAL REPORT 2022-23

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

Deemed to be University under *de novo* Category

CONTENTS

From the Director's Desk

I am honored and privileged to present the Annual Report of the Indian Association for the Cultivation of Science (IACS) for the years 2022-2023. IACS is an autonomous research institute under the Department of Science and Technology, Government of India, and is the symbol of the Bengal Renaissance epitomizing the science and cultural revolution against British Colonialism of 19th century. Enriched by numerous pioneers of Indian science, IACS happens to be an extraordinary institution where the past meets the present and creates the future. Sir C. V. Raman made his historic discovery of the 'Raman Effect', which won him the only Nobel Prize in Science from India and the first from Asia. This age-old institution is still brimming with vitality.To continue the culture of excellence and to break new grounds, it is imperative that the institute explores unchartered avenues and in the process evolves to scale newer heights.

The IACS is bestowed with the new status of de novo Science Research University in 2018 by the Government of India. It is now a pioneering institution providing exceptional research-led education to more than 1000 students from all over the country. Built on the ethos that education can unlock potential and transform lives, IACS features among the top-ranked institutions in the country, and our training enables our graduates to be among the most sought-after in the world.

The funding authorities have been generous; the Governing Council and other statutory bodies of IACS are very supportive and the Government is always keen to help IACS out of its difficulties in maintaining its performance parameters at a commendable scale. I thank them all. In the past year, there had been 380 Publications in Indexed Journals with an average Impact Factor of 7.16 and 08 Book Chapters. 58 Ph.D. Degrees were awarded. 03 Patents were Granted/Awarded and 05 nos. of Patents were filed.

The very high-quality research done by the IACS scientists has been recognized both nationally as well as internationally in the form of numerous laurels and accolades. To name a few it may be mentioned that Professor Abhishek Dey was elected Fellow of the Indian Academy of Science (FASc), Bangalore, and was awarded James Hoeschele Award by, the Asian Society for Biological Inorganic Chemistry; Dr.Anindita Das was awarded DAE-BRNS Young Scientist Award 2022; Associate of the Indian Academy of Sciences 2022; Editorial Board Member of the Journal of Macromolecular Science (Part A: Pure and Applied Chemistry since 2022;

Taylor & Francis); Prof. Somobrata Acharya was elected Fellows of both the National Academy of Sciences (FNASc) and Indian Academy of Sciences, (FASc), Bangalore; Professor Debashree Ghosh was awarded SERB-POWER Fellowship (SERB) and prestigious Walter Kohn Prize by ICTP, Italy, and Professor PK Bose Memorial Award, Indian Chemical Society.She has been elected as an Editorial Advisory Board Member of several journals like, Chemical Society Reviews, RSC; Journal of Chemical Theory and Computation, ACS; Journal of Physical Chemistry A/B/C, ACS, and also elected as Sectional Editor, Journal of the Indian Chemical Society. Prof. Pradyut Ghosh was awarded Silver Medal 2023 by, the Chemical Research Society of India (CRSI). Dr. Praveen Kumar was elected Member, of Global Young Academy (GYA) 2023-2028 and Advisory Panel Member, Nanotechnology (IOP) 2022.He has been selected for the Fulbright-Nehru Academic and Professional Excellence Fellowships 2022 and elected as the Chair, Career Development Working Group, (2022-2024), Marie Curie Alumni Association (MCAA).Prof. Asim Bhowmik Ranked 12 among the best Chemistry Scientists in India. Prof. Prasanta Kr. Das was elected as the Fellow of the Royal Society of Chemistry (FRSC). Prof. Rajib Kr. Goswami was awarded Bronze Medal from the Chemical Research Society of India, in 2023. Prof.Tapan Kanti Paine was elected as an Editorial Advisory Board Member of Transition Metal Chemistry, Springer Nature. Prof. Shyamal Kr. Saha became a Fellow of the Institute of Physics (UK) and Visited Kun-Shan University, Taiwan as Visiting Professor (April 18-October 17, 2022). Prof. Sourav Roy was elected as Honorary Associate Editor ofthe Indian Journal of Physics. Prof. Sudip Malik was awarded the 12th POLYMER Foundation Award, Prof. Sukumar Maiti Polymer Award Foundation. Prof. Suhrit Ghosh was awarded CNR Rao National Prize for Chemical Research (2023), CRSI. Dr. Sumanta Chakraborty was awarded the Young Scientist Award by Central Calcutta Science and Culture Organization for Youths and Department of Science and Technology, Government of West Bengal.

The year 2022-2023 is a special one for celebrating 'Azadi Ka Amrit Mahotsav', an initiative of the Government of India to celebrate and commemorate 75 years of independence of progressive India and the glorious history of its people, culture, and achievements. IACS actively and enthusiastically participated in the various activities under 'आजादी का अमृत महोत्सव' in a befitting way. Commemorating the occasion, numerous lectures and colloquia were delivered by eminent speakers such as Prof. Sunanda Banerjee, INSA Senior Scientist, IACS, Kolkata; Prof. Ajoy Ghatak, Optics & Photonics Centre, IIT Delhi; Prof. Urbasi Sinha, RRI, Bangalore; Prof. Sumitendra Mazumdar, Department of Physics, University of Arizona, USA; Prof. Mukundan Thelakkat, Applied Functional Polymers, University of Bayreuth Bavarian Polymer Institute (BPI), Bavarian Centre for Battery Technology (BayBatt) Bayreuth, Germany; Dr. M. Manoharan, Alnylam Pharmaceuticals, Cambridge, MA; Prof Gautam R Desiraju, SSCU, IISC Bangalore, and Prof. Amalendu Chandra, Department of Chemistry, IIT Kanpur.

Distinguished scientists delivered Endowment Lectures over the last year. They were Prof. Bernhard Keimer, Max Planck Institute for Solid State Research, Stuttgart, Germany delivered Mahendra Lal Sircar Memorial Endowment Lecture; Prof. Asit Kumar Chakraborti delivered the Dr. Nitya Anand Endowment Lecture of the Indian National Science Academy (INSA)

It will be our endeavor to continue to do high-quality blue-sky as well as translational research and impart quality education in basic science in the areas of Biology, Chemistry, Mathematics, Computer Science, and Physics at the under- and post-graduate levels. It will be of utmost importance for us to maintain a very cordial atmosphere inside the campus so that we can flourish better. We also, expect able guidance from our Administrative Ministry and Governing council to pursue our endeavors very smoothly.

My heartiest thanks to the members of the Annual Report Committee for their tireless efforts to bring out this issue of the Annual Report on time.

I congratulate all the members of the IACS family for completing one more outstanding year of excellent work.

Thank you all.

Ranjan Sen
Director

From the Deans

I am very happy to report another very productive academic year steered by the faculty members of the Indian Association for the Cultivation of Science (IACS). At present there are 67 permanent faculty members and there are 18 other academic members primarily consisting of superannuated faculties from IACS and also from other institutes to help the teaching program of IACS. In the year 2022-23, the institute was involved in several academic activities that included the teaching activity of the IACS University as well as research activities that look very impressive in terms of publications, obtaining extramural grants, scientific collaborations, hosting national and international conferences, workshops, schools, organizing outreach programmes etc.

Our faculty members continued to publish in top quality international journals. In the last fiscal year, the total number of papers published was 380 with an average impact factor of 7.16 making IACS best among the DST institutes and 7th among the institutes in India as reported in the Nature Index-2023. In the current year 25 new extramural projects by various funding agencies including industry were sanctioned in addition to 132 ongoing projects. The tenure of the Technical Research Centre funded by DST was extended which will not only promote translational research but also encourage academia-industry collaboration. Faculty members of IACS submitted 05 patent applicatons and 03 patents were granted. The faculty members delivered several lectures/ seminars in national and international conferences/ schools and also participated in the outreach programs.

In particular, in the framework of the Science for Equity, Empowerment & Development (SEED) project several traning seesions and outreach activities were organised for the underprivileged ST students in various remote places. Throughout the year, the Institute organized numerous seminars, colloquiums, workshops and schools. Like every year the six schools of IACS organized focussed conferences involving reputed national and internatonal speakers. The ongoing collaborations with various institutions in India and abroad in terms of academic visits and exchange programmes continued. The research infrastructure was boosted by the procurement of a high-resolution TEM, NMR, SQUID magnetometer, EPR, Optical Lithography and a Seahorse Bioanalyzer. The upgradation of the research infrastructure has been possible due to the generous funding received from the administrative ministry.

In view of their excelent performance, several young faculty members were promoted to the next level.

I applaud all the faculty members who received various awards and fellowships for their tireless work and sustained effort to take IACS to a newer height.

Finally, I congratulate all my colleagues for completing one more academically successful and productive year.

Indra Dasgupta
Dean (Faculty Affairs and R&D)

I am happy to put on record significant success achieved in streamlining functional aspects of administrative processes and procedures during 2022-'23. The work pertaining to audit and accounts, salary and establishment, sanction of funds, process of tendering are now routinely done in the online mode with layers of security protocols in-place. This has brought us closer to establishing complete e-governance in all aspects of functioning of IACS. The transparency and accountability have vastly improved. We have made some progress towards the revision of the pay scales and allowances of our technical and administrative colleagues taking due care of the sensitivity and emotional factors connected with this legacy issue with cooperation of everyone connected with administration. We hope to break the impasse and resolve all issues in the months ahead with empathy and understanding.

Satrajit Adhikari
Dean (Administration & Finance)

Office of the Dean Academic looks after all academic affairs of the institute, including students admission (advertisement, interview and all other related task), research fellowship (IACS and external), preparing academic calendar and running courses, communication with course instructors, research progress monitoring and comprehensive examination of PhD students, PhD registration, thesis colloquium, thesis submission, thesis evaluation and viva-voce, issuing provisional degree certificate and different other certificates to the students, Annual Convocation (partial responsibility together with the Office of the Director and Registrar) and other academic matters. Advertisement, appointment and fellowship disbursement of research associates are also done by this office. Dean (Academic) is assisted by Academic Coordinators (PhD, UG-PG and Result) for running the academic programs of the institute. Day to day work of the academic office is supervised by the in-charge, academic office, who is assisted by five staff members.

In the year 2022, students' admission for the Integrated BS-MS and MS/ Integrated MS-PhD program of IACS was conducted in two-steps. A national level written test was conducted for BS-MS (UPST) as well as MS-Integrated PhD (MPST) admission. Test centers were spread in different major cities across India. In the year 2022, 628 students appeared for the UPST while 1251 students appeared for the MPST. Students, short listed based on UPST or MPST, were called for interview and based on their performance in both the written test as well as in the interview, the final merit list was prepared. 53 students were admitted in the MS-Integrated PhD program while 31 students were admitted in the BS-MS program. PhD admission window was opened two times in the year, prior to the commencement of the Autumn and Spring semesters. Together 71 students took admission for the PhD program in 2022-23. In the 2nd Annual Convocation of IACS, held on 30th July, 2022, 13 students received PhD degree while 44 students received MS degree. Four students received Silver Medal for securing highest CGPA in their respective Schools while one student received the Gold Medal for securing highest CGPA among all MS degree recipients.

Suhrit Ghosh
Dean (Academic)

Greetings from the Office of the Dean of Student Affairs!

Conferred with the Deemed-to-be University status, IACS started several new teaching programs in 2018. With the introduction of the Integrated Bachelor's-Master's (BS-MS) and Master's/Integrated Master's-PhD programs, the culture of the campus community witnessed a paradigm shift. Currently, IACS is proud to provide high-quality research-focused education and a memorable learning experience for around 800 students nationwide. As the Dean of Student Affairs, my job is to support our students during challenging situations and create a campus environment where all students feel a strong sense of belonging. We are committed to diversity, equality, inclusion, and social justice on campus. Through this environment, we try to inculcate a culture of openness and respect for each other. All these we do for the success of our students and to help them lead lives with integrity, creativity, courage, and happiness. While this is difficult considering the diversity in the student community, it is hard work of all concerned associated with matters related to the welfare of our students.

The Office of the Dean of Student Affairs actively coordinates with the administration, faculty, staff members, and student community for different cocurricular activities to articulate their creativity and shape their aspirations. Other than lectures/symposia on academic and social issues, events such as cultural meet, Yoga programs, meditation, mental health and psychological counseling sessions, quizzes, and essay competitions are organized throughout the year. These provide ample opportunities to explore and nurture their talents and improve campus life besides their regular academic activities. In addition, academic counseling sessions are organized to help students to prepare for the next phase of their academic/research journey.

In 2022-2023, 44 Master's students and 58 PhDs received their degrees. Their placement record in academic research and the R&D sector proved our graduates to be among the most sought-after in the world. Our graduates are our ambassadors to different parts of the country and abroad. We are committed to being in touch with them through alumni activities and e-newsletters. In addition, our primary focus will be strengthening the academic counseling, training, and placement cell.

The academic year 2022-2023 was challenging as full offline academic activities started after the pandemic subsided. It was a relief for our students when they returned to the campus after going through the immense mental agony of sitting at home and doing coursework online. While most students immediately adjusted to campus life again, our team tried to provide the necessary support to others. I thank all my colleagues for their help in overcoming the difficult situation.

Despite several difficulties and challenges faced by us in a young university, we will continue excelling in providing opportunities and infrastructure for the overall development of students and creating an ecosystem for the students to thrive and succeed.

Once again, I thank all who supported our students on their academic journey at IACS.

Tapan Kanti Paine
Dean (Student Affairs)

From the Registrar's Desk

I feel delighted to see that IACS has completed one more successful year, vibrant with full of academic, administrative, technical, professional, social and cultural activities throughout the year. It was wonderful to see our IACS in full of life and vigour, full of students and staff buzzing with ambition and anticipation as to what the year had in store for them.

The pages in this Annual Report will make each one of us associated with IACS feel proud of our many achievements and successes in the respective domains and realms.

The Annual Convocation held to formally mark the graduation of our students had been organized in a spectacular style. Being able to celebrate their success alongside their family and friends was such a memorable occasion.

Students are at the heart of everything we do at IACS and we are committed to providing them with the opportunities, support and experiences that will enable them to forge a fulfilling and successful career once they graduate.

While IACS strives for the luminous research and teaching by the faculty members which the Annual Report speaks in its every page, I take this opportunity to record the brilliant support my administrative and technical colleagues have extended to help the faculty members and the students achieve their targeted goals and aspirations. Despite passing through a challenging time which remains unresolved till date, they made sure that the glory and repute of the Institute do not get affected. They carried out all their jobs having clear focus on timebound deliverables. Their work cannot be described in every detail; but they all worked silently as vital organs in giving IACS a peaceful and hasslefree life. All the Government mandated functionalities, including GeM, PFMS, TSA, ZBSA, LIMBS, Government Land Information System, etc, have been put in place. The audit visits and inspections could be carried out smoothly only for their relentless support and efforts. All the UGC directed programs and sessions were organized and attended. The staff members have been consistently showing their interest in enhancing their skills and aptitude and updating their knowledge by attending training and skill development programs.

The Administration, Establishment, Accounts, Projects Accounts, Academic Office, Engineering Workshop, Library, CSS, CCRES, all have been wonderful in ensuring smooth running of the Institute, helping the students and the faculty members in completing their official formalities without taking away their quality academic time and giving a One Institute-One Family kind of feeling. We have made automations to the maximum extent possible that makes the functioning seamless, unbiased and modern. Efforts of each one individual associated with all the Administrative and Technical Wings have given IACS a green, clean and safe campus having perfect academic ambience and tranquility. Many of their accomplishments are remarkable and engender a true sense of pride, clearly demonstrated throughout this report.

The progress we have made in striving towards our vision, and the achievements outlined in the Academic Report, would not be possible without the talent, expertise, commitment and passion of our staff. I would like to take this opportunity to thank them for their invaluable contribution to the Institute.

Our administrative and technical colleagues and the students have organized and participated in many social and cultural events and their performances have been recognized through many awards and accolades. Mr. Supriyo Chakraborty was invited for delivering lectures on TEM at National Workshop and Conference at Burdwan University, IIEST Guwahati, imparted Lecture and Technical Session at National Workshop on TEM, Burdwan University where he had been rated highest by the participating delegates. Many of the technical colleagues got Co-Authorship in Publications from Eminent Scientists in International Peer-reviewed Journal for effective contributions to their scientific research.

The Chairman, the Director, the Administrative Ministry, the Government Council and the Academic Council have throughout supported the entire positive, futuristic and developmental endeavor in making IACS a prominent institution of eminence.

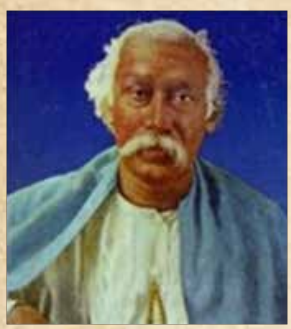
The approach of the authorities at the helms has been driven by a sense of justice and the view that each person must be able to fulfill their potential. Our success as a university and, indeed, our success as a society – socially, academically, and culturally – depends on every individual succeeding, irrespective of category or background. We feel proud to be playing our part in making that happen.

All of this work is underpinned by a One Institute ethos, and we have continued to make progress towards our goal of building a diverse community of faculty, staff and students and creating an inclusive, supportive and collaborative environment.

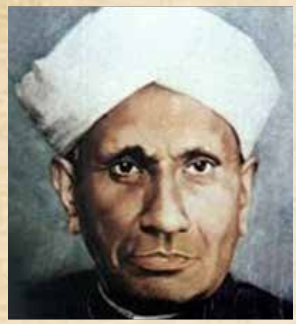
Sarbani Saha

Sarbani Saha
Registrar

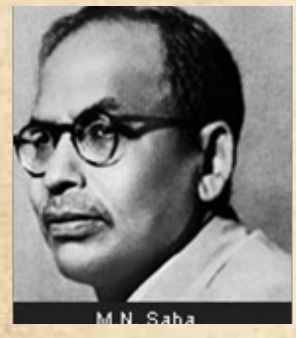
The Past Glory



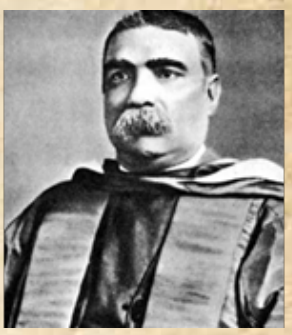
IACS is the oldest research institute in India. **Dr. M.L. Sircar** (1833-1904), a medical practitioner, founded IACS in 1876 to cultivate science in all departments. In the first 50 years, IACS was run only by donations received from individuals like Vidyasagar, Maharaja of Vijianagram, KalikrishnaTagore and others.



Original research at IACS was started in 1907 by **C.V. Raman**. Raman came to Calcutta as Assistant Auditor General of Government of India and started working at IACS outside office hours and holidays. The Raman Effect was discovered in 1928 for which Raman received the 1930 Nobel Prize in Physics. Raman was a Palit Professor of Physics of Calcutta University from 1917-1933 but he carried out all his research at IACS. Raman discovered the small angle X-ray.



After Independence, **M.N. Saha**, FRS (1893-1956, discoverer of Saha Ionization Formula) played a big role in making IACS as a full-fledged research institute. With the help of Dr. B.C. Ray, CM/WB and Pandit J.L. Nehru, PM, Saha built the present campus at Jadavpur. Saha was the first Director of IACS (1953-1956).



In the initial period Father Lafonte took major steps in teaching and building laboratories. **J.C. Bose**, FRS (1858-1937, inventor of microwave communication) and **Asutosh Mukherjee** (1864-1924), first Indian to publish a Paper in 1881) were among first lecturers of IACS.

S.N. Bose, FRS (1894-1974) (discoverer of the Bose Statics) joined IACS as a National Professor in 1958.

In 1933, Raman left IACS to join IISc, Bangalore as its first Indian Director. Before leaving Calcutta, he appointed **K.S. Krishnan**, FRS (1898-1961), co-discoverer of Raman Effect) as the first MLS Professor.

Professor **Kedareswar Banerjee** (1900-1975) was a world renowned X-ray crystallographer and he served as Director of IACS from 1959 until his retirement in 1965. He was the founder of crystallography in India and proposed a new approach to the crystallographic phase problem, which heralded the extremely powerful direct methods of crystallography of the modern era.

Professor Amal Kumar Raychaudhuri (1924-2005) was an acclaimed theoretical physicist well known for his seminal work on relativity and cosmology. He worked as a research scholar at IACS (during 1940's) and later took a research job at the institute. He is most well known for the Raychaudhuri equation which describes the gravitational attraction for pressure-free matter, showing the repulsive nature of a positive cosmological constant, and underlying the basic singularity theorem.

Professor Phanindra Chandra Dutta (1912-1983) took over the charge as the Head of the Department of Organic Chemistry at IACS in 1953 and guided the destiny of the Department for more than two decades. He introduced in our country for the first time the stereo controlled synthesis of organic molecules related to terpenoids and variety of other natural products.

Professor Santi Ranjan Palit (1912-1981) joined IACS in 1947 as a head of the Department of Physical chemistry and got actively engaged himself with all his vigour and enthusiasm in the development plan of the Association. He made significant contributions in many areas of physical chemistry as well as polymer chemistry. His contributions in the field of polymer chemistry are of lasting importance and he is justifiably regarded as the father of polymer research in India.

Professor Priyada Ranjan Ray (1958) was a renowned inorganic chemist who served as the Director of IACS. He is particularly well known for his seminal work on rhombic twist mechanism (Ray Dutt Twist), coordination chemistry stabilization of metal ions in unusual oxidation states and so on.

Suri Bhagavantam (1909-1989), impressed by the discoveries of Sir C.V. Raman, relocated to Calcutta and joined him in 1928 at IACS. After the Nobel Prize-winning discovery, Raman chose Bhagavantam as his collaborator to further his research work. Till the early decades of this century the IACS was the only place in India where high level research in Physical Sciences could be carried out. Prof. Bhagavantam was among the many distinguished scientists of modern India who carried out research at IACS to enrich the scientific research culture of India. In 1957, he became the Director of the Indian Institute of Science in Bangalore. He was then appointed as the scientific adviser to the Government of India under the Ministry of Defence and then joined as the Director of the Defence Research and Development Organisation (DRDO) in 1962 after the Indo-Chinese War. Professor Bhagawantam wrote the well known book titled The Theory of Groups and its Physical Applications along with Venkata Rayudu. This book was published in three editions and was translated into Russian. It is often said that a whole generation of spectroscopists are brought up on this book. He also wrote the book titled Scattering of Light and Raman Effect.

Distinguished Alumni and Associates

NOBEL LAUREATE

» Sir C.V. Raman(1888–1970,former faculty of IACS)

BHARAT RATNA (HIGHEST CIVIL HONOR IN INDIA)

» Sir C.V. Raman(1888–1970, former faculty of IACS)

» Prof. C.N.R.Rao (former Chairman of the Review Committee of IACS and IACS Fellow)

FELLOW OF THE ROYAL SOCIETY (FRS), LONDON

» Sir C.V. Raman(1888–1970, former faculty of IACS)

» Prof .Meghnad Saha (1893-1956, former faculty and Director of IACS)

» Sir J.C. Bose (1858-1937, former faculty of IACS)

» Prof. K.S.Krishnan (1898-1961, alumnus former faculty of IACS)

» Prof. S.N.Bose (1894-1974,former faculty of IACS)

» Prof. A.P. Mitra (1927-2007, former Chairman of the IACS Council)

» Prof. C.N.R. Rao (former Chairman of the Review Committee of IACS and IACS Fellow)

» Prof .M.M. Sharma (former Chairman of the IACS Governing Council and IACS Fellow)

» Prof. TV Ramakrishnan (IACS Fellow)

» Prof. Ajay Sood (IACS Fellow)

PADMA VIBHUSHAN (CIVIL HONOR IN INDIA):

» Prof. C.N.R. Rao (former Chairman of the Review Committee of IACS and IACS Fellow)

» Prof. M.M. Sharma (Chairman of the IACS Governing Council and IACS Fellow

PADMA BHUSAN (CIVIL HONOR IN INDIA):

» Prof. K.S.Krishnan (1898-1961, alumnus and former faculty of IACS)

» Prof. M.M. Sharma (Former Chairman of the IACS Governing Council and IACS Fellow)

» Prof. Sisir Kumar Mitra

PADMA SHRI (CIVIL HONOR IN INDIA):

» Prof. A.K.Barua (former faculty and Director of IACS)

» Prof. G. Mehta

» Dr. Srikumar Banerjee

ALEXANDER VON HUMBOLDT RESEARCH AWARD

» Prof. D. Mukherjee (former student, faculty and Director of IACS)

FELLOW OF THE WORLD ACADEMY OFSCIENCES (FTWAS)

» Prof. C.N.R. Rao (former Chairman of Review Committee of IACS and IACS Fellow)

» Prof. D. Mukherjee (former student, faculty and Director of IACS)

» Prof. D.D. Sarma (former faculty of IACS)

» Prof. K Bhattacharyya (former student, faculty and Director of IACS)

» Prof. Santanu Bhattacharya (former Director of IACS)

» Prof. T. Saha Dasgupta (former faculty of IACS)

TWAS PRIZE

» Prof. C.N.R. Rao (former Chairman of Review Committee of IACS and IACS Fellow)

» Prof. Animesh Chakravorty (former faculty of IACS)

» Prof. D.D. Sarma (former faculty of IACS)

» Prof. K. Bhattacharyya (former student, faculty and Director of IACS)

» Prof. Santanu Bhattacharya (former Director of IACS)

SHANTI SWARUP BHATNAGAR (SSB) PRIZE

» Prof. K.S. Krishnan (1898-1961, received in 1958, former faculty of IACS)

» Prof. S. Basu (1922–1992,received in 1965, former faculty of IACS)

» Prof. U.R. Ghatak (1931-2005, received in 1974, former Director and faculty of IACS)

» Prof. C.K. Majumdar (1938-2000, received in 1975, former faculty of IACS)

» Prof. C.N.R. Rao (former Chairman of Review Committee of IACS and IACS Fellow)

» Prof. Animesh Chakravorty (received in 1975, former faculty of IACS)

» Prof. M. Chowdhury (receivedin1977, former faculty of IACS)

» Prof .D. Mukherjee (received in 1987, former student, faculty and Director of IACS)

- Prof. M. Ray (received in 1989, former faculty of IACS)
- Prof. D.D. Sarma (received in 1994, former faculty of IACS)
- Prof. K. Bhattacharyya (received in 1997, former student, faculty and Director of IACS)
- Prof. Akhil R. Chakravarty (received in 1998, former student of IACS)
- Prof. D.S. Ray (received in 1999, former student and faculty of IACS)
- Prof. Sourav Pal (received in 2000, former student of IACS)
- Prof. Santanu Bhattacharya (received in 2003, former Director, IACS)
- Prof. Samaresh Bhattacharya (received in 2005, former student of IACS)
- Prof. Pradyut Ghosh (received in 2015, present faculty of IACS)
- Prof. Krishnendu Sengupta (received in 2012, present faculty of IACS)
- Prof. P.S. Mukherjee (received in 2016, former student of IACS)
- Prof. Tapas Maji (received in 2019, former student of IACS)
- Prof. Jyotirmayee Dash (received in 2020, present faculty of IACS)

FELLOW OF THE INDIAN NATIONAL SCIENCE ACADEMY (FNA)

- Sir C.V. Raman (1888–1970, former faculty of IACS)
- Prof. K.S. Krishnan (1898-1961, former faculty of IACS)
- Prof. K. Banerjee (1900–1975, former faculty of IACS)
- Prof. S.D. Chatterjee (1909-1995, former faculty of IACS)
- Prof. S.R. Palit (1912-1981, former faculty of IACS)
- Prof. D. Basu (1917-2005, former faculty and Director of IACS)
- Prof. S. Basu (1922–1992, former faculty of IACS)
- Prof. P.C. Dutta (1912-1971, former faculty of IACS)
- Prof. U.R. Ghatak (1931-2005, former faculty and Director of IACS)
- Prof. Akshayananda Bose (1911-1997, former faculty of IACS)
- Prof. Amal K. Raychaudhuri (1923-2005, former faculty of IACS)
- Prof. Sushil K. Mukherjee (1914-2006, former president of IACS)
- Prof. Priyada Ranjan Ray (1888-1982, former faculty and Director of IACS)
- Prof. M. Chowdhury (1937-2017, former faculty of IACS)
- Prof. C.N.R. Rao (former Chairman of Review Committee of IACS and IACS Fellow)
- Prof. Animesh Chakravorty (former faculty of IACS)
- Prof. D. Mukherjee (former student, faculty and Director of IACS)
- Prof. K. Bhattacharyya (former student, faculty and Director of IACS)
- Prof. Santanu Bhattacharya (former Director of IACS)
- Prof. B.C.Ranu (former student and faculty of IACS)
- Prof. A. Ghosh (former faculty of IACS)
- Prof .D.S.Ray (former student and faculty of IACS)
- Prof. D.D. Sarma (former faculty of IACS)
- Prof. R.N .Mukherjee (former student of IACS)
- Prof. Akhil R. Chakravarty (former student of IACS)
- Prof. Sourav Pal (former student of IACS)
- Prof. A. Samanta (former student of IACS)
- Prof. K. Nag (former faculty of IACS)
- Prof. Subrata Ghosh (former faculty of IACS)
- Prof. S. Goswami (former faculty of IACS)
- Prof. A.J. Pal (former faculty of IACS)
- Prof. P. Ghosh (present faculty of IACS)
- Prof. K. Sengupta (present faculty of IACS)
- Dr. R. Sen (present Faculty and Director of IACS)

FELLOW OF THE INDIAN ACADEMY OF SCIENCES (FASc)

- Sir C.V. Raman (1888–1970, former faculty of IACS)
- Prof. K. Banerjee (1900–1975, former faculty of IACS)
- Prof. S. Basu (1922–1992, former faculty of IACS)
- Prof. P.C. Dutta (1912-1971, former faculty of IACS)
- Prof. U.R. Ghatak (1931-2005, former faculty and Director of IACS)
- Prof. K.S. Krishnan (1898-1961, former faculty of IACS)
- Prof. S.R. Palit (1912-1981, former faculty of IACS)
- Prof. Amal K. Raychaudhuri (1923-2005, former faculty of IACS)

- Prof. M. Chowdhury (former faculty of IACS)
- Prof. C.N.R. Rao (former Chairman of Review Committee of IACS and IACS Fellow)
- Prof. Animesh Chakravorty (former faculty of IACS)
- Prof. R.N. Mukherjee (1999, former student of IACS)
- Prof. Akhil R. Chakravarty (1995, former student of IACS)
- Prof. Sourav Pal (1996, former student of IACS)
- Prof. A. Samanta (2003, former student of IACS)
- Prof. Samaresh Bhattacharya (2006, former student of IACS)
- Prof. M. Durga Prasad (2012, former student of IACS)
- Prof .D.D. Sarma (1993, former faculty of IACS)
- Prof. Surajit Sengupta (2006, former faculty of IACS)
- Prof. Jayanta K Bhattacharjee (1993, former faculty of IACS)
- Prof .A.K. Barua (1987, former faculty and Director of IACS)
- Prof. G.K .Lahiri (2005, former student of IACS)
- Prof. S.P. Bhattacharya (1993, former student and faculty of IACS)
- Prof .D. Mukherjee (1987, former student, faculty and Director of IACS)
- Prof. Santanu Bhattacharya (2000, former Director of IACS)
- Prof. K. Bhattacharyya (1997, former student, faculty and Director of IACS)
- Prof. D.S. Ray (1995, former student and faculty of IACS)
- Prof. B.C. Ranu (1995, former student and faculty of IACS)
- Prof. A. Ghosh (2009, former faculty of IACS)
- Prof. K. Nag (1992, former faculty of IACS)
- Prof. Subrata Ghosh (1998, former faculty of IACS)
- Prof. S. Goswami (2004, former faculty of IACS)
- Prof. A.J. Pal (2010, former faculty of IACS)
- Prof. A.K. Nandi (2009, former faculty of IACS)
- Prof. B.N. Dev (2006, former faculty of IACS)
- Prof. T. Chakraborty (2015, present faculty & Director of IACS)
- Prof. K. Sengupta (2012, present faculty of IACS)
- Prof. A.Patra (2016, present faculty of IACS)
- Prof. A. Banerjee (2015, present faculty of IACS)
- Prof. Pradyut Ghosh (2016, present faculty of IACS)
- Prof. P.K. Das (2017, present faculty of IACS)
- Prof. Tapas K. Maji (2018, former student of IACS)
- Prof. P.S. Dastidar (2018, present faculty of IACS)
- Prof. N. Pradhan (2019, present faculty of IACS)
- Prof. P.S. Mukherjee (former student of IACS)
- Prof. J. Dash (2021, present faculty of IACS)
- Dr. R. Sen (present Faculty and Director of IACS)
- Prof. S. Acharya (present faculty of IACS)

FELLOW OF THE NATIONAL ACADEMY OF SCIENCES (FNASc)

- Prof. M.N. Saha (1893-1956, former faculty, Director of IACS
- Prof .K.S. Krishnan (1898-1961, former faculty of IACS)
- Prof. Amal K. Raychaudhuri (1923-2005, former faculty of IACS)
- Prof. C.N.R. Rao (former Chairman of Review Committee of IACS and IACS Fellow)
- Prof. B.P. Chatterjee (former faculty of IACS)
- Prof. Jayanta K Bhattacharjee (former faculty of IACS)
- Prof. D.D. Sarma (former faculty of IACS)
- Prof. Sourav Pal (former student of IACS)
- Prof. A. Samanta (former student of IACS)
- Prof. D. Mukherjee (former student, faculty and Director of IACS)
- Prof .K. Bhattacharyya (former student, faculty and Director of IACS)
- Prof. D.S. Ray (former student and faculty of IACS)
- Prof. S. SenGupta (present faculty of IACS)
- Prof. B.N. Dev (former faculty of IACS)
- Prof. A.J. Pal (former faculty of IACS)
- Prof. K. Sengupta (present faculty of IACS)
- Prof .A. Patra (present faculty of IACS)
- Prof. S. Adhikari (present faculty of IACS)
- Prof. Benu Brata Das (present faculty of IACS)
- Prof. D. Basak (present faculty of IACS)
- Prof. N. Pradhan (present faculty of IACS)
- Dr. R. Sen (present Faculty and Director of IACS)
- Prof. S. Acharya (present faculty of IACS)
- Prof. D. Basak (present faculty of IACS)

G.D. BIRLA AWARD FOR SCIENTIFIC RESEARCH

» Prof. D.D.Sarma (former faculty of IACS)
» Prof. Santanu Bhattacharya (former Director of IACS)

JC BOSE FELLOWSHIP, DST

» Prof. D. Mukherjee (former student, faculty and Director of IACS)
» Prof. D.D. Sarma (former faculty of IACS)
» Prof. K. Bhattacharyya (former student, faculty and Director of IACS)
» Prof. R.N. Mukherjee (former student of IACS)
» Prof. Santanu Bhattacharya (former Director of IACS)
» Prof. Sourav Pal (former student of IACS)
» Prof. A. Samanta (former student of IACS)
» Prof. B.C.Ranu (former student and faculty of IACS)
» Prof. S. Goswami (former faculty of IACS)
» Prof. S. Ghosh (former student and faculty of IACS)
» Prof. A. Ghosh (former faculty of IACS)
» Prof. A.J. Pal (former faculty of IACS)
» Prof. D.S. Ray (former faculty of IACS)
» Prof. P. Ghosh (present faculty of IACS)
» Prof. K. Sengupta (present faculty of IACS)
» Prof. J. Dash (present faculty of IACS)
» Dr. R. Sen (present Faculty and Director of IACS)

B. M. BIRLA SCIENCE PRIZE

» Prof. Santanu Bhattacharya (former Director of IACS)
» Prof. G.K. Lahiri (former student of IACS)
» Prof. Arindam Banerjee (present faculty of IACS)
» Prof. P.K. Das (present faculty of IACS)
» Prof. Pradyut Ghosh (present faculty of IACS)
» Prof. Suhrit Ghosh (present faculty of IACS)
» Prof. Ayan Datta (present faculty of IACS)

SWARNAJAYANTI FELLOWSHIP, DST

» Prof. Santanu Bhattacharya (former Director of IACS)
» Prof. Narayan Pradhan (present faculty of IACS)
» Prof. Pradyut Ghosh (present faculty of IACS)
» Prof. S.P. Mukherjee (former student of IACS)
» Prof. Suhrit Ghosh (present faculty of IACS)
» Prof. J. Dash (present faculty of IACS)

INSA MEDAL FOR YOUNG SCIENTIST

» Prof. M. Ray (former faculty of IACS)
» Prof. B.K.Chaudhuri (former faculty of IACS)
» Prof. Sourav Pal (former student of IACS)
» Prof. D. Datta (former student and faculty of IACS)
» Prof. T. Jana (former student of IACS)
» Prof. T.K. Paine (present faculty of IACS)
» Dr. Arnab Sen (present faculty of IACS)
» Dr. Saptarshi Mukherjee (former student of IACS)
» Dr. Pratik Sen (former student of IACS)

ASSOCIATES OF THE INDIAN ACADEMY OF SCIENCES

» Prof. T. Jana (former student of IACS)
» Dr. S. Malik (former student of IACS)
» Prof. Suhrit Ghosh (present faculty of IACS)
» Dr. A. Dey (present faculty of IACS)
» Dr. Anindita Das (present faculty of IACS)

FACULTY MEMBERS

- **Abhishek Dey :** Fellow of Indian Academy of Science (FASc), Bangalore; James Hoeschele Award, Asian Society for Biological Inorganic Chemistry
- **Amitava Patra :** Acharya J. C. Ghosh Memorial Award, Indian Chemical Society.
- **Anindita Das :** DAE-BRNS Young Scientist Award 2022; Associate of the Indian Academy of Sciences 2022; Editorial Board Member of the Journal of Macromolecular Science, Part A: Pure and Applied Chemistry since 2022 (Publisher: Taylor & Francis); PI's work has been featured in the AsiaChem Science Magazineunder Federation of Asian Chemical Societies in their special issue covering Chemistry in India (https://www.facs.website/copy-of-asiachem-2-1-december-2021)
- **Asim Bhowmik :** Ranked 12 in the Best Chemistry Scientists in India
- **Debashree Ghosh :** SERB-POWER Fellowship (SERB); Walter Kohn Prize, International Center for Theoretical Physics, Italy; Editorial Advisory Board Member, Chemical Society Reviews, Royal Society of Chemistry; Editorial Advisory Board Member, Journal of Chemical Theory and Computation, Amarican Chemical Society; Editorial advisory board member, Journal of Physical Chemistry A/B/C, American Chemical Society.
- **Durga Basak :** Editorial advisory board member in ACS Applied Electronic Materials, ACS
- **Jyotirmayee Dash :** Sectional Editor, Journal of the Indian Chemical Society; Professor PK Bose Memorial Award, Indian Chemical Society.
- **Pradyut Ghosh :** Silver Medal 2023, Chemical Research Society of India (CRSI)
- **Praveen Kumar :** Member, Global Young Academy (GYA) 2023-2028; Advisory Panel Member, Nanotechnology (IOP) 2022; Fulbright-Nehru Academic and Professional Excellence Fellowships 2022; Chair, Career Development Working Group, (2022-2024), Marie Curie Alumni Association (MCAA)
- **Prasanta Kr. Das :** Fellow of the Royal Society of Chemistry (FRSC), Royal Society of Chemistry
- **Rajib Kr. Goswami :** Bronze Medal, Chemical Research Society of India, 2023.
- **Tapan Kanti Paine :** Editorial Advisory Board Member of Transition Metal Chemistry, Springer Nature.
- **Shyamal Kr. Saha :** Fellow of the Institute of Physics (UK), Institute of Physics (UK); Visited Kun-Shan University, Taiwan as Visiting Professor (April 18-October 17, 2022)
- **Sourov Roy :** Honorary Associate Editor, Indian Journal of Physics
- **Somobrata Acharya :** The National Academy of Sciences, FNASc; Indian Academy of Sciences, FASc, Bangalore
- **Sudip Malik :** 12th POLYMER Foundation Award, Prof. Sukumar Maiti Polymer Award Foundation.
- **Suhrit Ghosh :** CNR Rao National Prize for Chemical Research (2023), CRSI
- **Sumanta Chakraborty :** Young Scientist Award, Central Calcutta Science and Culture Organization for Youths and Department of Science and Technology, Government of West Bengal

Amitava Patra

Tapan Kanti Paine

Suhrit Ghosh

Praveen Kumar

Debashree Ghosh

Pradyut Ghosh

Jyotirmayee Dash

Rajib Kr. Goswami

Abhishek Dey

Anindita Das

Asim Bhowmik

Shyamal Kr. Saha

Somobrata Acharya

Durga Basak

RESEARCH FELLOWS

- **Anwesha Chakraborty :** CASM Flash Talk Prize, International Conference on Chemistry and Applications of Soft Materials (CASM 2022), CSIR-NIIST, Thiruvananthapuram
- **Aritra Rajak :** Best poster award, International Conference on Chemistry and Applications of Soft Materials (CASM 2022)CSIR-NIIST Thiruvananthapuram
- **Md. Anas :** Best Poster Award at Ionic Polymerization Conference, Ghent University, Belgium
- **Payel Khanra :** Flash Talk Prize for the Best Student Talk, International Conference on Chemistry and Applications of Soft Materials (CASM 2022), CSIR-NIIST Tiruvananthapuram
- **Priyanka Dinda :** Best Poster Award at 'SPSI-Macro-2022', CSIR-NCL, Pune
- **Ranajit Barman :** LANGMUIR Best Poster Prize, International Conference on Chemistry and Applications of Soft Materials (CASM 2022), CSIR-NIIST, Thiruvananthapuram
- **Tanushri Banerjee :** Best poster award, One day Symposium in Chemical Sciences organized by CRSI Kolkata Chapter at IACS, Kolkata.
- **Soubhik Ghosh :** Best poster presentation Award at SMS Day, IACS.

Aritra Rajak

Payel Khanra

Priyanka Dinda

Md. Anas

Anwesha Chakraborty

Tanushri Banerjee

Soubhik Ghosh

Ranajit Barman

KEY COMMITTEES

Governing Council

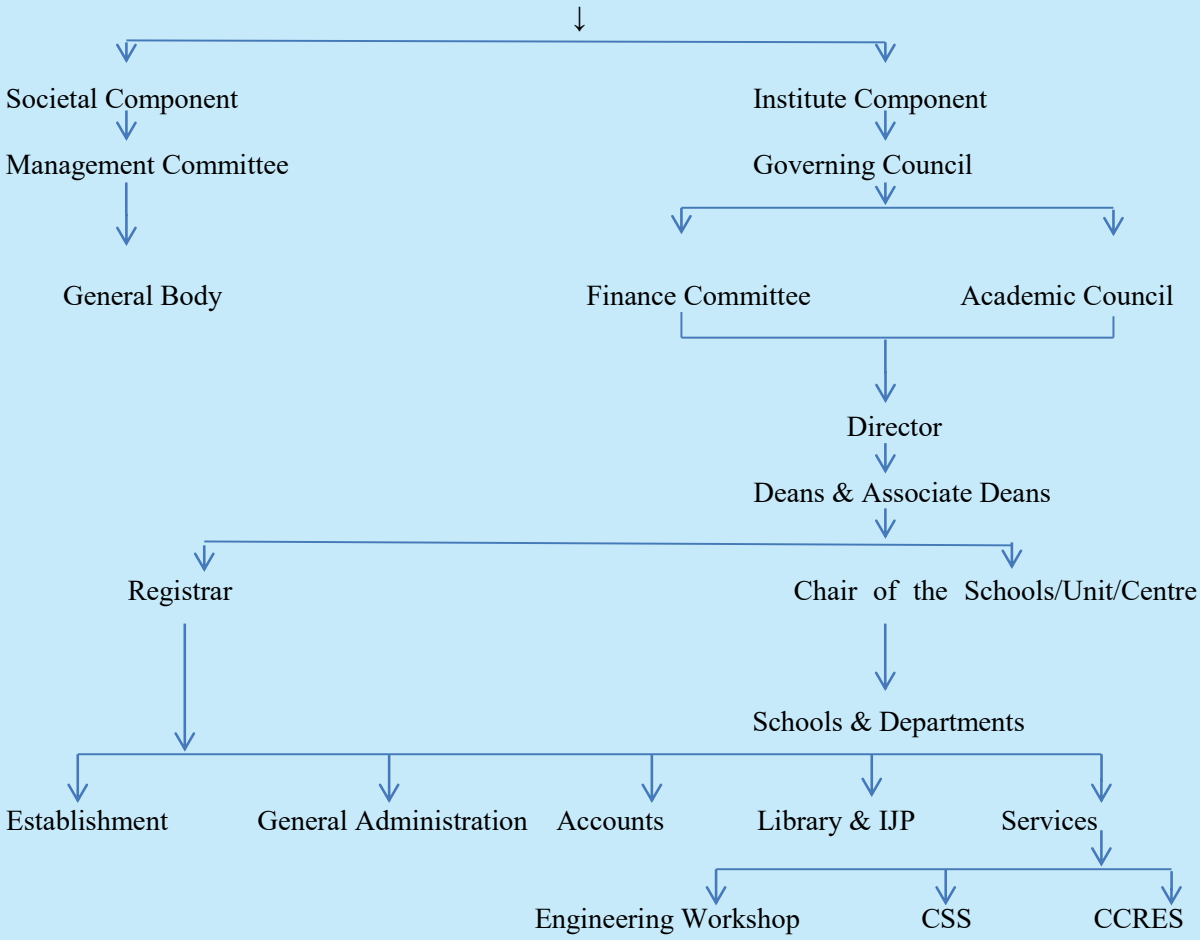
Finance Committee

Trustee

Research Advisory Committee

Management Committee

Organisational Chart



In accordance with DST guideline (letter no. AI/001/97, dated 01.08.1997) the administrative and financial set up of the institute is as following :

Governing Council

Professor Vinod K. Singh, Director, IIT, Kanpur (Chairman)
(Nominated by the Department of Science & Technology, Government of India)

Secretary to the Government of India or his nominee, *DST*

Dr. Ranjan Sen, (present Faculty and Director of IACS)

Financial Advisor to the Government of India, *DST*

Professor Devang Vipin Khakhar
IIT, Mumbai
(Nominated by the Council of IACS for three terms)

Professor G.R. Desiraju
IISc, Bangalore
(Nominated by the DST, Government of India for three terms)

Professor Bhushan Patwardhan
Vice Chairman, UGC
(Nominated by the DST, Government of India for three terms)

Professor Kapil Hari Paranjape
IISER, Mohali
(Nominated by IACS Governing Council for three terms)

Professor Subrata Sinha, AIIMS, New Delhi
(Nominated by INSA for three terms)

Smt. Sarbani Saha, Registrar – Non Member Secretary

Finance Committee

Chairman, Governing Council, IACS

Director, IACS

One Representative of Ministry of Science of Technology, GOI

Professor Bhupati Chakraborty, nominated by the Council

Principal Accountant General, Govt. of West Bengal

Registrar, IACS, Non-member Secretary

Research Advisory Committee (RAC)

Professor N. Sathyamurthy, FNA (Chairman)

Professor Mahan MJ

Professor Sandeep Verma

Professor Sanghamitra Bandyopadhyay

Professor H.R. Krishmurthy

Professor Satishchandra Ogale

Professor LS Shashidhara

Professor Anunay Samanta

Professor Giridhar Kulkarni

Dr. Chandrima Shaha

Professor G. Ravindran

Management Committee

Professor V.K. Singh, Director, IIT-Kanpur (President)

Professor Ranjan Sen, Director

(Vice President, Ex-Officio)

Professor Alok K Mukherjee (Vice President)

Professor Amitava Dutta (Hony. Secretary)

Professor Sanjib Ghosh (Hony. Treasurer)

Professor Dhiranjan Roy

Professor Indrani Bose

Professor Debasish Bhattacharya

Professor Kamal Bhattacharyya

Professor Subir Ghosh

Dr. Bhupati Chakraborty

Dr. Chinmoy Kumar Ghosh

Sri.Amit K. Majumdar, Executive Secretary

Trustee

Professor Milan Sanyal

Professor Bhupati Chakraborty

Professor R N Mukherjee

Annual Report and Publication Cell

Prof. K Sengupta -Chairman

Prof. P.S. Dastidar - Member

Prof. S. Ghosh – Member

Prof. T.K. Paine – Member

Prof. A. Paul - Member

Smt. D. Chakraborty – Member

Prof. S. Majumdar– Member

Prof. R. Mukhopadhyay – Member

Prof. S. Ray – Member

Prof. S. Ghosh De – Member

Smt. S. Saha – Member

Dr. G. Paul – Member

Shri A. Basak - Convener

Deans

Prof. Indra Dasgupta, Dean (Research & Development)

Prof. Satrajit Adhikari, Dean (Admn. & Fin.)

Prof. Suhrit Ghosh, Dean (Academic)

Prof. Tapan K. Paine, Dean (Student Affairs)

Prof. Somobrata Acharya, Associate Dean (Admn. & Fin.)

Prof. Rupa Mukhopadhyay, Associate Dean (Research & Development)

Academic Council

Director – Chairperson

Dean- Faculty

Prof. Tapas Chakraborty, SCS

Prof. Soumitra Sengupta, SPS

Prof. Indra Dasgupta, SPS

Prof. Satrajit Adhikari, SCS

Prof. Tapan Kanti Paine, SCS

Prof. Suhrit Ghosh, SAIS

Prof. Rupa Mukhopadhyay, SBS

Prof. Somobrata Acharya, SAIS

Prof. Abhishek Dey, SCS

Prof. Bimalendu Deb, SMCS

Prof. Saurav Giri, SPS

Prof. Shyamal Saha, SMS

Prof. Prasanta Kr. Das, SBS

Prof. Sugata Ray, SMS

Prof. Partha Basuchaudhuri (SMCS)

Prof. Sayani Bera (SMCS)

Prof. G.U. Kulkarni, President, JNCASR, Bangalore

Prof. Devajyoti Choudhury, University of Delhi, Delhi

Prof. Kolin Paul, Indian Institute of Technology, Delhi

Prof. Jayashree Saha, University of Calcutta, Kolkata

Prof. Amit Basak, Indian Institute of Technology, Kharagpur

Dr. Sreemonti Sarkar, Bose Institute, Kolkata

Dr. Shuvendra Bhattacharya, Indian Institute of Chemical Biology

Dr. Neena Gupta, Indian Statistical Institute

Dr. Sadhna Rana, TCS Innovation Labs, Tata Consultancy Services Ltd. Mumbai

Smt. Sarbani Saha, Registrar, Non Member Secretary

Alumni Affairs

Professor Satrajit Adhikari	Chairman
Professor Abhijit Kumar Das	Member
Professor Shyamal Kumar Saha	Member
Mr. Sauvik Chatterjee	Student Representative
Mr. Sumanta Ghosh	Student Representative

Amenities Committee

Prof. Ayan Dutta	Chairman
Prof. Somdatta Ghosh Dey	Member
Prof. Somobrata Acharya	Member
Dr. Sumanta Chakraborty	Member
Dr. Devajyoti Mukherjee	Member
Dr. Anindita Das	Member
Mr. Arunim Paul	Member
Mr. Debabrata Chakraborty	Member
Ms. Suhita Neogi	Joint Secretary
Mr. Soumik Mitra	Joint Secretary

Building Advisory Committee

Prof. Somobrata Acharya	Chairman
Dr. Satyanarayan Mukhopadhyay	Member
Dr. Debasis Das	External Expert
Mr. Asim Sinha	External Expert
Mr. Manas Kumar Pal	External Expert
Mr. Sohag Kr. Patra	Member
Mr. Prasanta Kundu	Joint Convener
Mr. Abhijit Basak	Joint Convener

Central Scientific Services (CSS)

Professor Indra Dasgupta, Head

Professor Somobrata Acharya, Associate Head

Professor Rupa Mukhopadhyay, Associate Head

Co-ordinators:

Dr. Mintu Mondal

Dr. Anindita Das

Dr. Nabanita Deb

Canteen Committee

Professor Amit Majumdar	Chairman
Dr. Shinto Varghese	Member
Mr. Rabindranath Banik	Member
Mr. Arunim Paul	Member
Mr. Soumik Mitra	Convener
Student as nominated by RSA	Member

CCRES Core Committee

Prof. Satrajit Adhikari	Chairman
Prof. Raja Paul	Member
Dr. Partha Basuchowdhuri	Member
Dr. Debshree Ghosh	Member
Ms. Sarbani Saha	Member
Mr. Abhra Paul and Ms. Rimi Chakraborty	Joint Secretaries

CREW Committee

Prof. Suhrit Ghosh, Chairman

Prof. Prashant Chandra Singh, Member

Prof. Deepak Kr. Sinha, Member

Dr. Devajyoti Mukherjee, Member

Mr. Somnath Bandyopadhyay, Member

Mr. Arka Mukherjee, Member

Mr. Arup Dhar, Convener

Disposal Committee

Dr. Subhadeep Datta	Chairman
Dr. K.D.M. Rao	Member
Sri Amit Kr. Sarkar	Member
Sri Rajib Debnath	Member
Sri Rajesh Mondal	Convener

Grievance Redressal Committee

Prof. Suhrit Ghosh	Chairman
Prof. Ankan Paul	Member
Prof. Somobrata Acharya	Member
Dr. Anindita Das	Member
Mr. Prabir Manna	Member
Ms. Saswati Bhattacharya	Secretary

Institutional Animal Ethics Committee

Dr. Parimal Karmakar, Chairman

Dr. Ritesh Pal, Basic Medical Scientist, Member

Dr. Abhimanyu Basu, Clinician, Member

Mr. Kumarjit Das, Legal Advisor, Member

Mr. Bhim Narayan Mitra, Member
(Representative of Non-Governmental Voluntary Agency)

Ms. Purbasha Banerjee, Lay Person, Member

Prof. Siddhartha S. Jana, Member Secretary

Institutional Biosafety Committee

Prof. Prasanta Kumar Das	Chairman
Dr. Krisnananda Chattopadhyay	External Expert
Dr. Parimal Karmakar	External Expert
Prof. Surajit Sinha	Member
Prof. Siddhartha Sarkar Jana	Member
Dr. Benubrata Das	Member
Dr. Deepak Sinha	Member
Dr. Prosenjit Sen	Convener

Internal Complaints Committee

Prof. Rupa Mukhopadhyay	Chairperson
Prof. Tanusree Kar	Advisor and Permanent Invitee
Prof. Srimonti Sarkar	External Expert
Prof. Siddhartha Sankar Jana	Member
Prof. Somobrata Acharya	Member
Dr. Somdatta Ghosh Dey	Member
Dr. Harapriya Rath	Member
Dr. Mitratun Nahar	Lady NGO Member
Ms. Sutapa Sanyal	Lawyer Member
Ms. Purbasha Banerjee	Secretary

International Travel Committee

Prof. Suhrit Ghosh, Chairman

Prof. Debasree Ghosh, Member

Smt. Purbasha Banerjee – Convener

IPR Cell, Patenting and Innovation Centre

Professor Surajit Sinha, Chairman

Professor Nikhil R Jana, Member

Ms. Suhita Neogi (Secretary)

Library Committee

Prof. Subham Majumdar	Chairman
Prof. Suhrit Ghosh	Member
Prof. Prasanta Kr. Das	Member
Prof. Abhishek Dey	Member
Dr. Partha Basuchowdhury	Member
Mr. Debajyoti Nath	Member Secretary
Ms. Suhita Neogi	Nodal Person for IACS Media Cell

New Campus at Baruipur

Prof. Pradyut Ghosh, Chairman

Prof. Dilip Ghosh

Prof. Shyamal Saha

Dr. Joyram Guin

Qualification Committee

Prof. Rupa Mukhopadhyay	Chairperson
Prof. Narayan Pradhan	Member
Prof. Nikhil Guchhait	External Expert
Dr. Partha Basuchowdhuri	Member
Ms. Purbasha Banerjee	Member
Mr. Sohag Kumar Patra	Convener

Safety Cell

Prof. Rajib Goswami	Chairman
Dr. Devajyoti Mukherjee	Member
Dr. Rajarshi Ray	Member
Dr. Ritesh Ranjan Pal	Member
Mr. Amit Sarkar	Member
Mr. Arka Mukherjee	Member
Mr. Somnath Banerjee	Member
Mr. Amit Chakraborty	Member
Mr. Dibakar Majumdar	Joint Convener
Mr. Rajib Debnath	Joint Convener

Space Committee

Prof. Somobrata Acharya	Chairman
Dr. Devajyoti Mukherjee	Member
Dr. Debashree Ghosh	Member
Dr. Deepak Sinha	Member
Dr. Rajarshi Ray	Member
Mr. Amit Chakraborty & Mr. Arup Dhar	Joint Conveners

Standing Medical Committee

Prof. Satrajit Adhikari	Chairman
Prof. Siddhartha S. Jana	Member
Dr. Indranil Paul, PTMO, IACS	Member
Dr. Shyamsundar Poddar, CMO, CGHS	Member
Dr. Bebi Chakraborty, PTMO, IACS	Member
Mr. Narayan Chandra Das Roy	Invitee
Registrar, IACS	Invitee
Mr. Tapan Sardar	Joint Convener
Miss Ankeeta Chakravarty	Joint convener

Vigilance Officer

Prof. Sugata Ray

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

To quote the Founder, the great visionary, Dr. Mahendra Lal Sircar "The objective of the Association is to enable the Natives of India to cultivate Science in all its departments with a view to its advancement by original research and with a view to its varied application to the arts and comforts of life." Even today, IACS is dedicated to the realization of the undying dream of its founder and his compatriots. The institute pursues relentlessly theoretical and experimental research in fundamental and basic sciences with emphasis on translating its discoveries into technology wherever possible and train and prepare the younger generation to handle the challenges of the future, be it in the emerging areas of science or technology.

IACS has currently 6 Schools (School of Applied and Interdisciplinary Sciences, School of Biological Sciences, School of Chemical Sciences, School of Mathematical and Computational Sciences, School of Materials Science and School of Physical Sciences) apart from Service Units that provide research facilitation (Central Scientific Services, Computer Centre, Library, Workshop etc.).

Highlights of major achievements in the different Schools are as follows:

School of Applied and Interdisciplinary Sciences (SAIS)

- Organic materials (polymers or small molecules) for energy storage
- Development of solid-state emissive organic materials.
- Externally regulated pathway selectivity for self-assembly of (macro)molecules with wide-spread implications in polymeric / supramolecular functional materials.
- Synthesis of novel functional polymers/ supramolecular polymers (1D, 2D)
- Small molecule-based anticancer agents
- Development of morpholino antisense reagents for gene silencing
- Non-peptide-based cellular transporter for the delivery of antisense reagents
- Design and fabrication of nanoelectronic and optoelectronic device applications
- Waste energy harvesting in novel Pb-free inorganic and organic material
- Complex nanostructures and molecular assemblies for Energy applications

School of Biological Sciences (SBS)

- Self-assembling peptide based nanobiomaterials
- Peptide attached Naphthalenediimide based gels
- Biomedicinal chemistry of self-assembled functional soft nanocomposites
- Fabrication of soft-nanocomposites from functional molecules with diversified applications
- Naphthalimide based fluorescent organic nanoparticles in selective sensing
- Lipase sensing by naphthalene diimide based fluorescent organic nanoparticles
- Nanoscale Bioengineering
- Nanoscale Biosensing
- Nanoscale Bioelectronics
- To understand the role of nonmuscle myosin II in bleb dynamics in tumor cell lines
- Functional analysis of Nonmuscle myosin IIs and their mutants found in human patients
- Functional analysis of the spliced isoforms of nonmuscle myosin II in mouse neuronal cells
- To probe how the mutation on ORF3a gene of SARSCoV2 changes its binding ability with host Caveolin protein
- Biological physics, Lipid droplets in development
- Impact of cytoplasmic stiffening on the phagocytic ability of the macrophage
- Switching between blebbing and lamellipodia
- Coagulation biology and cellular signaling
- Role of Phospholipid in blood coagulation
- SARS-CoV-2 main protease, structure-based drug design, molecular docking, ADMET, Drug-likeness, MD simulation
- Monocyte to Macrophage differentiation
- Molecular mechanism of DNA damage and repair in cancer
- Uncovering of stress induced novel post-translational modification of proteins
- Host-pathogen interactions and infection biology
- Pathogenesis of communicable diseases
- Therapeutic strategy development against infectious agents

School of Chemical Sciences (SCS)

- Co(II) mediated catalytic hydrolysis of C-S bonds for a series of aliphatic and aromatic thiolates.
- Understanding Reaction Mechanisms of Catalytic and transformative processes relevant to the cause of Environmental Sustainability and (b) Comprehending novel chemical phenomena using excited state theoretical techniques.

- Designing and developing new strategies for novel organic transformations following the concept of radical chemistry, photocatalysis, organocatalysis and transition metal catalysis.
- Understand how fundamental molecular interactions control structure, dynamics and ultimately, any macroscopic property of interest in a wide variety of molecular systems at the interfaces of chemistry, molecular biology and soft materials science.
- Unified understanding of phenomena at various length and time scales using techniques based on ab-initio and extended quantum mechanical methods.
- Uncovered that the pre-organization environment of the ATP hydrolysis reaction of kinesin-1 is critically dependent on having the broken state of the Arg203-Glu236 salt-bridge sufficiently populated. This disruption is responsible for the HSP disease in humans.
- Development of strategies to understand ground and excited state electronic structure of strongly correlated systems
- State-of the art synthetic design and isolation of artificial porphyrinoids by swapping pyrrole component(s) with diverse functionalized pyrrolic(heterocyclic)/carbacycle building block(s) to compare the impact on the electronic absorption spectra, aromaticity andanion receptor abilities of the incorporated isomeric/expanded porphyrinoids.
- Demonstrated the bioorthogonalmacrocyclization directed by G-quadruplex DNA as the templates.
- Application of supramolecular synthons/ coordination chemistry in the context of crystal engineering is being exploited to generate materials having potential for various applications such as topical gels for drug delivery, coordination polymer based metallogels for drug delivery, cell imaging etc.
- A halogen bond based water soluble tetrapodal iodoimidazolium receptor was developed which exhibited a high degree of efficiency (~ 96%) in extracting ReO_4^- from 100% aqueous medium within the wide range of concentrations and pH range
- Synthesis and charecterization of Metal-Organic Frameworks (MOF) and coordination polymers, coupled with identification of structure-property relationships in these systems.
- Coupled three-dimensional (3D) time dependent wave packet formalism in hyperspherical coordinates on ab initio calculated ground adiabatic potential energy surface for the F + H2/D2 (v = 0, j = 0) reaction was developed.
- The reactivity of iron(II)-mandelate and cobalt(II)-mandelate complexes of tetradentate nitrogen donor ligands toward dioxygen has been investigated. The complexes react with dioxygen to afford equimolar amounts of benzaldehyde and benzoic acid.
- Thermal reactions of selected atmospherically significant volatile organic compounds like hydroxyacetone and formaldehyde with nitrogen dioxide (NO2) have been studied with the aim to identify the unknown sources ofatmospheric nitrous acid (HONO).
- Use of different macromolecular engineering tools to synthesize stimuli-responsive smart homo-/ block-copolymers, peptide-polymer conjugates, amino acid-based polymers, poly(ionic liquid)s, poly(zwitterions) and functionalized polypeptides.

School of Mathematical and Computational Sciences (SMCS)

- Amino-borane dehydrogenation in functionalizing pristine and Li+-encapsulated C60, C70 and C36 fullerenes has been investigated
- A new theoretical strategy using both exohedral as well as endohedral functionalizations has been proposed in stabilizing the non-IPR isomers of C72 fullerene
- Isomers of peptide like large molecules of astrochemical interest have been studied in detail using dispersion-corrected density functional theory and highly correlated methods
- Biological processes such as cell division, intracellular transport and organization of active and passive matter systems are investigated using Monte Carlo methods and molecular dynamics simulations, the group examines active matter systems.
- Computational studies of phase transition and domain coarsening in disordered materials have been carried out.
- Dynamics of semigroups of complex Hénon maps in via techniques from (pluri) potential theory has been studied.
- The basin of attraction of an automorphism corresponding to an attracting fixed point in has been investigated. Such domains are known to be pathological and exists only in higher dimension. A long-standing open problem concerning the existence of such domains has been resolved.
- A description of higher rank numerical range of a normal operator on an infinite dimensional Hilbert along with various results in dilation theory has been presented.
- An affirmative solution of a conjecture posed by Halmos is given, and the Halmos conjecture is generalized in various ranges.
- A framework for entity recognition and identification of NASA astrophysics dataset, which was published as a part of the DEAL SharedTask has been introduced using a pre-trained multilingual model.

- A series of transition-metal (TM) based single atom catalysts (SAC) embedded on carbon nitride (C6N6) have been been studied using density functional theory (DFT) to explore the NRR activity. The results show that amongst the 18 metal centers, Ta based C6N6 emerges as a good candidate for the reduction of nitrogen to NH3.
- Novel ways to use negative sampling to improve neural topic models have been deisgned. Algorithms have been developed to distill knowledge from a large topic model to a smaller one.
- The role of dropout in neural topic models has been investigated, with observation that dropout might lead to a drop in topic quality.
- The applications of artificial Intelligence in enhancing the performance of model-checking and also in using model-checking for explainable AI have been explored.
- A software SAT-Reach for efficiently finding erroneous behavior in models of cyber-physical-systems has been developed.
- A contrastive explanation framework for cyber-physical-systems and demonstrated its efficacy on a number of planning case-studies has been proposed.

School of Materials Sciences (SMS)

- Solubility tuning of alkyl amine functionalized carbon quantum dots for selective detection of nitroexplosive
- Synthesis of new mixed metal oxide RuNi2O4 phase decorated on reduced graphene oxide for supercapacitor applications
- Polysulfide functionalized reduced graphene oxide for electrocatalytic hydrogen evolution reaction and supercapacitor applications
- Magnetic properties in atomic Co manipulated graphitic carbon nitride
- Synthesis of polythiopene graft block copolymers,
- Synthesis of polymer peptide conjugates.
- Ultrafast dynamics of two-dimensional (2D) semiconductor nanoplatelets (NPLs)
- Quantum dots
- Metal clusters
- Perovskite nanocrystals
- Polymeric nanoparticles
- Carbon dotsfor designingefficient light-harvesting systems.
- Designing and synthesis of porous nanomaterials for gas storage, metal ion sensing, water purification, eco-friendly catalysis for the synthesis of organic fine chemicals, CO2 fixation, electrochemical/ photoelectrochemical water splitting and biomedical applications.
- Chemistry of Physics of Semiconductor Nanocrystals
- Understanding role of spin-orbit coupling in deciding the magnetic and electronic round states of 4d-5d transition metal oxides,
- Inducing multifunctionalities in solids by lone pairs and also by manipulating local coordinations, and anion vacancy,
- Observation of unusual colossal electroresistance in vanadates,
- Understanding nucleation of metal clusters in water and manipulating the process for the use of water purification.
- Hemin-based colloidal nanoparticle has been designed for cell therapy via intracellular reactive oxygen species generation and autophagy induction.
- Nanocomposite with imprint of cholesterol has been designed forits nonenzymatic, visual, and smartphone-based detection
- Piezocatalytic property of calcium phosphate nanowire has been shown to enhance via gold nanoparticle conjugation
- Cytotoxicity of ZnOnanoparticles under dark conditions has been demonstrated due to oxygen vacancy dependent reactive oxygen species generation.
- Development of facile and scalable synthesis processes for 2D materials, MXenes, Quasi-2D Materials, Carbides, Oxides and other nanomaterials
- Understanding the various fundamental and technological aspects of electron transport in various heterostructures
- Utilizing the developed heterostructure for energy harvesting (Water-splitting and Photodetectors) and storage (Supercapacitors) applications
- Transition metal oxide-based cathode materials for Na and Li ion battery – electrochemical performance, mechanistic and degradation studies using in-situ and ex-situ spectroscopic and diffraction methods.
- Growth of thin films of intrinsic and dopednc-Si–Quantum-Dots, Si-Nano-Wires, a-Si/nc-Si super lattice, nc-SiOx, nc-SiCx, nc-SiNx, nc-SiOxCy, nc-SixGe1-x, Diamond-Like-Carbon, Nano-Crystalline-Diamond, Carbon-Nano-Tube, In2O3, ZnO, TiO2, etc, for photovoltaic, photocatalytic, and other energy applications.

School of Physical Sciences (SPS)

Experimental Physics:

- We have investigated the evolution of various point defects in 100 keV lithium (Li) ion-implanted 1D ZnO nanorods (NRs) by varying

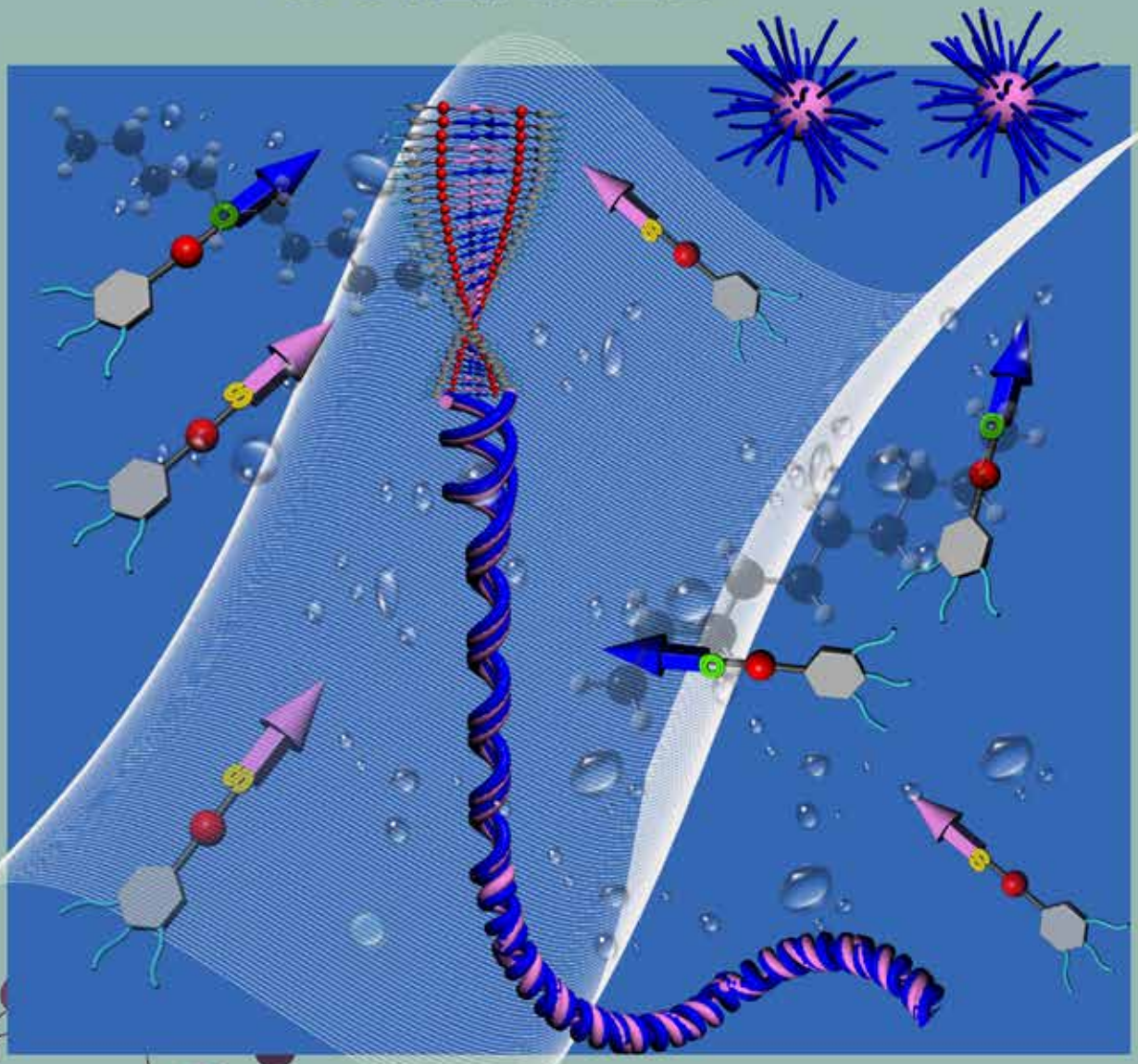
the fluences experimentally and also by using a simulation stopping and range of ions in matter (SRIM). Also we have reported high broad band photosensitivity from ultraviolet (UV) to visible wavelength of sol-gel grown TiO2 film decorated with Ag nanoparticles (NPs) as well as in a simple metal-Zn2SnO4 (ZTO) thin film-metal structure in a simple planar photoconductive geometry. We have investigated the effect of O2 on the donor-acceptor compensation by comprehensive photoconductivity measurements supported by the PL studies in P doped ZnO films. Interestingly, we have demonstrated that donor–acceptor (D-A) compensation in the doped film is influenced largely by the dopant valence using trivalent Al, tetravalent Ti, and pentavalent Vanadium. In an another study, we unprecedentedly demonstrate an n+ -ZnO/n-Si isotype heterojunction as a potential candidate for detecting light in a broad ultraviolet to infrared region with a very high speed and >1 kHz frequency bandwidth as well. In an another study, the crossover amongst band and various hopping mechanisms has been observed in the temperature range of 300–10 K in Mo doped ZnO films deposited at various substrate temperatures.

- Magnetoelectric coupling in multiferroics
- Anomalous Hall effect in strongly correlated system
- Topological quantum materials: synthesis of single crystals and elploring electronic structures
- Probing Elementary Excitation in Atomically Thin Magnets and Related Heterostructures
- In our research group, we aim to inspect fundamental doubts on the presence of magnetism in two-dimension (2D). To explore magnetism at the atomic scale, we intend to combine Raman scattering and low-temperature transport measurements. Moreover, our group has initiated experiments which concern detection of pressure induced phase transition in few-layer magnetic systems. At the device level, we design, fabricate, and characterize micro-/nanoelectronic circuits with novel 2D/quasi-1D semiconductors.
- Magnetic and electronic properties of strongly correlated electron system.
- Investigation of intriguing quantum phenomena in layered low-dimensional quantum materials. Specifically, we are working on van der Waals (vdW) materials, for example, (1) quasi-2D vdW ferromagnets and semimetals, and (2) quasi-1D vdW materials. These materials provide us with a versatile scientific platform for studying various critical quantum phenomena such as the dynamical response of charge density wave (CDW) and topological phase in 1D chains, with enormous potential for device applications. To investigate these quantum materials, we have developed various in-house experimental facilities, for example, (1) THz spectroscopy, (2) low-frequency 1/f noise spectroscopy, (3) spatial self-phase modulation (SSPM) spectroscopy, and (4) thermoelectric power measurement.
- Artificial Multiferroic Heterostructures
- Magnetocalorics&Electrocalorics
- Complex-oxide magnetic and ferroelectric thin film heterostructures
- Magneto-optic Kerr effect (MOKE) magnetometry

Theoretical Physics:

- Theoretical Quantum Optics, Quantum Information Science, Atomic, Molecular and Optical Physics
- Statistical and Condensed Matter physics; spin liquids, phase transitions, entanglement in many-body systems, Monte-Carlo methods, anomalous thermalization in interacting models including lattice gauge theories
- We have worked on the signatures of the physics beyond the standard model, focusing on dark matter and flavour issues of the standard model.
- Conformal integrals from Quaternionic Lauricella system and GKZ hypergeometric series.
- Scattering amplitudes from titlting structures in quotient triangulated categories.
- Studied non-eq. dynamics of quantum systems.
- Studied effect of quasiperiodicity in driven quantum chain.
- (1) Cosmology of Particle Dark Matter, (2) Dark Matter Searches using Cosmological, Astrophysical and Laboratory-based Probes, (3) Elementary Particle Physics
- Black hole physics, Gravitational waves, Quantum physics in curved spacetime, Cosmology, Theories beyond general relativity, Quantum aspects of gravity.
- Involved in the high energy physics experiment at the Large Hadron Collider. Coordinating the efforts in detector simulation for the experiment as well as evaluating the Great 4 tool which is used world wide for nuclear science as well as medical physics.
- Black hole shadows
- Study of regular black holes and naked singularitiec
- Non singular bounce in modified gravity theories
- Nested modulus stabilization in doubly worped braneworld model and moduli stabilization
- Quasar continuum spectra and magnetic monopole charge
- Phenomenology of non-standard soft SUSY breaking interactions.

SCHOOL OF APPLIED & INTERDISCIPLINARY SCIENCES



School of Applied and Interdisciplinary Sciences

PROFESSOR SUDIP MALIK
School Chair

SCHOOL PROFILE

People

Faculty :	07
Post-doctoral Research Associate :	08
Ph.D. Students:	44
Non-Academic Staff:	03

Extra Mural Funding

Projects (ongoing) :	16

Research Achievements

Research Papers in Journals	: 24
Book Chapter	: 01
Ph.D. degree awarded	: 04

Academic Activities

Talks delivered by members	National	: 28
of School in conferences/symposia	Intl.	: 04

ANINDITA DAS

Assistant Professor

Controlled supramolecular polymerization;Functional polyesters; Crystallization-driven self-assembly of chromophore-conjugated bio-degradable polymers; Halogen bonding-mediated stimuli-responsive self-assembled systems.

Associate:

(1) A Rajak, SRF, (2) A Jamadar, SRF, (3) S. Biswas, SRF, (4) Payel Khanra, SRF, (5) Chhandita Chakraborty, JRF, (6) Dr. Anindyasundar Adak, RA-1, (7) Chandrayee Banerjee, JRF, (8) Y. Das Karmakar, JRF, (9) S. Show, JRF, (10) M. Biswas, JRF, MS-Project (11) S. Nayak, MS-Project.

i) Controlled Supramolecular Polymerization: In the recent past, the focus in supramolecular polymers has been shifted to investigating their formation pathways, thermodynamic and kinetic parameters, controlling their structure over multiple length scales or dispersities, and realizing spatio-temporal control, similar to elegant examples in nature. Quite similar to controlled covalent polymerizations in chain-growth mechanism, we have achieved controlled or living supramolecular polymerization in specifically designed chiral dipolar monomeric building blocks with hydrogen (H)-bonding amide groups (O-NMI and S-NMI) by understanding the complexity of their formation pathways. These molecules offer an interesting possibility of realizing how the interplay of dipole-dipole interaction and H-bonding imparts pathway complexity in their supramolecular polymerization in an organic solvent, decane. By replacing a single heteroatom (oxygen vs. sulfur), the intermolecular interactions and the supramolecular polymerization pathways can be tuned in the two monomers. As a result, one of the monomers (O-NMI) can be trapped in a metastable dormant state, which can be used as a monomer reservoir and later activated by an external stable spherical "seed" of the second monomer (S-NMI) to realize unprecedented core-multiarmed living supramolecular star block copolymerization by secondary nucleation effect. This strategy demonstrates exciting possibilities for achieving temporal control over the arm lengths and the helical bias of the arms as per the information encoded in the seed. In contrast to sequence-controlled core-multiarmed "star" topology under seed-copolymerization conditions, mixing of the two monomers under thermodynamic conditions generates a temporally controlled supramolecular copolymer with distinct internal order, where the two monomers are randomly distributed in the polymer chain. Such control over mesoscopic structures and internal order is an emerging endeavour in dynamic supramolecular assemblies.

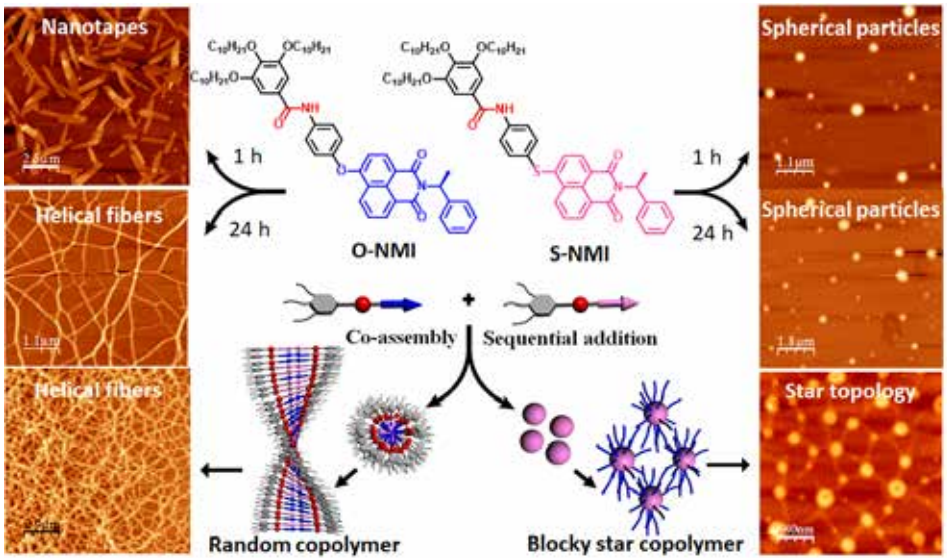


Figure 1. Top: Chemical structures of O-NMI and S-NMI and their supramolecular homopolymerization showing time-dependent morphological transition from nanotapes to helical fibers for O-NMI and stable spherical particles for S-NMI in decane. Bottom: Schematic representation of their random copolymerization and sequence-controlled living copolymerization under different mixing conditions.

ii) **Functional Polyesters**: In this project, we have developed a versatile methodology for functional polyester synthesis by organocatalyzed transesterification from activated pentafluorophenyl diester of adipic acid and functional diols by step-growth polymerization under mild reaction conditions. Further, by varying the stoichiometry of the diol and the diester, we could tune the molecular weight of the polyesters and their end-group functionality by post-polymerization modification, and living polymerization. Currently, we are exploring the antibacterial properties of a series of aromatic dye pendant cationic and water-soluble fluorescent polyesters prepared by this newly established methodology.

iii) **Precision 2D assemblies:** In this project, we are exploring the crystallization property of a biodegradable poly(L-lactide) (PLLA) for controlled 2D-assembly of distinct π-conjugated chromophores end-functionalized to the PLLA chains by crystallization-driven self-assembly in solutions for preparing discrete organic 2D nanocrystals with exciting photoluminescent properties, cascade energy transfer, and white light emission.

iv) **Halogen-bonded self-assembled systems**: In this project, we are working on developing stimuli-responsive supramolecular systems that are driven by orthogonal halogen bonding and H-bonding interactions and investigating their self-assembly properties and pathway complexity in water.

Awards/Recognitions :

» DAE-BRNS Young Scientist Award 2022

» Associate of the Indian Academy of Sciences 2022

» Editorial Board Member of the Journal of Macromolecular Science, Part A: Pure and Applied Chemistry since 2022 (Publisher: Taylor & Francis)

» PI's work has been featured in the AsiaChem Science Magazine under Federation of Asian Chemical Societies in their special issue covering Chemistry in India (https://www.facs.website/copy-of-asiachem-2-1-december-2021)

Publications in Journals

1. Pathway Complexity in Supramolecular Copolymerization and Blocky Star Copolymers by a Hetero-Seeding Effect-P. Khanra, A. K. Singh, L. Roy, A. Das*, *J. Am. Chem. Soc.***145**,5270–5284. (2023). [IF:16.383]

2. A Versatile Step-Growth Polymerization Route to Functional Polyesters from an Activated Diester Monomer-S. Biswas, A. Das*, *Chem. Eur. J.***29**,e202203849 (2023).[IF: 5.02]

3. Solvophobically-Driven Merocyanine Dye Assembly: Predominant Dipole-Dipole Interactions Over Hydrogen-Bonding-A. Rajak, A. K. Singh, L. Roy*, A. Das*, *ChemNanoMat,* **8**,e202200082 (2022).[IF: 3.82]

Publications in Book Chapter :

1) Precision Macro (molecular) Assemblies- A. Rajak, A. Das*, *Asia Chem*magazine under Federation of Asian Chemical Societies (Published in the special issue covering Chemistry in India) (https://www.facs.website/copy-of-asiachem-2-1-december-2021)

Lectures Delivered :

Invited talk at (1) Soft Matter Young Investigators Meet, Mysore, (2) FORCE-IICS, Agra, (3) CE:FMC2022, Jammu & Kashmir, (4) TIFR, Mumbai, (5) Kathmandu, Nepal, (6) JNCASR, Bangalore, (7) NCL Pune and (8) ITC Hotel Rama Intl. Aurangabad.

Sponsored Project

» Halogen-Bonded ……. Organic Materials (DAE-BRNS)

» Programming Macromolecular …… Dipole interaction (CSIR)

» A Versatile Methodology …… Self-Assemblies (SERB)

K.D. MALLIKARJUNA RAO

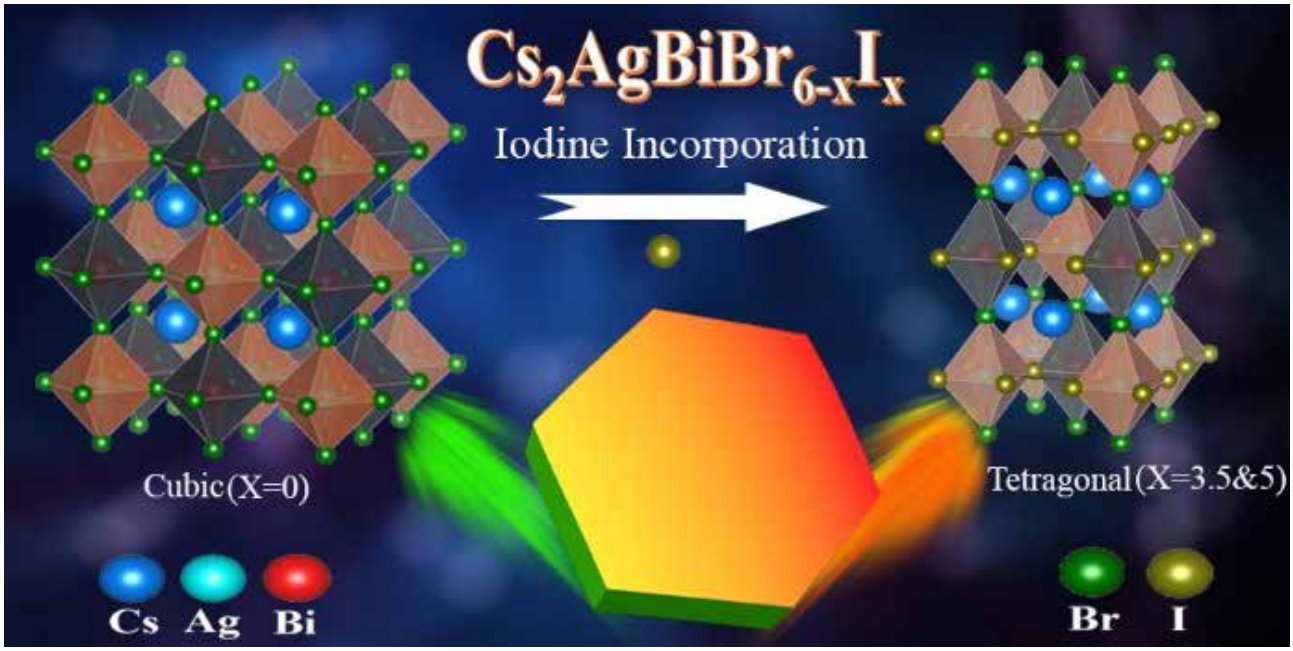
Assistant Professor

Design and fabrication of nanoelectronic and optoelectronic device applications

Associate:

(1) Mozakkar Hossain (Ph.D. student), (2) Prakash Sarkar (Ph.D. student), (3) Kuntal Singh (Ph.D. student) and (4) Sougata Karmakar (Ph.D. student) (5) Ali (RA-I)

Iodine incorporation in double perovskites (DPs) framework facilitates broad spectral range absorbance for high-performance optoelectronic device applications. However, the synthesis of Iodine-based DPs is a central challenge due to the favourable formation of non-perovskite phases arising from large I- anion, structural and thermodynamic instability. Herein, we propose a simple, yet efficient in-situ Iodine incorporation in DPs to synthesize $Cs_2AgBiBr_6$-xI DP MCs for X = 3.5, and 5. The Rietveld refined XRD patterns of Iodine incorporated $Cs_2AgBiBr_6$-xI DP MCs (X = 3.5 and 5) confirm the tetragonal crystal structure. The Iodine incorporated DP MCs demonstrated a small bandgap of 1.79 eV for X = 5 compared to 2.23 eV of DPs MCs for X=0. The Iodine-rich DP MCs (X =5) manifested improved diffusion length and mobility withreduced trap density,as compared to DP MCs for X = 3.5. To the best of our knowledge, this is the first study thatreports iodine incorporation in DPs and realize self-driven photodetectors with high Responsivity (2.63 A/W) and Detectivity (~ 10^{12} Jones) in a broad spectral range (400-900 nm). The successful Iodine incorporation in the DPs framework opens new avenues to venture broad spectral absorption and high-performance optoelectronic devices.



Sponsored Project

» Solution-processed synthesis …….. Field effect transistors

» Fabrication and development …… optoelectronic devices

Lectures Delivered

» Invited talk at (1) SRM University, AP

SHINTO VARGHESE

Faculty Fellow

Organic Optoelectronic Devices, Photo-physics/Chemistry, Organic Synthesis.

Associate:

(1) P Majumdar, SRF, (2) M. Ghora, SRF (3) R Manna, JRF, (4) R Kumar, JRF, (5) P Chanda, JRF, (6) D Jana, JRF

OFET devices integrates the switch capability of a field effect transistor and the light emission capability of OLED into single planar device structure and have enormous potential to integrate into optoelectronic devices, particularly appealing for display technology. In our group, we are interested in the development of light emitting field effect transistors (OLET) with defect free, highly ordered, densely packed organic conjugated semiconductor materials as active medium for high current densities, brightness, control over emission zone, high aperture ratio and low operational voltages.

The major difficulty of employing the organic semiconductors as active medium is the low charge carrier mobilities and the necessity of high luminescence efficiencies. Single crystals and crystalline thin films due to dense molecular packing and defect free long-range order are ideal active materials for planar single layer OLET devices. Implementation of single crystals, doped crystal and crystalline thin films with high luminescence and charge transport properties lies in the heart of the project. The low luminescence efficiencies of the planar π-conjugated chromophores in condensed phase

will be circumvent by employing AIEE moieties in conjunction with the planar π-conjugated core. The initial results from a luminescence point of view are promising. Ambipolar charge transport in the OFET devices are explored for low operational voltage and control over emission zone. Asymmetric source drain electrodes as well as the emissive CT crystals will be employed for ambipolar OLET. Dielectric materials with covalent functionalization to the active materials were explored to overcome trap sites and interfacial homogeneity. As an initial step, emissive Aza[7]helicene chromophores functionalized with trimethoxysillane as anchoring group to form self-assemble monolayer on SiO2 gate dielectric. The molecular design allows us to incorporate alkylthiols functionalized planar π-conjugated chromophores with AIEE moieties to attach to the gold electrode to reduce Shockley barrier for Ohmic contact. Split gate device geometry will be employed to attain independent control over the charge carriers and attaining high brightness. The OLET devices also opens up the possibility of investigating charge injection, carrier mobilities, influence of the work function of electrodes on ambipolar transport, dielectric materials on field induced transport, charge recombination, exciton-polaron quenching and exciton decay leading to luminescence in a single device from a fundamental science view point.

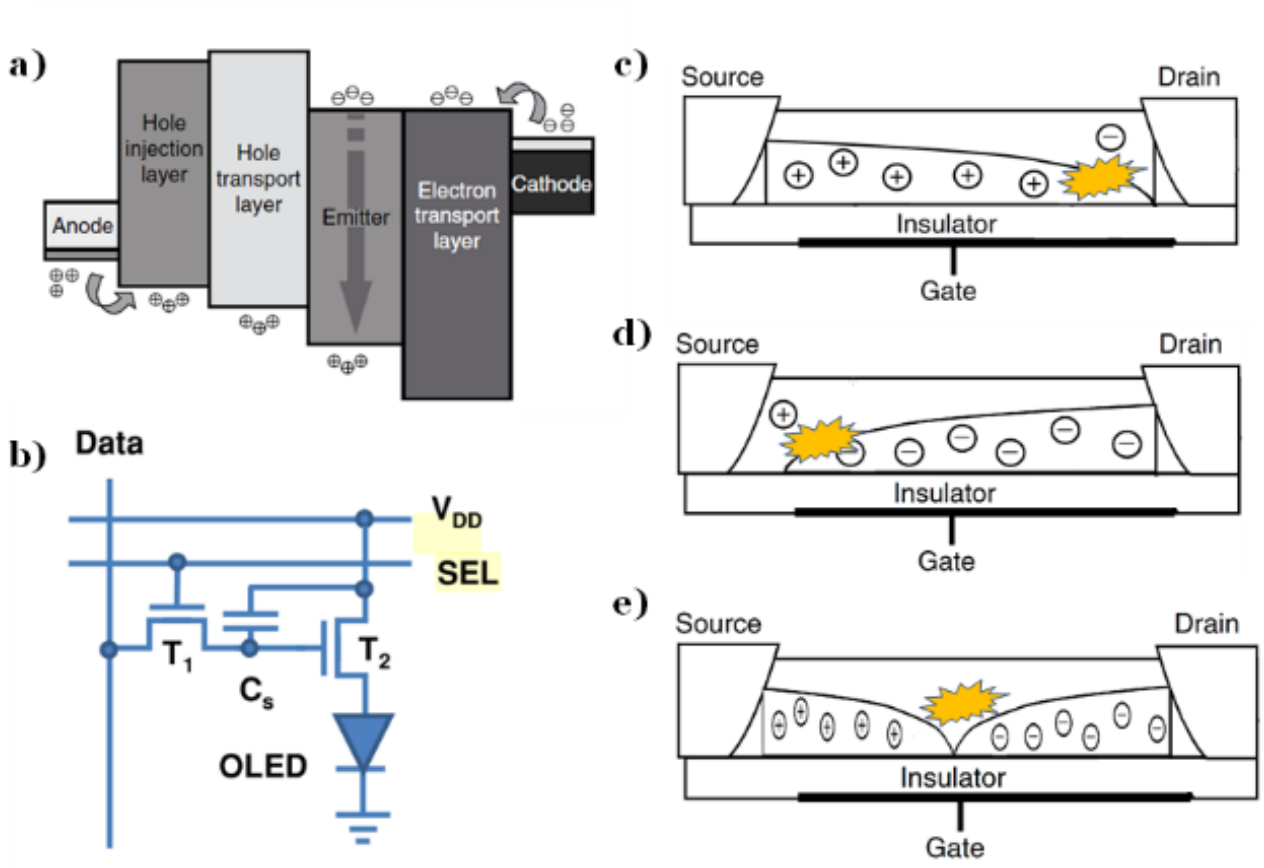


Figure 1. a) Working principle of an OLED with injection/transport layers used for balanced charge transport. b) Circuitry of OLED display, adapted from [1]. LET in unipolar c) hole accumulation mode, d) electron accumulation mode and e) ambipolar mode.

Publications in Journals

1. Luminescent assemblies of pyrene-containing bent-core mesogens: liquid crystals, π-gels and nanotubes - M. Martínez-Abadía, S. Varghese, J. Gierschner, R. Giménez, M. Blanca , Ros, J. Mater. Chem. C, 10. 12012 (2022). IF: [8.1]

Sponsored Project

» Exploring Single Crystals, Doped Crystals and Crystalline Thin Films of Conjugated Molecular Materials for Organic Light-Emitting Field-Effect Transistors. (SC-OLET)".

SOMOBRATA ACHARYA, FASc, FNASc

Senior Professor & Associate Dean, (Finance & Administration)

Molecular assemblies, Perovskite nanocrystals, Supramolecular assemblies, Heterostructures, and energy related applications.

Associate:

(1) Susmita Paul (Institute Bridge Fellow), (2) Md. Yousuf Sk, JRF (UGC-NET Fellow), (3) Ms. Shramana Guha (Integrated MS-Ph.D.), (4) Ms. Namrata Saha (DST Inspire fellow), (5) Ms. Anusmita Ghosh (DST Inspire fellow) and (6) Dr. Nur Amin Haque (NPDF)

The prime motivation of Acharya group is to explore the structure-properties relationship of a variety of nanomaterials. The group expertise in synthesis a variety of nanomaterials, to characterize structures, properties and depending on that, to fabricate a suitable device. Superfine nanocrystals with a target to reach atomic scale dimension are prepared. Complex heterojunctions and planar materials are the major subject of interest of Acharya's group. Creating multi-dimensional assemblies of nanocrystals and molecules are of interests. The research of Acharya's group is directed towards energy generation and savings using nanomaterials and functional molecules. Supramolecular assemblies of AIE-gens towards energy related applicationsareof intense interest of Acharya group.

Awards/Recognition

» The National Academy of Sciences, FNASc

» Indian Academy of Sciences, FASc

Publications in Journals

1. Postsynthesis Transformation of Halide Perovskite Nanocrystals - Susmita Paul and Somobrata Acharya*, *ACS Energy Lett*. 7, 6, 2136–2155 (2022)
2. Mechanical Manipulation of Archimedean Spirals of an Achiral Pyrazinacene for Chiral Assemblies - Pramita Mondal, Gouranga Manna, Tapas Kamilya, Mrinmay Das, Katsuhiko Ariga, Gary J. Richards, Jonathan P. Hill*and Somobrata Acharya, *Adv. Mater. Interfaces*, **9**, 2200209 (2022)
3. Effect of size of CdO on bias dependent conduction and relaxation mechanism by means of Impedance Spectroscopy: Experimental and Theoretical Studies Animesh Layek, Joydeep Datta,Animesh Biswas, Somobrata Acharya and Partha Pratim Ray* *Materials Chemistry and Physics*, **130**, 105799 (2022)

Ph.D. Degree Awarded

(1) Dipanwita Roy (IACS Deemed to be University)

Sponsored Project

» Unveiling mechanism of AIE … electroluminescence devices

» Stimulating scientific …….. self-sustainable empowerment

Lectures Delivered

Invited talk at (1) CSIR-NIIST, Thiruvananthapuram, (2) CoEN, Assam Down Town University, (3) IACS, Kolkata, (4) APCTP, Pohang, Korea, (5) CSIR-CGCRI, Kolkata, (6) NIMS, Tsukuba, Japan and (7) Kaziranga, Assam.

SUDIP MALIK

Senior Professor & School Chair

Physical properties of polymer, Luminescent oligomers or polymers, Polymer for energy storage; Electro-chromic polymers and Supramolecular aggregates.

Associate:

(1) Dr. Tanmay Kar (DST-TARE) (2) Ayan Dutta (SRF, UGC) (3) Prasanta Pal (SRF, Int. Ph D, IACS), (4) Gopal Lal Dhakar (JRF, IACS) (5) Saily Sriwastav (JRF, Inspire DST) (6) Lalmohan Das, JRF (CSIR) (7) Mustak Ahamed, JRF (CSIR) (8) Praduman K Gupta, JRF (CSIR), (9) Runa Mondal, JRF (CSIR) (10) Bankim Paul, JRF (Int. PhD, IACS).

Metal-nanoparticle embedded benzene tetracarboxylic acid-doped polyaniline (MBDP) nanotubes were demonstrated by charge transport measurements and low-frequency 1/f conductance noise spectroscopy for resistive switching (RS) applications. To improve the RS properties, MBDP nanotubes were prepared by in-situ reduction of silver ions (Ag^{+}) on the surface of the benzene tetracarboxylic acid-doped polyaniline (BDP, Figure 1a-b) nanotubes with the silver nanoparticles (Ag NPs). The Ag NPs acted like conformal active materials inside BDP nanotubes to effectively control the charge transport by modifying electron-phonon and electron-electron interactions. The RS device on the optimized MBDP (in Ag/MBDP/Ag - configuration) revealed a considerable OFF/ON ratio with excellent RS characteristics (Figure 1c). The transport results and conductance noise spectroscopy indicated that RS phenomena were originated from current driven space-charge limited carrier drift and Columb blocked in transport channels. RS devices exhibited no noticeable change in RS characteristics even after eighteen months of storage at the ambient condition.

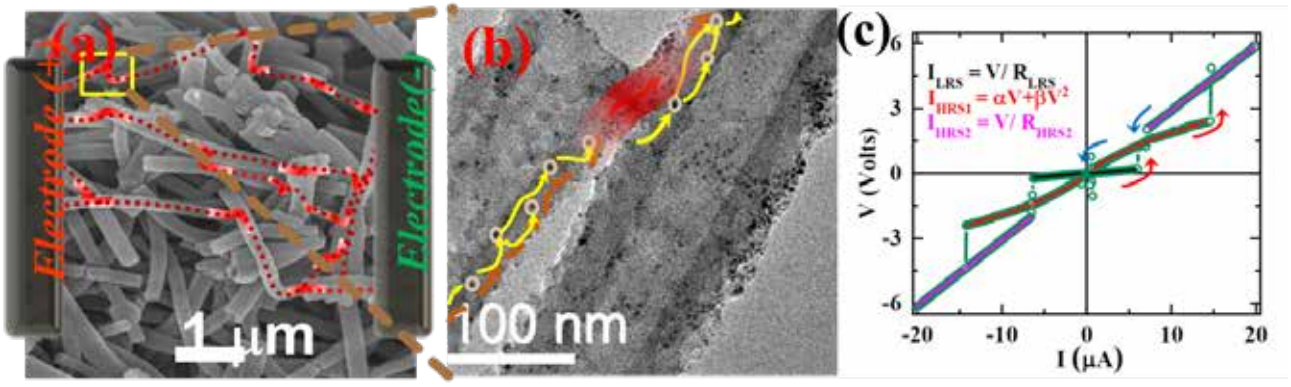


Figure1: (a) FESEM and (b) HRTEM of benzene tetracarboxylic acid-doped polyaniline (MBDP) nanotubes and (c) IV characteristics of MBDP showing the double symmetric complementary RS behavior.

Awards/Recognitions

» 12th POLYMER Foundation Award, Prof. Sukumar Maiti Polymer Award Foundation.

Publications in Journals

1. Solid-State Emissive Zn^{2+} Directed Metallo-Supramolecular Polymers of bis-Terpyridine Appended Aryl substituted Buta-1,3-diene Derivatives: Synthesis, Photo-physical and Electrochemical Properties, P. Pal, A. Datta, R. Jana, A. Datta and Sudip Malik*, Eur. Polym. J. 194, 112115 (2023) doi: 10.1016/j.eurpolymj.2023.112115.[IF: 6.00]
2. Charge Transport and Low-frequency conductance Noise in Metal-nanoparticle Embedded One-dimensional Conducting Polymer Nanotubes: Multiple Resistive Switching Phenomena, S, Bera, P. Das, B. Das, S. Mondal, P K Gupta, A. Bera, Sk Kalimuddin, Sk M. Ahamed, S. Gayen, M. Mondal* and Sudip Malik* Materials Today Nano., **22**, 100312 (2023).[IF:13.34]

3. Fully Organic Electroactive Monomers for Electrochromic Behaviors having High Coloration Efficiency and Long Cycle Stability towards Flexible Solid-State Electrochromic Device, S. Nad, R. Jana, A. Datta and Sudip Malik*, J. Electroanal. Chem., 918, 112484 (2022).[IF:4.598]

Ph.D. Degree Awarded

(1) Mahuya Pakhira (CU)

Lectures Delivered

Invited talk at (1) POLYSOLVAT-14, Strasbourg, France.

Sponsored Project :

» Wearable Bioelectronic Circuit…….. Glucose

» Making of Electrochromic windows ….. polymers (Nova Survace-Care Center Pvt. Ltd, Mumbai.

» Design and Development of Small Molecules ……. Diversified Fields (DST-TARE)

SUHRIT GHOSH

Senior Professor & Dean (Academic)

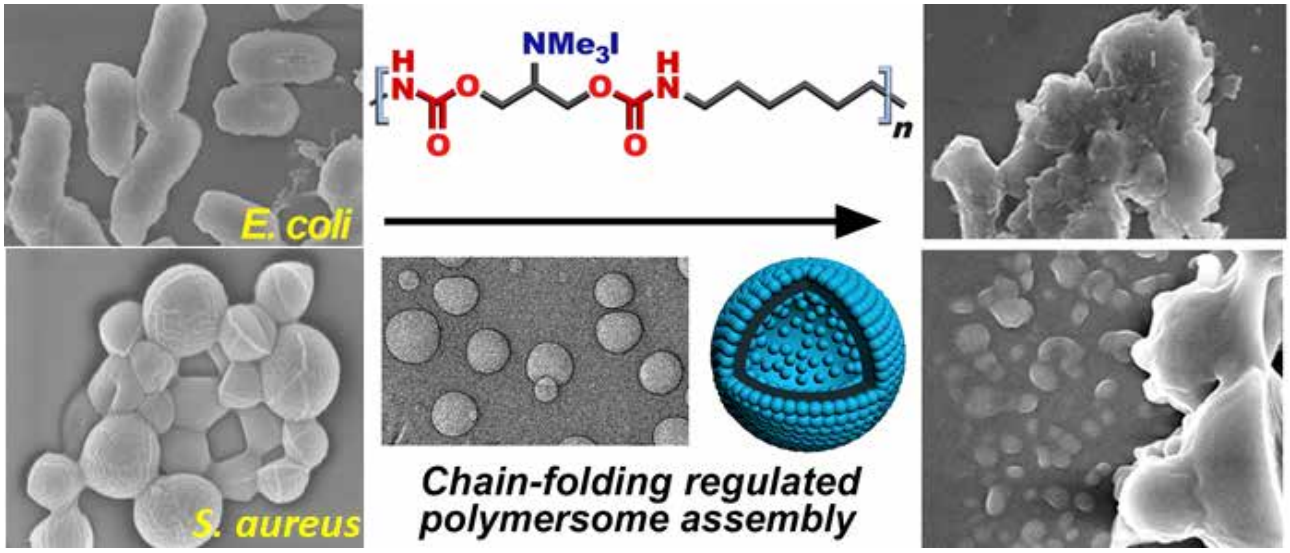
Polymer Chemistry, Supramolecular Chemistry, Functional Materials

Associate:

(1) Krishna Dan (RA-1), (2) Ranajit Barman (RA-II), (3) Anwesha Chakraborty (SRF), (4) Sukanya Bera (SRF), (5) Rajesh Khamrui (SRF), (6) Atish Nag (SRF), (7) Aritri Pal (SRF), (8) Tanushri Banerjee (SRF), (9) Supriya Bandyopadhyay (JRF), (10) Mr. Soumya Koner (JRF) and (11) Shria Chatterjee (MS Project)

We have explored polyurethanes as functional materials with particular emphasis on understanding the role of secondary structure on their hierarchical assembly and its direct correlation with the functional property. Different polyurethanes have been synthesized with flexible backbone and different pendant functional groups. Depending on the nature of the functional group, they can be dispersed either in water or hydrocarbon and in both medium such polymers exhibit chain-folding by intra-chain H-bonding and subsequent assembly of the folded chains to different nanostructures further polymersome or nanotube. Depending on the nature of the pendant functional group, they appear promising for diverse applications including antibacterial material, antiviral material, ferroelectric materials and others.

In a different project, we have explored supramolecular polymers of π-systems and established generally applicable strategies for controlled supramolecular polymerization by externally regulated specific molecular recognition. We have developed supramolecular polymers of different donor-acceptor systems as promising materials for room temperature ferroelectricity. We also have established direct solvent participation in the supramolecular polymerization process and highlighted its great impact.



Awards/Recognitions

» CNR Rao National Prize for Chemical Research (2023), CRSI

Publications in Journals

1. R. Barman, R. Bej, P. Dey and S. Ghosh, "Cisplatin-Conjugated Polyurethane Capsule for Dual Drug Delivery to Cancer Cell". *ACS Appl. Mater. Interfaces* **2023**, DOI:10.1021/acsami.2c22146. [IF:10.38]
2. A. Nag, K. Banerjee, R. Barman, J. Kar, D. P. Sarkar, S. S. Jana and S. Ghosh, "Direct Correlation between the Secondary Structure of an Amphiphilic Polymer and its Prominent Antiviral Activity". *J. Am. Chem. Soc.* **2023**, *145*, 579−584.[IF:16.38]
3. R. Khamrui, R. Manna, P. Rajdev, A. Paul and S. Ghosh, "Impact of the Hydrogen-Bonding Functional Group on Hydrogelation of Amphiphilic Naphthalene-diimide Derivatives and Non-specific Protein Adsorption" *ACS Appl. Bio Mater.* **2022**, *5*, 5410–5417.[IF:not known yet]
4. S. Barman, S. Bandyopadhyay, A. Ghosh, S. Das, T. Mondal, A. Datta, S. Ghosh and A. Datta, "Ferroelectricity in Hydrogen-Bonded Alternating Donor-Acceptor Supramolecular Copolymer" *Chem. Commun.* **2022**, *58*, 10508–10511.[IF:6.22]
5. S. Bera, R. Barman and S. Ghosh, "Hyperbranched vs. Linear Poly(disulfide) for Intra-cellular Drug Delivery" *Polym. Chem.* **2022**, *13*, 5188-5192.[IF: 5.36]
6. R. Barman, D. S. Ray, V. K. Aswal and S. Ghosh, "Chain-Folding Regulated Self-Assembly, Outstanding Bactericidal Activity and Biofilm Eradication by Biomimetic Amphiphilic Polymers" *Polym. Chem.* **2022**, *13*, 4384-4394.[IF: 5.36]
7. R. Barman, P. Rajdev, T. Mondal, P. Dey and S. Ghosh, "Amphiphilic Alternating Copolymers with Adjustable Lower Critical Solution Temperature (LCST) and Correlation with Non-specific Protein Adsorption" *ACS Appl. Polym. Mater*. **2022**, *4*, 5261−5268.[IF:4.85]
8. G. Ghosh, A. Chakraborty, P. Pal, B. Jana and S. Ghosh, "Direct Participation of Solvent Molecules in the Formation of Supramolecular Polymers" *Chem. Eur. J.* **2022**, e202201082.[IF:5.02]

Ph.D. Degree Awarded

(1) Ranajit Barman (JU)

Lectures Delivered

Invited talk at (1) IIT, Bombay, (2) IISER-Pune, (3) Assam down town University, Guwahati, (4) Strasbourg, France, (5) IISER-Thiruvananthapuram, (6) BITS Hyderabad Campus, (7) Somaiya Vidyasagar University, Mumbai and (8) Sophia College, Mumbai.

Sponsored Project

» Molecular Interaction …….Naphthalene-Diimide (NDI) (WACKER-IACS)

» Supramolecular Polymers …… Organic Ferroelectrics

SUROJIT SINHA

Senior Professor

- Synthesis of artificial amino acids and nucleic acids and morpholino oligonucleotides for biological applications.
- Non-peptide-based cellular transporter for the delivery of antisense reagents.
- Major contribution: Cell-permeable morpholino antisense-based therapy for genetic disorder diseases.
- Synthesis of biologically important natural products and their analogues. Recently, an analogue of ibogaine has been identified which could substitute "morphine".
- Small molecule modulation of Hedgehog signaling pathway which plays a critical role in embryogenesis, tissue regeneration, stem cell differentiation and in the development of cancer and studies of Hedgehog dependent physiology using zebrafish as a model organism.

Associate:

(1) Dr. J. Kundu, SRF, (RA-1, IACS) (2) Dr. Chandra Bose (DST Women's scientist supported), (3) Ujjwal Ghosh (SRF CSIR), (4) Shalini Gupta (SRF, CSIR), (5) Abhishek Gupta, (SRF, IACS fellow) (6) Arnab Das (IntPhD SRF, CSIR) and (7) Atanu Ghosh (IntPhD SRF, CSIR) (8) Swrajit Nath Sharma (IntPhD Biology, JRF, CSIR), (9) Sudipta Sarkar (JRF, Biology), (10) Dr. Pallab Shaw, DBT RA-1, (11) Gargi Sarkar (IntPhD M.Sc Project scholar), (12) Swapnendu Deb (IntPhD M.Sc Project scholar) and (13) Subhamoy Pratihar (IntPhD JRF), (13) MD Qasim ((IntPhD JRF, CSIR), (14) Arpan Banerjee Integrated BS-MS (Semester VII)

Synthesis of morpholino oligonucleotides has been achieved by automated oligo synthesizer and is the only available method to make 25-30-mer long morpholino sequence in 20-22 % overall yield. After standardization the morpholino synthesis, we then extended to the synthesis of thiol functionalized oligonucleotides as they are useful intermediates for a wide range of applications including DNA nanobiotechnology field through conjugation with various types of probes and cargos. Due to the limitation of synthetic process, phosphorodiamidate morpholino oligonucleotides (PMOs) have not been explored like other oligonucleotides through SH conjugation as mentioned above. We then reported the synthesis of 5′-SH functionalized PMO using solid support synthesis protocol with an optimized cysteine derived linker so that loading and coupling efficiency of morpholino monomers were effective enough to get a 25-mer 5′-SH functionalized PMO against human Nanog. The PMO with SH functionality was subsequently conjugated with our previously reported Internal Oligo-guanidinium Transporter (IGT) in solution phase to obtain the IGT-PMO conjugate. Interestingly, 5′-conjugated PMO (IGT-PMO) showed 2.5 times better antisense efficacy than 3′-conjugated PMO with IGT (PMO-IGT). 5′-Conjugation enables us to use IGT- PMO for further conjugation at the 3′-*N* terminal of PMO which was not possible earlier with 5′-OH-PMO-IGT. PMO have become an important class of antisense reagents because four PMO-based drugs have been approved for the treatment of Duchenne muscular dystrophy, hence such an improved result with 5′-modified PMO could be useful for enhancing the therapeutic efficacy of DMD drugs. Similarly, thiol-modified PMO could also be explored like other thiol-containing oligonucleotides for various other applications.

Further extension of the protocol applied to the synthesis of various functionalized morpholino ligonucleotides and new piperidino oligonucleotides.

Despite the enormous potential of siRNAs to transcriptionally downregulate disease causing proteins in many genetic diseases, efficient delivery and endosomal escape are the two bottlenecks that have resulted in only a handful of FDA approved drugs. In this report, we have successfully delivered siRNA against Nanog with the help of pentafluorobenzyl modified Internal Oligo-guanidinium transporter (IGT) that has previously shown promising results in peptide and antisense morpholino delivery. Nanog downregulation in prostate cancer cell line DU145 in serum containing media led to suppression of associated proteins such as KLF4, FAK and cMyc and also enhanced the chemosensitivity of Epirubicin, an anthracycline based drug, in DU145 cells by associated MDR-1 downregulation *in vitro*. These results show that IGT is a promising candidate for siRNA delivery

and its conjugation with stable siRNAs could enhance the chemotherapeutic efficiency of siRNAs alone and in combination with small molecule-based drugs.

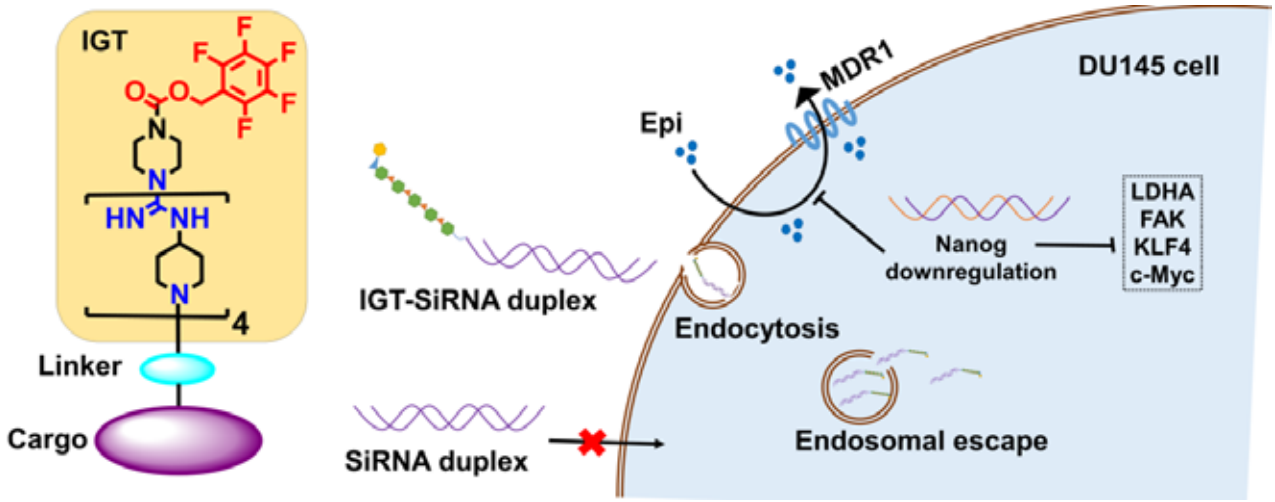


Figure: Delivery of siRNA

Publications in Journals

1. Gupta, A.; Gupta, S.; Das, U. and Sinha, S. Guanidinium Functionalized Flexible Azaproline Transporter for Efficient Intracellular Delivery of Proapoptotic Peptide and PDL1 Antisense Morpholino Oligo in Human Carcinoma Cells In Vitro. *Bioconjugate Chem.* **2022,** *33*, 907-917 https://doi.org/10.1021/acs.bioconjchem.2c00129.[IF:6.069]

2. J. Kundu, A. Ghosh, U. Ghosh, A. Das, D. Nagar, S. Pattanayak, A. Ghose and S. Sinha: Synthesis of Phosphorodiamidate Morpholino Oligonucleotides Using Trityl and Fmoc Chemistry in an Automated Oligo Synthesizer. *J. Org. Chem.* **2022**, 87, 15, 9466–9478.[I. F. 4.198)

3. Das, O.; Kundu, J.; Ghosh, A.; Gautam, A.; Ghosh, S.; Chakraborty, M.; Masid, A.; Gauri, S. S.; Mitra, D.; Dutta, M.; Mukherjee, B.; Sinha, S.; Bhaumik, M. AUF-1 knock down in mice overarches butyrate driven hypo-cholesteraemia by conjuring 1 AUF-1-Dicer-1-miR122 hierarchy. **bioRxiv 2022**, https://doi.org/10.1101/2022.06.13.496022 *Front. Cell. Infect. Microbiol.* **2022**, 1-20 (doi: 10.3389/fcimb.2022.1011386). (I. F. 6.073)

4. Gupta, S.; Das, U.; Sinha, S. IGT mediated Nanog siRNA delivery in prostate cancer cells improves chemosensitization of Epirubicin *in vitro*. *Bioorg. Med. Chem. Lett.* **2022**, https://doi.org/10.1016/j.bmcl.2022.129017. (I. F. 2.94)

5. Ghosh, U.; Gupta, S. and Sinha, S. Synthesis of 5′-Thiol Functionalized Morpholino Oligo-nucleotide and Subsequent Conjugation with IGT to Improve Delivery and Antisense Efficacy *In Vitro*. *Bioconjugate Chem.* **2023**, *34*, 174–180, https://doi.org/10.1021/acs.bioconjchem.2c00587 (I. F. 6.069)

6. Das, A.; Gupta, S.; Sinha, S. C5-Pyrimidine-Functionalized Morpholino Oligonucleotides Exhibit Differential Binding Affinity, Target Specificity and Lipophilicity. *Org. Biomol. Chem.* 2023, **21**, 1242 - 1253 https://doi.org/10.1039/D2OB01759H. (I. F. 3.89)

7. Ghosh, A.; Akabane-Nakata, M.; Kundu, J.; Harp, J. M.; Madaoui, M.; Egli, M.; Manoharan, M.; and Sinha, S. Synthesis and Biophysical Properties of Phosphorodiamidate Piperidino Oligomers (PPOs). *Org. Lett.* **2023,** *25*, 6, 901–906, 10.1021/acs.orglett.2c04067 (Cover art) (I. F. 6.072)

Books Chapter :

1. Cis-Amide Stabilizing Proline Analogs: Synthesis and Applications https://doi.org/10.1142/9789811261664_0001, 1-24.

Patent Filed/Awarded :

1. Filed: Sinha, S.; Ghosh, A.; Das, A. Modified morpholino oligonucleotides incorporating 5-substituted pyrimidines to improve binding stability, hydrophobicity or lipophilicity useful for antisense applications. Patent Application no.: 202231042899 dated 27.07.2022.

Awarded:

1. Sinha, S.; Bhadra, J.; Pattanayak, S.; Kundu, J. OLIGO-GUANIDINES based cellular transporter comprising heterocyclic rings with hydrophobic and /or lipophilic group at N-terminal for effective

delivery of nonpenetrable cargos in vitro and in vivo 1328/KOL/2015, 23.12.2015, PCT/IN2016/000150, 10th June 2016, US20190002408A1. US 10,919,857 B2, **date of patent Feb 16, 2021; Indian 401773; 21.07.2022**

2. Sinha, S.; Pattanayak, S. **Substituted Internal Ologo-Guanidines As Cellular Penetrating Agents.** 71/KOL/2013 dated 21 January 2013. Indian patent 418923, date 23.01.2023.

Ph.D. Degree Awarded

(1) Chandra Bose (CU)

Sponsored Project :

» Chemical modification of …..Cancer stem cells

» Synthesis of Fmoc protected …… morpholino oligomer

» Design, synthesis and cellular uptake …….siliencing in cancer cells.

Lectures Delivered

Invited talk at (1) CSIR-IICB, (2) IACS, Kolkata, (3) IIT-Kanpur, (4) NIPER-Kolkata, (5) Calcutta University, Kolkata, (6) Scottish Church College, Kolkata, (7) REDRESS 2022 (online), (8) Adamas University and (9) TIFAC-DSIR-IICB Joint Workshop.

ANUJA DATTA

Ramanujan Fellow

Emerging functional properties and waste energy harvesting in novel Pb-free inorganic and organic materials for flexible electronics

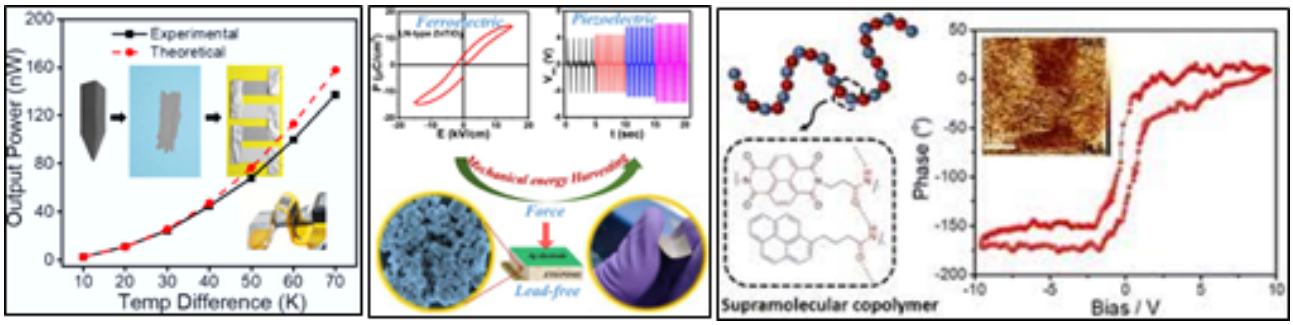
Associate:

(1) S. Barman, SRF (CSIR), (2) B. Mandal, SRF (CSIR) and (3) S. Paul, SRF (UGC), (4) S. Das, SRF (CSIR), (5) P Ranjan, JRF (UGC)

a. H-bonding and charge-transfer (CT) interaction-promoted driven supramolecular copolymerization of amide-functionalized pyrene (Py) and naphthalene-diimide (NDI) building blocks was studied and the emergence of ferroelectricity was reported.

b. Lead-free inorganic Lithium Niobate (LN)-type oxide perovskites such as, $ZnSnO_3$, and $ZnTiO_3$ are studied as attractive candidates for emerging ferroelectric, piezoelectric and ferroelectric-photovoltaic properties through band-gap engineering.

c. Flexible thermoelectrics (TEs) involving simplified processeability are attractive, with limited choice of materials and low endurance, remaining as major challenges. We reported an economic emery paper-based thermoelectric generator (PTEG) from graphite as p-type leg and bismuth as n-type leg, prepared by simple bulk tracings. Tracing provided a feasible approach to modulate the TE properties, as supported by finite-element analysis.



Flexible Thermoelectrics → Fexible Piezoelectrics → Flexible Ferroelectrics

Figure: Novel Functional Materials (Nano) for Flexible Waste Energy Harvesting and Sensing Technologies

Publications in Journals:

1. Emerging Ferroelectricity and Piezoelectric Energy Harvesting Properties in Lead-Free Zinc Titanate Nanocrystals - S. Barman, S. Paul, P. Ranjan, S. Das, Anuja Datta*, J. Mater. Sc., (2023) (10.1007/s10853-023-08435-1).[IF:4.682]

2. Flexible Thermoelectric Generator from Bulk Graphite and Bismuth Traces on Emery Paper- B. P Mondal, P. Ranjan, G. Sarkar, Anuja Datta*, Energy Technol., 2201361 (2023).[IF:4.149]

3. Ferroelectricity in hydrogen-bonded alternating donor-acceptor supramolecular copolymer- S. Barman, S. Bandyopadhyay, A. Ghosh, S. Das, T. Mondal, A. Datta,* S. Ghosh*, Anuja Datta*, Chem. Commun., DOI: 10.1039/D2CC02506J (2022).[IF:6.065]

4. Coexisting ferroelectricity and photoconductivity in doped LN-type $ZnSnO_3$ nanospikes- S. Barman, Anuja Datta*, Mat. Chem. Phys., 290, 126507 (2022). [IF:4.77]

Lecture Delivered

Invited talk at (1) Chemistry Meet 2023, Kaziranga, (2) STREE-2020, JNU, New Delhi, (3) IACS, Kolkata.

Sponsored Project:

» Sustainable and safe nanomaterials ……. Energy harnessing (SERB-RJN)

» Supramolecular Polymers ……. Organic Ferroelectrics. (SERB - CRG)

SCHOOL OF BIOLOGICAL SCIENCES

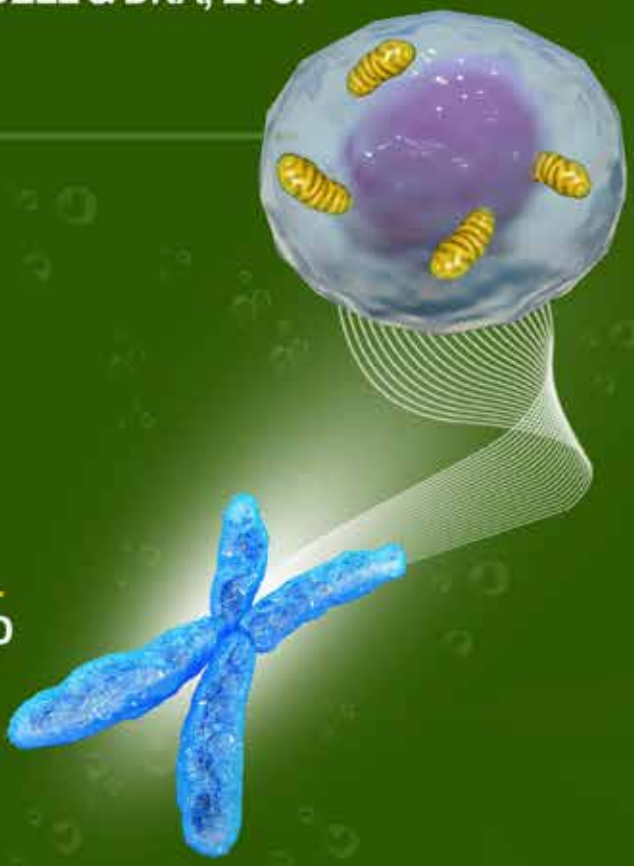
PHOSPHORUS: BACKBONE OF LIFE

YOUR BODY INCLUDES 1 KG OF PHOSPHOROUS, THAT HOLDS TOGETHER CELL & DNA, ETC.

A CELL MEMBRANE CONSISTS OF PHOSPHORUS COMPOUNDS.

A CELL ENERGY IS GENERATED IN THE SHAPE OF THE ATP MOLECULE THAT INCLUDES PHOSPHORUS

THE GENETIC MATERIAL OF CHROMOSOMES AND DNA STRANDS IS HELD TOGETHER BY PHOSPHORUS COMPOUNDS.



School of Biological Sciences

PROFESSOR PRASANTA K. DAS
School Chair

SCHOOL PROFILE

People

Faculty	: 08
Post-doctoral Research Associate	: 04
Ph.D. Students	: 58
Non-Academic Staff	: 05

Extra Mural Funding

Projects (ongoing)	: 13

Research Achievements

Research Papers in Journals	: 31
Ph.D. degree awarded	: 05

Academic Activities

Talks delivered by members of School in conferences/symposia	National :	14

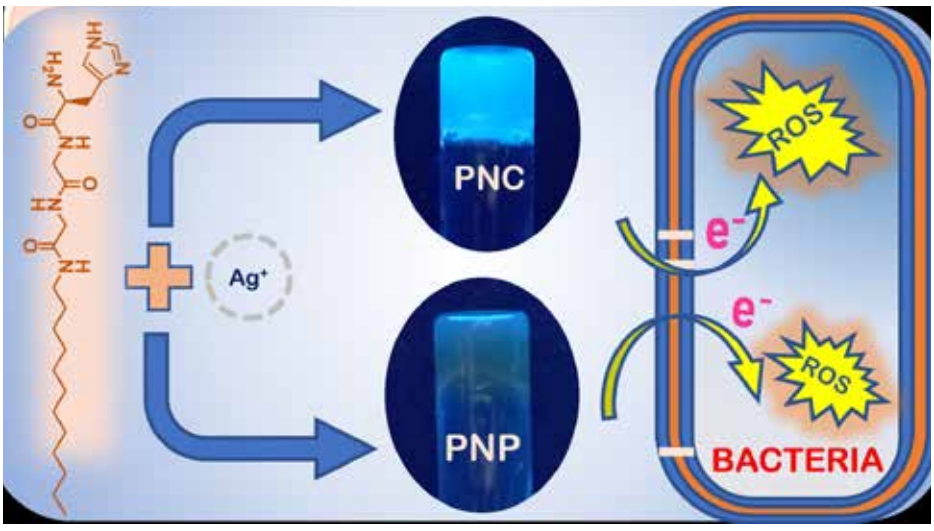
ARINDAM BANERJEE, FASc
Senior Professor

Self-assembling peptide and amino acid based functional nanobiomaterials

Associate:
(1) KousikGayen SRF (Institute), (2) Biplab Mondal SRF (Institute); (3) Biswanath Hansda SRF (UGC)' (4) Dipayan Bairagi SRF (UGC); (5) Soumyajit Hazra, SRF (UGC); (6) Nilardi Hazra, JRF (UGC); (7) Purna Das Ghosh, SRF (CSIR), (8) Tanushree Mondal SRF (CSIR), (9) Swapnendu Deb, JRF, (10) Supratim Basu JRF

Peptide and amino based hydrogels as potential antimicrobials : A series of aromatic amino acid containing amphiphilic hydrogelators have been synthesised, purified and examined for antimicrobial activity. Two of these gelators have been discovered to display potential antibacterial activity against both Gram-positive bacteria *B. subtilis* and Gram-negative bacteria *E. coli* and *P. Aeruginosa*. Moreover, these gelators also show excellent anti-protozoan activity and they are cytotoxic towards a wide variety of protozoal parasites, that includes Indian varieties of Leishmania donovani and also destroy resistant parasitic strains including BHU-575, MIL^R and CPT^R cells. Interestingly, these hydrogelators exhibit non-cytotoxicity towards host macrophage cells. This suggests the potential use of these gels as therapeutic agents against various forms of leishmaniasis in future. A histidine based peptide amphiphile has been observed to form hydrogel and this gel has been used to form *in situ* generation of silver nanoparticles and a few atom Ag nanoclusters within the gel matrix in presence of Ag^+ ions and light. Interestingly, the new nanohybrid system consisting of peptide gel-based nanofibers and Ag nanoclusters/particles exhibit potential applications against both Gram-positive and Gram-negative bacteria indicating this metallo-hydrogel's uses as a good antimicrobial agent in future.

Carbon nanodots for bioimaging and peptide conjugation : Yellow-emitting carbon nanodots (C dots) have been synthesised by slovothermal method. Interestingly, these carbon nanodots are successfully and effectively used for the selective imaging of lipid droplets inside the living cells as it is evident from very similar staining patterns with other staining dyes and starvation study. Surface modification of C dots has been successfully achieved through covalent conjugation with a dipeptide and this results in a good fluorescence shift from green to red. Moreover, covalent attachment of peptide units to the surface of the modified carbon dots assisted them to aggregate by forming a nanodot-fabricated nanofibrous network structure. This network structure has exhibited very good electrical conductivity and photo-switching behaviour and this is of course much better than those of the non-aggregated dots.



D. Bairagi, P. Ghosh, P. Roy and A. Banerjee, ACS Applied Nano Materials, **2023**, *6, 2299-2309.*

This work vividly demonstrates formation of nanoclusters as well as nanoparticles of silver in a peptide-based hydrogel matrix and successful utilization of thus formed nano-hybrid materials in antimicrobial activity.

Publications in Journals :

1. Surface Modification of Carbon Dots via Covalent Peptide Conjugation - Niladri Hazra, Soumyajit Hazra, Subir Paul, Arindam Banerjee, *Chem. Commun.,* 2023, **59**, 4931–4934.[IF: 6.065]
2. Polythiophene-g-Poly (methacrylic acid) and Perylene Diimide Appended Peptide Conjugates with Tuneable Photoluminescence, OMEIC and Photo-switching Properties - Soumyajit Hazra, Arindam Banerjee and Arun K. Nandi *J. Mater. Chem.* C, 2023, **11**, 4808–4819.[IF:8.067]
3. Metallogels from Silver Nanoparticles and Peptide Nanofibers as Antimicrobial Surfaces – Dipayan Bairagi, Purnadas Ghosh, Priyanka Roy, and Arindam Banerjee , *ACS Appl. Nano Mater.* 2023, **6**, 2299−2309.[IF:6.14]
4. Organic Mixed Ion-Electron Conductivity in Polymer Hybrid Systems - Soumyajit Hazra, Arindam Banerjee and Arun K. Nandi *ACS Omega,* 2022, **7**, 2849−32862.[IF:4.13]
5. Amino acid containing amphiphilic hydrogelators with antibacterial and antiparasitic activity - Biplab Mondal, Vivek Kumar Gupta, BiswanathHansda, Arpita Bhoumik, Tanushree Mondal, Hemanta K. Majumder, Charlotte J. C. Edwards-Gayle, Ian W. Hamley, Parasuraman Jaisankar and Arindam Banerjee, *Soft Matter*, 2022, **18**, 7201–7216. [IF:4.046]
6. A Nanohybrid Containing Cyan-Emitting Copper Nanoclusters and TiO_2 Nanoparticles: Tuning of Optoelectronic Properties – Dipayan Bairagi, Soumyajit Hazra, Kingshuk Basu, and Arindam Banerjee, *Chemistry Select,* 2022 (doi.org/10.1002/slct.202201701).[IF:2.307]
7. Yellow Emitting Carbon Dots for Selective Fluorescence Imaging of Lipid droplets in Living Cells - Subir Paul, Anindita Bhattacharya,Niladri Hazra, Kousik Gayen , Prosenjit Sen and Arindam Banerjee, *Langmuir,* 2022, **38**, 8829−8836.[IF:4.33]
8. Copper Nanoclusters for Catalytic Carbon-Carbon and Carbon-Nitrogen Bond Formations - Biplab Mondal, Kingshuk Basu, Rajkumar Jana, Partha Mondal, Biswanath Hansda, Ayan Datta and Arindam Banerjee, *ACS Appl. Nano Mater.* 2022, **5**, 6, 7932–7943.[IF:6.14]

Lectures Delivered:

Invited talk at (1) CSIR - IICB, Kolkata

BENU BRATA DAS

Professor

Self-assembling peptide and amino acid based functional nanobiomaterials

Associate:

(1) Kousik Gayen SRF (Institute), (2) Biplab Mondal SRF (Institute); (3) Biswanath Hansda SRF (UGC)' (4) Dipayan Bairagi SRF (UGC); (5) Soumyajit Hazra, SRF (UGC); (6) Nilardi Hazra, JRF (UGC); (7) Purna Das Ghosh, SRF (CSIR), (8) Tanushree Mondal SRF (CSIR), (9) Swapnendu Deb, JRF, (10) Supratim Basu JRF

Our laboratory primarily focuses on DNA topoisomerases, Top1 is essential in higher eukaryotes as it relaxes positive DNA supercoiling in advance of replication forks and transcription complexes as well as negative supercoiling behind such complexes. Supercoiling relaxation requires the production of transient Top1 cleavage complexes (Top1cc), which are Top1-linked DNA single-strand breaks. Top1cc catalytic intermediates can be converted into irreversible Top1-DNA cleavage complexes by colliding replication and transcription complexes. It is those DNA lesions that trigger cell death and the antitumor activity of camptothecin (CPT) and its clinical derivatives irinotecan and topotecan after the drugs selectively trap Top1cc. Despite the clinical successes of Top1 inhibitors, inherent resistance has been reported with significant limitation. CPT and its derivatives bind reversibly to the Top1 cleavage complexes. The drug-DNA-Top1-complexes are destabilized in the serum or when CPT is

diluted out or removed from cell culture, leading to rapid reversal of Top1cc that limits the efficacy of Top1-poisons. Thus, our group at IACS is focused to understand how new genes and novel post-translational modifications coordinate the DSBs repair signaling in cells, which can eventually pave the pathway into therapeutic benefit.

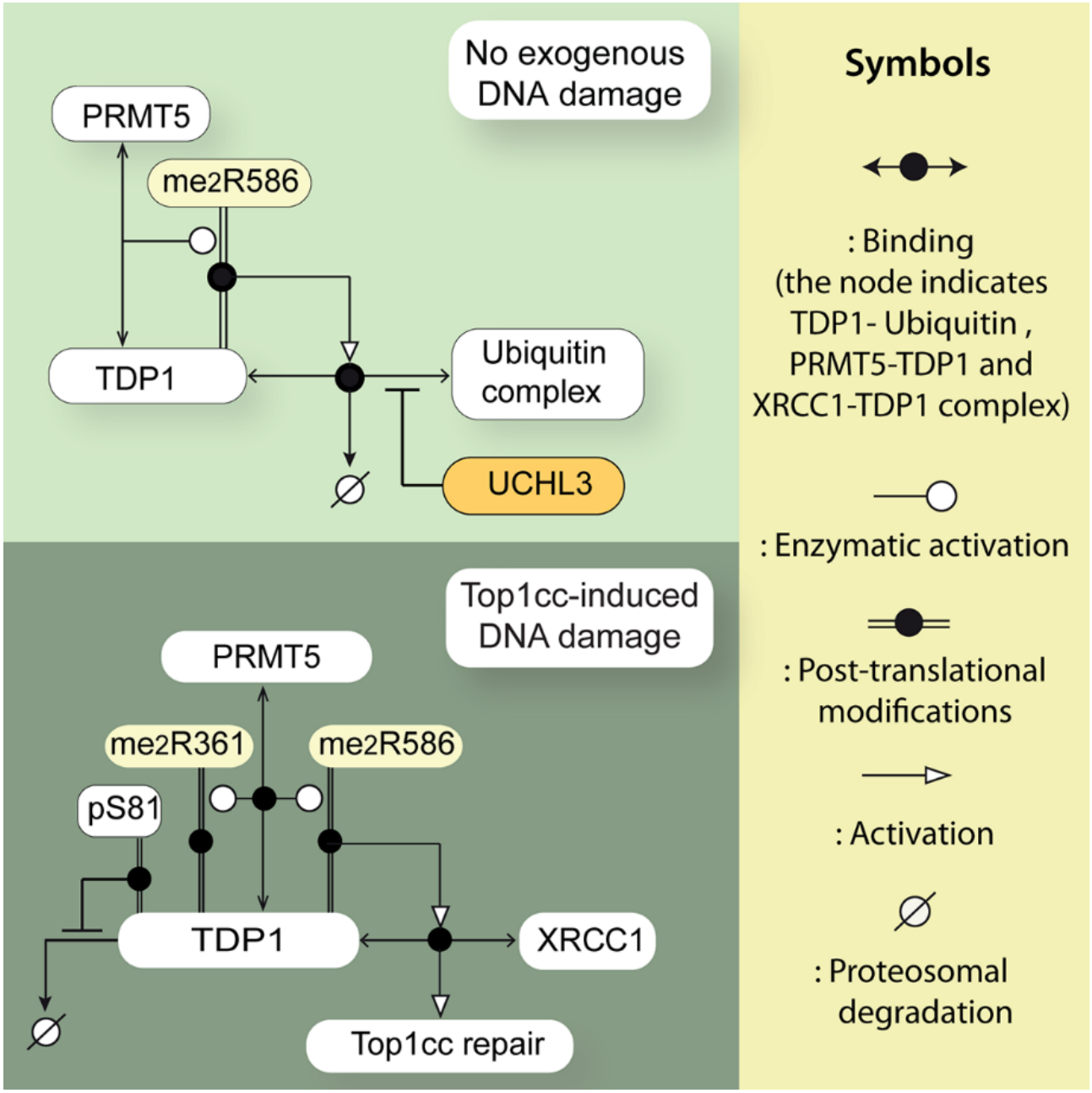


*Figure: Schematic representation of a novel mechanism by which PRMT5 regulates Top1cc repair and genome stability by controlling the crosstalk between TDP1 arginine methylation and ubiquitylation, by binding with UCHL3, which is critical for TDP1 homeostasis and responses to Top1 poisons. PRMT5 KO cells show defective TDP1 proteostasis and increased CPT- induced cell death. (**Cell Reports, 2022,39, 110940**)*

- Genomic instability leads to cancer, premature aging, neurodegeneration and several human diseases. Other than the nuclear genome, mitochondria also harbor the small, circular DNA (mtDNA) that is essential for life. Mitochondrial reactive oxygen species (ROS) is the source for the endogenous DNA damage. Thus, DNA repair enzymes provide a critical defense mechanism against endogenous and exogenous DNA damage.
- DNA topoisomerases are essential enzymes involved in maintaining the topology of both the nuclear and mitochondrial DNA. However, topoisomerase I (Top1) is detrimental to the cell when Top1 gets irreversibly trapped on the DNA (Top1cc) that generates DNA double-strand breaks.

- The key enzyme for the repair of Top1cc is tyrosyl-DNA phosphodiesterase (TDP1). Active site mutation of TDP1 causes the severe neurodegenerative syndrome spinocerebellar ataxia with axonal neuropathy (SCAN1).
- Research in our lab is focused on understanding the molecular mechanism of DNA damage response pathways both in the nucleus and mitochondria. We are especially interested to uncover stress induced novel post-translational modification of proteins and evaluate their role in genome maintenance. We will also explore the cellular stress response network with potent anti-cancer agents in preclinical development.
- A homozygous mutation of human tyrosyl-DNA phosphodiesterase 1 (TDP1) is responsible for the neurodegenerative syndrome, spinocerebellar ataxia with axonal neuropathy (SCAN1). TDP1 hydrolyzes the phosphodiester bond between DNA 3′-end and a tyrosyl moiety that is linked with trapped topoisomerase I (Top1)-DNA covalent complexes (Top1cc). TDP1 is critical for mitochondrial DNA (mtDNA) repair, however the role of mitochondria remains largely unknown for the etiology of SCAN1. In the present study, we show that mitochondria in cells expressing SCAN1-TDP1 ($TDP1^{H493R}$) are selectively trapped in the regulatory non-coding region and promoter sequences of mtDNA which was markedly increased in the presence of selectively mitochondria targeted Top1 poison (mito-SN38). $TDP1^{H493R}$-trapping accumulates mtDNA damage and perturbs the dynamic equilibrium between mitochondrial fusion and fission rates and triggers Drp1-mediated fission which blocks mitobiogenesis. $TDP1^{H493R}$ prompts mitochondrial membrane depolarization and activates PINK1-dependent mitophagy to eliminate dysfunctional mitochondria. We further show that SCAN1-TDP1 in mitochondria is a pathological state that allows neurons to turn on mitophagy to rescue fit mitochondria as mechanisms of survival.

Publications in Journals

1. Bhattacharjee S, Rehman I, Basu, S., Nandy S, Richardson J., Das, B.B*. The interplay between symmetric argininedimethylation and ubiquitylation regulates TDP1 proteostasis for the repair of topoisomerase I-DNA adducts. *CellReports*, 2022, **39**,110940.[IP:9.99]
2. Roy Chowdhury S., Das SK., Banerjee B., Paul Chowdhuri S., Majumder H.K., and Das, B.B*. TDP1 knockout*Leishmania donovani*accumulate Topoisomerase1-linked DNA damage and are hypersensitive to clinically usedantileishmanialdrugs, *TheFASEBJournal*, 2022, 36(4): e22265.[IP:5.84]
3. Bhattacharjee S, Rehman I, Nandy S, Das, B.B*. Post-translational regulation of Tyrosyl-DNA phosphodiesterase(TDP1and TDP2) for the repair of the trapped topoisomerase-DNA covalent complex. *DNA Repair (Amst)*. 2022;111:103277. [IP:4.4]

Sponsored Project

» DNA damage control ….. post-translational regulations (Wellcome Trust/DBT)

» Exploring the role …. Covalent complexes (DAE-BRNS)

» Targeting the RNA-dependent RNA polymerase…… inhibitors (DST-SERB)

» Exploring the molecular ….. stratified ovarian cancer (DST-SERB)

Lectures Delivered :

Invited talk at (1) Keynote Speaker : Russian Academy of Science, (2) IISc Bangalore, (3) IISER-Trivandrum, (4) IISc-Bangalore, (5) IIT-Kanpur, (6) BHU Varanasi and (7) IACS-Kolkata.

DEEPAK KR. SINHA

Professor

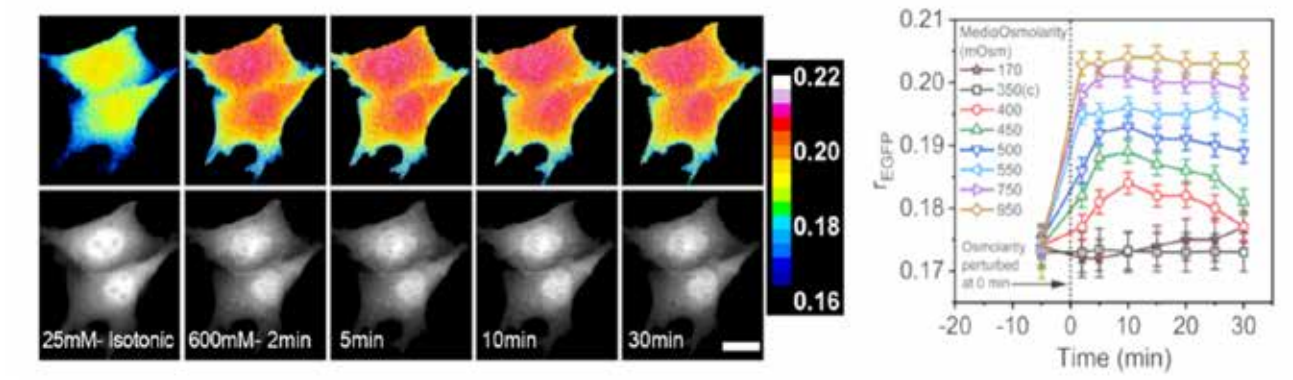
Biological physics, Lipid droplets in development.

Associate:

(1) Mr. Mahesh Agarwal (CSIR), (2) Mr.Parijat Biswas, (3) Ms Anindita Bhattacharya (CSIR), (4) Ms Sudipta Sarkar, (5) Ms Priyanka Roy (CSIR), (6) Sumomaya, (7) Dipanjan Ray

Project1: This Project concentrates on understanding the macromolecular crowding (MMC) in cytoplasm, an entropic effect, that affects a host of vital processes such as active transport, enzyme-substrate reaction rates, protein folding, post-translational modifications, and self-assembly. In spite of the high relevance of cytoplasmic MMC, literature lacks study of MMC in live cytoplasm. Cytoplasmic MMC and cell volume are inversely related, and MMC is hypothesized to be the thermodynamic condition that cell volume regulation machinery utilizes as a volume sensor. Yet, there is no direct evidence to establish this, primarily due to lack of suitable methods to accurately monitor MMC in live cells. In this work, we establish that steady state fluorescence anisotropy of mEGFP (r_{EGFP}) is a reliable indicator of MMC in cell cytoplasm and *in vitro*. r_{EGFP} . It changes linearly with MMC over a large dynamic range, displays reversibility, indifference to salt and small molecule concentration and is insensitive to pH and solution viscosity. This makes r_{EGFP} a good semi-quantitative indicator of cellular MMC. Contrary to the current understanding, our research establishes that MMC in cytoplasm is spatially inhomogeneous. Organaization of actin cytoskeleton is linked to maintenance of inhomogeneous MMC in the cytoplasm. However the average cytoplasmic MMC in a given cell is stable temporally for long durations. Different cell lineages maintain noticeably unique levels of their respective average cytoplasmic MMC.

We observe that, depending on the method used to shift MMC, the cells respond differently to change in its cytoplasmic MMC. Hypertonic stress induced elevation of cytoplasmic MMC triggers the regulatory volume increase (RVI) in cells at relatively longer timescales. It is noteworthy that hypertonic stress causes a relatively small change in intracellular osmolarity at short timescales (~10 minutes). However, at longer timescales, there is considerable shift in intracellular osmolarity with import of osmolytes. Interestingly, other methods of increasing cytoplasmic MMC in isotonic conditions that leads to only a minor shift in intracellular osmolarity, fails to trigger RVI. Based on experiments that involve subjecting cells to hypertonic stress, it is hypothesized that the cell volume regulatory apparatus utilizes the cytoplasmic MMC as a volume sensor. Thus, our research challenges the role of cytoplasmic MMC in existing hypotheses. Rather, the changes in spread area of cells in isotonic conditions trigger the regulatory volume change, both during spreading and contraction. Since every condition reported to trigger regulatory volume change involve changes in membrane organization, we hypothesize that the cue to sense the volume of the cell resides in the physical organization of plasma membrane and actin cytoskeleton.



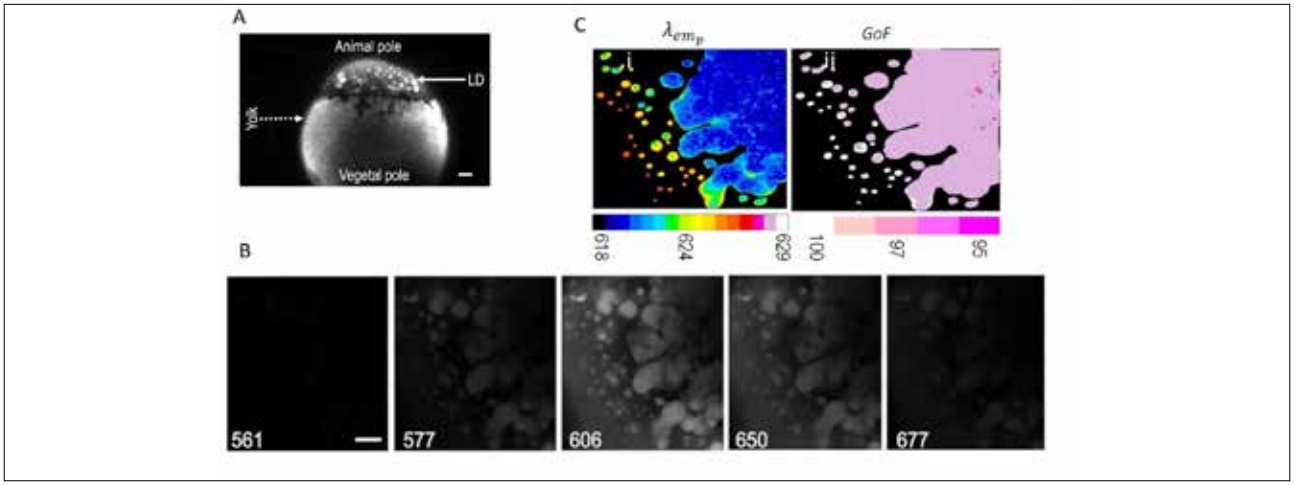
Left:Time series of Anisotropy map (top panel) and intensity image (bottom panel) of NIH3T3 fibroblasts expressing mEGFP upon exposure to hypertonic media (600mM Dextrose). Colour bar on the right shows the corresponding anisotropy values. Right: Fluorescence Anisotropy plotted against cell volume at 10 min post hypertonic shock

Project2: The development of the embryonic body (blastodisc) is spatially separated from the yolk in zebrafish embryos. While the yolk is filled with lipids, the blastodisc stores the lipids in specialized organelles called lipid droplets (LDs). In lecithotrophic systems such as zebrafish embryos, the metabolism of lipids in the yolk and the blastodisc cell is crucial for sustaining the development of the embryonic body. Despite the importance, there are fewer studies of lipid metabolism in live biological systems, primarily due to a lack of suitable techniques. Lipidomic technics such as mass spectrometry or NMR are incompatible with live samples. The fluorescence of Nile Red exhibit solvatochromism, .i.e, its emission spectrum depends on the solvent's polarity. In this manuscript, we utilize the solvatochromism of NR to investigate the lipid metabolism of LDs in the blastodisc in live zebrafish embryos.

The blastodisc contains many LDs whose sizes (area) ranges two order of magnitude ($0.5 < a < 300 \mu m^2$). We uncover the importance of polarity in deciding the size of the LDs at the time of their biogenesis. We find that the mechanism of biogenesis of LDs in the blastodisc differs from that in the prokaryotic cells. While in prokaryotic cells, neutral lipids accumulate between the ER leaflets before budding off as LD, in zebrafish embryos, the yolk serves as the reservoir from which a small chunk of lipids parts off into the cytoplasm as LDs. The yolk-blastodisc interface's local polarity controls the nascent LDs' sizes. We find a similar correlation between the polarity and the size of the oil droplets synthesized in vitro, suggesting polarity's role in determining the LDs' size in zebrafish blastodisc.

The polarity of the LDs (an indicator of lipidomic composition) correlates inversely with the size of the LDs. The LDs in the blastodisc undergo a cycle of lipolysis (while the blastodisc is in G1/ S phase), which increases the polarity of the LDs. Following lipolysis, the LDs undergo another cycle of lipid synthesis (during initiation and ingression of the furrow), reducing their polarity. Using NR, we probe the time-lapse lipidomic changes of an LD during the phase of lipolysis or lipogenesis. With time-lapse polarity measurements of LDs, we validate that the smaller LDs are efficient in lipolysis due to a higher surface-to-volume ratio. The polarity map of an LD reveals inhomogeneous mixing of lipids within the LDs. The lipolysis generates mechanical instability within the LDs, causing a rapid shape fluctuation. We establish that the rapid shape fluctuation is an indicator of the lipolytic state of the LD. In zebrafish blastodisc, the cytoplasm near the yolk-blastodisc interface has a higher potential for LD lipolysis. Our manuscript reports spatially uneven potential of lipolysis of LDs within the cytoplasm of the zebrafish blastodisc cell.

Our research utilizes solvatochromism to study the LD's lipidomic dynamic in the live system. We establish that in zebrafish blastodisc cells, 1) the size, 2) the location within the cytoplasm, and 3) the developmental stages of the embryos decide the lipidomic composition of an LD. Some of the exciting findings of this manuscript are 1) the uneven likelihood of lipolysis of LDs within the cytoplasm, 2) a novel mechanism of LDs biogenesis, and 3) polarity-dependent sizes of the LDs. To the best of our knowledge, it is unknown for any biological system in the literature. The lipid biochemistry in zebrafish is remarkably similar to that in humans. Therefore the methodology used in this manuscript is potentially relevant for developing a zebrafish-based model system to investigate human lipid metabolism-related diseases. We suppose the content of our manuscript is novel and of considerable research interest to a large community of cell and developmental biologists.



(A)Fluorescence image of NR-stained zebrafish embryo at the one-cell stage. The white arrow indicates the LDs in the blastodisc. The White dashed arrow indicatesthe yolk. The animal pole and the vegetal pole of the embryo are indicated. (B)Spectrally resolved (8.9 nm resolution) representative image of a zebrafish embryo stained with NR. For clarity, five representative spectral channels are depicted. The numbers on the image represent the wavelength of the spectral channel in nm. (C)(i) Polarity Map of λ_{em_p} (in nm)obtained from the fits in. For clarity, only LDs and the regions of yolk have been depicted. The rest of the embryo is set to black. (ii) The corresponding map of R-square values to access GOF. The respective color bar is indicated at the bottom.

Publications in Journals:

1. Probing the role of macromolecular crowding in cell volume regulation using fluorescence anisotropy Parijat Biswas, Dipanjan Ray, Subhamoy Jana, Jibitesh Das, Bidisha Sinha, Deepa kKumar Sinha[8]bioRxiv 2022.04.07.487477; doi: https://doi.org/10.1101/2022.04.07.487477(a lso under review in *elife*)
2. JOCES/2023/261133, Size, location and metabolism are key regulators for lipid droplets' composition in zebrafish embryos: A polarity sensitive spectral imaging investigation Sudipta Sarkar, Subhasis Mandal, Nandana Nanda, SayaniHaldar, Prosenjit Sen, and Deepak Sinha* (*Journal of cell sciences*, Under review since march 2023)

Ph.D. Degree Awarded :

(1) Parijat Biswash (Jadavpur University)

Sponsored Project

» Study of actin filament conformational dynamics (DST)

» Study of cell-cell interaction mediated via substrate viscoelasticity (DBT)

PRASANTA KUMAR DAS, FASc, FRSC

Senior Professor & School Chair

Biomedicinal chemistry of self-assembled functional soft nanocomposites

Associate:

(1) D. Sarkar, SRF (CSIR), (2) A. K. Ghosh, SRF (CSIR), (3) M. Chowdhury, SRF (UGC), (4) S. Pal, JRF (UGC), (5) A. H. Khan, JRF (CSIR), (6) K. Roy, JRF (Integrated PhD), (7) A. Zaman, JRF (UGC) (8) D. Basu, DST-Inspire (9) Dr. A. Ghosh, RA-I (DST-SERB)

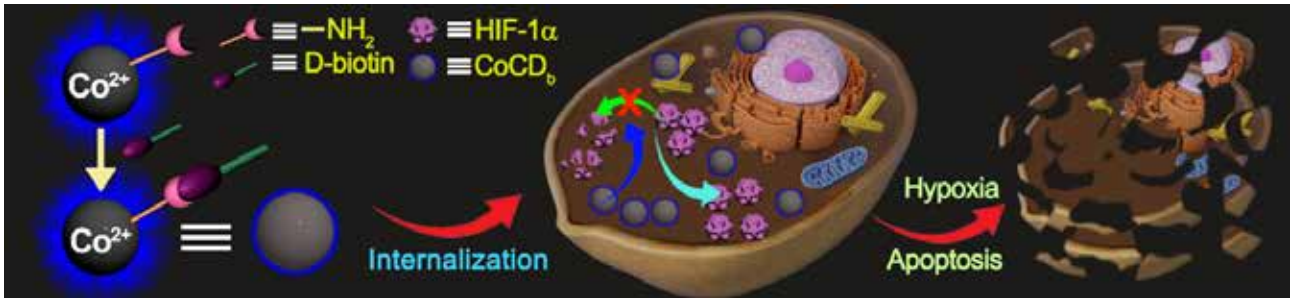
Naphthalimide-Based Azo-Functionalized Supramolecular Vesicle in Hypoxia-Responsive Drug Delivery : Supramolecular materials that respond to external triggers are being extensively utilized in developing spatiotemporal control in biomedical applications ranging from drug delivery to diagnostics. The present article describes the development of self-assembled vesicles in 1:9 (v/v), tetrahydrofuran (THF)–water by naphthalimide-based azo moiety containing amphiphile (NI-Azo) where azo moiety would act as the stimuli-responsive junction. The self-assembly of NI-Azo took place through H-type of aggregation. Microscopic and spectroscopic analyses confirmed the formation of supramolecular vesicles with a dimension of 200–250 nm. Azo (−N═N−) moiety is known to get reduced to amine derivatives in the presence of the azoreductase enzyme, which is overexpressed in the hypoxic microenvironment. The absorbance intensity of this characteristic azo (−N═N−) moiety of NI-Azo (1:9 (v/v), THF–water) at 458 nm got diminished in the presence of both extracellular and intracellular bacterial azoreductase extracted from Escherichia coli bacteria. The same observation was noted in the presence of sodium dithionite (mimic of azoreductase), indicating that azoreductase/sodium dithionite induced azo bond cleavage of NI-Azo, which was confirmed by matrix-assisted laser desorption ionization time-of-flight spectrometric data of the corresponding aromatic amine fragments. The anticancer drug, curcumin, was encapsulated inside NI-Azo vesicles that successfully killed B16F10 cells (cancer cells) in CoCl2-induced hypoxic environment owing to the azoreductase-responsive release of drug. The cancer cell killing efficiency by curcumin-loaded NI-Azo vesicles in

the hypoxic condition was 2.15-fold higher than that of the normoxic environment and 2.4-fold higher compared to that of native curcumin in the hypoxic condition. Notably, cancer cell killing efficiency of curcumin-loaded NI-Azo vesicles was 4.5- and 1.9-fold higher than that of noncancerous NIH3T3 cells in normoxic and hypoxic environments, respectively. Cell killing was found to be primarily through the early apoptotic pathway.

Organic nanoparticles with tunable AIE derived from amino acids appended naphthalenediimide based amphiphiles : Fluorescent organic nanoparticles (FONPs) are unique cooperative manifestations of supramolecular self-aggregates and luminescent nanoparticles. In this work, we developed naphthalenediimide (NDI) based amphiphiles (NDI-1-9) having amino acids substitution from L-alanine to L-phenyl alanine to 3-(2-naphthyl)-L-alanine in absence and presence of alkyl spacer (C-6, C-11). Formation of self-aggregated spherical organic nanoparticles of ~50 nm took place at and above 50 vol% water or methyl cyclohexane (MCH) in different binary solvent systems (DMSO/DMF-water, $CHCl_3$-MCH) via *J*-aggregation. In case of NDI-1-3 (amino acids are directly connected to the NDI) self-assembled FONPs (MCH in $CHCl_3$) exhibited aggregation-induced emission (AIE) through excimer formation. Red shift in the emission maxima were observed from 484 nm to 495 nm, and 590 nm, respectively with increasing π electron cloud at substituted donor from NDI-1 to NDI-3. Alongside, in case of aromatic amino acids substitution, FONPs of 6-amino caproic acid spacer containing NDI derivatives (NDI-5 and NDI-6) showed AIE at 505 nm and 545 nm (water in DMF/DMSO). Corresponding 11-amino undecanoic acid containing analogues (NDI-8 and NDI-9) showed AIE at 480 nm and 585 nm in $CHCl_3$-MCH and DMF/DMSO-water. The multi colour emission from blue-green to yellow-orange with enrichment of π-electron cloud density in the side chain substitution of NDI was observed possibly due to the facilitated electron transfer at a lesser energy to the electron deficient NDI core that resulted in red shifted emission maxima. This was further clarified by regulating the availability of π-electrons of phenyl ring of NDI-2 by including electron withdrawing –NO_2 and donating -OMe groups at the molecular backbone (NDI-2a and NDI-2b) that showed blue shifted (475 nm) and red shifted (570 nm) emission maxima with respect to NDI-2 (495 nm). However, increase in alkyl spacer length between side chain substitution and NDI core yielded relatively lower quantum yield presumably due to the impeded electron transfer.

Co_2+ Doped Biotinylated Carbon Dot: A Theranostic Agent for Target Specific Killing of Cancer Cells via Hypoxia Induced Apoptosis : Conventional cancer treatments have systematic side effects that stand against its desirable therapeutic efficacy. Alternative strategies using biochemical features of cancer cells to promote apoptosis are finding notable significance. One such important biochemical feature of malignant cells is hypoxia, alteration of which can lead to cell death. Hypoxia inducible factor 1a (HIF-1a) has the key role in hypoxia generation. Herein, we synthesized biotinylated Co2+-integrated carbon dot (CoCDb) that specifically diagnose and selectively killed cancer cells with 3-3.1-fold higher efficiency over non-cancer cells by hypoxia induced apoptosis in absence of traditional therapeutic intervention. Immunoblotting assay in CoCDb treated MDA-MB-231 cells confirmed the increased expression of HIF-1a that was responsible for efficient killing of cancer cells. In 2D cells and 3D tumor spheroid, CoCDb treated cancer cells showed significant apoptosis that make CoCDb a potential theranostic agent.

Folic Acid-Functionalized Carbon Dot-Enabled Starvation Therapy in Synergism with Paclitaxel against Breast Cancer : Glucose oxidase (GOx)-induced cancer starvation has recently emerged for halting the abnormal proliferation of triple-negative breast cancer (TNBC). However, monotherapy with GOx or a conventional chemotherapeutic displays suboptimal efficacy in eliminating tumors and poses impending risks to healthy tissues. To augment therapeutic efficacy and tumor selectivity, folic acid (FA)-functionalized carbon dots (CDs) embedded with GOx and paclitaxel (PTX) [FA−CD−(PTX−GOx)] was developed that showed the efficient killing of TNBC, MDA-MB-468 cells over noncancerous HEK 293 cells through synergistic effects of cancer starvation-induced oxidative stress and chemotherapy. The cargo-laden FA− CD complex resulted in a 4−8 fold increase in cancer cell death at 60 μg/mL when compared to standalone therapy with the native compounds and individually loaded cargo on FA−CD. This improved cancer cell killing efficacy of the FA−CD−(PTX−GOx) complex could be endorsed by folate receptor (FR)-mediated target-specific cellular internalization of the FA−CD complex. The antitumorigenic efficacy of the FA−CD−(PTX−GOx) complex was further validated in a three-dimensional (3D) breast tumor spheroid model. A significant 4.5-fold reduction in spheroid dimension along with antiproliferation was observed with time up to 72 h following exposure to the FA−CD−(PTX−GOx) complex. This antitumorigenic potential of FA−CD−(PTX−GOx) could be attributed to the enhanced intratumoral reactive oxygen species generation following glucose depletion by GOx that has been facilitated by the chemotherapeutic efficacy of PTX resulting in the efficient killing of cancer cells. The present study provides a novel strategy of FR-mediated fluorescent CD-enabled combined formulation of GOx and PTX for the target-specific superior killing of TNBC cells in the synergism of glucose starvation with chemotherapy.



Representative Figure:Biotinylated Co^{2+}-integrated carbon dot ($CoCD_b$)selectively diagnosed and killed cancer cells with marked superiority over normal cells by hypoxia induced apoptosis ***(Chem.Eur.J.****2023****,doi.org/10.1002/chem.202300928).***

Publications in Journals:

1. Naphthalimide-based azo-functionalized supramolecular vesicle in hypoxia-responsive drug delivery - D Sarkar, M Chowdhury, and PK Das. *Langmuir* 2022, **38,** 3480-3492.
2. Folic acid functionalized carbon dot enabled starvation therapy in synergism with paclitaxel against breast cancer." A Ghosh, AK Ghosh, M Chowdhury and PK Das. *ACS Appl. Bio Mater* 2022, **5**, 2389-2402.
3. Co^{2+} Doped Biotinylated Carbon Dot: A Theranostic Agent for Target Specific Killing of Cancer Cells via Hypoxia Induced Apoptosis.M Chowdhury, S Pal, A Ghosh and P K Das. *Chem. Eur. J.* 2023, e202300928.
4. Organic nanoparticles with tunable AIE derived from amino acids appended naphthalenediimide based amphiphiles. D Sarkar, A K Ghosh, A H Khan and P K Das. *Journal of Molecular Liquids,* 2023. **382**, 121824.

Awards/Honours

» Fellow of the Royal Society of Chemistry (FRSC), Royal Society of Chemistry.

Ph.D. Degree Awarded

(1) Deblina Sarkar (Jadavpur University)

Sponsored Project :

» Fabrication of Conjugates …….. Combination Therapy (DST-SERB)

Lectures Delivered

Invited talk at (1) Indo-German Workshop, Mahabalipuram, (2) IISER-Kolkata, (3) Two lectures at NIT, Warangal; (4) Two lectures at Krishna Chandra College, Hetampur and (5) Symposium in IACS

PROSENJIT SEN

Professor

Coagulation Biology and cellular signaling

Associate:

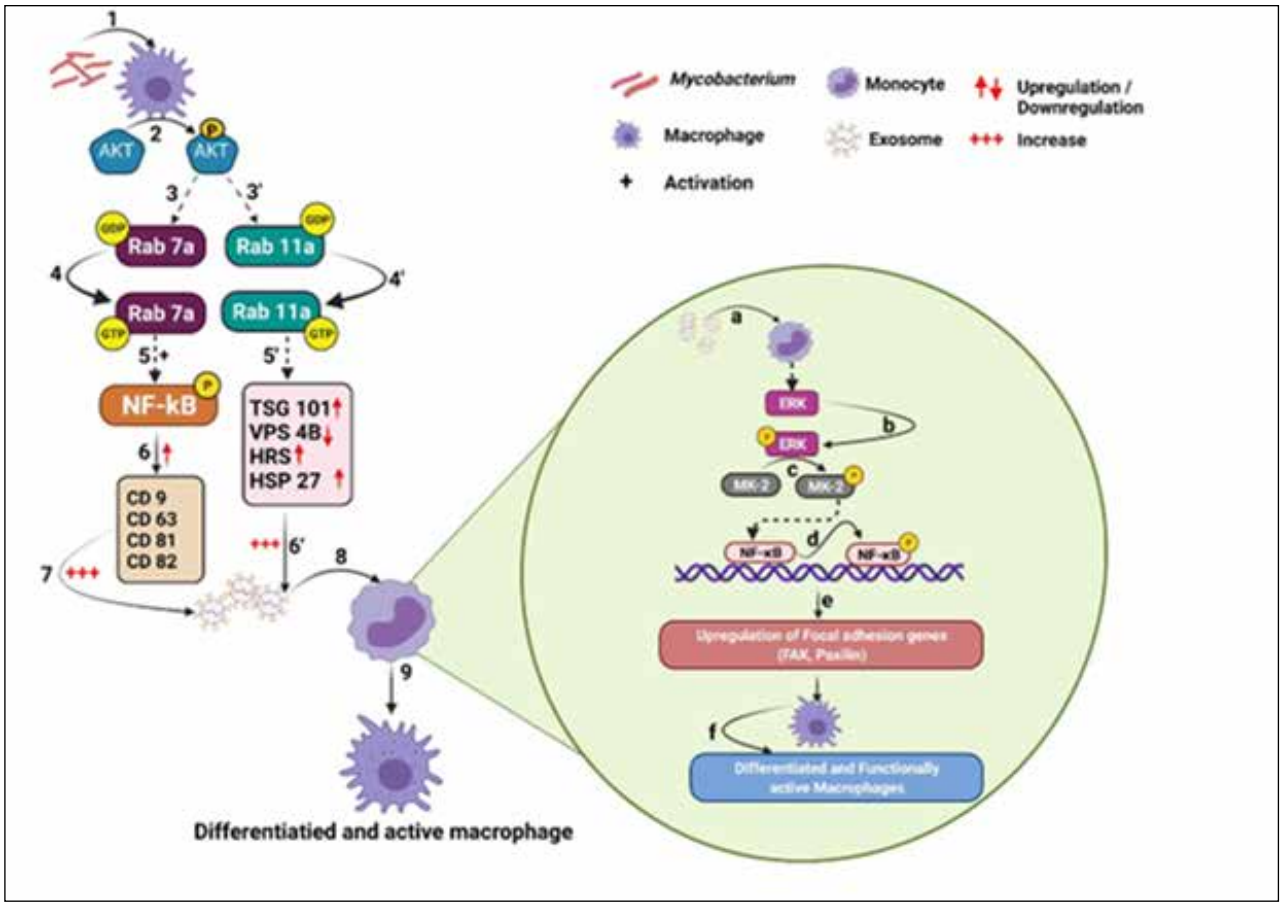
(1)Arpana Singh, (2) Subhojit Paul, (3) Arnab Ghosh, (4) Subhashish Mondal, (5) Avinandam Bhaowmik, (6) Akash Chetterjee

Signaling Pathways Unveiled: Enhanced Exosome Release from Mycobacterium-Infected Macrophages and Subsequent Induction of Differentiation : Exosomes, which are extracellular vesicles released by various cell types, play a crucial role in cell-to-cell communication, growth, and differentiation, among other important functions. These exosomes carry vital information in the form of DNA, RNA, or protein, facilitating various signaling mechanisms. In our study, we demonstrate that exosomes released from macrophages infected with Mtb (Mycobacterium tuberculosis) not only trigger the differentiation of naïve monocytes but also

generate functionally active macrophages. This process occurs through a MAPK-dependent signaling mechanism involving the activation of MK-2 and NF-κβ, which differs significantly from the differentiation induced by exosomes from uninfected macrophages.

Furthermore, we provide clear insights into the signaling mechanism behind the increased release of exosomes from infected macrophages, which is driven by AKT phosphorylation and involves the participation of Rab7a and Rab11a. We find that genes associated with both ESCRT-dependent and ESCRT-independent pathways are implicated in the enhanced exosome release and are modulated by AKT. Interestingly, the genes of the ESCRT-independent pathway are dependent on NF-κβ activation, while the genes of the dependent pathway are not, indicating the presence of two parallel signaling cascades that operate concurrently.Overall, our study provides valuable insights into the signaling pathways responsible for the increased release of exosomes from Mycobacterium-infected macrophages and their subsequent impact on the induction of differentiation. These findings contribute to a better understanding of the intricate cellular processes involved in host-pathogen interactions and may have implications for the development of therapeutic interventions targeting these pathways.

Amino Acid-Mediated Differential Organelle Targeting: Insights from Nitrobenzofurazan Conjugates : Amino acids, beyond their role as protein building blocks, exhibit diverse functionalities within cellular processes. In this study, we explore how amino acids guide the selective transportation of a dye molecule to specific cellular organelles based on their intrinsic properties. To achieve this, we synthesized water-soluble and biocompatible derivatives of nitrobenzofurazan (NBD) by conjugating it with lysine and a histidine derivative, connected by a linker. Surprisingly, our findings reveal that the lysine-conjugated NBD (NBD-Lys) preferentially stains lipid droplets, while the histidine-conjugated NBD (NBD-His) selectively stains lysosomes. We also assessed the spectral properties of these NBD conjugates and observed exceptional stability in both air and inert atmospheres. Furthermore, fluorescence analysis demonstrated that the derivatives' fluorescence remained largely unaffected across a range of pH values. By modulating the functionality of the side chain, we elucidated the contribution of each functional group in the differential targeting of organelles. This study sheds light on the intricate relationship between amino acids and organelle-specific dye transportation, paving the way for further exploration of their roles in cellular processes.



Cholesterol-Induced Structural Modulations in the Tissue Factor-Factor VIIa-Factor Xa Complex: Insights from Molecular Dynamics Simulation : In this study, the focus is on Tissue Factor-Factor VIIa-Factor Xa (TF-FVIIa-FXa) complex, which plays a vital role in clot formation. Previous research has suggested that TF-FVIIa coagulant activity can be influenced by cholesterol content and post-translational modifications of TF, but results have been inconclusive. The objective of this study is to investigate how cholesterol impacts the structural changes in the TF-FVIIa-FXa complex. Additionally, the effect of palmitoylation on the Cys245 residue of TF and its structural implications on TF-FVIIa-FXa are examined. Four systems were created with different lipid environments and subjected to molecular dynamics (MD) simulation: TF-FVIIa-FXa in POPC: POPS (CS), TF-FVIIa-FXa in POPC: POPS: CHOL (CSL), Palmitoylated TF-FVIIa-FXa in POPC: POPS: CHOL (CSLP), and Palmitoylated TF-FVIIa-FXa in POPC: CHOL (CLP).The results of hydrogen-bond and contact probability analysis revealed novel interactions between key domains of TF-FVIIa-FXa, including Asn93FVIIa:L-Lys48TF, Arg178FVIIa:H-Asp95FXa:B, Lys20FVIIa:H-Glu193FXa:A, Arg178FVIIa:H-Asp97FXa:B, and Arg153FVIIa:H-Gln135FXa:B. Further analysis indicated that the systems with cholesterol and palmitoylation (CSL and CSLP) exhibited greater thermodynamic stability compared to those without (CS and CLP). In conclusion, the MD simulation data suggests that the presence of cholesterol and palmitoylation contribute to the structural rigidity, stability, and compactness of key domains within the TF-FVIIa-FXa complex. This is achieved by enhancing protein-protein and protein-lipid interactions.

Publications in Journals

1. A molecular dynamics simulation study to understand the effect of cholesterol and tissue factor palmitoylation on tissue factor-factor VIIa-factor Xa ternary complex in different lipid environments Suparna Banerjee, Prosenjit Sen *Journal of Thrombosis and Haemeostasis,***21**, 912-932 (2023).[IF:16.04]
2. Late-Stage Functionalization: Total Synthesis of Beauveamide A and Its Congeners and Their Anticancer Activities. Sanu Saha, Sourya Shankar Auddy,Akash Chatterjee, Prosenjit Sen, and Rajib Kumar Goswami *Org. Lett*., **24**, 7113–7117, (2022). [IF:6.072]
3. Amino acid triggered water-soluble NBD derivatives for differential organelle staining and the role of the chemical moiety for their specific localization. Subhasis Mandal, Arpana Singh, Subhojit Paul, Arnab Ghosh, and Prosenjit Sen *Chem Asian J. 2022, **17**, e2022008* (2022) doi. org/10.1002/asia.202200837.[IF:4.568]
4. Elucidation of signaling pathways for enhanced exosome release from Mycobacterium infected macrophages and subsequent induction of differentiation. Arpana Singh, Kaushik Das, Sampali Banerjee, Prosenjit Sen *Immunology,***168**,63– 8 2 (2023).[IF:7.397]
5. Yellow-Emitting Carbon Dots for Selective Fluorescence Imaging of Lipid Droplets in Living Cells Subir Paul, Anindita Bhattacharya, Niladri Hazra, KousikGayen, Prosenjit Sen, and Arindam Banerjee *langmuir*, **38**, (2022) ,8829– 8 8 3 6 . [IF:4.331]
6. Amphiphilic Perylene Bisimide-Polymer Conjugates by Cystein –Based Orthogonal Strategy: vascular Aggregation, DNA binding, and Cell Imaging .Mahuya Kar, Md Anas, Palash Banerjee, Arpana Singh, Prosenjit Sen, and Tarun k. Mandal, *ACS Appl.Polym.Mater,* **4**, ,3697-3710,(2022).[IF:4.855]
7. Ion-/Thermo-Responsive fluorescent perylene-poly (ionic liquid) conjugates: One- pot microwave synthesis, self-aggregation and biological applications Mahuya Kar , Mahammad Anas , Arpana Singh , Ambuz Basak , Prosenjit Sen , Tarun K. Mandal. *European Polymer Journal* ,**179** ,111561 (2022).[IF:5.546]

Ph.D. Degree Awarded

(1) Suparna Banerjee (Jadavpur University), (2) Arpana Singh (IACS Deemed to be University)

Lectures Delivered

Invited talk (1) IABS-2023, Kolkata

RITESH RANJAN PAL

Assistant Professor

Host-pathogen interactions and infection biology

Associate:

(1) Suparno Banerjee, JRF, (2) Anirban Naha, JRF, (3)Ananyo Kumar Ghosh, JRF, (4) Umme Umara, JRF, (5) Debjani Ghosh, Project Assistant

Intra and inter-kingdom crosstalk of bacteria : The enormous versatility of bacteria enables the formation of multi-species communities that colonize nearly every niche on earth, making them the dominant life form and a major component of the biomass. Exchange of molecules among neighbouring bacteria in such microbial communities, as well as between bacteria and proximal eukaryotic cells, is key for bacterial success. One highly conserved strategy for such communication is membranous nanotube formation. Experiments are going on to define this poorly understood principle controlling these multicellular interactions with following hypothesis (Fig 1) which may lead to the development of creative strategies to modulate, predict and even design bacterial communities, and may lay the foundation for new and innovative approaches to fight bacterial diseases.

Pathogenesis of communicable diseases : Communicable diseases are caused by pathogenic organisms such as bacteria and virus. They take various strategies to cause and spread the disease. Using various model pathogens like *V. cholerae* and pathogenic *E. coli*, we are trying to understand the gene regulation of their virulence, effect of various conditions on it and their strategies for suppressing host immune response. The advancement of knowledge in this direction will add to design better strategy to combat against those pathogens.

Intra and inter-kingdom crosstalk of bacteria : The enormous versatility of bacteria enables the formation of multi-species communities that colonize nearly every niche on earth, making them the dominant life form and a major component of the biomass. Exchange of molecules among neighbouring bacteria in such microbial communities, as well as between bacteria and proximal eukaryotic cells, is key for bacterial success. One highly conserved strategy for such communication is membranous nanotube formation. Experiments are going on to define this poorly understood principle controlling these multicellular interactions with following hypothesis (Fig 1) which may lead to the development of creative strategies to modulate, predict and even design bacterial communities, and may lay the foundation for new and innovative approaches to fight bacterial diseases.

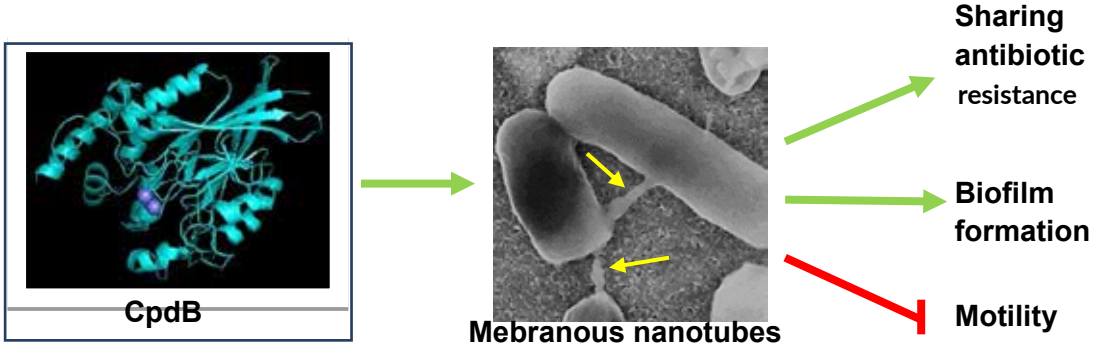


Fig 1. CpdB is the predicted E. coli homologue of YmdB of B. subtilis. Like YmdB, CpdB is predicted to activate membranous nanotube formation, which in turn activates sharing of antibiotic resistance and biofilm formation. Motility is also found to be down-regulated by CpdB.

Publications in Journals

1. Kaplan, M.; Oikonomou, C. M.; Wood, C. R.; Chreifi, G.; Ghosal, D.; Dobro, M. J.; Yao, Q.; Pal, R. R.; Baidya, A. K.; Liu, Y.; et al. Discovery of a Novel Inner Membrane-Associated Bacterial Structure Related to the Flagellar Type III Secretion System. *J Bacteriol* **2022**, *204* (8), e0014422. DOI: 10.1128/jb.00144-22.

2. Sharma, H.; Mondal, J.; Ghosh, A. K.; Pal, R. R.; Goswami, R. K. Total synthesis of the antibacterial polyketide natural product thailandamide lactone. *Chem Sci* **2022**, *13* (45), 13403-13408. DOI: 10.1039/d2sc04727f.

3. Stolovich-Rain, M.; Kumari, S.; Friedman, A.; Kirillov, S.; Socol, Y.; Billan, M.; Pal, R. R.; Das, K.; Golding, P.; Oiknine-Djian, E.; et al. Intramuscular mRNA BNT162b2 vaccine against SARS-CoV-2 induces neutralizing salivary IgA. *Front Immunol* **2022**, *13*, 933347. DOI: 10.3389/fimmu.2022.933347.

4. Zacharia, A.; Pal, R. R.; Katsowich, N.; Mannully, C. T.; Ibrahim, A.; Alfandary, S.; Serruya, R.; Baidya, A. K.; Ben-Yehuda, S.; Rosenshine, I.; et al. Activation of the Type III Secretion System of Enteropathogenic Escherichia coli Leads to Remodeling of Its Membrane Composition and Function. *mSystems* **2022**, *7* (3), e0020222. DOI: 10.1128/msystems.00202-22.

Sponsored Project

» Membranous Nanotube : The Unrevealed CORE-associated…….. Interaction.

» A combined experimental …….indole based drugs or their precursors.

» Response against …… for the therapy

» Exploring the role of XIAP …. Lung Carcinogenesis

Lectures Delivered

» Invited talk at (1) IACS, Kolkata, (2) Presidency University

RUPA MUKHOPADHYAY

Senior Professor & Associate Dean (R&D)

Nanoscale Bioengineering

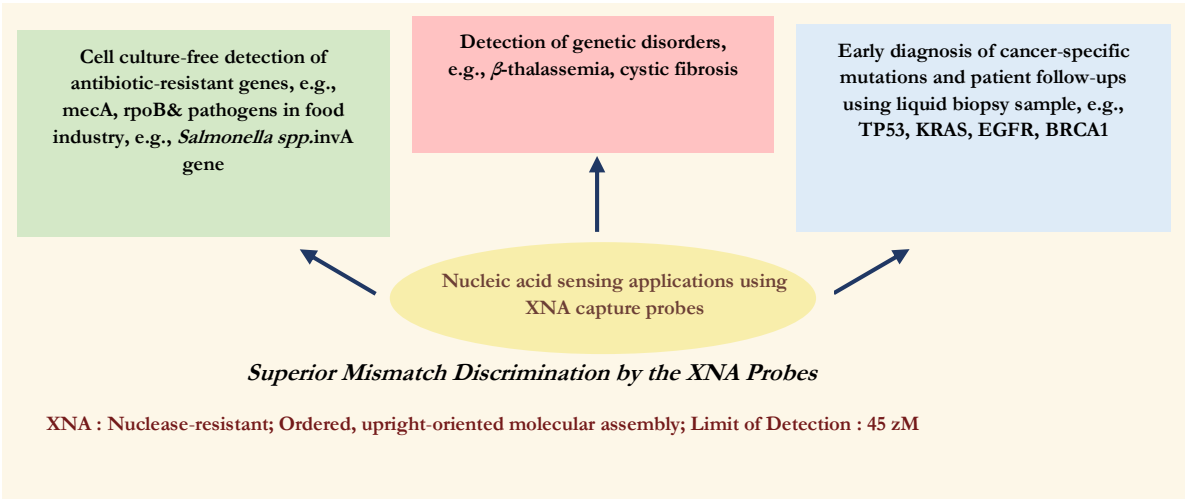
Associate:

(1) T. Mana, SRF (Institute), (2) S. Mondal, SRF (CSIR), (3) B. Bhattacharya, JRF (Institute), (4) J. Biswas, JRF (DBT), (5) A. Paul, JRF (DBT)

Nanoscale Biosensors: Applicability of the on-surface peptide nucleic acid (PNA)-based and morpholino (MO)-based single molecule force spectroscopy (SMFS) assay that we have developed has been tested in detection of nucleic acid sequences in a label-free manner.

- **Single Molecule Level Structural Biology**:

  1. UV radiation-induced DNA damage has been studied at the single molecule level.
  2. Effects of HMGB1 on platinum drug-treated DNA has been studied at the single molecule level.
  3. Interaction betweenE-cadherin, which is a Type I classical Cadherin (Calcium Adhering protein) present on epithelial cell surface participating in cell-cell adhesion, and LpqH, which is a 19 kDalipoprotein expressed by *Mycobacterium tuberculosis* has been studied at single molecule level by using the single molecule structural biology (SMFS) approach. It was found that LpqH was involved in stable and strong interaction with E-cadherin. As pulmonary tissue is the main target of *Mycobacterium sp.*, this finding may have important consequences in understanding the mechanism for getting entry of *Mycobacterium tuberculosis* bacterium into the host cell machinery.



Representative Figure.*The XNAs - A Troubleshooter for Nucleic Acid Sensing, ACS Omega (2022) (invited minireview).*

Publications in Journals

(1) The XNAs - A Troubleshooter for Nucleic Acid Sensing, Tanushree Mana, Budhaditya Bhattacharya, Hiya Lahiri and Rupa Mukhopadhyay*, *ACS Omega*, 7, 15296-15307 (2022) (***Invited Minireview***).[IF: 4.132]

Ph.D. degree awarded :

(1) Tanushree Mana (CU)

Patent Filed/Awarded

PCR-INDEPENDENT DETECTION OF DNA SEQUENCES USING FLUORESCENT LABEL-FREE, LNA-PROBE-BASED SINGLE MOLECULE FORCE SPECTROSCOPY APPROACH (patent application no. 202331002606 A; patent publication date. 09/06/2023)

SIDDHARTHA S JANA

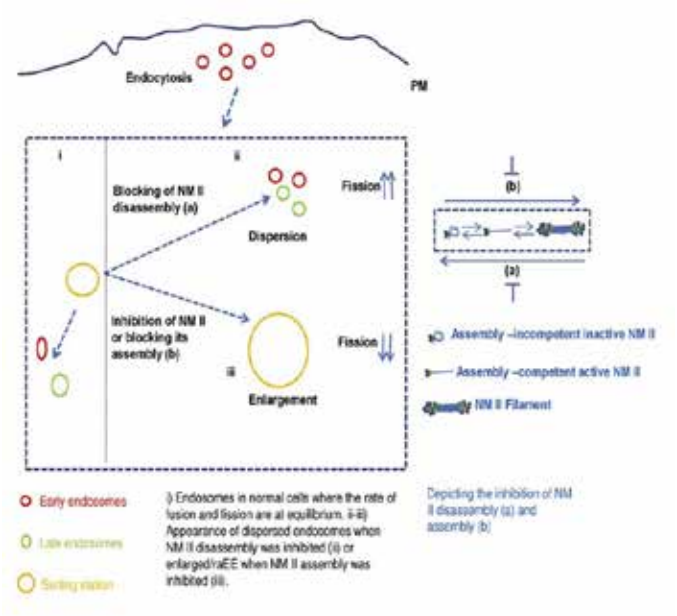
Senior Professor

Molecular Cell Biology

Associate:

(1)Joy Kar, (2) Samprita Das (SRF), (3)Indranil Ghosh (SRF), (4) Kumarjeet Banerjee (SRF), (5) Ditipriya Mallick (SRF), (6) Debapriya Dey (JRF), (7)Ayushi Das (MS-PhD), (8) Asmita Majumder (BS-MS),(9) Madhushree Seal (BS-MS), (10) Sampurna Dutta (BS-MS), (11) Suman Das (RA).

NM IIs are required for endosomal fission



Left in box: i) Endosomes in normal cells where the rate of fusion and fission are at equilibrium. ii-iii) Appearance of dispersed endosomes when NM II disassembly was inhibited (ii) or enlarged/raEE when NM II assembly was inhibited (iii). Right: Depicting the inhibition of NM II disassembly (a) and assembly (b).

Publications in Journals

1. Assembly and disassembly dynamics of nonmuscle myosin II control endosomal fission. Kar J, Kar S, Gupta A, Jana SS. Cell Reports. Feb 11;42(2):112108. (2023).[IF:9.99]
2. Direct Correlation between the Secondary Structure of an Amphiphilic Polymer and Its Prominent Antiviral Activity. Nag A, Banerjee K, Barman R, Kar J, Sarkar DP, Jana SS, Ghosh S. J Am Chem Soc. Jan 11;145(1):579-584. (2023).[IF:16.38]

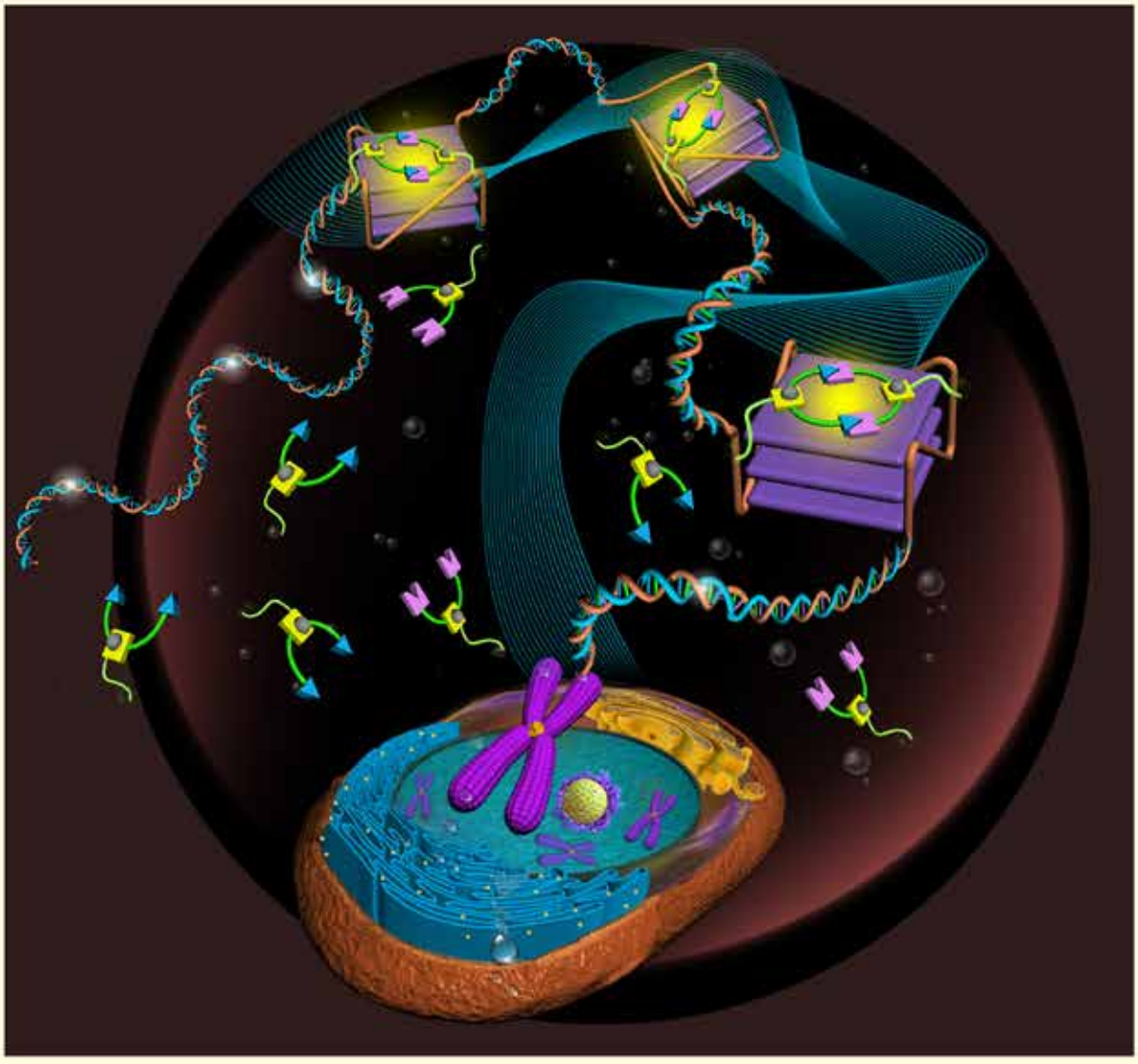
Lectures Delivered

» Invited talk at (1) SBC, IACS, Kolkata, (2) University of Delhi South Campus, (3) IABS, Kolkata.

Sponsored Project

» Role of actomyosin …. Endocytic trafficking

SCHOOL OF CHEMICAL SCIENCES



School of Chemical Sciences

PROFESSOR ABHISHEK DEY
School Chair

SCHOOL PROFILE

People

Faculty	: 21
Post-doctoral Research Associate	: 23
Ph.D. Students	: 158
Non-Academic Staff	: 10

Extra Mural Funding

Projects (ongoing)	: 31

Research Achievements

Research Papers in Journals	: 121
Book-Chapters/Books	: 02
Ph.D. degree awarded	: 25

Academic Activities

Talks delivered by members of School in conferences/symposia	National : 58 Intl : 08

ABHISHEK DEY

Professor & School Chair

Inorganic reaction mechanism

Associate:

(1) Ankita Sarkar (2) Paramita Saha (3) Suman Patra (4) Soumya Samanta (5) Souvik Dinda (6) Soumili Ghosh (7) Triparna Roy (8) Rabin Paria (9) Kumarjeet Bannerjee (10) Arnab Roy (11) Srijan Sengupta (12) Sudip Barman, (13) Suman Patra (CSIR)

The impact of axial ligand and 2nd sphere hydrogen bonding interactions in O_2 and CO_2 reduction by iron and cobalt complexes have been discovered. In particular, the factors that determine selectivity and rate have been discovered. These factors have been now incorporated in catalyst design to result in better turnover numbers and selectivity.

Publications in Journals:

1. S Bhunia, A Ghatak, A Rana, A Dey*Amine Groups in the Second Sphere of Iron Porphyrins Allow for Higher and Selective 4e⁻/4H⁺ Oxygen Reduction Rates at Lower Overpotentials*J. Am. Chem. Soc. **2023**, 145, 3812-3825.[IF: 16.38]
2. S Chattopadhyay, S Samanta, A Sarkar, A Bhattacharya, S Patra, **A Dey***Silver Nanostructure Modified Graphite Electrode for In-operando SERRS Investigation of Iron Porphyrins during High Potential Electrocatalysis*J. Chem. Phys.**2023**, 158, 044201 [IF: 4.30]
3. A. Ghatak, S. Samanta, A. Nayek, S. Mukherjee, S. Ghosh Dey, **A Dey***Second-Sphere Hydrogen-Bond Donors and Acceptors Affect the Rate and Selectivity of Electrochemical Oxygen Reduction by Iron Porphyrins Differently*Inorg. Chem. **2022,** 61, 33, 12931–12947.[IF: 5.60]
4. A. Nayek, Md E. Ahmed, S. Samanta, S. Dinda, S. Patra, S. G. Dey and **A Dey***Bioinorganic Chemistry on Electrodes: Methods to Functional Modeling*J. Am. Chem. Soc. **2022,** 144, 19, 8402–8429.[IF:16.38]
5. S. Bhunia, A. Ghatak, **A. Dey** *Second Sphere Effects on Oxygen Reduction and Peroxide Activation by Mononuclear Iron porphyrins and Related Systems*Chem. Rev.**, 2022,** 122, 14, 12370–12426.[IF: 72.08]
6. A Sarkar, S Chattopadhyay, M Mukherjee, SG Dey, **A Dey** *Assembly of redox active metallo-enzymes and metallo-peptides on electrodes: Abiological constructs to probe natural processes*Curr. Op. Chem. Biol.**2022***68,* 102142.[IF: 8.97]
7. Md E. Ahmed, A. Nayek, A. Krizan, N. Coutard, A. Morozan, S. Dey, R. Lomoth, L. Hammarström, V. Artero, **A. Dey** *A Bidirectional Bio-Inspired [FeFe]-Hydrogenase Model* J. Am. Chem. Soc. **2022,** 144, 8, 3614–3625.[IF: 16.38]
8. Sk Amanullah, P. Saha, **A. Dey***Selectivity in Electrochemical CO_2 Reduction* Acc. Chem. Res. **2022**, 55, 134–144.[IF: 24.46]
9. A. Singha, K. Mittra, **A. Dey** *Synthetic heme dioxygen adducts: electronic structure and reactivity* Trends in Chemistry **2022**, *4*, 15-31.[IF: 22.48]

Award/Recognition :

» Fellow of Indian Academy of Science (FASc), Bangalore.

» James Hoeschele Award, Asian Society for Biological Inorganic Chemistry

Ph.D. Degree Awarded

(1) Sarmistha Bunia (CU)

Sponsored Project

» Porphyrin Iron-Sulfur Conjugates …… Chemical Reductions

Lectures Delivered

Invited talk at (1) Award Lecture, Asian Biological Inorganic Chemistry, (2) ADHOC, 2022 (3) EUROBIC and (4) Gordon Conference on Metallocofactors.

AMIT MAJUMDAR

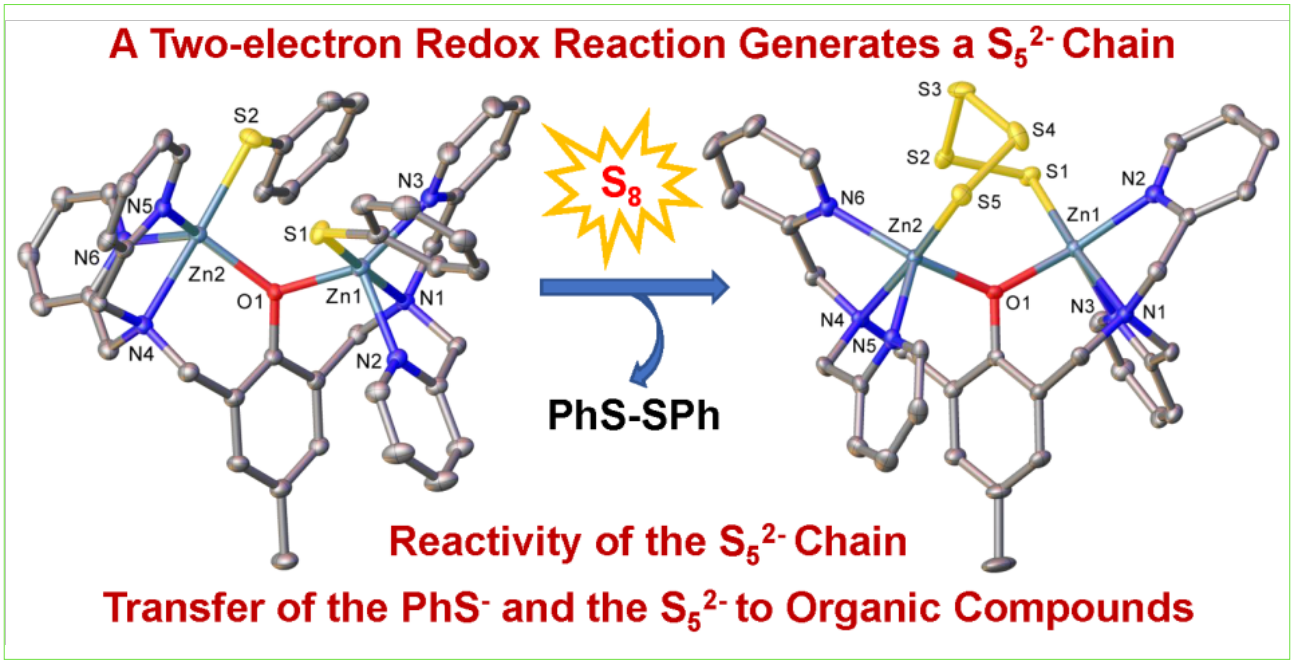
Professor

Inorganic and Bioinorganic Chemistry

Associate:

(1) Sayan Atta (SRF, CSIR), (2) Kamal Hossain (SRF, UGC), (3) Anuj Baran Chakraborty (SRF, CSIR), (4) Soumik Karmakar (SRF, CSIR), (5) Amit Mandal (JRF, UGC), (6) Arindam Basak (JRF, UGC), (7) Tridib Bannerjee, SRF (CSIR), (8) Tuhin Ganguly, RA-1 (Institute)

- Co(II) mediated catalytic hydrolysis of C-S bonds for a series of aliphatic and aromatic thiolates.
- Conversion of a binuclear Zn(II)-bis(thiolate) complex to a binuclear Zn(II)-pentasulfido complex and further reactivity of the latter with phosphines, protons and selected organic substrates.
- Synthesis, characterization and nitrite induced structural changes in binuclear manganese(II)-thiolate complexes.



Publications in Journals

1. Catalytic Hydrolysis of Thiolates to Alcohols - Ganguly, T.; Bera, A.; Chakraborty, A.; Majumdar,A., *Inorg. Chem.* **2022,** *61*, 7377-7386.[IF: 5.60]
2. Polysulfido Chain in Binuclear Zinc(II) Complexes"Hossain, K.; Majumdar, A., *Inorg. Chem.* **2022**, *61*, 6295-6310.[IF: 5.60]
3. Binuclear Manganese(II)-Thiolate Complexes: Synthesis, Characterization and Nitrite Induced Structural Changes - Naskar, T.; Jana, M.; Majumdar, A., *J. Mol. Struct.* **2022**, *1262,* 133041. [F: 3.84]

Ph.D. Degree Awarded

(1) Tilak Naskar (IACS Deemed to be University)

Sponsored Project:

» Nonheme Dinuclear ……. Hydrosulfide Ligands (CSIR)

» Reactivity of Nitric Oxide ….. Diiron Complexes (SERB)

ANKAN PAUL

Senior Professor

Quantum computational chemistry

Associate:

(1) Sourav Bhunya (RA-1), (2) Debabrata Halder (Bridge Fellow), (3) Munia Sultana (extension), (4) Ishita Bhattacharjee (CSIR-SRF), (5) RounakNath (CSIR-SRF), (6) Anuj Ray (CSIR-JRF), (7) Amit Mondal (SERB-JRF), (8) Rahul Sutradhar(IntPhD-JRF), (9) Sayan Ghosh (BS-MS)

Our Research Group has devoted its efforts broadly in two different areas: (a) Understanding Reaction Mechanisms of Catalytic and transformative processes relevant to the cause of Environmental Sustainability and (b) Comprehending novel chemical phenomena using excited state theoretical techniques. In the past year or so we had been investigating reaction channels for N_2 activation through Solar and Electrochemical means using DFT.On another front, we have been able to comprehend reaction mechanisms involved in Enzymatic Degradation of environmental pollutants using hybrid QM/MM approaches. Insights from such studies might assist inthe development of Biomimetic Fe(II) based complexes for Organic Pollutant Degradation. A section of the group is involved in understanding excited state electron transfer processes through the prism of aromaticity. Over the years we show how photochemical processes are influenced by the changes in aromaticity in aromatic rings on photoexcitation. A different leg of our research is focused upon developing a sound understanding of the number of bonds in diatomic molecular species by employing a spin ladder of excited states.

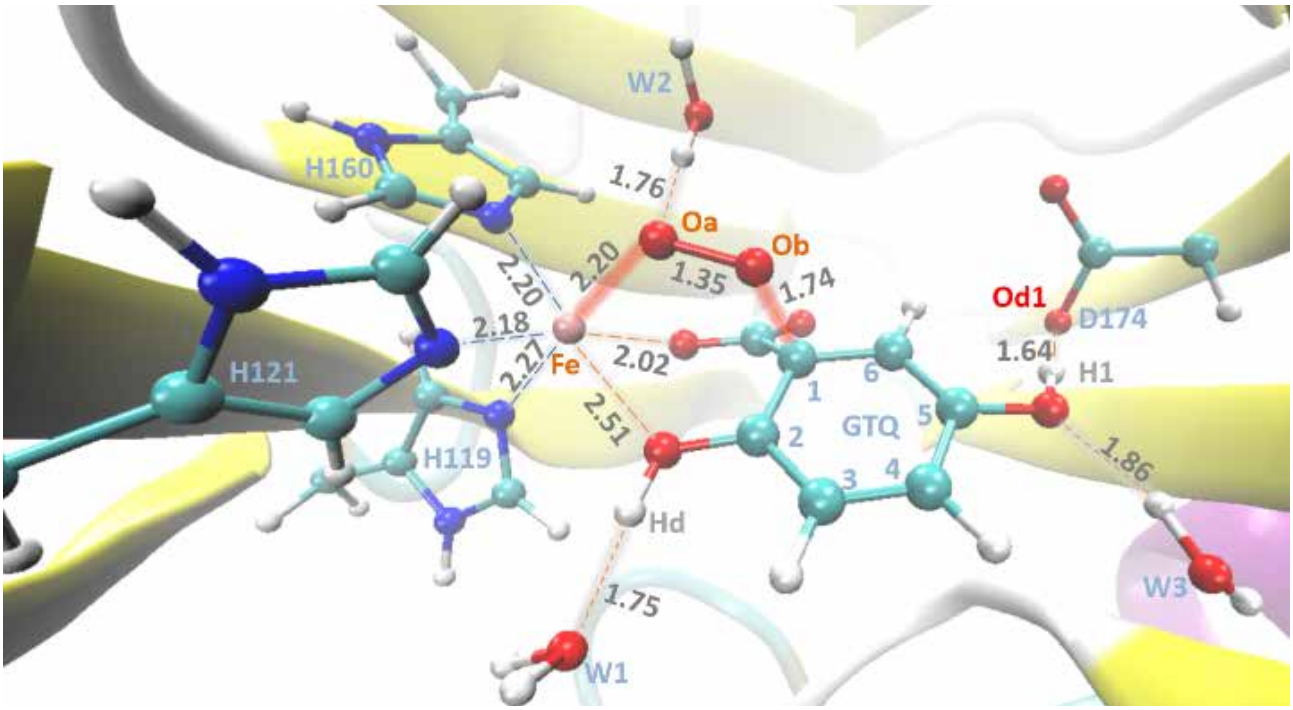


Figure Legend. A snapshot of Transition State for the Rate Determining Step of Oxidative Pollutant Degradation in the Enzyme Active Site of Gentisate 1,2-dioxygenase

Publications in Journals :

1. Room-Temperature Synthesis of 1,3,5-Tri(*het*) aryl Benzene from Nitroalkenes Using $Pd(OAc)_2$: Complete Mechanistic and Theoretical Studies - S P Midya, S Mondal,A S M Islam, A Rashid, S Mondal, A Paul and P Ghosh*, *Org. Lett.*, **24**, 4438–4443 (2022).[IF :6.072]
2. Decoding regioselective reaction mechanism of gentisic acid catalyzed by the gentisate 1,2-dioxygenase enzyme - R Nath, R N manna and A Paul*, *Catal. Sci. Technol.*, **12**, 5742-5751 (2022). [IF :6.177]
3. Uncovering the Synchronous Role of Bis-borane with Nucleophilic Solvent as Frustrated Lewis Pair in Metal-Free Catalytic Dehydrogenation of Ammonia-borane- M Sultana, I Bhattacharjee, S Bhunya and A Paul, *Eur. J. Inorg. Chem.*, **e202200311**(2022).[IF : 2.551]
4. Impact of the Hydrogen-Bonding Functional Group on Hydrogelation of Amphiphilic Naphthalene-diimide Derivatives and Nonspecific Protein Adsorption–R Khamrui, R N Manna, P Rajdev, A Paul* and S Ghosh*, *ACS Appl. Bio Mater.*, **5**, 5410–5417 (2022). [IF : 3.25]
5. Understanding photoenolization of O-methyl acetophenone, and its subsequent [4 + 2] and 1,4 addition of its photoproduct from an aromaticity perspective- D Halder, A K Ray and A Paul *, *J. Phys. Org. Chem.*, **36**, e4456 (2023).[IF:2.155]
6. Mechanism of B-H Redistribution during Reduction of Polyborazylene by Hydrazine- SBhunya, P M Zimmerman and A Paul*, *Eur. J. Inorg. Chem.*,**e202200784** (2023).[IF: 2.551]
7. Metal-Ligand Cooperativity in Mn^{I}-Catalysed N-Formylation of Secondary Amides and Lactams Using CO_2 at Room Temperature - S Chakraborty, R Nath, A K Ray, A Paul* and S K Mandal*, *Chem. Eur. J.*, **29**, e202202710 (2023).[IF:5.02]

Ph.D. Degree Awarded

(1) Dibyajyoti Chakravarti (co.supervisor Prof. D. Mukherjee) (IACS Deemed to be University), (2) Munia Sultana (CU)

Lectures Delivered

Invited talk at (1) St. Xavier's College, Kolkata, (2) TCMSD-2022, IISER-Kolkata and (3) APATCC-2023 in Quy Nhon Vietnam

Sponsored Project:

» Decoding the Mechanism …….. theoretical approaches.

AVISEK DAS

Associate Professor

Computational Biophysics

Associate:

(1) Rumela Adhikary, (2) Sumitava Kundu, (3) Soumak Ghosh, (4) Sangeeta Das, (5) Sk. Hasibo Hasan, (6) Kaustav Chakraborty, (7) Argha Chakraborty, (8) Snehamay Bagchi.

The main focus of our research group is to understand how fundamental molecular interactions control structure, dynamics and ultimately, any macroscopic property of interest in a wide variety of molecular systems at the interfaces of chemistry, molecular biology and soft materials science. Major accomplishments in three main areas of current interest are summarized in this write-up. **Peptide Self-assembly:** Peptide self-assembly is an important topic in contemporary soft-matter research, due to the potential applications in biomedical and smartmaterials industries. For self-assembly of oligopeptides, there is a diversity in the initialbuildingunit, which encompasses peptide-amphiphiles, alternating hydrophobic-hydrophilic peptides and completely hydrophobic ultrashort peptides. In our group, we are focusing on ultrashort peptide self-assembly. We undertook a thorough study of the self-

assembly processes of some ultrashort peptides leading to formation of differentnanostructures from the randomized initial state by molecular dynamics simulations. The interplay of different chemical interactions leads to formation of nanostructures in water. Due to considerable amount of water interaction and combining effect of electrostatics and hydrophobic sidechains, the elongated fibrilous structure is formed. Presence of β-sheet patterns are seen in the H-bonding network throughout the self-assembled states providing molecular picture behind spectroscopic observations. **Enhanced sampling on pathway analysis:**We performed a pathway analysis of peptide self-assembly for the triphenylalanine and discovered three types of phases. There are several nucleus formations at first by rapid fusion of single molecules and small clusters, then single molecules attached to the nucleus formed in the previous stage ripen to form sphere-like clusters. Finally, these clusters fuse together first to form anisotropic clusters and these anisotropic clusters fuse end to end to form the final fiber. Because this fusion process is relatively time-consuming, we are employing a specialized method known as Forward Flux Sampling as a tool for enhanced sampling (FFS). The entire dynamical propagation is divided into segments between consecutive interfaces in the FFS method, where interfaces are defined in terms of order parameter. In this scenario, the order parameter used to track the spherical clusters is a combination of the number of clusters present and the minimum distance between these clusters. When the cluster number decreases or the minimum distance decreases while the cluster number remains constant in the trajectory, it is considered to have arrived at the next interface. The fusion is being tracked in this manner. We are currently working on automating the FFS mechanism and experimenting with various other order parameters to improve microstate sampling and reduce simulation world clock time. **Hard particle self-assembly:**Various instances of nature exhibit the spontaneous organization of building blocks with individual lengthscales into intricate structures. Our building blocks comprise of hard, convex, regular anisotropicpolyhedra, which exhibit a rich phase behaviour in terms of translational and orientational brokensymmetry. It is a known fact that shape attributes, such as moment of inertia (MOI) and isoperimetricquotient (IQ), govern whether an orientationally ordered crystal will be formed via an orientationallydisordered crystal under self assembly. The existence of an orientational quenched correlated disorder phase at veryhigh packing fractions is studied with detailed nature of the disorder at unit cell level. When we introduceirregularities in various ways into these building blocks, they exhibit different types of thermodynamicphases including liquid crystals at various packing fractions, which can be distinguished by suitable orderparameters. The phase behaviour of sphero-polyhedra, i.e., polyhedra with rounded vertices, has also beeninvestigated thoroughly, and we have discovered the robustness of the crystal structures formed by hardsphero-polyhedra.

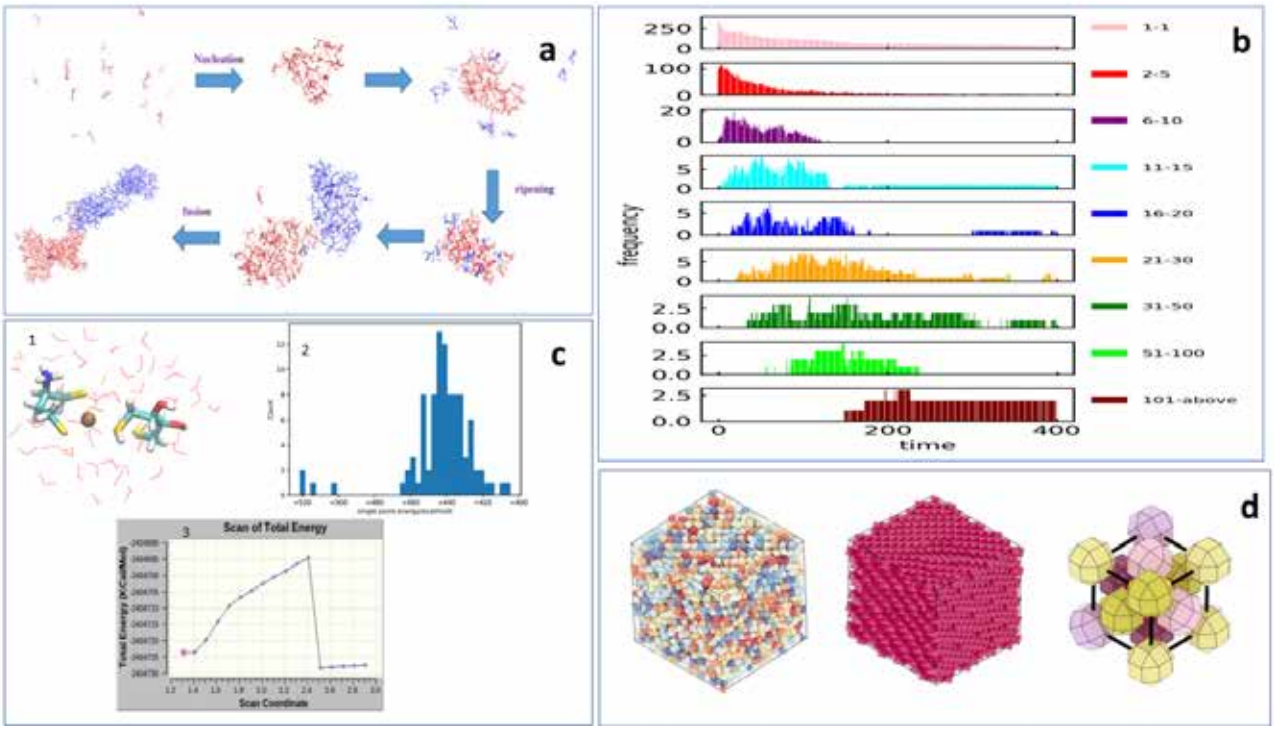


Figure a) *Different phases of peptide self-assembly b) Distribution of different size of clusters over the trajectory c)1. Solvated configuration of an intermediate in Cu(I) transfer path between small thiol-based; 2. Single point energy distribution of solvent configurations 3. Scan of total energy for the pKa calculations of the thiol groups of DTT. d) Orientationally ordered crystal having a single orientation in each unit cell, orientationally disordered plastic crystal and orientationally quenched correlated disorder in unit cell respectively*

Copper trafficking in biology: One of our objectives is to study the copper(I) transfer mechanism between a pair of carrierproteins i.e., a chaperone and a corresponding MBD. We have chosen sulfur containing chelating ligandsDTT and DTBA as a model systems to study the copper(I) transfer pathway. We have proposed a reactionscheme for the transfer pathway and optimized the intermediates. On optimization certain intermediateswere found in presence of proper solvation. The role of solvation on the energy profile of the reaction hasbeen studied. Protonation/ deprotonation steps in the reaction profile handled with proper explicitsolvation along with implicit solvent model. Simulations were run on optimized intermediates withenough number of solvent molecules for proper solvation of the reactive species. We have also worked onthepKa calculation of these sulfur containing chelating ligands.

Publications in Journals :

1. Atomistic Pictures of Self-Assembled Helical Peptide Nanofibers – Rumela Adhikary and Avisek Das*, *J. Phys. Chem. B*, 126,9476-9492 (2022)

Sponsored Project

» Understanding the Role of Protein……. Copper Trafficking (SERB).

AYAN DATTA

Senior Professor

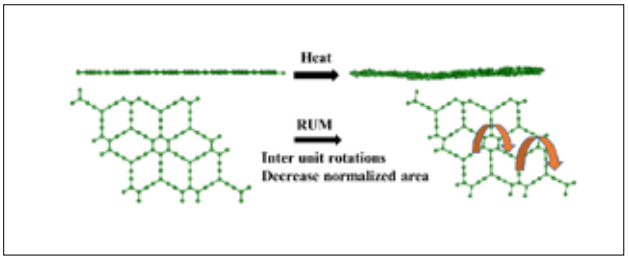
Computational Chemistry

Associate:

(1) Sucharita Mandal (CSIR) SRF, (2) Partha Mondal (INSPIRE) SRF, (3) Pranab Gain (CSIR) SRF, (4) Soumya Mondal (CSIR) SRF, (5) Ankita Das (INSPIRE) SRF, (6) Chandralekha Hajra (IACS) SRF, (7) Sovan Das (CSIR) SRF, (8) Oshiya RA (IACS) JRF, (9) Nilangshu Mandal (RA-I), (10) Moumita Mukherjee (RA CSIR), (11) Anupam Ghosh, SRF (CSIR)

Our group focuses on anunified understanding of phenomena at various length and time scales using techniques based on ab-initio and extended quantum mechanical methods. This group has contributed towards two – dimensional systems like silicene and other graphene analogues and provided a relationship between electronic structure and ground state properties. We study various aspects of both homogeneous and heterogeneous catalysis and examine the role of metal particles. Quantum mechanical tunneling including carbon tunneling is investigated in various chemical transformations. Modeling of terahertz (THz) spectra of crystal polymorphs is studied through solid – state DFT phonon calculations. Optoelectronic properties of organic molecules for Singlet Fission is actively pursued for extremely high LED efficiency. Dynamical behavior of these systems at finite temperatures are captured using approximate methods like ab-initio MD or classical MD or even reactive MD depending on the time-scale of the chemical or physical phenomenon of interest. Recent interest have been to study solvent phase exfoliation of two-dimensional materials from their bulk van der Waals state of aggregation. One of our long-term interest lies in exploring rare and unusual interactions in chemistry like nc-2e bonds or ultrashort H...H non-bonded contacts and even hypervalent species in constained environments. While, these structures have at best, fleeting existence at ambient conditions many new phases of molecules/solids remain yet to be discovered particularly in the emerging area of high pressure chemistry.

Though computational chemistry is evolving and improving, we do realize that quantitative numbers are model dependent. Hence, most importantly, to gain a qualitative picture, we are always eager to work very closely with experimentalists to refine, reframe and even refute predictions.



Negative thermal expansion in Graphyne

Publications in Journals :

1. Two dimensional materials are non-nanotoxic and biocompatible towards cyclotides: evidence from classical molecular dynamics simulations - A Ghosh, TK Mukhopadhyay, Ayan Datta* *Nanoscale*, 2023, 15 (1), 321-336.[IF:7.5]
2. External Electric Field Induces a Mechanistic Crossover in the Reactivity of 1,3-Dienes with Sulfur Dioxide: Sulfolene Versus Sultine - C. Hajra, S. Mandal, and Ayan Datta*, *J. Org. Chem*. 2023, 88, 917–923. [IF:4.5]
3. [(Flu)-(CH 2) 2-(NHC)-CH 2-(NHC)-(CH 2) 2-(Flu)] 2−: an 'all-organic'hybrid and flexible ligand that enwraps a Ca 2+ pseudo-tetrahedrally - S Baguli, S Das, M Chakraborty, S Goswami, Ayan Datta*, D Mukherjee*. Chemical Communications 2022, 58, 12188-12191.[IF:6.5]
4. A highly contorted push–pull naphthalenediimide dimer and evidence of intramolecular singlet exciton fission - D Bansal, A Kundu, VP Singh, AK Pal, A Datta, J Dasgupta, P Mukhopadhyay, *Chemical Science*, 2022, 13, 11506- 11512.[IF:10.5]
5. Rational Design of Biaxial Tensile Strain for Boosting Electronic and Ionic Conductivities of Na2MnSiO4 for Rechargeable Sodium-Ion Batteries - G Sakata Gurmesa, T Teshome, N ErmiasBenti, G AyalnehTiruye, Ayan Datta, Y S Mekonnen, C A Geffe. *Chemistry Open* 11 (6), e202100289.[IF:2.5]
6. Negative Thermal Expansion Induced in Tri-graphene and T-graphene by the Rigid-Unit Modes, S. Mondal, Ayan Datta*, *J. Am. Chem. Soc*., 2022, 144, 16703-16707.[IF:14.5]
7. Deciphering the Role of Substitution in Transition-Metal Phosphorous Trisulfide (100) Surface: A Highly Efficient and Durable Pt-free ORR Electrocatalyst, R. Jana, C. Chowdhury, A. Datta*, *ChemPhysChem*, 2022, 23, e202200013.[IF:3.5]
8. Metal-Free Kinugasa Reaction Catalyzed by External Electric Field, S. Mandal, Ayan Datta*, *J. Phys. Org. Chem*. 2022, 35, e4327 (A Special Issue in honour of Prof. Barry Carpenter).[IF:3.5]
9. Understanding the Regioselectivity of Ion-pair-Assisted Meta-Selective C(sp2)-H Activation in Conformationally Flexible Arylammonium Salts, P. Mondal, R. Pal, A. K. Pal, S. Das, A. Misra, Ayan Datta*, *J. Org. Chem*. 2022, 87, 9222-9231.[IF:4.5]
10. Performance of Nitrogen Reduction Reaction on Metal Bound g-C6N6: Combined Approach of Machine Learning and DFT - M. Mukherjee, S. Dutta, M. Ghosh, P. Basuchowdhuri, Ayan Datta*, *PCCP*, 2022, 24, 17050 - 17058. (Published in a special issue on the Festchrift of Prof. Wolfgang E. Ernst).[IF:4.5]
11. Ferroelectricity in a hydrogen-bonded alternating donor–acceptor supramolecular copolymer - S. Barman, S. Bandopadhyay, A. Ghosh, S. Das, T. Mondal, Ayan Datta, S. Ghosh, A. Datta, *Chem. Commun*., 2022, 58, 10508-10511.
12. Thiazole Containing PNA Mimic Regulates c-MYC Gene Expression through DNA G-Quadruplex - A. Gorai, R. Chaudhuri, T. K. Mukhopadhyay, Ayan Datta, J. Dash, *Bioconjugate Chem*. 2022, 33, 1145 - 1155.[IF:4.5]
13. Fully organic electroactive monomers for electrochromic behaviors having high coloration efficiency and long cycle stability towards flexible Solid-State electrochromic device - S. Nad, R. Jana, Ayan Datta, S. Mallick, *J. Electroanal. Chem*. 2022, 918, 116484.[IF:3.5]
14. Copper Nanoclusters for Catalytic Carbob-Carbon and Carbon-Nitrogen Bond Formations - B. Mondal, K. Basu, R. Jana, P. Mondal, B. Hansda, Ayan Datta*, A. Banerjee*, *ACS Appl. Nano Mater*. 2022, 5, 7932 - 7943.[IF:7.5]
15. Compression Produces a Square-Planar Iron Tetracarbonyl - P. Gain, S. Das, Ayan Datta*, *Inorg. Chem*. 2022, 61, 9055 - 9062.[IF:4.5]
16. Epitaxial Orientation Angle Tuned Disk-on-Rod Nanoheterostructures for Boosting Charge Transfer. S. Sen, R. Jana, S. Bera, S. Shyamal, P. Sahu, Ayan Datta, N. Pradhan, *J. Phys. Chem. Lett*. 2022, 13, 3804-3811.[IF:6.5]
17. A Hierarchical (Macro)molecular Assembly Assisted by Donor-Acceptor Charge-Transfer Interactions Exhibiting Room-Temperature Ferroelectricity - A. Mukherjee, S. Barman, A. Ghosh, Ayan Datta, A. Datta, S. Ghosh, *Angew. Chem. Int. Ed*. 2022, e202203817.[IF:12.5]
18. Substituent Effect of Benzyl Moiety in Nitroquinoxaline Small Molecule upon DNA Binding: Cumulative Destacking of DNA Nucleobases Leading to Histone Eviction - R. Pal, J. Chakraborty, T. K. Mukhopadhyay, A. Kanungo, R. Saha, A. Chakraborty, D. Patra, Ayan Datta, S. Dutta, *Eur. J. Med. Chem*. 2022, 229, 113995. [IF:6.5]
19. Remarkable COx Tolerance of Ni(III) active Species in Ni2O3 Catalyst for Sustained Electrochemical Urea Oxidation - M Safeer NK, C Alex, Ayan Datta, N. S. John, *J. Mater. Chem.* A 2022, 10, 4209 - 4221. [IF:8.5]

20. Stereoelectronic and Dynamical Effects Dictate Nitrogen Inversion During Valence Isomerism in Benzene Imine - N. Mandal, A. Das, C. Hajra, Ayan Datta, *Chem. Sci.* 2022, 13, 704-712.[IF:10.0]
21. Stable room temperature ferroelectricity in hydrogen-bonded supramolecular assemblies of ambipolar π-systems - A. Mukherjee, S. Barman, A. Ghosh, S. Chakraborty, Ayan Datta, A. Datta, S. Ghosh, *Chem. Sci*., 2022,13, 781-788.[IF:10.0]
22. Adsorbate-Induced Phase Transformation of Ambient Stable Noncubic Lattices in Au Microcrystallites - C. Sow, R. Jana, G. Mettela, Ayan Datta, G. U. Kulkarni, *J. Phys. Chem. C* 2022, 126, 823–831.[IF:4.5]

Ph.D. Degree Awarded

(1) Nilangshu Mandal (IACS Deemed to be University)

Sponsored Project

» Single Atom Catalysis …… Heterogeneous Reactions (DST-DIA)

» CO_2 to Useful chemicals (SERB)

Lectures Delivered

Invited talk at (1) Chemistry Meet, Kaziranga and (2) BARC, Mumbai.

BIMAN JANA

Professor & Academic Coordinator-BS-MS

Theoretical Physical Chemistry

Associate:

(1) Dr. Debasis Saha (RA-I), (2) Prasun Pal (SRF), (3) Rahul Aich, (SRF), (4) Rohon Mitra (SRF), (5) Pradipta Kumar Das (SRF), (6) Subhajit Sarkar (SRF), (7) Subhabrata Hazra (JRF), (8) Sourav Satapathi (JRF), (9) Saikat Dhibar (JRF), (10) Kingshuk Das (JRF).

Our study uncovered that the pre-organization environment of the ATP hydrolysis reaction of kinesin-1 is critically dependent on having the broken state of the Arg203-Glu236 salt-bridge sufficiently populated. This salt-bridge in turn is controlled by a second sphere Asn255 residue (also by MT-binding interactions located far away) through backbone-mediated inter-actions with Glu236. We demonstrated that the Asn255Ser mutation allosterically disrupts the whole interaction network, causing a destabilization of the pre-organization environment required for efficient ATP hydrolysis reaction in the kinesin motor. This disruption is responsible for the HSP disease in humans. In earlier studies, we have shown that some of the HSP-related genotypic mutations altered the energetic balance between the MT binding and coiled-coil dimerization interactions. Such a disruption affects the order–disorder transition of the neck linker domain leading to heavy loss in communication between the two motor head domains of the dimer. This makes kinesin very inefficient by reducing its processivity and therefore shortening of the MT run. In this work, we demonstrate that another genotypic mutation leads to impaired ATP hydrolysis by essentially making the kinesin very sluggish on the MT. Such slow kinesin blocks the road ahead for other swiftly moving kinesins. The fate is again HSP disease. Therefore, different mutations in the same gene (genotypic mutation) manifest two distinct mechanisms in the phenotypic level but ultimately lead to the same HSP disease.

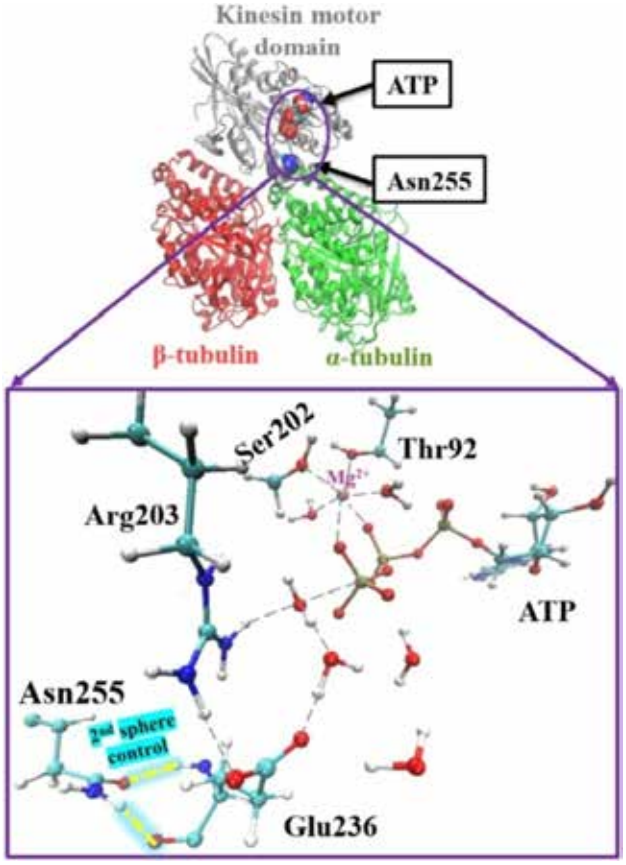


Fig:ATP-bound kinesin-α/β-tubulin complex. It is composed of the kinesin motor domain region, α-tubulin, and β-tubulin. The tubulins are the units of the microtubule filaments. The γ-phosphate group of the ATP is surrounded by the Glu236, Arg203, Ser202, Thr92, Mg2+ ion, and six water molecules. The HSP disease-related residue, Asn255, is also shown, and the proposed second sphere interactions are highlighted.

Publications in Journals :

1. Road-blocker HSP disease mutation disrupts pre-organization for ATP hydrolysis in kinesin through a second sphere control - Rabindranath Manna, José Onuchic* ,and Biman Jana*, *PNAS*, **120**, e2215170120, (2023).[IF:12.779]
2. Real-time Observation of Macroscopic Helical Morphologies under OM: A Curious Case of π-π Stacking Driven Molecular Self-assembly of an Organic Gelator Devoid of Hydrogen Bonding- Sourabh Bera, Sushmita Basu, Biman Jana*,and Parthasarathi Dastidar*, *Angew. Chem*., **135**, e202216447, (2022).[IF:15.336]
3. Number of Hydrogen Bonds Per Unit Solvent Accessible Surface Area: A descriptor of funtional states of protein. Prasun Pal, Sandipan Chakraborty*,and Biman Jana*. *J. Phys. Chem. B*., **126**, 10822-10833, (2022).[IF:3.466]
4. Molecular Factors of Ice Growth Inhibition for Hyperactive and Globular Antifreeze Proteins: Insights from Molecular Dynamics Simulation. Prasun Pal, Rahul Aich, Sandipan Chakraborty*, and Biman Jana*. *Langmuir*., **38**, 15132-15144, (2022). [IF: 4.331]
5. Identifying the Template for Oligomer to Fibril Conversion for Amyloid-β (1-42) oligomers using Hamiltonian Replica Exchange Molecular Dynamics. Debasis Saha, and Biman Jana*, *ChemPhysChem*., **23**, e202200393, (2022).[IF:3.52]
6. Direct Participation of Solvent Molecules in the Formation of Supramolecular Polymers. Goutam Ghosh, Anwesha Chakraborty, Prasun Pal, Biman Jana*, and Suhrit Ghosh*. *Chem. Eur. J.* ,**28**,e202201082, (2022).[IF:5.236]

Sponsored Project

» Characterizing the effect of IBS …… ice nucleation and growth

Lectures Delivered

Invited talk at (1) TCMSD-2022, (2) IABS-2023, Kolkata and (3) Chemistry Meet 2023, Kaziranga.

DEBASHREE GHOSH

Professor

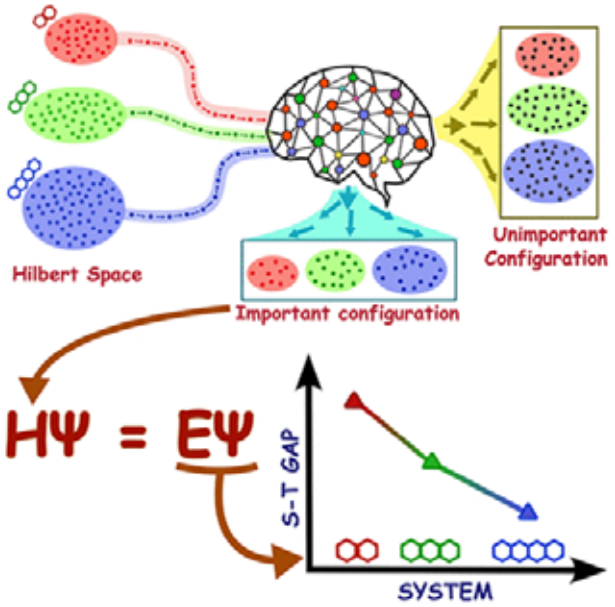
Theoretical and Computational Chemistry

Associate:

(1) Dr. Rabindranath Manna (postdoc), (2) Ms. Madhumita Rano (SRF), (3) Mr. Sumanta K. Ghosh (SRF), (4) Mr. Koushik Seth (SRF), (5) Mr. Arpan Chowdhury (SRF), (6) Mr. Supriyo Santra (SRF), (7) Ms. Mandira Dey (SRF), (8) Mr. Pradipta Dey (JRF), (9) Mr. Bishnu Prasad Rakshit (BSMS), (10) Mr. Adityakrishnan P. (BSMS), (11) Mr. Atreyo Palit (MS), (12) Sukanya Bhattacharya, RA-1 (Institute)

The overarching theme of the research in the Ghosh group revolved around development of strategies to understand ground and excited state electronic structure of strongly correlated systems.

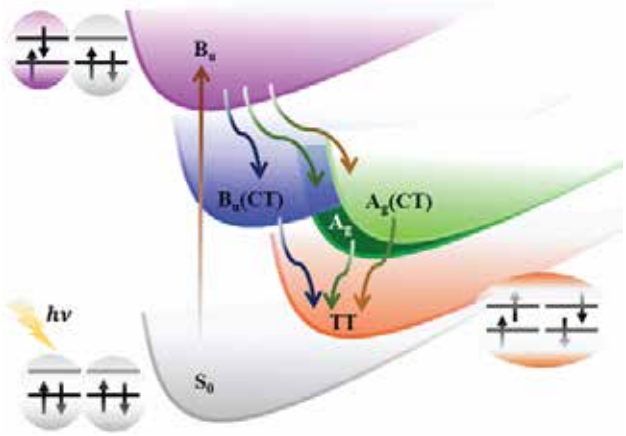
(a) Machine learning optimization of quantum chemical wavefunctions - The machine learning based strategies to calculate approximate wavefunctions of strongly correlated systems was extended to include matrix product state ansatz wavefunctions. This provides an alternative to the traditional variational optimization of the MPS ansatz and therefore, circumvents the need to compute energy expectation values and their derivatives.



Furthermore, the machine learning algorithm was refined and optimized using active learning methods. The MPS learning and active learning algorithms were tested for various low-lying states of polyaromatic hydrocarbon molecular Hamiltonians and corresponding Heisenberg model Hamiltonians.

These methods were published in J. Chem. Phys. And J. Chem. Theory Comput. papers.

(b) Singlet fission mechanism and singlet triplet gaps – Understanding and predicting suitable singlet fission (SF) materials have been a recurrent theme in the group. To that effect, we have calculated the singlet triplet (ST) gaps of polyaromatic hydrocarbons with different topology and connectivity. The effect of non-linearity and non-planarity on the ST gaps were calculated using DMRG and other state of the art methods.



Furthermore, the mechanism of SF process itself have been under scrutiny. We have shown that unlike in acene systems, carotenoids and polyenes have a markedly different mechanism for SF. Furthermore, owing to multiple pathways the SF process in polyene systems is less affected by change in geometry.

These works were published as *J. Phys. Chem. Lett. Papers.*

Publications in Journals:

1. Machine learning matrix product state ansatz for strongly correlated systems - S.K. Ghosh and D.

Ghosh, *J. Chem. Phys.*, **158**, 064108 (2023).[IF :4.304]

2. Active learning assisted MCCI to target spin states - K. Seth and D. Ghosh, *J. Chem. Theory Comput.*, **19**, 524 (2023).[IF:6.578]
3. Curious case of singlet triplet gaps in nonlinear polyaromatic hydrocarbons - M. Dey and D. Ghosh, *J. Phys. Chem. Lett.*, **13**, 11795 (2022).[IF:6.88]
4. Mechanism of singlet fission in carotenoids from a polyene model system - S. Santra, J. Ray and D. Ghosh, *J. Phys. Chem. Lett.*, **13**, 6800 (2022).[IF:6.88]
5. Substitution enables significant new decay channels for a non-canonical amino acid - P. Ghosh, T. Nandy, P.C. Singh and D. Ghosh, *Phys. Chem. Chem. Phys.*, **24**, 17695 (2022).[IF:3.676]
6. Photo-processes in biology: A glimpse from computational chemistry and machine learning - D. Ghosh and A. Choudhury, *Asia Chem,* 3(1), 86 (2023). [IF:3.488]

Award/Recognition :

» SERB-POWER Fellowship (SERB)

» Walter Kohn Prize, International Center for Theoretical Physics, Italy.

» Editorial Advisory Board Member, Chemical Society Reviews, Royal Society of Chemistry.

» Editorial Advisory Board Member, Journal of Chemical Theory and Computation, Amarican Chemical Society.

» Editorial advisory board member, Journal of Physical Chemistry A/B/C, American Chemical Society.

Ph.D. Degree Awarded

(1) Paulami Ghosh (CU)

Lectures Delivered

(1) Emerging Dimensions in Chemical Sciences 2023, (2) ML4Science Discussion Meeting, 2023, (3) Intl. Conference on Systems in Physics, (4) Quy Nhon, Vietnam, (5) Trieste, Italy (award lecture), (6) SINP, Kolkata, (7) 59th Annual Convention of Chemists, (8) Recent Advances in Chemistry, 2022, (9) 29th CRSI-NCS Women in Chemical Sciences, 2022, (10) CRSI Kolkata Champter conference, 2022, (11) Quantum Information Quantum Technology, 2022 (Plenary Lecture) and (12) TIFR Mumbai.

Sponsored Project

» Fast lower scaling multireference …… in CPU-GPU platform.

» Structure and rational design of melanin and melanin-based materials – an in-silico approach (SERB-POWER fellowship)

HARAPRIYA RATH

Professor

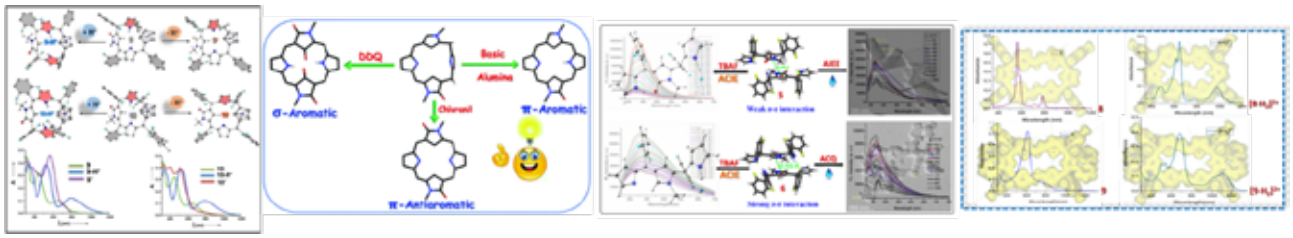
Multifaceted Singly, Doubly and Multiply N-Confused Calixphyrins, Porphyrins and Porphyrinoids

Associate:

(1) Sumit Sahoo (IACS-SRF); (2) Manik Jana (UGC-SRF); (3) Anirban Panua (CSIR-SRF); (4) Nilesh ranjan Ghosh (JRF-CSIR project)Palit (MS)

We have mainly focused on the state-of the art synthetic design and isolation of artificial porphyrinoids by swapping pyrrole component(s) with diverse functionalized pyrrolic(heterocyclic)/carbacycle building block(s) to compare the impact on the electronic absorption spectra, aromaticity andanion receptor abilities of the incorporated isomeric/expanded porphyrinoids. Attention has been directed towards five distinct criteria of utilizing functionalized pyrrole(heterocycle)/aromatic hydrocarbons as synthons.We have achieved the very first structural proof of electronically fascinating de novo hybrid singly N-methyl N-confused ferrocenocalixphyrins with the very high affinity of towards protonation induced NIR absorption and acting as colorimetric fluoride anion sensor owing to deprotonation of pyrrole NH with pronounced color changes. [1]The very first report of chemically

transformation of doubly N-confused porphodimethenes to doubly N-confused porphyrinoids/isophlorinoids with varying π-aromaticity (antiaromaticity) and σ aromaticity triggered by α-C and β-C oxygenation are successfully reported.[2]We have unraveled de novo N-Methyl N-confused tripyrromonomethene analogues displaying highest resistance to degradation, the advent of which has been revealed via their anion binding studies, AIEE and ACQ studies. Both the tripyrromonomethene analogues could act as efficient and selective fluorescence-enhanced turn-on fluoride ion receptors.[3]We have investigated new convergent synthetic methodologies for arriving at variants of hitherto unknown new generation of core-modified N-confused calixphyrins with and/or-pyrrole connectivity, and have unraveled their conformational analyses and electronic properties via in depth spectroscopic and DFT level theoretical studies.[4]Judicious syntheses, spectroscopic analyses, solid state structural evidence of two structurally variants of (with planar geometry) strongly aromatic hybrid [30] *E*-ethylene bridged hexaphyrins (2.1.1.2.1.1) exhibiting strong NIR absorption have been achieved. The induced correspondence of fused phenanthrene on the pyrrole moieties has led to further redshift up to ~45 nm in neutral and protonated form of the macrocycles. [5]



Publications in Journals:

1. Metallocene incorporated Hybrid Singly N-methyl N-confused Calixphyrins: Synthesis, Characterization, Protonation and deprotonation Studies - Nyancy Halder, M. Jana, S. Kottekad, D. Usharani, * and Harapriya Rath* *Chem. Asian J.* 2022, e202200108 [Invited article, Women in Chemistry-Special Issue].
2. Chemical transformation of Doubly N-Confused Porphodimethene to variants of (anti)Aromatic Doubly N-Confused Porphyrinoids and σ aromatic Doubly N-Confused Isophlorinoid - Nyancy Halder, S. Kottekad, D. Usharani* and Harapriya Rath* *Org. Chem. Front*., 2022, 9, 2333-2342. (https://bit.ly/3Jj0Y45)
3. Fluoride ion Coordination-Induced Turn-On Fluorescence of Tailored N-Methyl N-Confused Tripyrromonomethene Analogues - Manik Jana, R. Narayanswamy, D. Usharani*, K. Tripathi and Harapriya Rath* *Org. Biomol. Chem*., 2022, 20, 6741-6749.
4. N-protected pyrroles as synthons for variants of Core-modified N-confused Calixphyrins: Spectroscopic and Theoretical Characterization - Sumit Sahoo, A. Marzeena, D. Usharani* and Harapriya Rath* *J. Porphyrins Phthalocyanines*, 2022 [Invited Article on the occasion of 70th Birthday of Professor Tomas Torres: https://doi.org/10.1142/S108842462250064X].
5. NIR Absorbing AromaticE-Ethylene Bridged Hexaphyrins (2.1.1.2.1.1): Synthesis, Characterization, and Protonation Studies – Sumit Sahoo, M. H. Mahadavaiah, D.Usharani*and Harapriya Rath*, *Organic Letters*, 2023, 25 (9), 1491-1496 (Letter).

Sponsored Project

» Mutant Heterocyclic macrocycles …….. Fluorescent Molecular Probes, SERB

» Redox Noninnocent Doubly ……. Tetracarbaporphyrins, CSIR

JOYRAM GUIN

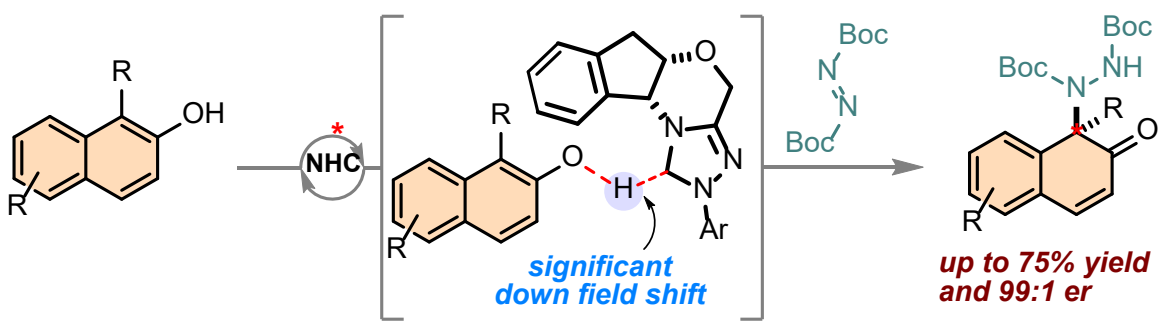
Professor

Asymmetric catalysis using N-heterocyclic carbene, Photocatalytic C-H functionalization, Radical chemistry and novel method development for organic synthesis involving aerobic oxidation

Associate:

(1) ManotoshBhakat, SRF (CSIR); (2) Ujjwal Maji, SRF (CSIR); (3) Bhaskar Deb Mondal, SRF (CSIR); (4) Jayanta Dey, SRF (CSIR); (5) Sourav Dutta, SRF (CSIR); (6) Ishita Roy, SRF (IntPCS); (7) Arpita Baidya, JRF (CSIR), (8) BitasikKhatua, JRF (CSIR), (9) Anjulika Ghosh, JRF (CSIR), (10) SadhanGorai, JRF (UGC) and (11) SwikritiDaw, JRF (UGC), (12) Dr. Debajyoti Saha, TARE

The research interest of our group is primarily focused on designing and developing new strategies for novel organic transformations following the concept of radical chemistry, photocatalysis, organocatalysis and transition metal catalysis. Considering the growing need for environmentally benign chemical synthesis, the group currently concentrates in developing new generation methods for C-H bond functionalization that enable selective transformation of abundant chemicals to high value materials using visible light-induced photocatalysis. Along with this line, we have developed a simple yet efficient photocatalytic method for the cross-dehydrogenative coupling (CDC) of azaarenes and simple alkanes involving HAT with Cl. using air as the sole oxidant. The novel alkylation process provides access to various alkylated azaarenes of significant value in medicinal chemistry without the need of any chloride salt, toxic reagent, high-energy UV-light, special reaction conditions or set-up. The non-conventional generation of Cl. via photocatalytic aerobic decomposition of common chlorinated solvent, DCE and its utilization towards alkane C(sp3)-H bond homolysis is the key aspect of this study. Furthermore, a visible-light induced photocatalytic method for the direct incorporation of oxime ether functional group at inert C(sp^3)-H bonds of different chemical feedstocks like ethers, amides, alcohols, amines and alkanes under mild conditions has been developed. Additionally, the design and development new principles for asymmetric organocatalysis for synthesis of enantioenriched small molecules of chemical, medicinal and materials significant remains an active research area of our group. In this connection, we have demonstrated an acid-free strategy for the aminativedearomatization of 2-naphthols using non-covalent asymmetric NHC-catalysis (Scheme 1). This catalytic process exhibits widen substrate scope providing access to enantioenriched cyclic enone having acid-labile functional groups. Also, an effective strategy for enantioselective synthesis of oxindoles having C3-quaternary stereocenter via N-heterocyclic carbene (NHC) catalyzed desymmetrization of diol has been developed. The catalytic process enables easy access to diversely functionalized C3-quaternary oxindoles with excellent enantioselectivity. The synthetic potential of the process has further demonstrated via the preparation of the key intermediate for (-)-esermethole and (-)-physostigmine.



Scheme 1: NHC-catalyzed asymmetric aminative dearomatization of α-substituted-2-naphthols

Publications in Journals :

1. N-Heterocyclic Carbene Catalyzed Desymmetrization of Diols: Access to Enantioenriched Oxindoles Having C3-Quarternary Stereocenter - Sourav Dutta, Arko Porey, Joyram Guin*, *Chem. Commun.,* 2023, Accepted (DOI:10.1039/d3cc00489a).[IF = 6.07]

2. Asymmetric AminativeDearomatization of 2-Naphthols via Noncovalent N-Heterocyclic Carbene Catalysis - Ujjwal Maji, Bhaskar Deb Mondal, Joyram Guin*, *Org. Lett.*2023, *25*, 2323-2327 (DOI: 10.1021/acs.orglett.3c00700).[IF:6.09]

3. Photocatalytic Incorporation of an Oxime Ether Functional Group at Inert C(sp3)–H Bonds via HAT"Jayanta Dey, Subhasis Paul, ManotoshBhakat, Joyram Guin**Org. Lett.,* 2022, 24, 8047-8051 (DOI: 10.1021/acs.orglett.2c03300).[IF:6.09]

4. Photocatalytic Aerobic Coupling of Azaarenes and Alkanes via Nontraditional Cl• Generation - Manotosh Bhakat, Bitosik Khatua, Joyram Guin*, *Org. Lett.*2022, *24*, 5276–5280 (DOI: 10.1021/acs.orglett.2c01784).[IF:6.097]

Publications in Book Chapter

(1) Metal-Free Radical C-H Functionalization via Aldehyde Auto-Oxidation. In Handbook of CH-Functionalization, D. Maiti. Wiley-VCH GmbH https://doi.org/10.1002/ 9783527834242.chf00931-32, 2022

Ph.D. Degree Awarded

(1) Manotosh Bhakat (IACS Deemed to be University)

Sponsored Project :

» Asymmetric N-Heterocyclic …… Non-Covalent Interaction

Lectures Delivered

Invited talk at (1) IIT, Guwahati

JYOTIRMAYEE DASH

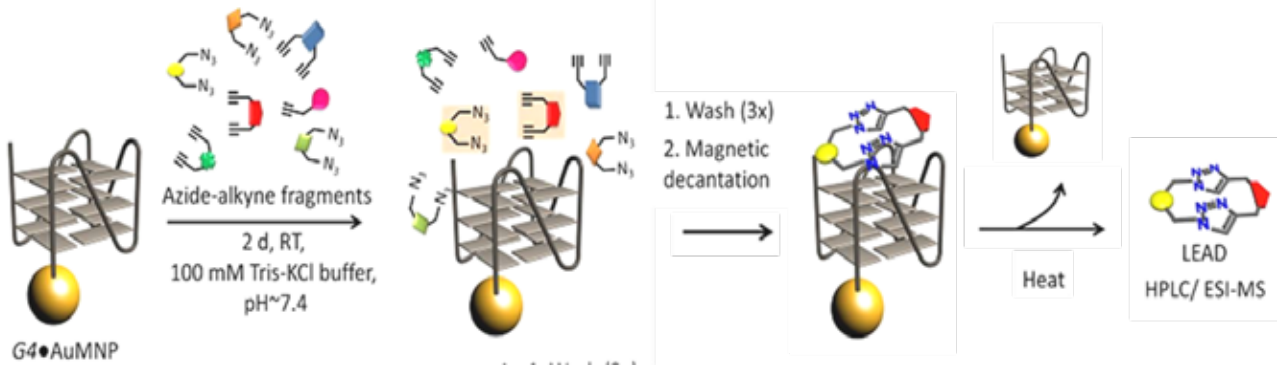
Senior Professor

Non-canonical nucleic acids structure and function.

Associate:

(1) Dr. Joydeb Halder RA, (2) Shilpi Karmakar SRF, (3) Soumya Jyoti Basak SRF, (4) Nabin Parui SRF, (5) Binayak Lala SRF, (6) Charles Patriot Roy SRF, (7) Sandip Maiti JRF, (8) Pratap Paul JRF, (9) Sk. Jubayar Ahashan JRF, (10) Neha Poddar JRF, (11) Sudeshna Mondal JRF, (12) Swomi Basu JRF, (13) Somenath Paul JRF, (14) Tathagato Bhattacharyya SRF, (15) Debasmita Biswas SRF, (16) Khushnood Fatma SRF, (17) Ritapa Chaudhuri SRF, (18) Semantee Bhattacharya RA, (19) Rakesh Paul RA, (20) Raj Paul RA and (21) Joyshree Karmakar RA.

- **DNA template directed in-situ macrocyclization:** We have demonstrated the bioorthogonalmacrocyclization directed by G-quadruplex DNA as the templates. The macrocyclic core possesses size complementarity with the G-quartet of a G-quadruplex DNA, driving the macrocyclization.Themacrocyclizationcould take place in cells, showing promising therapeutic activities. (*Angew Chem.* 2023)



Schematic representation of the target-guided synthesis of G-quadrplexbindingmacrocyclesby DNA-functionalized magnetic gold nanoparticles.

- **Synthesis of PNA mimics to bind and regulate DNA secondary structure:**We have designed and synthesized Peptide nucleic acids (PNAs) like scaffolds (Thz-2, Thz-3) by incorporating five membered thiazole rings as modified bases instead of nucleobases. For the comparison, a cytidinetrimer (Cyt-3) has also been synthesized. A thiazole modified PNA trimer Thz-3 selectively recognizes c-MYC G-quadruplex DNA over other G-quadruplexes and duplex DNA and downregulated oncogene expression in cancer cells (*Bioconjug. Chem.* 2022)
- **Putative G-quadruplex Formation in the Upstream Region of mTOR Gene:**The mammalian target of rapamycin (mTOR)signaling pathways are critical for maintaining cell homeostasis and commonly activated in tumors which controls cancer cell metabolism. We envisage to investigate the presence of any secondary structures in the mTOR gene, which may offer an attractive alternative approach for mTOR inhibition. (*ChemRxiv*, **2022)**

Award/Recognition :

» Sectional Editor, Journal of the Indian Chemical Society.

» Professor PK Bose Memorial Award, Indian Chemical Society.

Patent filed/awarded :

1. Ultra-small drug nano-conjugates (MTC-AUNPS) and process of its synthesis' **J. Dash**, D. Panda, P. Saha, S. Jana, T. Das, Indian Patent Application No. 202231064387 dated 10.11.2022 in India Our Ref: PP-3692/IACS (SRC).
2. Coumarin conjugated thiazole peptide that binds to SARS-CoV-2 RNA G-quadruplex' **J. Dash**, R. Paul, D. Dutta, T. Bhattacharyya, R. Paul,Indian Patent Application No. 202231052854 in India Our Ref: PP-3685/IACS (DJB).

Publications in Journals :

1. Cycloaddition of N-sulfonyl and N-sulfamoylazides with alkynes in aqueous media for the selective synthesis of 1, 2, 3-triazoles, T Prasanth, G Chakraborti, T Mandal, V Ravichandiran, , J Dash*, *Green Chemistry* 24 (2), 911-915.
2. Thiazole Containing PNA Mimic Regulates *c-MYC* Gene Expression through DNA Gquadruplex. A Gorai,R Chaudhuri, T K Mukhopadhyay, A Datta, J Dash*, *Bioconjugate Chem.* (2022) doi: 10.1021/acs.bioconjchem.2c00075 [IF: 6.069]
3. Diastereoselective Reversible C-C Bond Exchange of Oxindole-Thiazolidinediones for Dynamic Combinatorial Chemistry. A. Gorai, G. Chakraborti, S. Basak, J. Dash*, *Organic &Biomolecular Chemistry*, 20, 9307-9312(2022)[IF: 3.876]
4. Expanding the Toolbox of Target Directed Bio-Orthogonal Synthesis: In Situ Direct Macrocyclization by DNA Templates. R. Chaudhuri, P.Thumpati, J. Dash*, *Angew. Chem. Int. Ed.(2022)* 10.1002/ange.202215245 [IF: 16.82]
5. Rapid Access to Substituted Indenones via Grignard Reaction and its Application in the Synthesis ofFluorenones using Ring Closing Metathesis N. Parui, T. Mandal, J. Dash*, *European Journal of Organic Chemistry.* (2023)[IF: 3.26]
6. Nucleic Acids as Templates and Catalysts in Chemical Reactions: Target-guided Dynamic Combinatorial ChemistryandIn situ ClickChemistry and DNA/RNA Induced Enantioselective Reactions. P. Saha, D. Panda, J. Dash*, *Chemical Society Reviews.* (2023) [IF: 54.56]
7. Putative G-quadruplex Formation in the Upstream Region of mTOR Gene. K. Fatma, P. Saha, T. Das, J. Dash*, *ChemRxiv*, 2022, DOI: 10.26434/chemrxiv-2022-sfsd4-v2.

Ph.D. Degree Awarded

(1) Ritapa Chaudhuri (CU), (2) Shilpi Karmakar (CU) and (3) Raj Paul (JU).

Sponsored Project

» Regulation of non-canonical ……. Molecular probes

» Design and Construction of Nucleic ….. Nanopores

Lectures Delivered

Invited talk at (1) IIT (ISM) Dhanbad, (2) IISc, Bangalore and St. Xavier's College, Kolkata.

NABANITA DEB
Assistant Professor

Cold Collisions/Cold Chemistry

Associate:
(1) Anushree Dutta and (2) Ayan Bhowmick

Cold chemistry/Cold Collisions is the investigation of interactions of atoms and molecules at near-absolute-zero temperatures, few-Kelvin to milli-Kelvin range (cold), and below (ultra-cold). It helps us shed light on the reaction dynamics at the very fundamental level by experimentally probing the potential energy surface. With cold chemistry we are able to know what exactly happens during a chemical reaction, with quantum details.Cold conditions unveil the quantum nature of interactions between atoms and molecules, such effects are not observable at higher temperatures where statistical averaging destroys any quantum information which could be observed experimentally. Additionally, at these temperatures atoms and molecules possess nearly no kinetic energy and chemical species occupies a very narrow range of quantum states – hence experimental data are no longer thermally averaged over several quantum states. All these factors combined enable subtle features on the *underlying potential energy surfaces to be probed.* As a chemist this is the most important feature of this research as it enables us to get the first look at what exactly happens during the chemical reaction. Cold chemistry is also important for the understanding *the rich gas phase chemistry occurring at the interstellar medium and the upper atmosphere* where the conditions are similar to that of that within the experimental apparatus, and reactions are expected to proceed through quantum mechanisms, unlike at room temperatures. Therefore, such experimental measurements enable the accuracy of high-level theoretical calculations to be *assessed and the validity of such models of chemical reactivity to be tested.*

Two PhD students are currently working with me. The work that has been done in the last one year include, designing the whole experimental apparatus (inhouse), consisting of three chambers using AutoCAD Inventor, undertaking vacuum simulations to conclusively understand how many turbo molecular pumps and of what pumping speed will be necessary for the cold collisions study. Besides, we are also undertaking the designing of our velocity-mapped imaging set up. This is being currently designed inhouse based on Simion simulations being undertaken in our group. Additionally, we are developing a camera imaging software to capture the velocity mapped images.

PARTHASARATHI DASTIDAR, FASc

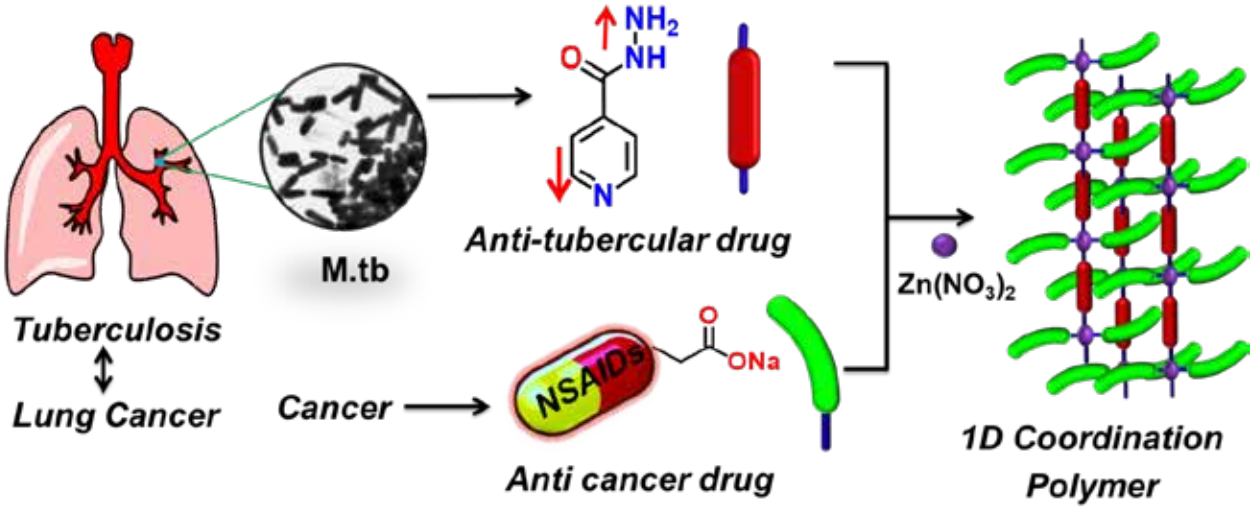
Senior Professor

Crystal Engineering, Supramolecular Chemistry, Molecular Gels, Molecular nanotubes, Coordination polymers and microporous materials, Crystal Growth

Associate:

(1) P Chakraborty, SRF (INSPIRE), (2) P Biswas, SRF (IACS), (3), Dr. Utsab Manna (NPDF), (4) S Bera, SRF (UGC), (5) Nabanita Roy, (6) Abhishek Dutta, (7) Dr. H. K. Datta (RA-I, IACS), (8) Dr. Rajdip Roy (RA-1, IACS), (9) P Pal, JRF (UGC), (10) M Baskey, JRF (UGC), (11) A Pharas, JRS (UGC)

Application of supramolecular synthons/coordination chemistry in the context of crystal engineering is being exploited to generate materials having potential for various applications such as topical gels for drug delivery, coordination polymer based metallogels for drug delivery, cell imaging etc.



Publications in Journals :

1. Design, Synthesis and Structural Insights of a series of Zn(II)-NSAID Based Coordination Complex Derived Metallogels and Their Plausible Applications in Self-drug-delivery - Protap Biswas, Abhishek Dutta and Parthasarathi Dastidar*, *Cryst. Growth Des. 2023, 23, 342−353*

2. Selective Separation of Hazardous Chemicals from Vapor phase by an Easily Accessible Breathing Coordination Polymer Derived from Terpyridyl/ terephthalate Mixed Ligands - Sourabh Bera, Parthasarathi Dastidar*, *Chem. Eur. J., 2023, 29, e202203133*

3. Weak Interactions Matter: Real-time Optical Microscopic Observation of Macroscopic Helical Morphologies Arising due to Molecular Self-assembly of a Small Organic Gelator Devoid of Hydrogen Bonding - Sourabh Bera, Sushmita Basu, Biman Jana* and Parthasarathi Dastidar*, *Angew. Chem. Int. Ed., 2023, 62(7), e202216447.*

4. Designing Coordination Polymers as Multi-drug-self-delivery System for Tuberculosis and CancerTherapy: in vitro Viability and in vivo Toxicity Assessment - Protap Biswas , Hemanta Kumar Datta, and Parthasarathi Dastidar*, *Biomater. Sci., 2022, 10, 6201-6216.*

5. Supramolecular Gels from Simple Bisamides of L-Phenylalanine: Synthesis, Structure and Material Applications - Utsab Manna, Rajdip Roy, Hemanta Kumar Datta and Parthasarathi Dastidar*, *ChemAsianJ.2022,e202200660*

6. Nitrile Containing Terpyridyl Zn(II)-coordination Polymer Based Metallogelators Displaying Helical

Structures: Design, Synthesis, Structures and The 'Drug-like' Action Against Melanoma Cells B16-F10 - Sourabh Bera, Hemanta Kumar Datta and Parthasarathi Dastidar*, *ACS Appl. Mater. Interface,*2022, *in press;* https://doi.org/10.1021/acsami.2c05338

Sponsored Project

» Developing Self-Drug Delivery …… Complexes/ Polymers (SERB)

» Developing Supramolecular …… Applications (CSIR)

PRADYUT GHOSH, FNA, FASc

Senior Professor

Molecular Recognition, Sensing, Catalysis and Interlocked Molecules.

Associate:

(1) S. Midya (NPDF, SERB), (2)Abu Saleh Musha Islam (NPDF, SERB), (3) M. Nandi (RA, SERB), (4) Sahidul Mondal, (RA, IACS), (5) A. Rashid SRF (CSIR), (6) Subal Mondal, SRF (CSIR), (7). S. Pramanik, JRF (CSIR), (8) Subham Mondal JRF (CSIR), (9) Soumya Mondal JRF (CSIR), (10) Iti Ghosh JRF (Integrated PhD), (11) Tarun Jana, JRF (CSIR) and (12) R. Ghosh, (Part-time).

A halogen bond based water soluble tetrapodal iodoimidazolium receptor was developed which exhibited a high degree of efficiency (~ 96%) in extracting ReO_4^- from 100% aqueous medium within the wide range of concentrations and *p*H range compared to its hydrogen bond analogue (Figure 1). Further,a newly developed Ir^{III} based 3,3'-([2,2'-bipyridine]-5,5'-diylbis(methylene)) bis(1-ethyl-1H-imidazol-3-ium) functionalized receptor was utilized for selective lifetime enhancement based sensing for $H_2PO_4^-$ and $HP_2O_7^{3-}$. In separate work a new fluorophoric [2]rotaxane was developed that selectivly sense Zn(II) over other transition, alkali and alkaline earth metal ions. On the other hand, NDI-based fluorophoric [2]rotaxane and [2]catenane were investigated towards the selective sensing of fluoride and cyanide in the visible and NIR regions. Moreover, room-temperature catalytic pathway for 1,3,5-tri(het)aryl derivatives from nitroalkenes using simple $Pd(OAc)_2$ was developed. Furthermore, the first merged photocatalytic pathway for the C−O cross-coupled esterification of carboxylic acids to *α*- oxycarbonyl-*β*-ketones was also developed. This new C=O and C−O bond-forming methodology takes place in a cascade manner under a dual Ir/Pd-catalytic pathway, with the liberation of H_2O and CO_2 as the only byproducts.

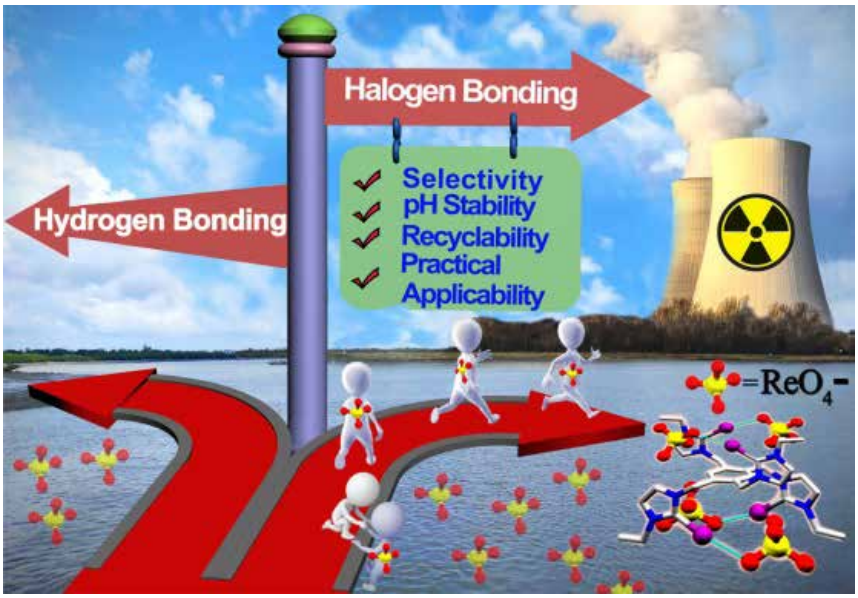


Figure 1: Efficient Extraction of Perrhenate from Water, [ACS Appl. Mater. Interfaces2022, 0000. https://doi.org/10.1021/acsami.2c19555]

Publications in Journals:

1. Merging Photocatalytic C−O Cross-Coupling for α-Oxycarbonyl-β- ketones: Esterification of Carboxylic Acids via a Decarboxylative Pathway - S. Mondal, S. Mondal, S. P. Midya, S. Das, S. Mondal, P. Ghosh*, *Org. Lett.* 2023, 25, 184-189.[IF:6.072]
2. Development and Application of Ruthenium(II) and Iridium(III) based Complexes for Anion Sensing - A. Rashid, S. Mondal, P. Ghosh*, *Molecules* 2023, *28*(3), 1231. [IF : 4.927]
3. Iridium(III) complex of fluorinated cyclometalating ligands and imidazolium-bipyridine as an effective lifetime based phosphates sensor - A. Rashid, S. Mondal, P. Ghosh*, *Inorg. Chim. Acta*. 2023, 121453. [IF:3.118]
4. Superiority of the Supramolecular Halogen Bond Receptor over Its H-Bond Analogue toward the Efficient Extraction of Perrhenate from Water - R. Ghosh, T. K. Ghosh, S. Pramanik, A.S.M. Islam, and P. Ghosh*, *ACS Appl. Mater. Interfaces*2022, 000−000. [IF : 10.380]
5. Room-Temperature Synthesis of 1,3,5-Tri(het) aryl Benzene from Nitroalkenes Using $Pd(OAc)_2$: Complete Mechanistic and Theoretical Studies - S. P. Midya, S. Mondal, A.S.M. Islam, A. Rashid, S. Mondal, A. Paul, P. Ghosh*, *Org. Lett.* 2022, 24, 4438–4443.[IF : 6.072]
6. A Bis-heteroleptic Imidazolium-bipyridine Functionalized Iridium(III) Complex for Fluorescence Lifetime-based Recognition and Sensing of Phosphates - A. Rashid, S. Mondal, S. Mondal, P. Ghosh*, *Chem. Asian J.* 2022, *17*, e2022003. [IF : 4.839]
7. NDI integrated rotaxane/catenane and their interactions with anions - M. Nandi, S. Bej, P. Ghosh*, *Dalton Trans.* 2022, *51*, 13507-13514.[IF:4.569]
8. Development of fluorophoric [2]pseudorotaxanes and [2]rotaxane: Selective sensing of Zn(II), S. Bej, M. Nandi, and P. Ghosh*, *Org. Biomol. Chem.,* 2022, *20*, 7284-7293.[IF : 3.890]

Award/Recognition :

» Silver Medal 2023, Chemical Research Society of India (CRSI)

Ph.D. Degree Awarded

(1) Rajib Ghosh (IACS Deemed to be University)

Sponsored Project

» Development of Organo- and Transition ….. Organic Transformations

» JC Bose Fellowship, SERB.

Lectures Delivered

Invited talk at (1) Banaras Hindu University, UP, (2) St. Paul's Cathedral Mission College, Kolkata, (3) BIT-Mesra, Ranchi, (4) IIEST-Shibpur and (5) FS-CHEM 2022, IISER-Trivandrum.

PRASHANT CHANDRA SINGH

Professor

Spectroscopy

Associate:

(1) Asim Bisoi, (2) Abhinanda Chowdhury, (3) Tithi Lai, (4) Sanchita Datta and (5) Asmita Saha

Research *in the lab is focused on investigating* the folding mechanism of proteins, Stability of unnatural proteins, Role of lipids in the blood coagulation and role of weak intermolecular interaction in the aerosol formation using a combination of spectroscopic techniques.

Publications in Journals :

1. Understanding of the interactions of biological macromolecules with lipids using vibrational sum-frequency generation spectroscopy - S. Sarkar, A. Bisoi, P.C. Singh*, *J Raman Spectrosc, 2022, 53, 1828*

2. Contrasting Effect of Salts on the Binding of Antimalarial Drug Hydroxychloroquine with Different Sequences of Duplex DNA - A. Bisoi†, S. Sarkar†, P.C. Singh*, *J. Phys. Chem. B*, *2022*, 126, 4, 5605-4612
3. Substitution enables significant new decay channels in non-canonical amino acid - P. Ghosh, T. Nandy, P.C. Singh*, D. Ghosh*. *Phys. Chem. Chem. Phys*., 2022, 24, 17695
4. Spectroscopic and Molecular Dynamics Aspect of Antimalarial Drug Hydroxychloroquine Binding with Human Telomeric G-Quadruplex - S. Sarkar*, A. Bisoi, P.C. Singh*, *J. Phys. Chem. B*, 2022, 126, 4, 5641-5249
5. pH Regulates Ligand Binding to an Enzyme Active Site by Modulating Intermediate Populations - Kushal Singh, Aswathy N. Muttathukattil, Prashant Chandra Singh, Govardhan Reddy*, *J. Phys. Chem. B*, 2022, 126, 47, 9759-9770
6. DNA-induced Reorganization of Water at Model Membrane Interfaces Investigated by Heterodyne-Detected Vibrational Sum Frequency Generation Study - P.C. Singh, M. Ahmed, S. Nihonyanagi*, S. Yamaguchi, T. Tahara*, *J. Phys. Chem. B*, 2022, 126, 4, 840-846
7. Protonation State of Dopamine Neurotransmitter at the Aqueous Interface: Vibrational Sum Frequency Generation Study - B. Biswas and P.C. Singh*, *Langmuir*, 2022, 38, 4, 1380-1385
8. Role of the weak noncovalent interactions in the stability of the aggregated protonated dopamine in the aqueous solution: Spectroscopic and quantum chemical calculation studies - A. Chowdhury and P.C. Singh*, *J. Chem. Sci*., 2022, 134, 25

Ph.D. Degree Awarded

(1) Tonima Nandy (IACS Deemed University)

Sponsored Project:

» Molecular level understanding ….. Frequency Generation

» Structural changes in proteins ….. transfor infrared study.

Lectures Delivered

Invited talk at (1) RIKEN, Japan

RAJIB KUMAR GOSWAMI

Professor

Total Synthesis of bioactive natural products

Associate:

(1) Dr. Dhiman Saha (IACS-RA1); (2) Mr. Joyanta Mondal, CSIR-SRF then bridge fellow IACS; (3) Mr. Sanu Saha, UGC-SRF then SRF-IACS; (4) Mr. Himangshu Sharma, CSIR-SRF; (5) Mr. Sourya Shankar Auddy, CSIR-SRF; (6) Mr. Moinul Haque Sahana, CSIR-SRF; (7) Mr. Nasif Ali, DST-Inspire; (8) Mr. Subrata Mandi, UGC-JRF; (9) Mr. Sandip Kr Mondal, UGC-JRF; (10) Mr. Sujan Paul, UGC-JRF; (11) Mr. MaheswarTantubay, Integrated MS-PHD Project Student; (12) Mr. Swapnamoy Ganguly, Integrated BS-MS Project Student.

Novel secondary metabolites are discovered from the natural sources, usually in minute quantities. Some of them turn out to be highly important for the benefit of our society. In order to learn the physical, chemical and biological properties of these important molecules, they need to be synthesized chemically. In this process, the structure of a novel complex molecule, which is usually based on physical data, is also unambiguously proved. With this view in mind, we envisaged the chemical synthesis of bioactive natural products thailandamide lactone, beauveamide A, strasseriolide A, boscartin A, phosphoeleganin. We developed efficient synthetic routes to access some of them efficiently. We have discovered an analogue of beauveamide A which showed good anticancer activity.

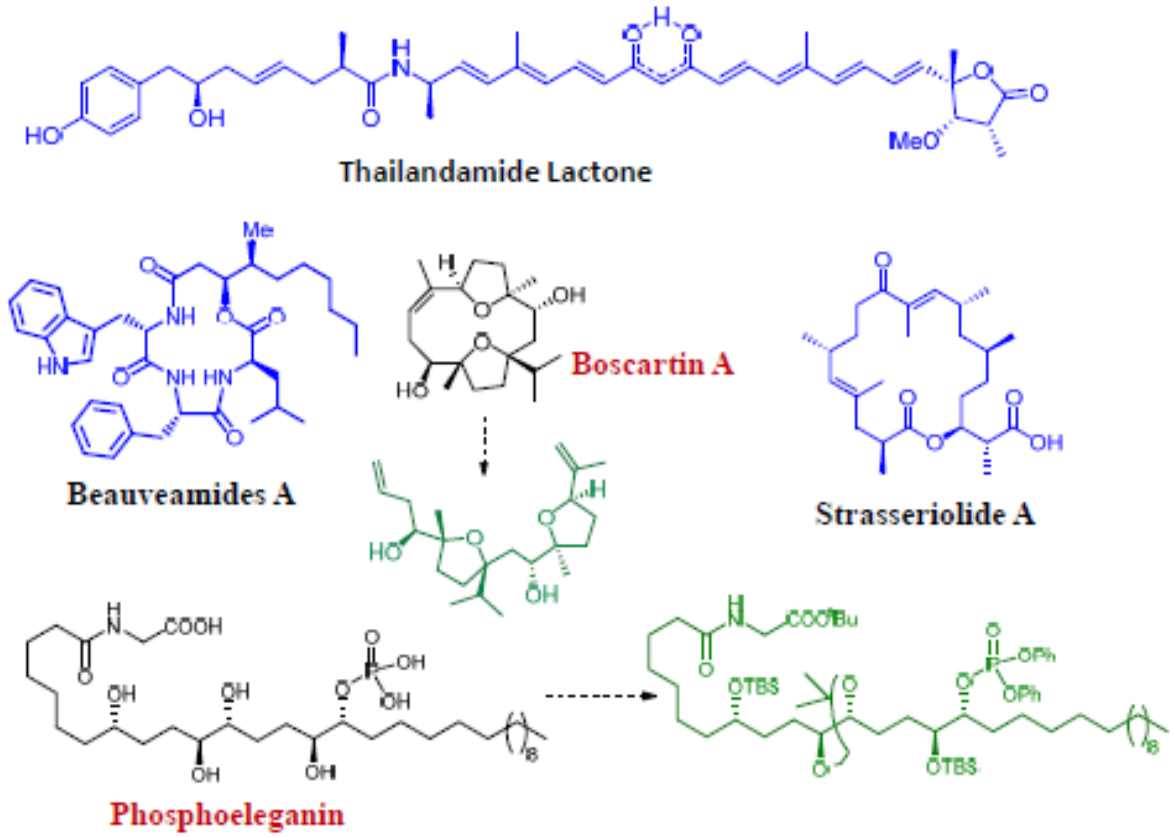


Figure 1:Targeted natural products for chemical synthesis

Publications in Journals :

1. Total Synthesis of Antibacterial Polyketide Natural Product ThailandamideLactone - Himangshu Sharma, Joyanta Mondal, Ananyo K. Ghosh, Ritesh Ranjan Pal and Rajib Kumar Goswami*; *Chem. Sci*., 13, 13403-13408(2022).[IF:9.97]
2. Late-Stage Functionalization: Total Synthesis of Beauveamide A & its Congeners and Their Anticancer Activities - Sanu Saha, Sourya Shankar Auddy, Akash Chatterjee, Prosenjit Sen and Rajib Kumar Goswami*; *Org. Lett*., 39, 7113-7117(2022).[IF:6.07]
3. Stereoselective Synthesis of Acyclic Skeleton of Boscartin A - Dhiman Saha, Moinul Haque Sahana, Gour Hari Mandal and Rajib Kumar Goswami*; *Synlett*, 33, 1943-1947(2022).[IF:2.37]
4. Total Synthesis of Strasseriolide A - Moinul Haque Sahana, Dhiman Saha and Rajib Kumar Goswami*;J. Org. Chem, 17, 11805–11815(2022) [IF: 4.19]
5. Synthesis of Key Skeleton of Phosphoeleganin - Gour Hari Mandal, Dhiman Saha, Sourya Shankar Auddy and Rajib Kumar Goswami*; *Synlett*, 34, 673-677(2023) [IF: 2.37]

Award/Recognition

» Bronze Medal, Chemical Research Society of India, 2023.

Sponsored Project

» Total Synthesis of Macrocyclic ….. Anticancer Activities (SERB-DST)

» Total Synthesis of Marine …… Structural Variations (DST-SERB)

Lectures Delivered

Invited talk at (1) IIT-Kanpur, (2) Manipur University, Manipur, (3) Krishnath College, Berhampore, (4) North Eastern Hill University, Shillong and (5) National Organic Symposium Trust Meeting, Hotel Rama, Aurangabad.

RAJU MONDAL

Professor

Crystal Engineering, Metallogelation, Magnetic materials, Synthesis and characterization and reactivity studies of metal-organic frameworks, Role of hydrogen bonds and weak interactions in coordination polymers

Associate:

(1) Krishna Sundar Das (RA) and (2) Sayan Saha (UGC-SRF).

Our research goals are centred around the synthesis and charecterization of Metal-Organic Frameworks (MOF) and coordination polymers, coupled with identification of structure-property relationships in these systems. As a part of our ongoing research several novel 1D, 2D and 3D coordination polymers have been synthesized using a divergent sterically hindered polydentate ligand, methylenebis(3,5-dimethylpyrazole) (H_2MDP).

One of the most successful approaches for generating metal-organic frameworks (MOFs) would be reticular synthesis using a secondary building unit (SBU). The strategy is to identify a robust and reproducible building block (SBU) as a vertex and subsequently design a network by linking them with organic ligands of well-defined geometry. This, in effect, can pave the way for the strategic control of vertex geometry in the resulting MOFs, which should enable us to predict the topology of the resulting structure. We have identified a robust and reproducible metal-carboxylate non-cluster type SBU, designed with the proper utilization of the complimentary hydrogen bonding of the H_2MDP molecule and carboxylate group. Subsequently, we have successfully synthesized a series of coordination polymers based on this tailor-made SBU using benzene polycarboxylic acids as auxiliary ligands. It has been observed that the conformational freedom of the linker molecules plays a crucial role in determining both the dimensionality and topology of the final structure.

The Pyrazole molecules possess two different nitrogen atoms, which may be involved in both metal coordination and/or hydrogen-bonding interactions. The H_2MDP molecule has two H-bond acceptor sites as well as two protonated nitrogen atoms, which can be used for hydrogen bond donating purpose. It has been observed earlier that the hydrogen bonds formed between coordinated H_2MDP and carboxylate groups play some pivotal role in the metal-organic coordination framework formation. This prompts us to evaluate the potential of this molecule as a co-crystallization agent to produce interesting supramolecular architecture. Accordingly, we have synthesized various interesting supramolecular architectures, including a polyrotaxane type network, constructed with heterosynthons in cocrystals of H_2MDP and acids. We have been able to identify three major supramolecular synthons that would be helpful in the prediction of structural motifs for these kinds of studies.

Publications in Journals :

1. A Silver Based Integrated System Showing Mutually Inclusive Super Protonic Conductivity and Photo-Switching Behaviour - S.Saha, K. S. Das, P. Pal, S. Hazra, A. Ghosh, S. Bala, A. Ghosh, A. K. Das, Raju Mondal,* *Inorg. Chem*., 2023, 62, 3485−3497.
2. Magnetic and Electric Properties of Pyrazole Based MOFs Grafted With Sulfonic Moiety - S. Saha, M. Das, K. S. Das, R. Datta, S. Bala, J. –L. Liu, P. P. Ray,* and R. Mondal*, *Cryst. Growth & Des*., 2023, 23, 1104−1118.
3. Synergistic Experimental And Theoretical Studies Of Luminescent-Magnetic Ln2Zn6 Clusters - S. Saha, K. S. Das, T. Sharma, S. Bala, A. Adhikary, G. –Z. Huang, M.-L.- Tong, A. Ghosh, B. B. Das, G. Rajaraman*, R. Mondal*, *Inorg. Chem*., 2022, 61, 2141−2153.
4. A Nd6 Molecular Butterfly: An Unique All-in-One Material for SMM, MCE and Maiden Photosensitized Opto-electronic Device Fabrication - K. S. Das, S. Saha, B. Pal, A. Adhikary, S. Moorthy, S. Bala, S. Akhtar, P. K. Ghosh, S. K. Singh,* P. P. Ray,* R. Mondal*, *Dalton Trans*., 2022, 51, 1617–1633.
5. Design of Dual Purpose Fe-metallogel for Magnetic Refrigeration and Fabrication of Schottky Barrier Diode - S. Saha, B. Pal, K. S. Das, P. K. Ghose, A.

Ghosh, A. De, A.K. Das, P.P. Ray,* R. Mondal*, *Chem Select*, 2022, https://doi.org/ 10.1002/ slct. 202203307.

6. Toxic Metal-Organic Gels Using a Unique Pyridine-Pyrazole Based Ligand with Pb(II), Cd(II) and Hg(II) Salts: Multi-stimuli Responsiveness and Toxic Dye Adsorption - M. Roy*, A. Adhikary, S. Saha, R. Mondal*, *Mater. Adv*., 2022, 3, 7328– 7338.

Ph.D. Degree Awarded :

(1) Krishna Sundar Das (CU)

Sponsored Project

» Nanometric Sensitizer …… Water Splitting

SATRAJIT ADHIKARI, FNASc

Senior Professor & Dean (Finance & Administration)

Theoretical developments on beyond Born-Oppenheimer treatment.

Associate:

(1) Dr. Abhishek Kumar, RA-I (Institute), (2) Dr. Soumya Mukherjee, RA-I (Institute), (3) Mr. Koushik Naskar, SRF (CSIR), (4) Mr. Saikat Hazra, SRF (DST-INSPIRE), (5) Mr. Mantu Kumar Sah, JRF (UGC) and (6) Ms. Subhali Basu, JRF (DST-INSPIRE), (7) Joy Dutta

- Professor Adhikari and his coworkers have employed coupled three-dimensional (3D) time dependent wave packet formalism in hyperspherical coordinates on *ab initio* calculated ground adiabatic potential energy surface for the F + H_2/D_2 (v = 0, j = 0) reaction. The convergence profiles for various reactive channels are explored at low collision energy regimes with respect to the total angular momentum (J) quantum numbers. Those converged reaction probability profiles are used to compute integral cross sections as a function of collision energy, temperature dependent rate constants as well as the kinetic isotope effect for various reactivity profiles of F + H_2 and F + D_2 reactions. [1]
- Trajectory surface hopping (TSH) formalism has been employed to compute cross-sections or/and rate constants of D^++H_2 (v=0, j=0) and H+H_2^+ (v=0, j=0) reactions. For the first time *ab initio* nonadiabatic coupling terms (NACTs)have been explicitly used to calculate the switching probabilities while solving Hamilton's equations over adiabatic potential energy surfaces (PESs). In this study the limitations of TSH algorithm as well as the computational advantage with respect to quantum dynamics have been explored. [2]
- Professor Adhikari and his group have constructed Beyond Born-Oppenheimer (BBO) [3-5] based diabatic PESs of pyrazine ($C_4N_2H_4$) molecule involving lowest four excited adiabatic PESs (S_1 to S_4) and nonadiabatic coupling terms among those surfaces as functions of nonadiabatically active normal modes (Q_1, Q_{6a}, Q_{9a} and Q_{10a}) to compute its photoabsorption (PA) spectra. *Ab initio* computed adiabatic PESs and NACTs are employed to construct diabatic surface matrices for the system and thereafter, those are used to perform multi-state multi-mode nuclear dynamics with the aid of Time-Dependent Discrete Variable Representation (TDDVR) methodology initializing the product type wavefunction on 1^1B_{1u} (S_1) and 1^1B_{2u} (S_2) states to obtain the corresponding PA spectra. [6]
- The effect of surface temperature on the dissociative scattering of D_2 (v=0, j=0/2) from Cu (111) surface has been investigated by developing an extended many oscillator model, where both the linear vibration-translation (VT) and quadratic vibration-vibration (VV) molecular DOFs-surface mode couplings have been considered. This extended many oscillator model reveals appreciable effect of anharmonic molecular DOFs-surface mode couplings on dissociative chemisorption process at higher temperature situation. [7]
- First-principles based BBO theory has been employed to construct multistate global PESs for the HeH_2^+ system using adiabatic PESs and NACTs for the lowest four electronic states ($1^2A'$, $2^2A'$, $3^2A'$

and $4^2A'$) in hyperspherical coordinates. Conical intersections between different states are validated by integrating the NACTs along appropriately chosen contours. Subsequently, adiabatic-to-diabatic (ADT) transformation angles are determined by solving the ADT equations to construct the diabatic potential matrix for the HeH_2^+ system will be employed for performing accurate scattering calculations for the titled system. [8]

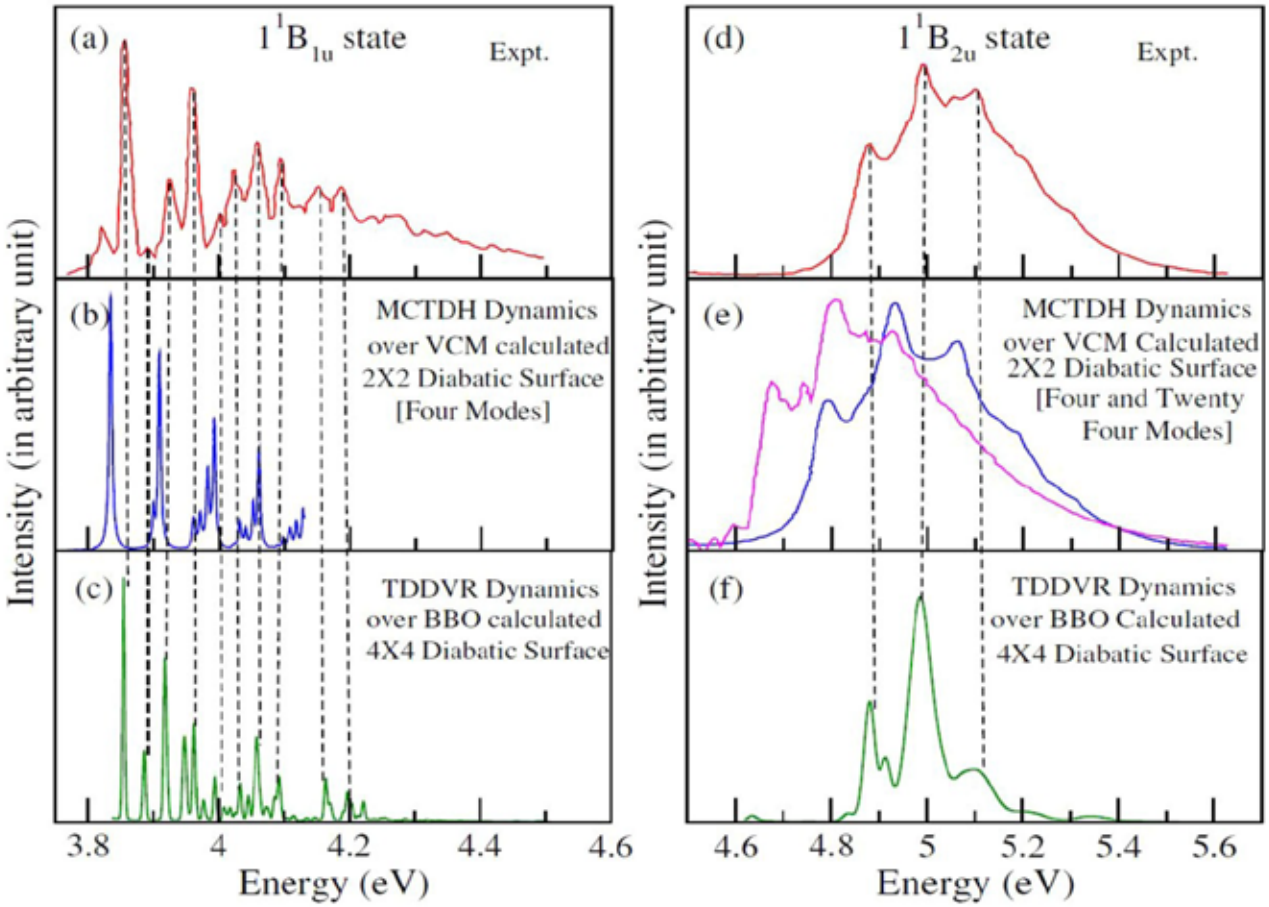


Figure 1: In the above diagram, (a) the experimental PA spectrum (Faraday Discuss. Chem. Soc. 1983, **75***, 395) of pyrazine molecule for 1^1B_{1u} (S_1) state is compared with (b) MCTDH spectrum (J. Chem. Phys.1994,* **100***, 1400) obtainedfrom VCM based 2×2 diabatic surfaces as well as (c) TDDVR spectrum evaluated from BBO based 4×4 diabatic surfaces. In a similar way, the right panel (d-e) demonstrates comparison of TDDVR calculated spectra of 1^1B_{2u} (S_2) state with experimental as well as MCTDH computed spectra [obtained from four (blue curve) (J. Chem. Phys.1994,* **100***, 1400) and twenty-four (magenta curve) (J. Chem. Phys.1999,* **110***, 936) mode Hamiltonian].*

1. Koushik Naskar, Sandip Ghosh and Satrajit Adhikari; J. Phys. Chem. A, 126, 3311 (2022)
2. Soumya Mukherjee, Saikat Hazra, Sandip Ghosh, Saikat Mukherjee and Satrajit Adhikari; Chem. Phys. 560, 111588 (2022)
3. Joy Dutta, Soumya Mukherjee, Koushik Naskar, Sandip Ghosh, Bijit Mukherjee, Satyam Ravi and Satrajit Adhikari; Phys. Chem. Chem. Phys. (Perspective), 22, 27496-27524 (2020).
4. Bijit Mukherjee, Koushik Naskar, Soumya Mukherjee, Sandip Ghosh, Tapas Sahoo and Satrajit Adhikari; Int. Rev. Phys. Chem., 38:3-4, 287-341 (2019)
5. Koushik Naskar, Soumya Mukherjee, Bijit Mukherjee, Satyam Ravi, Saikat Mukherjee, Subhankar Sardar and Satrajit Adhikari, J. Chem. Theo.Comput. 16, 1666-1680 (2020).
6. Saikat Hazra, Soumya Mukherjee, Satyam Ravi, Subhankar Sardar and Satrajit Adhikari; Chem. Phys. Chem. 23, e202200482 (2022).
7. Joy Dutta, Koushik Naskar, Satrajit Adhikari, Joerg Meyer, and Mark Somers; J. Chem. Phys. 157, 194112 (2022).
8. Koushik Naskar, Satyam Ravi, Satrajit Adhikari, Michael Baer and Narayanasami Sathyamurthy; J. Phys. Chem. A127, 3832 (2023)

Publications in Journals:

1. Accurate Calculation of Rate Constant and Isotope Effect for F+H_2 Reaction by Coupled 3D Time-dependent Wave Packet Method on the Newly Constructed *ab initio* Ground Potential Energy Surface - Koushik Naskar, Sandip Ghosh and Satrajit Adhikari; *J. Phys. Chem. A*, **126**, 3311 (2022). [IF:2.944]
2. Trajectory Surface Hopping vs. Quantum Scattering Calculations on D^++H_2 and H+H_2^+ Reactions using Ab-initio Surfaces and Couplings - Soumya Mukherjee, Saikat Hazra, Sandip Ghosh, Saikat Mukherjee and Satrajit Adhikari; *Chemical Physics,* **560**, 111588 (2022).[IF:2.348]
3. Construction of Beyond Born-Oppenheimer Based Diabatic Surfaces and Generation of Photoabsorption Spectra: The Touchstone Pyrazine ($C_4N_2H_4$) - Saikat Hazra, Soumya Mukherjee, Satyam Ravi, Subhankar Sardar and Satrajit Adhikari; *Chem. Phys. Chem.***23**, e202200482 (2022).[IF:3.52]
4. Effect of surface temperature on quantum dynamics of D_2 on Cu(111) using a chemically accurate potential energy surface - Joy Dutta, Koushik Naskar, Satrajit Adhikari, Joerg Meyer, and Mark Somers; *J. Chem. Phys.,***157**, 194112 (2022). [IF: 4.304]
5. Beyond Born-Oppenheimer Constructed Diabatic Potential Energy Surfaces for HeH2+ - Koushik Naskar, Satyam Ravi, Satrajit Adhikari, Michael Baer and Narayanasami Sathyamurthy; *J. Phys. Chem. A*, **127**, 3832 (2023).[IF:2.944]

Ph.D. Degree Awarded

(1) Joy Dutta (IACS Deemed to be University) and (2) Soumya Mukherjee (IACS Deemed to be University).

Sponsored Project

» Beyond Born-Oppenheimer ….. Surface Scattering (SERB)

Lectures Delivered

Invited talk at (1) IACS, Kolkata, (2) IIT-Mumbai, (3) University of Potsdam, Germany, (4) Leiden University, Netherlands, (5) NIT Meghalaya, (6) IACS, Kolkata, (7) IIT-Guwahati, (8) ISM Dhanbad, (9) SNBNCBS, Kolkata.

SOMDATTA GHOSH DEY

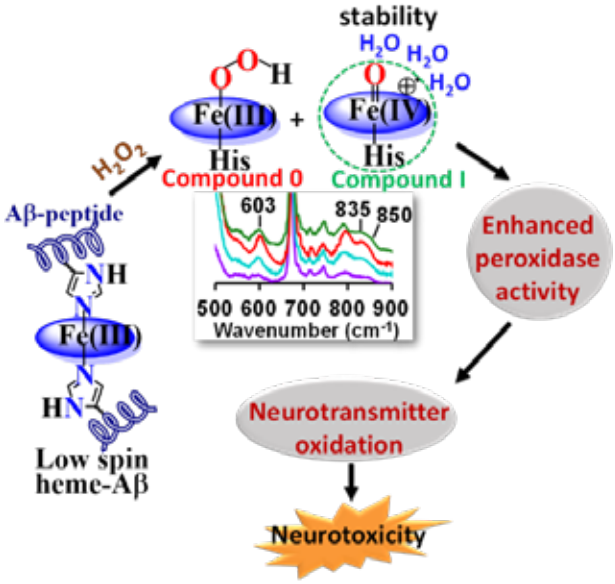
Professor

Bioinorganic Chemistry associated with Alzheimer's disease and Type 2 Diabetes

Associate:

(1) Ishita Pal, RA-1 (Institute), (2) Madhuparna Roy, SRF (CSIR) and (3) Chimay Dey, JRF (CSIR), (4) Abhijit Naik, SRF (INSPIRE), (5) Arnab Kumar Nath, RA-1 (Institute).

Colocalization of heme rich deposits in the senile plaque of Aβ in the cerebral cortex of Alzheimer's disease (AD) brain along with altered heme homeostasis and heme deficiency symptoms in AD patients have invoked the association of heme in AD pathology. Heme bound Aβ complexes, depending on the concentration of the complex or peptide to heme ratio, exhibit an equilibrium between a high-spin mono-His bound peroxidase-type active site and a low-spin bis-His bound cytochrome b type active site. The high-spin heme-Aβ complex shows higher peroxidase activity than free heme where compound I is the reactive oxidant. It is also capable of oxidizing neurotransmitters like serotonin in the presence of peroxide, owing to the formation of compound I. The low-spin bis-His heme-Aβ complex on the other hand shows enhanced peroxidase activity relative to high-spin heme-Aβ. It reacts with H2O2 to produce two stable intermediates, compound 0 and compound I, which are characterized by absorption, EPR and resonance Raman spectroscopy. The stability of compound I of low-spin heme-Aβ is accountable for its enhanced peroxidase activity and oxidation of the neurotransmitter serotonin. The effect of second sphere Tyr10 residue of Aβ in the formation and stability of the intermediates of low-spin heme-Aβ has also been investigated. The higher stability of compound I for low-spin heme-Aβ is likely due to H-bonding interactions involving Tyr10 in the distal pocket.



Reactive compound 0 and compound I intermediates responsible for the oxidation of neurotransmitters like serotonin in Alzheimer's disease.

Publications in Journals :

1. Role of Redox Active Transition Metals in Alzheimer's Disease and Type 2 Diabetes - I Pal, S Ghosh Dey, *JACS* Au. **3**, 657 (2023).[IF:NA]

2. Spin State Dependent Peroxidase Activity of Heme bound Amyloid Peptides Relevant to Alzheimer's Disease - A Nath, M Roy, C Dey, A Dey, SGhoshDey, *Chem. Sci.***13**, 14305(2022).[IF:9.969]

3. Heme/Cu-oxygen intermediates of amyloid β peptides associated with Alzheimer's disease - M Roy, S Ghosh Dey, *Advances in Inorganic Chemistry*, 81 of. **2022**.

4. Second-Sphere Hydrogen-Bond Donors and Acceptors Affect the Rate and Selectivity of Electrochemical Oxygen Reduction by Iron Porphyrins Differently - A Ghatak, S Samanta, ANayek, S Mukherjee, A Dey, S Ghosh,*Inorg., Chem.***61,** 12931 (2022).[IF:5.436]

5. Bio-inorganic Chemistry On Electrodes: Methods to Functional Modelling-A Nayek, M E Ahmed, S Samanta, S Dinda, SPatra, S GhoshDey, A Dey,*J. Am. Chem. Soc*.**144**, 8402 (2022).[IF:16.383]

6. Second Sphere Interactions in Amyloidogenic Diseases - M Roy, A K Nath, I Pal, S Ghosh Dey, *Chem. Rev*. **122**, 12132, (2022)[IF:72.087]

Ph.D. Degree Awarded

(1) Ishita Pal (JU)

Sponsored Project

» Interaction of Metal-Amyloid …. Micellar Environment

» Lytic Polysaccharide …… Amyloid-β Peptides

Lectures Delivered:

Invited talk at (1) 10th Asian Biological Inorganic Chemistry Conference (AsBIC-10), 2022 and (2) BHU, Vanarash

TAPAN KANTI PAINE

Senior Professor & Dean (Student Affairs)

Bioinspired and Mechanistic Inorganic Chemistry

Associate:

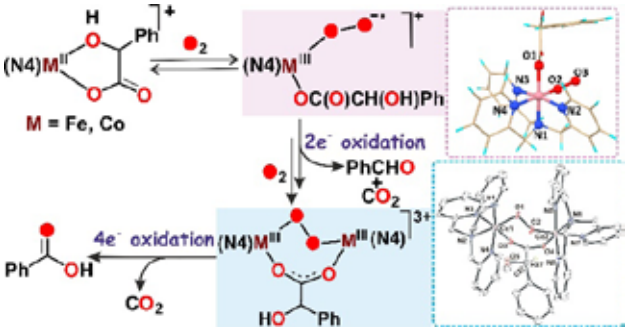
(1) S Biswas, RA-I (Institute); (2) Somali Mukherjee, RA-I (Project); (3) A Bera, Extended SRF (Institute); (4) A Das, Extended SRF (Institute); (5) S Sutradhar, Extended SRF (Institute); (6) E Ghosh, SRF (CSIR); (7) A Bhowmik, SRF (IntPhD); (8) R Samanta, JRF (CSIR); (9) S Mahapatra, JRF (CSIR), (10) T Mukherjee, JRF (CSIR), (11) A Maity, JRF (UGC), (12) S Pal, TARE , (13) P Pal, RA-1 (SERB), (14) M Pal, RA-1 (Institute)

Dioxygen Activation and Mandelate Decarboxylation by Iron(II) Complexes of N4 Ligands: Evidence for Dioxygen-Derived Intermediates from Cobalt Analogues:

The reactivity of iron(II)-mandelate and cobalt(II)-mandelate complexes of tetradentate nitrogen donor ligands toward dioxygen has been investigated. The complexes react with dioxygen to afford equimolar amounts of benzaldehyde and benzoic acid. The cobalt(II) complexes bind dioxygen reversibly at -80°C to yield a cobalt(III)-superoxo species. Increasing the temperature to -20°C, the cobalt(III)-superoxo species converts to

a μ-1,2-peroxo-dicobalt(III) complex with coordinated carboxylate (mandelate or 2-methoxyphenyl acetate). The reversible dioxygen binding by the cobalt(II) complexes becomes irreversible in the presence of a protic acid leading to the formation of a μ-1,2-peroxo-μ-carboxylate-dicobalt(III) complex, which was characterized by X-ray crystallography. The trapping and characterization of metal-oxygen intermediates from cobalt complexes provide mechanistic information about possible involvement of reactive species to affect mandelate decarboxylation. A metal-superoxo species initiates the decarboxylation reaction with two-electron reduction of dioxygen forming benzaldehyde in a kinetically fast process. The formation of benzoic acid, however, involves a slow step via four-electron reduction of dioxygen. Although the nonheme iron enzyme CloR catalyzes the decarboxylation of a substituted mandelic acid derivative to form the corresponding benzoic acid, synthetic iron(II)- and cobalt(II)-mandelate complexes of the tetradentate N4 ligands react with dioxygen to afford a equimolar mixture of benzaldehyde and benzoic acid. This study sheds light on the role of supporting ligands to direct the reactivity of metal-mandelate complexes for two-electrons vs. four-electrons reduction of dioxygen.

Inorg. Chem. **61**, 10461 (2022)



Publications in Journals:

1. Iron(II)-α-Keto Acid Complexes of Tridentate Ligands on Gold Nanoparticles: Effect of Ligand Geometry and Immobilization on Their Dioxygen-Dependent Reactivity - A Bera, D Sheet and T K Paine, *Dalton Trans.,***52**, 1062 (2023).[IF:4.569]
2. Dioxygen Activation by Redox-Active Bis(aldimine) Ligand Bridged Diruthenium Complex Possessing Singlet Ground State - M Biswas, S Dey, A Das, T K Paine, S Panda and G K Lahiri, *Chem. Eur. J.*, *e202202088* (2022).[IF:5.03]
3. Dioxygen Activation and Mandelate Decarboxylation by Iron(II) Complexes of N4 Ligands: Evidence for Dioxygen-Derived Intermediates from Cobalt Analogues - R D Jana,B Chakraborty,S Paria,T Ohta, R Singh, S Mandal, S Paul, S Itoh and T K Paine,*Inorg. Chem.***61**, 10461 (2022).[IF:5.436]

Publications in Books Chapter :

1. Iron Catalyzed C-H Halogenation- R D Jana and T K Paine, Book Chapter for *Handbook of CH-Functionalization (CHF)*, John Wiley & Sons, Ltd, 2022.

Award/Recognition :

» Editorial Advisory Board Member of Transition Metal Chemistry, Springer Nature.

Ph.D. Degree Awarded

(1) Abhijit Bera (IACS Deemed to be University) and (2) Abhishek Das, (IACS Deemed to be University).

Sponsored Project

» Tuning Reactivity and Selectivity …… Nonheme Iron Complexes (SERB)

Lectures Delivered

Invited talk at (1) Dibrugarh University, Assam, (2) North Bengal University, (3) ICCC8, Taiwan, (4) Bankura University, (5) St. Paul's Cathedral Mission College, Kolkata, (6) IIT Bombay, (7) Vellore Institute of Technology and (8) Presidency University.

TAPAS CHAKRABORTY, FASc

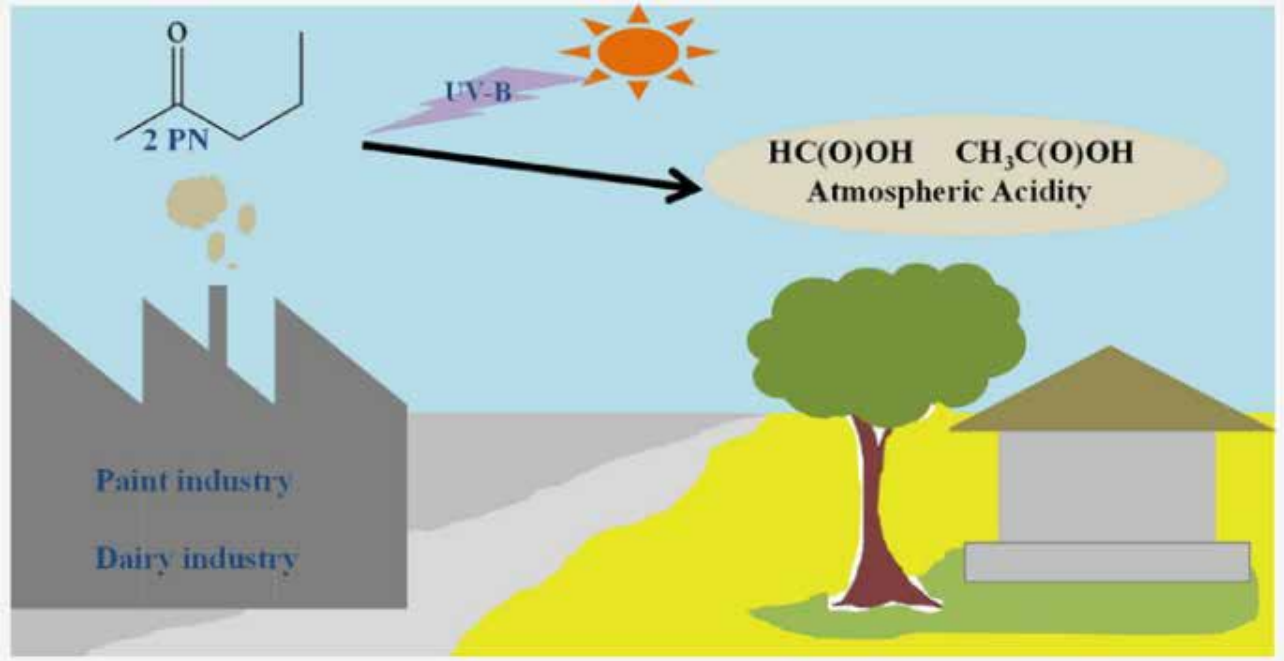
Senior Professor

Molecular Spectroscopy, Photochemistry, Mass spectrometry

Associate:

(1) Dr. Piyali Chatterjee, RA, (2) Mr. Subhra Sankar Dutta, SRF, (3) Mr. Subhasis Mandal, SRF, (4) Ms. Anwesha Datta, SRF, (5) Ms Megha Agarwal, SRF, (6) Ms Rinjini Saha, JRF, (7) Mr Supriyo Dey, JRF and (8) Mr. Tamal Dutta, JRF

Thermal reactions of selected atmospherically significant volatile organic compounds like hydroxyacetone and formaldehyde with nitrogen dioxide (NO_2) have been studied with the aim to identify the unknown sources ofatmospheric nitrous acid (HONO). Thus, a new atmospheric source of HONO has been discovered. We also have investigated the photo-oxidation of methachroleinunder a simulated atmospheric condition, and have found that formic acid is produced in the atmosphere by this pathway. In both the studies, infrared spectroscopy method has been used as a probe. Photo-polymerization of methachrolein under hydrared condition has been investigated using Raman and mass spectrometry as the probes. We have found that UV-A light in the presence of atmospheric oxygen can initiate the radical polymerization reaction. Vibrational Circular Dichroism (VCD) spectroscopy has been utilized to investigate chirality transfer in a binary complex between propylene carbonate and DMSO, where the chirality is induced in the latter. Photochemistry of naturally occurring bioactive compounds have been studied using high performance liquid chromatography (HPLC) with optical and mass spectrometric probing method and the structures of the photoproducts have been characterized using ion mobility mass spectrometry.



Publications in Journals

1. Photooxidation of 2-Pentanone in the Gas Phase: Photo-Products, Reaction Mechanism, OH Reaction Kinetics, and Atmospheric Implication - ACS Earth Space Chem., 7, 449–459 (2023) Koushik Mondal, Aparajeo Chattopadhyay, Indrani Bhattacharya, Piyali Chatterjee, Subhasis Mandal, and Tapas Chakraborty*, ACS Earth Space Chem., 7, 2, 449–459 (2023).[IF:3.475].

Ph.D. Degree Awarded

(1) Kaushik Mondal (IACS Deemed University)

Sponsored Project

» Laser-induced chemistry …… mass-spectrometry study.

Lectures Delivered

Invited talk at (1) Bilbao, Spain, (2) Calcutta University, Kolkata, (3) Diamond Harbour Women University, (4) Bhopal, 2023 and (5) Jadavpur University, Kolkata.

TARUN KUMAR MANDAL

Senior Professor

Polymer chemistry

Associate:

(1) P. Banerjee, SRF (Institute); (2) Md. Anas, SRF (Inspire); (3) P. Dinda, SRF (Inspire); (4) M. Kar, SRF (CSIR); (5) A. Basak, JRF (CSIR); (6) J. Das, JRF (UGC) and (7) S. Karmakar, JRF (Institute).

Our research focuses on the various aspects of polymer chemistry that includes the use of different macromolecular engineering tools to synthesize stimuli-responsive smart homo-/block-copolymers, peptide-polymer conjugates, amino acid-based polymers, poly(ionic liquid)s, poly(zwitterions) and functionalized polypeptides.

Another part of our research project is to investigate the self-assembly of functionalized polypeptides, block copolymers and amino acid-based polymers into polymer nanostructures of different morphologies and their various specific applications including their use as delivery vehicles.

The synthesis of pseudopeptidic poly(2-oxazoline)-based stimuli-responsive block/graft copolymers and their self-assembly into micelles/reverse micelles/conjugate micelles/vesicles for potential applications in drug delivery is also a topic of our research.

We are also continue focusing on the design and synthesis of novel poly(ionic liquid)s (PILs), PIL-based copolymer, poly(zwitterions) and their applications in generating materials for sensing, energy storage and in particular for antifouling applications of poly(zwitterions).

The focus of our work is also on the functionalization of polypeptides and amino-acid based polymers to introduce water solubility, thermoresponsiveness and for various bioapplications including antifouling.

The synthesis of fluorescent perylene-based and azo containing polymers, stimuli-responsiveness and their self-assembly to fluorescent nanostructures is also the recent focus of our work.

Publications in Journals

1. Dual Thermoresponsive Boc-Lysine-Based Acryl Polymer: RAFT Kinetics and Anti-Protein-Fouling of Its Zwitterionic Form - P. Dinda, Md. Anas, P. Banerjee and T. K. Mandal, *Macromolecules,* 2022, *55*, 4011.
2. Stimuli-Responsive Triblock Terpolymer Conversion into Multi-Stimuli-Responsive Micelles with Dynamic Covalent Bonds for Drug Delivery through a Quick and Controllable Post-Polymerization Reaction – E. Hlavatovicova, R. Fernandez-Alvarez, K. Bys, S. Kereiche, T. K. Mandal, L. I. Atanase, M. Stepanek, M. Uchman, *Euro. Pharmaceutics, 2023, 15, 288*.
3. Ion-/Thermo-Responsive fluorescent perylene-poly (ionic liquid) conjugates: One-pot microwave synthesis, self-aggregation and biological applications – M. Kar, Md. Anas, A. Singh, A. Basak, P. Sen and T. K. Mandal, *Euro. Polym. J.* 2022, *179*, 111561.

Ph.D. Degree Awarded

(1) Palash Banjerjee (JU)

Sponsored Project

» Stimuli-Responsive Block……. And applications

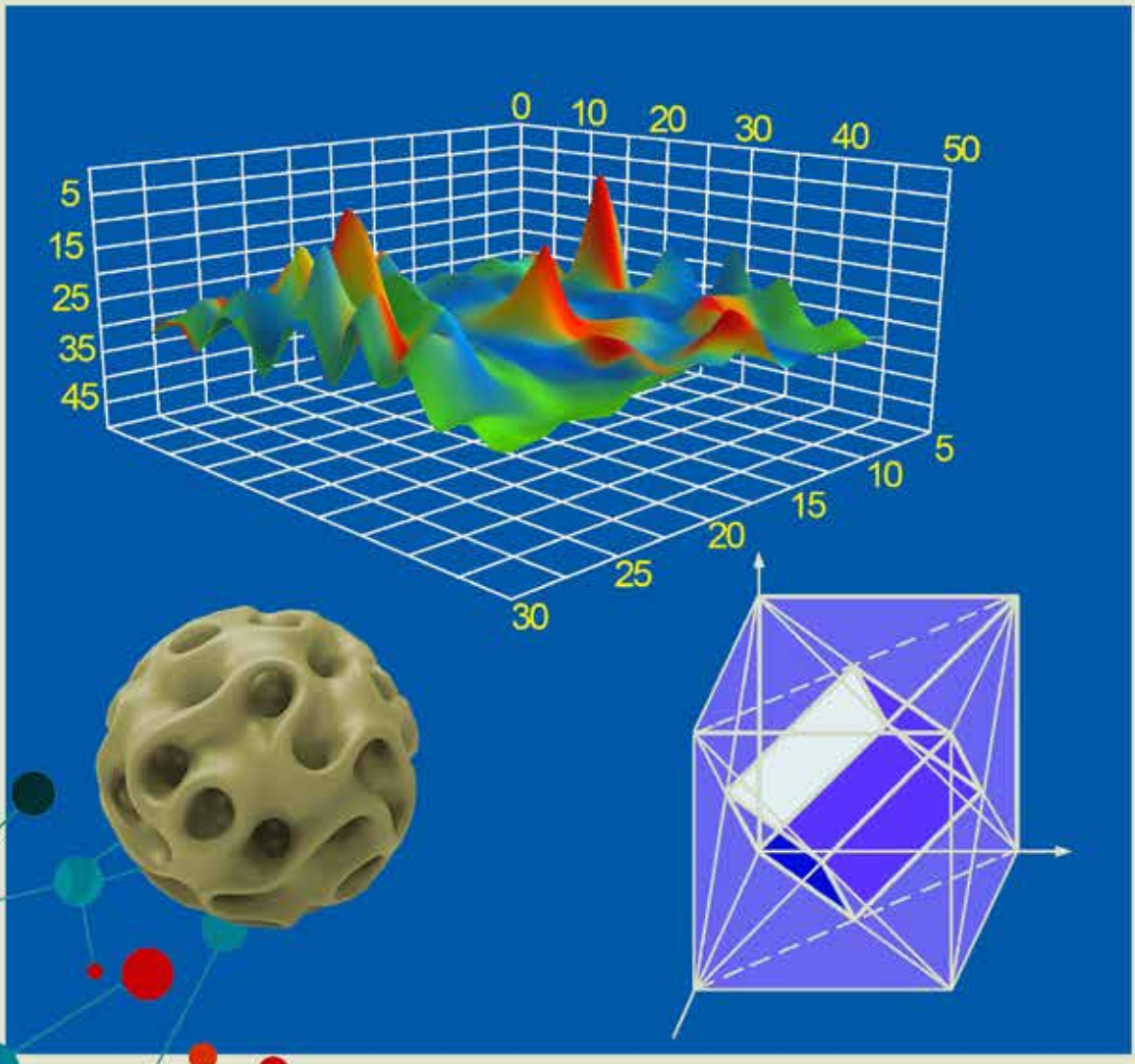
» Ionically Functionalized …… including Antifouling.

Lectures Delivered

Invited talk at (1) University of Tokyo, Japan, (2) SPSI-Macro 2022, CSIR-NCL, Pune.

SMCS

SCHOOL OF MATHEMATICAL & COMPUTATIONAL SCIENCES



School of Mathematical and Computational Sciences

PROFESSOR BIMALENDU DEB
School Chair

SCHOOL PROFILE

People

Faculty	: 07
Post-doctoral Research Associate	: 05
Ph.D. Students	: 13
Non-Academic Staff	: 03

Extra Mural Funding

Projects (ongoing)	: 02

Research Achievements

Research Papers in Journals	: 20
Ph.D. degree awarded	: 01

Academic Activities

Talks delivered by members of School in conferences/symposia	National	: 06

ABHIJIT KUMAR DAS

Senior Professor

Theoretical and Computational Science

Associate:

(1) S. Ghosh, JRF (CSIR) (2) R. Rathi JRF (UGC) (3) S. Banerjee, SRF (UGC) (4) A. Ghosh, RA (Institute) (5) S. Sarkar, RA (Institute) (6) R. Sinha Roy, RA (CSIR)

1. **Fullerene Functionalization** : Amino-borane dehydrogenation in functionalizing pristine and Li^+-encapsulated C_{60}, C_{70} and C_{36} fullerenes has been investigated. Thermodynamic and kinetic feasibility of exohedral functionalization of pristine C_{60} by sequential DA reactions, i.e., Multi-Diels–Alder (MDA) reaction have been explained, with the effect of Li^+ encapsulation on the energetics.
2. **Stabilization of non-IPR fullerene :** A new theoretical strategy using both exohedral as well as endohedral functionalizations has been proposed in stabilizing the non-IPR isomers of C_{72} fullerene.
3. **Superalkali :** Design of superalkalis by rationally modifying molecules.
4. **Non Linear Optical (NLO) properties :** NLO properties of a new kind of Sandwich-Electride complexes.
5. **Astrochemistry :** Isomers of peptide like large molecules of astrochemical interest have been studied in detail using dispersion-corrected density functional theory and highly correlated methods.
6. **Value-added organic molecules :** Computational exploration of the effectiveness of metal as well as non-metalated Pincer complexes in synthesizing simple organic molecules
7. **Porphyrin systems :** Applications of different porphyrin systems effective for solar cells will be explored.

Publications in Journals

1. Energetics and Spectroscopic properties of low-lying CaC_6H_2 isomers: an astrochemical perspective - A Ghosh, S Banerjee, S Sarkar, T Debnath, T Ash, R S Roy, A K Das, *Chemistry Select* 7, e202200763, (2022) [IF: 2.307]
2. $ZnAl_2O_4$ Nanomaterial as Naked Eye Arsenate Sensor: A Combined Experimental and Computational Mechanistic Approach - T Chowdhury, T Chakraborty, A Ghosh, A K Das, D Das *ACS. Appl. Mater. Interfaces,* **14**, 28, 32457 (2022) [IF: 10.383]
3. Dual Modification to Stabilize Non-IPR C_{72} Fullerene: A New Theoretical Strategy - S Banerjree, T Ash, T Debnath, A K Das J. Mol. Graph. Model **117**, 108289 (2022) [IF: 2.942]
4. Advances on Understanding Coke Gasification Process with CO_2: A Report from Density Functional Theory - T Debnath, K Sen, A Suresh, P S Dash, A K Das *Chemistry Select* **7**, e202201539 (2022) [IF: 2.307]
5. Design of Dual Purpose Fe-metallogel for Magnetic Refrigeration and Fabrication of Schottky Barrier Diode - S Saha, B Pal, K S Das, P K Ghose, A Ghosh, A De, A K Das, P P Ray, R Mondal *Chemistry Select*, **7**, e202203307 (2022) [IF: 2.307]
6. A New Kind of Sandwich-Electride Complexes of Cyclooctatetraene Ligand $M^1_2(\eta^8\text{-}C_8H_8)_2M^2_2$($M^1$=Na, K and M^2=Ca, Mg): A Theoretical Study -R S Roy, A Ghosh, S Banerjee, S Ghosh, A K Das *Phys. Chem. Chem. Phys*., **25**, 4710 (2023) [IF: 3.945]
7. Designing metal-free organic superalkalis by modifying benzene: a theoretical perspective - S Sarkar, T Debnath, A K Das, *Theor. Chem. Acc*., **142**, 3 (2023) [IF: 2.154]
8. A Silver-Based Integrated System Showing Mutually Inclusive Super Protonic Conductivity and Photoswitching Behavior - S Saha, K S Das, P Pal, S Hazra, A Ghosh, S Bala, A Ghosh, A K Das, R Mondal, *Inorg. Chem*., **62**, 8, 3485 (2023) [IF: 5.436]

DEBARSHI KUMAR SANYAL

Assistant Professor

Machine learning, Deep learning, Natural language processing, Digital library technologies.

Associate:

(1) P. Chakraborty, JRF (Institute), (2) S. Adhya, JRF (Institute) and (3) Avishek Lahiri

His current research interest is in the application of machine learning to text processing. In particular, he focuses on topic modeling and design of tools for analysis of scientific literature. Recently, he and his collaborators have designed novel ways to use negative sampling to improve neural topic models. His group has also designed algorithms to distill knowledge from a large topic model to a smaller one, without loss in topic quality. Another recent work from his lab focuses on the role of dropout in neural topic models; it reports an apparently surprising observation that dropout might lead to a drop in topic quality. His research on automatic analysis of scientific papers has led to publications on discourse segmentation in abstracts, and novel methods for generating highlights from research papers.

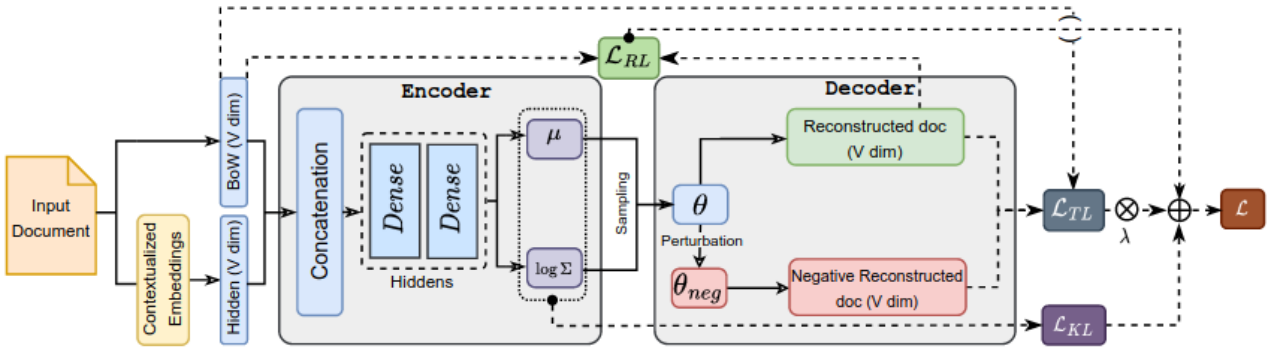


Figure 2: Contextualized topic model with negative sampling

Publications in Journals

1. Adhya, S., & Sanyal, D. K. (2023). Improving Neural Topic Models with Wasserstein Knowledge Distillation. In *Advances in Information Retrieval: 45th European Conference on Information Retrieval, ECIR 2023, Dublin, Ireland, April 2–6, 2023, Proceedings, Part II* (pp. 321-330). Cham: Springer Nature Switzerland.
2. Adhya, S., Lahiri, A., & Sanyal, D. K. (2023). Do Neural Topic Models Really Need Dropout? Analysis of the Effect of Dropout in Topic Modeling. In *Proceedings of the 17th Conference of the European Chapter of the Association for Computational Linguistics(EACL)* (pp. 2212-2221).
3. Tokala, Y. S. S. S., Aluru, S. S., Vallabhajosyula, A., Sanyal, D. K., & Das, P. P. (2023). Label informed hierarchical transformers for sequential sentence classification in scientific abstracts. *Expert Systems*, e13238.
4. Rehman, T., Sanyal, D. K., Majumder, P., & Chattopadhyay, S. (2022). Named Entity Recognition Based Automatic Generation of Research Highlights. In *Proceedings of the Third Workshop on Scholarly Document Processing @ COLING 2022*.
5. Adhya, S., Lahiri, A., Sanyal, D. K., & Das, P. P. (2022). Improving Contextualized Topic Models with Negative Sampling. In *Proceedings of the 19th International Conference on Natural Language Processing (ICON)* (pp. 128-138).

Sponsored Project :

» Extraction, Organization and Query ……. (DST-SERB) (with IIT Kalyani)

Lectures Delivered

» Invited talk at (1) Jadavpur University and (2) Ashoka University.

MITHUN MUKHERJEE

Assistant Professor

Operator Algebra, Operator Theory, Dilation Theory, Non-Commutative Dynamics, Linear Algebra.

Associate:

(1) A. Talukdar (PG)

1. Higher rank numerical range of an operator is well known. We give a description of higher rank numerical range of a normal operator on an infinite dimensional Hilbert space and using this description we find various results in dilation theory. We found an affirmative solution of a conjecture posed by Halmos.
2. We generaliseHalmos conjecture in various generalized ranges and obtain various interesting results.
3. Matricial range of an operator was introduced by Arveson. We obtain various results on matricial range and its connection to dilation theory. This work is still in progress.

Publications in Journals

1. Higher Rank Numerical Ranges of Normal Operators and Unitary Dilations, Pankaj Dey, Mithun Mukherjee, J. Math Anal. & Appl. 2 (2023)
2. Generalized Halmos conjectures and constrained unitary dilations, Pankaj Dey, Mithun Mukherjee. *Adv. Oper. Theory* 7 (2022).

PARTHA BASUCHOWDHURI

Assistant Professor

Applications of Deep Learning in Natural Language Processing (NLP) and Bioinformatics, Biomedical Image Processing, Social Networks.

Associate:

(1) Madhusudan Ghosh (SRF): NLP; (2) Shrimon Mukherjee (JRF): Drug repurposing; (3) Payel Santra (JRF): Fact verification; (4) Samiran Dey (JRF, funded by DBT-Vinnova project): Biomedical

1. Area: Entity Extraction from Astrophysics Literature

Scientific research requires reading and extracting relevant information from existing scientific literature in an effective way. To gain insights over a collection of such scientific documents, extraction of entities and recognizing their types is considered to be one of the important tasks. Numerous studies have been conducted in this area of research. In our study, we introduce a framework for entity recognition and identification of NASA astrophysics dataset, which was published as a part of the DEAL SharedTask. We use a pre-trained multilingual model, based on a natural language processing framework for the

given sequence labeling tasks. Experiments show that our model, Astro-mT5, out-performs the existing baseline in astrophysics related information extraction

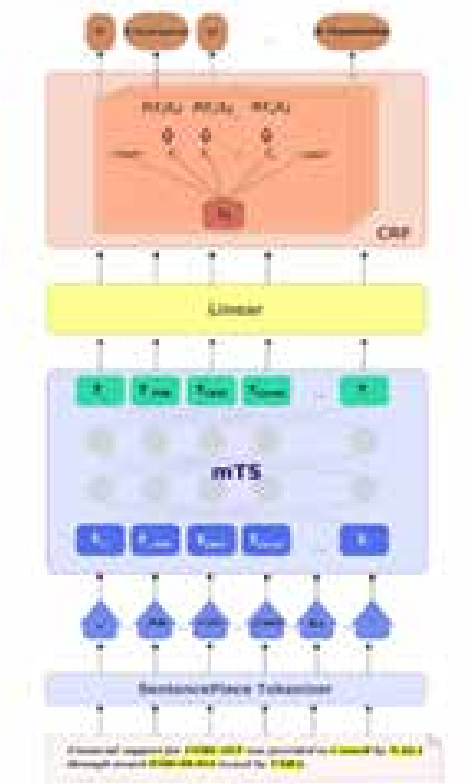


Figure 1. Model architecture of Astro-mT5

2. Area: Computational Chemistry

Developing a cost-effective and environmentally benign substitute for the energy-intensive Haber–Bosch process for the production of ammonia is a global challenge. The electrocatalytic nitrogen reduction reaction (NRR) under ambient conditions through the six proton–electron process has attracted significant interest. Herein, a series of transition-metal (TM) based single atom catalysts (SAC) embedded on carbon nitride (C_6N_6) have been chosen to explore the NRR activity. The promising metals have been primarily screened through density functional theory (DFT) by calculating their adsorption energies on C_6N_6 – energies for dinitrogen binding and the barriers at the rate determining step. Based on these criteria, amongst the 18 metal centers, Ta based C_6N_6 emerges as a good candidate for the reduction of nitrogen to NH_3. On the other hand, for the Machine Learning (ML) regression models, the covalent radiusand the d-band center of the TM have been identified as the most correlated descriptors for predicting the adsorption energy of nitrogen on the active metal center. Besides, probabilistic modelling using the soft voting technique in the classification model allows us to predict the most efficient single atom catalyst. Despite therealistic bottleneck of having only a limited number of TMs to choose from, this technique effectively predicts the best catalystfrom a modest dataset. With the highest probabilistic score, Ta based C_6N_6 dominates over the other catalysts in a good agreement with DFT findings. This letter manifests the effectiveness of the soft voting technique in an ensemble-based classification model.

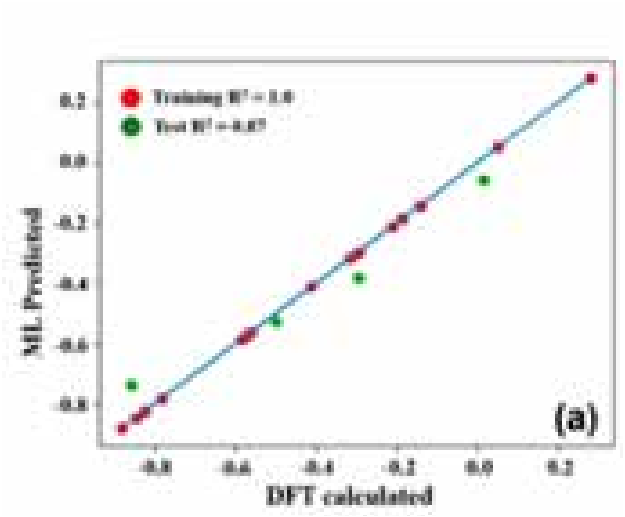


Figure 2. ΔG_{*N_2} *as predicted by ML vs as calculated by DFT.*

Publications in Journals :

1. Performance of the nitrogen reduction reaction on metal bound g-C6N6: a combined approach of machine learning and DFT - Moumita Mukherjee, Sayan Dutta, Madhusudan Ghosh, Partha Basuchowdhuri, and Ayan Datta. 2022. Pp -17050-17058, *Physical Chemistry Chemical Physics. Phys. Chem. Chem. Phys*. Vol 24.

Lectures Delivered

» Invited talk at (1) 4th IABS Conference, Kolkata

Sponsored Project

» AI based Detection of Acute Respiratory Distress Syndrome (AI-DARDS): An artificial intelligence aided ……..microwave sensors - DBT

RAJA PAUL
Professor

Soft-matter biophysics & statistical mechanics

Associate:
1. SubhenduSom (RA-I) 2. Apurba Sarkar (RA-I) 3. MintuKarmakar (SRF) 4. Pinaki Nayak (SRF) 5. Aditya Dutta (JRF) 6. Sayam Bandyopadhyay (MS-Project) 7. Arnab Das (MS-Project)

Active and passive matter systems are the primary interests of the research group headed by Prof. Raja Paul. Combining statistical mechanics and numerical simulation, and using Monte Carlo methods, molecular dynamics simulations, the group examines active matter systems and biological processes, such as cell division, intracellular transport, and organization. The group further carries out computational studies of phase transition and domain coarsening in disordered materials.

Paul-group has been trying to understand macroscopic behavior in active and passive systems using theoretical and computational models. Developing agent-based models for exploring various sub-cellular and tissue-level phenomena has been the group's primary goal of biophysical research. Projects undertaken aimed at developing theoretical models for studying optimization processes during organelle assembly, T-cell interaction, chromosomal segregation during mitosis, dynamic positioning of mitotic organizing center, etc., in yeast and mammalian cells. The group has a strong interest in developing computational frameworks to explore active matter systems predicting collective migration, and phase transitions. Besides, in passive systems, many exciting processes e.g., domain coarsening of disordered random magnets, frustrated magnetic systems, etc., are studied. The model-predicted data are often compared with experiments carried out by the collaborators.

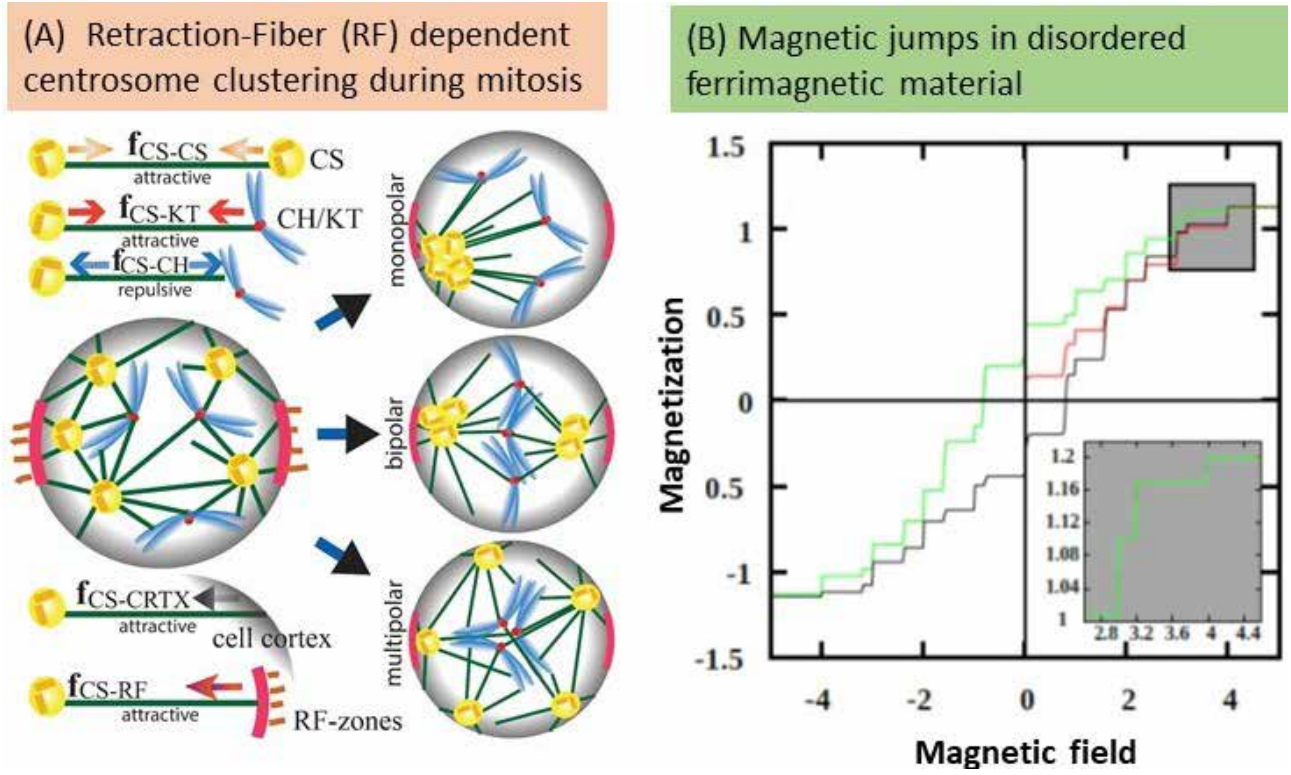


Figure 1: (A) Various outcomes of the mitotic spindle for cells interacting with the extracellular substrate via retraction fiber (Ref: Jana et al., PNAS, 120, 10 e2120536120 (2023)). (B) Jumps observed in the magnetization with varying magnetic field indicate self-organized criticality (Ref. Mondal et al, Physical Review E 107 (3), 034106 (2023)).

Publications in Journals

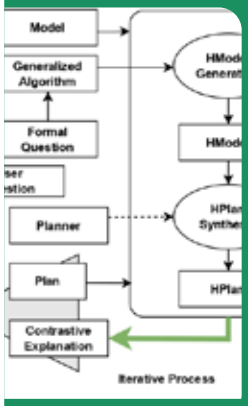
1. Mitotic outcomes and errors in fibrous environments - Aniket Jana, Apurba Sarkar, Haonan Zhang, Atharva Agashe, Ji Wang, Raja Paul, Nir S. Gov, Jennifer G. DeLuca, and Amrinder S. Nain, *PNAS,* 120, 10 e2120536120 (2023)
2. Self-organized criticality of magnetic avalanches in disordered ferrimagnetic material - S Mondal, M Karmakar, P Dutta, S Giri, S Majumdar, R Paul, *Physical Review E* 107 (3), 034106 (2023)

Ph.D. Degree Awarded

(1) Apurba Sarlar (IACS Deemed to be University)

Lectures Delivered

Invited talk at (1) IISER-Pune, (2) ICTS-Bangalore and (3) Amity University.



RAJARSHI RAY

Assistant Professor

Formal Verification and Model Checking

Associate:

Mr. Mir M. Sajid Sarwar (JRF), Mr. Atanu Halder (JRF), Sarthak Das (BS-MS student), Devdan Dey (MS student)

Rajarshi Ray and his group's primary research focus is in the formal verification of systems having a combination of continuous and discrete dynamics, called Cyber-Physical-Systems (CPS) in the recent literature. Particularly, Dr. Ray and his team design algorithms and implement practical software tools in order to analyze mathematical models of CPS and certify safety properties of the model. This is called model-checking. The model-checking software developed by Dr. Ray and his team are available online as open-source.

Recently, Dr. Ray is exploring the applications of Artificial Intelligence in enhancing the performance of model-checking and also in using model-checking for explainable AI.

In this year, his team has the following contributions: (i) Designed and developed a software **SAT-Reach** for efficiently finding erroneous behavior in models of cyber-physical-systems. The novelty of the tool is its ability to detect and highlight erroneous behavior from potentially infinite behaviors of the model. (ii) The insights behind the working of artificial intelligence (AI) planning algorithms are often unclear. Therefore, explainable AI planning has emerged as a new and vibrant research area. Dr. Ray's team has proposed a contrastive explanation framework for cyber-physical-systems and demonstrated its efficacy on a number of planning case-studies.

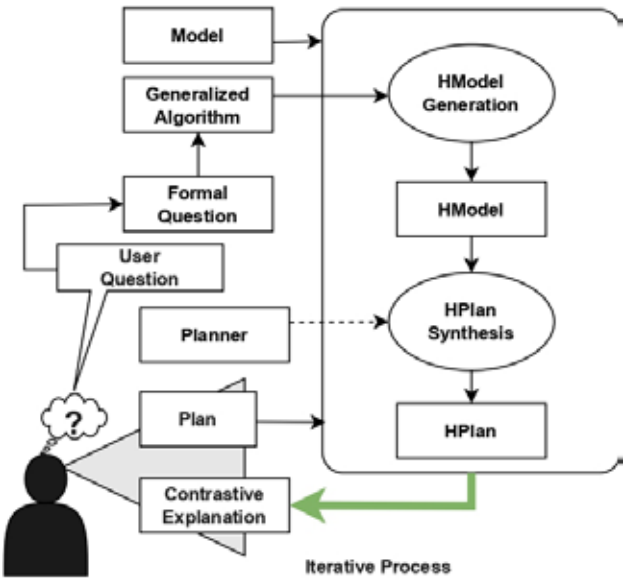


Fig 1. A Contrastive Explanation Framework for Cyber-Physical-Systems.

Publications in Journals :

1. Mir M. Sajid Sarwar, Rajarshi Ray, Ansuman Banerjee, "A Contrastive Plan Explanation Framework for Hybrid System Models - *ACM Transactions on Embedded Computing Systems*, Vol-2, Issue-2, Article-22, Pages 1-51, 2023. [IF: 1.886]

2. Atanu Kundu, Sarthak Das, Rajarshi Ray, "SAT-Reach: A Bounded Model Checker for Affine Hybrid Systems - *ACM Transactions on Embedded Computing Systems*, Vol-2, Issue-2, Article-26, Pages 1-36, 2023. [IF: 1.886]

Sponsored Project

» Development of Lizard-like Robotic …..Surveillance System (DST-SERB Imprint-II)

SAYANI BERA

Assistant Professor

Holomorphic Dynamics, Several complex variables, Potential theory.

We study the dynamical properties of automorphisms in $\mathbb{C}^m, m \geq 2$. In particular we investigate iterated dynamical system of an automorphism or dynamics of semigroups or non-autonomous families of certain classes of automorphisms of $\mathbb{C}^m, m \geq 2$.

On semigroups:

We study dynamics of semigroups of complex Hénon maps in C^2 via techniques from (pluri) potential theory. These leads to generalisation of some important phenomena that was known in the literature for dynamics of polynomial maps in one complex variable.

On geometry of complex domains:

We study the basin of attraction of an automorphism corresponding to an attracting fixed point in $\mathbb{C}^m, m \geq 2$. Such domains are known to be pathological and exists only in higher dimension. Finally by revising some of the techniques for complex Hénon maps appropriately, we resolve a long-standing open problem, concerning the existence of such domains.

Publications in Journals :

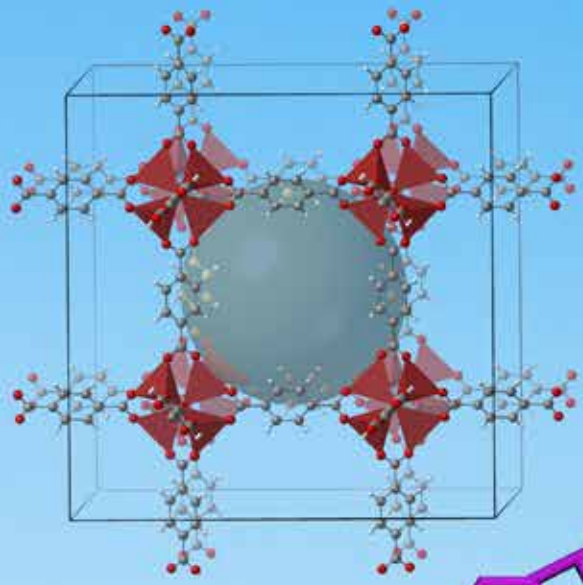
1. Bera. S, Pal. R, Verma. K, On the automorphism group of certain Short C^2's, accepted for publication in IMRN (International Mathematics Research Notices), https://academic.oup.com/imrn/advance-article/doi/10.1093/imrn/rnac235/6674255,MCQ(IF)=1.28.
2. Bera. S, Dynamics of semigroups of Hénon maps in $\mathbb{C}^2$, accepted for publication in Indiana Univ. Math. *J.*, https://arxiv.org/abs/2202.06522. MCQ[IF =1.43].

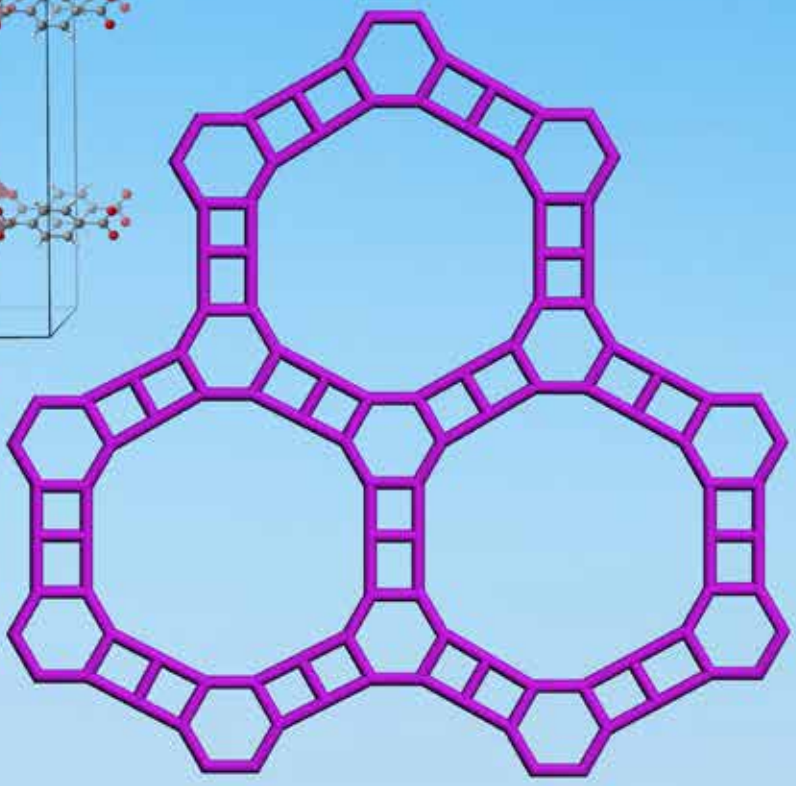
Lecture Delivered:

(1) Invited talk at (1) RMS Annual Conference, Chennai
(2) IWM Annual Conference, IISER Pune.

SMS

SCHOOL OF MATERIALS SCIENCES





Amines & other
single molecule templates
(AlPOs. MAPOs, SAPOs)

School of Materials Sciences

PROFESSOR SHYAMAL KR. SAHA
School Chair

SCHOOL PROFILE

People

Faculty	: 09
Post-doctoral Research Associate	: 15
Ph.D. Students	: 48
Non-Academic Staff	: 02

Extra Mural Funding

Projects (ongoing)	: 16

Research Achievements

Research papers in Journals	: 95
Book Chapter	: 04
Ph.D. degree awarded	: 10

Academic Activities

Colloquium Lecture/Meeting organized		: 03
Talks delivered by members	National	: 41
of School in conferences/symposia	Intl	: 07

AMITAVA PATRA, FASc, FNASc

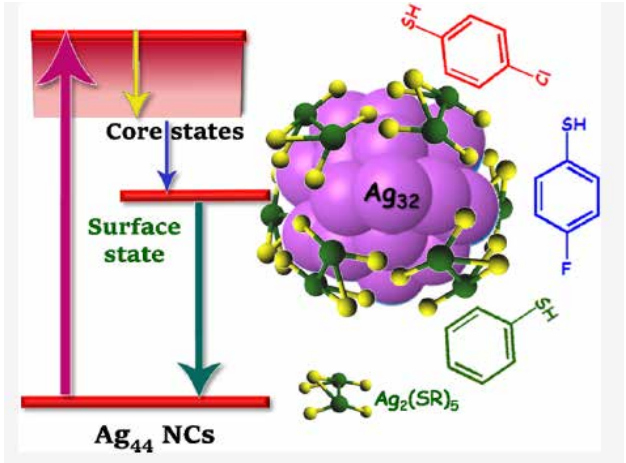
Senior Professor, upto March 10, 2020 (on Lien)

Our research focuses on understanding the ultrafast dynamics of two-dimensional (2D) semiconductor nanoplatelets (NPLs), quantum dots, metal clusters, perovskite nanocrystals, polymeric nanoparticles, and carbon dotsfor designingefficient light-harvesting systems.

Associate:

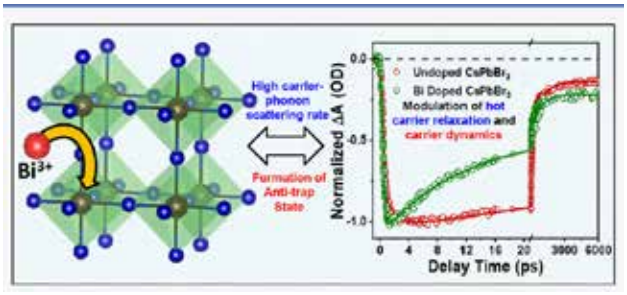
(1) Dr. Debarati Ghosh, Research Associate-I (CSIR), (2) Dr. Antika Das, Research Associate-I (IACS) (3) Mr. Srijon Ghosh, SRF (CSIR) (4) Ms. AnusriMedda, SRF (UGC), (5) Mr. KritimanMarjit, SRF (CSIR), (6) Ms. Sarita Kolay, SRF (UGC); (7) Ms. Sikta Chakraborty, SRF(Int-PhD, IACS), (8) Mr. Soubhik Ghosh, JRF (CSIR).

The influence of the substituent groups of surface staple motifs on the ultrafast relaxation dynamics of atomically precise $Ag_{44}(SR)_{30}^{4-}$ nanoclusters (NCs) has been investigated. This work reveals that the electronegativity and polarization of the surface ligand control the electron−phonon interaction, which ultimately influences the population transfer from the core state to the surface state of the Ag_{44} NCs upon photoexcitation. Global analysis of the transient absorption spectroscopic data reveals the slower relaxation from the core state to the surface state, depending on electronegativity. This study provides insights into the origin of the excited-state decay times and is expected to stimulate future work on Ag NCs.



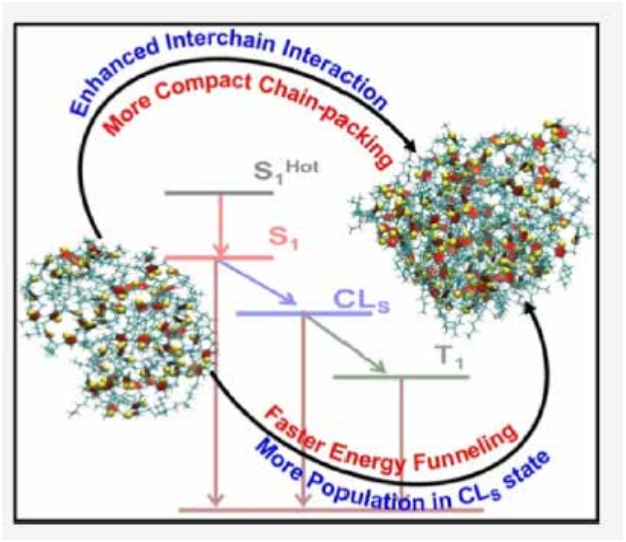
J. Phys. Chem. C 2023, 127, 3769−3777

The influence of heterovalent Bi^{3+} doping on the ultrafast carrier dynamics and hot carrier (HC) cooling relaxation of $CsPbBr_3$ NCs has been studied using femtosecond transient absorption spectroscopy and first-principles calculations. The initial HC temperature and LO phonon decay time point to a faster HC relaxation rate in the Bi^{3+}-doped $CsPbBr_3$ NCs. The first-principles calculations disclose the acceleration of carrier relaxation in Bi^{3+}-doped $CsPbBr_3$ NCs due to the appearance of localized bands (anti-trap states) within the conduction band.



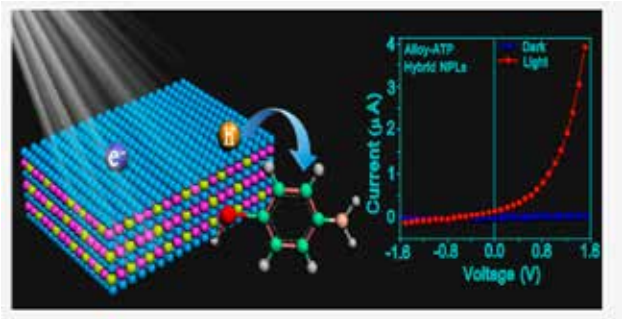
J. Phys. Chem. Lett. 2022, 13, 5431−5440

We studied the intermolecular interactions and ultrafast relaxation processes of poly(3-hexylthiophene-2,5-diyl) (P3HT) PNPs with increasing polymer chain concentrations using molecular dynamics simulations and ultrafast transient absorption spectroscopy. The proximity of the chromophoric sub-units residing in neighboring chain segments increases with increasing the polymer chain concentration, which, in turn, enhances the intermolecular interactions. A simple way is provided to modulate the relaxation dynamics of the amorphous collapsed state of a conjugated polymer toward its tunable optoelectronic applications.



J. Phys. Chem. C 2022, 126, 18177−18187

We have synthesized CdSeS alloy NPLs by incorporating S atoms in theCdSe NPLs to tune their optical properties and investigated the charge transfer dynamics of alloy NPLs by preparing a hybrid witha 4-amino thiophenol (ATP) molecule. Efficient charge separation from alloy NPLs to ATP molecules isbeneficial for photon-to-current conversion and optoelectronic applications. Photodetector devices based on hybrid alloy NPLs exhibit high photocurrent, fast response, and high detectivity of 2.5 × 10^{10} Jones.



J. Phys. Chem. C 2022, 126, 21882−21890

Award/Recognitions :

» Acharya J.C. Ghosh Memorial Award, Indian Chemical Society.

Publications in Journals :

1. Atomically Precise Ni Nanoclusters for Improving Hydrogen Evolution Reaction Performance - LipipuspaSahoo, Aarti Devi, Amitava Patra*,*ACS Sustainable Chem. Eng*., **11**, 4187–4196 (2023). [IF:9.224]
2. Electron Transfer Dynamics from $CsPbBr_3$ Nanocrystals to Au_{144} Clusters – Kritiman Marjit, Goutam Ghosh, Srijon Ghosh, Debarati Ghosh, Anusri Medda, Amitava Patra*,*ACS Phys. Chem*. Au (2023) (Accepted).[IF:Nil]
3. Electronegativity of the Substituent on Surface Motifs Influences the Ultrafast Relaxation Dynamics of $Ag_{44}(SR)_{30}^{4-}$ Nanoclusters – Sarita Kolay, Subarna Maity, Sikta Chakraborty, Srijon Ghosh, Amitava Patra*, *J. Phys. Chem. C*, **127**, 3769–3777(2023). [IF:4.177]
4. Experimental and Computational Insights into Luminescence in Atomically Precise Bimetallic $Au_{6-n}Cu_n(MPA)_5$ Clusters - Aarti Devi, HarshitaSeksaria, Dipankar Bain, SaritaKolay, Rashi, Abir De Sarkar and Amitava Patra*, *Phys. Chem. Chem. Phys*., **25**, 9513-9521(2023).[IF:3.676]
5. Cationic Polymer Functionalized Copper Nanocluster-Based Fluorescent Probe for the Selective and Sensitive Detection of S^{2-} Ions - Rashi, Dipankar Bain, Aarti Devi, Sikta Chakraborty and Amitava Patra*, *ACS Sustainable Chem. Eng*., **11**, 1995–2004(2023).[IF:9.224]
6. Hole Transfer Dynamics of 2D CdSeS Alloy Nanoplateletes for Photon-to-Current Conversion" Soubhik Ghosh, Anusri Medda, Srijon Ghosh and Amitava Patra*, *J.Phys. Chem. C*, **126**, 21882-21890(2022).[IF:4.177]
7. Ultrafast Relaxation Dynamics of Conjugated Polymer Nanoparticles by Tuning Their Interchain Interactions - Srijon Ghosh, Sandipan Chakraborty, Arnab Ghosh, KritimanMarjit, Goutam Ghosh and Amitava Patra*, *J.Phys. Chem. C*, **126**, 18177-18187(2022).[IF:4.177]
8. Penicillamine-Capped Red-Emitting Gold Nanoclusters for Therapeutic Application -Dipankar Bain, Mimansa, Aarti Devi, SubarnaMaity, AsifkhanShanavas and Amitava Patra*, *ACS Sustainable Chem. Eng*., **10**, 12730–12737(2022). [IF:9.224]
9. Charge Transfer Dynamics of Two-Dimensional Ruddlesden Popper Perovskite in the Presence of Short-Chain Aromatic Thiol Ligands - Debarati Ghosh, Kritiman Marjit, Goutam Ghosh, Srijon Ghosh and Amitava Patra*, *J.Phys. Chem. C*, **126**, 14590-14597(2022).[IF:4.177]
10. 2D CdSe/CdS Core-Shell Nanoplatelets for High-Performance Photodetectors - Avisek Dutta^, AnusriMedda^, Soubhik Ghosh, SumantaSain and Amitava Patra* (^Contributed Equally), *ACS Appl. Nano Mater*.,**8**, 11679-88(2022).[IF:6.140]
11. Unraveling the Effect of Single Atom Doping on the Carrier Relaxation Dynamics of MAg24n– Nanoclusters – Subarna Maity, Sarita Kolay, Srijon Ghosh, Sikta Chakraborty, Dipankar Bain and Amitava Patra*, *J. Phys. Chem. Lett*., **13**, 5581-88(2022).[IF:6.88]
12. Modulating the Carrier Relaxation Dynamics in Heterovalently (Bi^{3+}) Doped $CsPbBr_3$ Nanocrystals - KritimanMarjit, Goutam Ghosh, Raju K Biswas, Srijon Ghosh, Swapan K Pati and Amitava Patra*, *J. Phys. Chem. Lett*., **13**, 5431-40(2022).[IF:6.88]
13. Evidence of Hot Charge Carrier Transfer in Hybrid $CsPbBr_3$/Functionalized Graphene - Goutam Ghosh, Kritiman Marjit, Srijon Ghosh, Debarati Ghosh and Amitava Patra*, *ChemNanoMat*, **8**, e202200172(2022).[IF:3.82]
14. Silver Nanocluster/MoS_2 Heterostructures for Hydrogen Evolution – Monojit Ghoshal Chowdhury, Lipipuspa Sahoo, Subarna Maity,

Dipankar Bain, Ujjal K Gautam and Amitava Patra*, *ACS Appl. Nano. Mater*., **5**, 7132-7141(2022). [IF:6.140]

15. Impacts of Dopant and Post-Synthetic Heat-treatment on Carrier Relaxation of Cu^{2+} Doped CdSeNanoplatelets - AnusriMedda, Avisek Dutta, SumantaSain, Srijon Ghosh, Indranil Sarkar and Amitava Patra*, *J. Phys. Chem. C*, **126**, 7739-7747 (2022). [IF:4.177]

Ph.D. Degree Awarded

(1) Srijon Ghosh (IACS Deemed to be University)

Lectures Delivered

Invited talk at (1) IIT-Delhi, (2) IISER-Pune, (3) Inter-University Accelerator Centre, New Delhi, (4) SGT University, (5) Phosphor Safar 2022, China, (6) INST-Mohali, (7) University at Buffalo, USA, (8) INST, Mohali, (9) National Institute of Technical Teachers Training & Research, (10) Himachal Pradesh Univ, (11) Punjab University, (12) IIT-Ropar, (13) CNRS, Lyon, (14) IACS, Kolkata, (15) IIT-Madras, (16) Punjabi University, (17) IISF, Bhopal, (18) INST, Mohali, (19) Sangrur, Punjab and (20) NIT Kurukshetra.

ASIM BHAUMIK

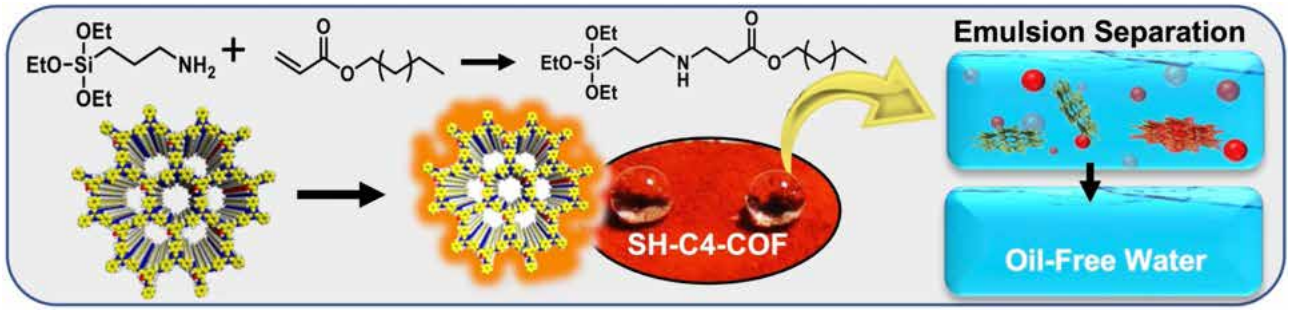
Senior Professor

Designing and synthesis of porous nanomaterials for gas storage, metal ion sensing, water purification, eco-friendly catalysis for the synthesis of organic fine chemicals, CO_2 fixation, electrochemical/ photoelectrochemical water splitting and biomedical applications.

Associate:

(1) D Charaborty SRF (DST-INSPIRE); (2) A Chowdhury SRF (CSIR); (3) S Ruidas SRF (CSIR); (4) A Ghosh SRF (CSIR); (5) S Chongdar JRF (Int-PhD); (6) S Bhattacharjee JRF (IGSTC-Project); (7) R Chatterjee JRF (CSIR); (8) T Chakraborty RA (Project); (9) B Malakar JRF (UGC); (10) B Chowdhury (Collaborator).

Porous nanomaterials for energy, environment and biomedical applications : Organic, organic-inorganic hybrid and purely inorganic porous nanomaterials have attracted huge interest over the years due to their potential applications in different frontier areas of science and technology. We have designed several novel porous organic polymers (POPs), covalent organic frameworks (COFs), porous metal oxides and metal phosphonates through hydrothermal/solvothermal or condensation/ polymerization of molecular building blocks. These materials are thoroughly characterized by using powder XRD, N_2 sorption, SEM/TEM-EDX, FTIR, UV-Vis., photoluminescence spectroscopy, XPS, TG-DTA, solid state MAS NMR, etc. Eco-friendly liquid and gas phase organic transformations are carried out using these porous nanomaterials as heterogeneous catalyst under mild conditions. CO_2 storage potential of these functionalized porous materials as adsorbent as well as heterogeneous catalysts for the CO_2 fixation reactions for the synthesis of value added fine chemicals are explored. Some of these porous nanomaterials showed outstanding catalytic activity in the photoelectrochemical water oxidation and CO_2 reduction reactions, and these processes are highly sustainable. Some of these materials are also employed as drug-delivery vehicle for targeted delivery of anti-cancer drugs and thus they offer very useful therapeutic applications also.



Selective removal of oil/oily phases from the stabilized oil-in-water emulsion by a superhydrophobic functionalized COF material (Angew. Chem. Int. Ed. 2022, 61, e202210507).

Publications in Journals :

1. A novel chemical approach for synthesizing highly porous graphene analogue and its composite with Ag nanoparticles for efficient electrochemical oxygen reduction. SK Das, S Chatterjee, A Banerjee - G Kumar, AK Patra, RS Dey, AJ Pal, A. Bhaumik, *Chemical Engineering Journal,* **451**, 138766 (2023).[IF:16.74]

2. Influence of catalase encapsulation on Cobalt@ Nanoporous carbon with multiwall shell for supercapacitor and polyurethane synthesis using carbon dioxide - R Patil, N Kumar, S Bhattacharjee, HY Wu, PC Han, BM Matsagar, KCW Wu, RR. Salunkhe, A Bhaumik, S Dutta, *Chemical Engineering Journal*, **453**, 139874 (2023).[IF:16.74]

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Award/Recognitions :

» Ranked 12 in the Best Chemistry Scientists in India

» https://research.com/scientists-rankings/chemistry/in, Research.com

Ph.D. Degree Awarded

(1) D. Chakraborty (IACS Deemed to be University)

Sponsored Project :

» CO_2 as a building for synthesis ….. materials (Indo-Russia Intl Collaboration)

» Development of green bio-conjugation ……. Materials, Greenito Pte. Ltd. Singapore

» CO_2 and Biomass as feedstock…… intermediates. Indo-German, IGSTC

» Synthesis of Highly Stable Non-Covalent……. Water Splitting, TARE, SERB

Lecture Delivered

» One Day Workshop on Indo-German Collaboration of IGSTC January 23, 2023, IIT (ISM) Dhanbad

DEBAJYOTI DAS

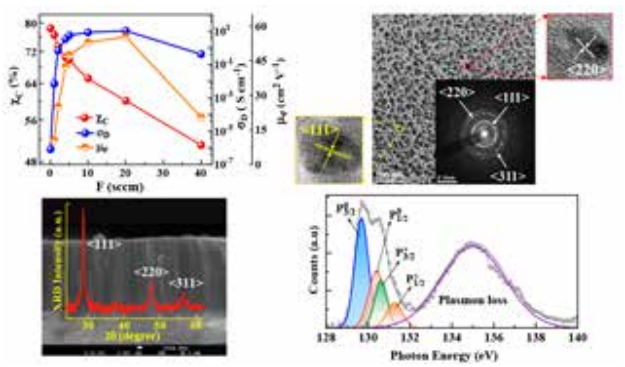
Senior Professor (upto July 2022)

SiH_4/GeH_4& CH_4/C_2H_2 plasma applications using RF-PECVD, MW-CVD & ICP-CVD for the development of nc-Si–QDs, Si-NWs, a-Si/nc-Si superlattice, nc-SiO_x, nc-SiO_xC_y nc-Si_xGe_{1-x}, DLC and nano-diamond thin films for photovoltaic and quantum-effect devices; growth of ZnO:Ga:Al:Cu, In_2O_3:Sn thin films by RF/DC sputtering applications and dye sensitized solar cells.

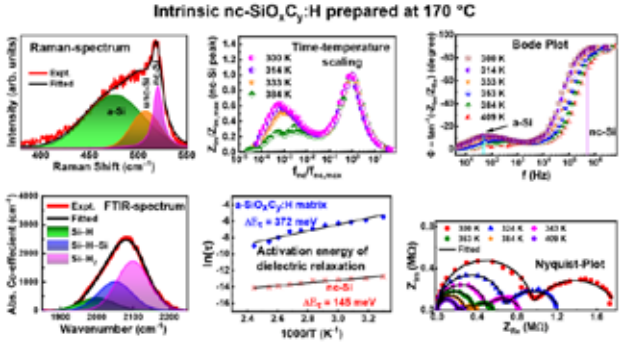
Associate:

(1) Amaresh Dey, (2) Chandralina Patra, (3) Kalyan Sarkar (SRF), (4) Sucharita Saha (SRF), (5) Payel Sahu (SRF), (6) Sukalyan Shyam (SRF), (7) Brijmohan Paramanik (SRF).

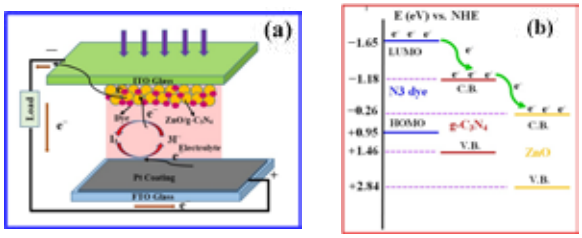
Superior Phosphorous Doping in Nanocrystalline Silicon Thin Films and their application as Emitter Layers in Silicon Heterojunction Solar Cells : Phosphorous doping in the nc-Si network induces gradually reduced crystallinity; however, preferential growth along <220>-oriented crystallites promotes the columnar-like growth morphology. At optimum doping, substitution by donor P^+-atoms in the c-Si lattice contributes surplus free electrons and high carrier mobility, resulting in superior electrical conductivity in the *n*-nc-Si network. An elevated doping leads to incorporating elemental P^0 atoms in the interstitial position or forming P-Si-H clusters and generating voids between the crystalline columns. Segregation of defects contributes to decreasing carrier mobility and reducing conductivity after diminishing crystallinity and narrowing the optical band gap. By precisely controlling the growth at 250 °C and efficient electrically active doping by P^+-atoms *n*-nc-Si thin films with superior dark conductivity (~10^1 S cm^{-1}) are produced in which the percolation of charge carriers through the crystalline columns could facilitate stacked-layer devices. The optimum *n*-nc-Si thin films are used as the emitter layers in *n*-nc-Si/*p*-c-Si heterojunction solar cells (HJSC). Furthermore, an ultrathin a-Si:H buffer layer on the *p*-c-Si minimizes the junction carrier recombination loss, and subsequent post-deposition short-time H-plasma treatment (PSHPT) ensures seeds for superior nanocrystallization in the *n*-nc-Si emitter layer. The *n*-nc-Si/(PSHPT)*i*-nc-Si(buffer-layer)/*p*-c-Si HJSC delivers a PV conversion efficiency, η ~12.35%, via reasonable fill factor ~0.647 and sensible J_{SC} ~32.75 mA cm^{-2}. Further improvement in the PV performance could be possible using suitably thinner *p*-c-Si wafers, harmonizing with the effective carrier diffusion length, and fabricating a high-quality passivation structure on the backside.



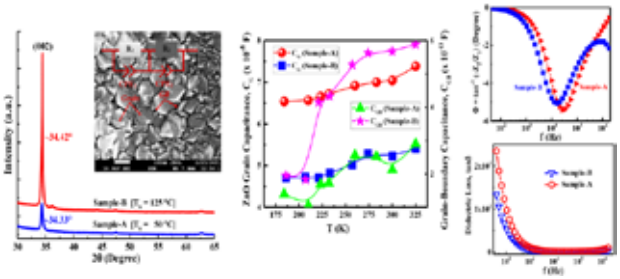
Impedance characteristics, dielectric relaxation and ac conductivity in silicon-oxycarbide (SiO_xC_y:H) films at the amorphous–to–nanocrystalline transition zone : The impedance characteristics and ac conductivity behavior of the silicon oxy-carbide (SiO_xC_y:H) network has been investigated during its transition from an amorphous dominated to a crystalline populated structure, grown by varying only the growth temperature (T_S) from 160 to 180 °C. At elevated T_S the Si nanocrystals (Si-ncs) increased in size and number density, with corresponding elevation in crystallinity from 28% to 45%. Two distinct dielectric relaxations for the individual a-SiO_xC_y:H and nc-Si components were identified in the low-frequency and high-frequency zones, respectively, for the film deposited at higher T_S (180 °C). In contrast, for the lower T_S (160 °C) grown film a significant fraction of the ultra-nanocrystalline (unc-Si) component contributed only one consolidated relaxation peak at a moderate frequency. The scaling measurements of the imaginary part of impedance ($-Z_{Im}$) revealed two distinct physical events for a-SiO_xC_y:H and nc-Si, both being temperature scale independent. The activation energy of relaxation is low for the ordered nc-Si component and high for the disordered a-SiO_xC_y:H matrix. According to the Bode plot analysis, the presence of several defects in the grain boundary contributed a poor carrier lifetime to the nc-Si component, while the a-SiO_xC_y:H matrix with lesser defects had a longer carrier lifetime. An equivalent circuit model formed by parallel resistors and constant phase elements (R||CPE), following Nyquist plot analysis, demonstrated an intense association between the microstructural and charge carrier characteristics. The temperature-dependent ac-conductivity behavior of the mixed-phase material is well explained by the non-overlapping small polaron tunnelling (NSPT) model, at two individual stages across a transition from an amorphous to crystalline configuration around a small span of growth temperature.



ZnO/g-C_3N_4 Heterostructures: Synthesis, Characterization, and Application as Photoanode in Dye-Sensitized Solar Cells : The ZnO/g-C_3N_4 heterojunction structures formed at the interfaces between the ZnO NRs and g-C_3N_4 nano-sheets, when combined with N3 dye, deliver increased optical absorption extending from UV to the visible range. The binary ZnO/g-C_3N_4 heterostructures are used as the photoanode in the DSSC application. Improvement in the DSSC performance arises because of the growth of g-C_3N_4 layer on the ZnO nanorods surface, which efficiently delays the reverse recombination of electrons from ZnO to the electrolyte. The g-C_3N_4 layer also increases the electron concentration in the photoelectrode and, thereby, directly contributes to the improved performance of the DSSC device.The optimal DSSC based on the ZnO/g-C_3N_4 photoanode delivers its characteristic J_{SC} ~14.18 mAcm^{-2}, V_{OC} ~544 mV, FF ~0.586 and η ~4.52%, which is about 2.3 times greater than the DSSC efficiency based on pure ZnO nanorod photoelectrode andretains the spirit of generating the green energy followingthe photovoltaic endeavor.



Structural characteristics, impedance spectroscopy, ac-conductivity and dielectric loss studies on RF-magnetron sputtered F doped ZnO (FZO) thin films : The structural characteristics, impedance spectroscopy, ac-conductivity and dielectric loss studies are performed on the F-doped ZnO films grown by RF-magnetron sputtering at T_S~50 and 125 °C. The electrical impedance spectroscopy enables separately recognizing the contributions of grain and grain-boundary on the electronic properties. The relaxation time distribution on temperature results in the asymmetric and depressed nature of the semi-circular arcs in the Cole-Cole plot and endorses a non-Debye type response under changing electric fields. The negative temperature coefficient of resistance behaviour indicates the semiconducting characteristics. A parallel equivalent circuit model (R||CPE) is designed to fit the semi-circular arc. The grain boundary being more resistive than ZnO-grain, its activation energy appears more significant because of the dynamic disorder characteristics. The ac-conductivity obeys Jonscher power law, and frequency exponent n < 1 suggests hopping of charge carriers with translation motion under ac electric field. The temperature-dependent dc-conductivity follows the Arrhenius behaviour. Sample deposited at higher T_S has a greater carrier lifetime due to the improved crystalline structure and lesser defects. Although, the dielectric loss in the form of conduction loss is higher for the low temperature grown sample owing to the relatively effortless movement of charge carriers and formation of dipoles due to its elevated dc conductivity consequent to increased doping.



Publications in Journals :

1. Superior phosphorous doping in nanocrystalline silicon thin films and their application as emitter Layers in silicon heterojunction solar cells, Debajyoti Das and Chandralina Patra; *Energy & Fuels***37** (2023) 6062–6077.[IF:4.654]
2. ZnO/g-C_3N_4 heterostructures: Synthesis, characterization and application as photoanode in dye sensitized solar cells, Debajyoti Das and Prami Nandi; *Sol. Energy Mater. Sol. Cells***248** (2022) 112002.[**IF: 7.305**]
3. Near room-temperature synthesis of transparent conducting fluorine-doped ZnO thin films as window layer for solar cells, B. Paramanik, S. Samanta and Debajyoti Das; *Optical Mater.***133** (2022) 112961.[**IF: 3.754**]
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5. Structural characteristics, impedance spectroscopy, ac-conductivity and dielectric loss studies on RF-magnetron sputtered F doped ZnO (FZO) thin films, S. Samanta, B. Paramanik and Debajyoti Das; *Ceramics International***48** (2022) 31370 –31380.[**IF: 5.532**]
6. Morphological variations of ZnO nanostructures and its influence on the photovoltaic performance when used as photoanodes in dye sensitized solar cells, Prami Nandi and Debajyoti Das; *Sol. Energy Mater. Sol. Cells***243** (2022) 111811.[**IF: 7.305**]
7. Optimal H_2-dilution playing key role in accomplishing significant nanocrystallinity with both Si and Ge moieties in SiGe nanocomposite thin film network, Amaresh Dey and Debajyoti Das; *Appl. Surf. Sci.***597** (2022) 153657.[**IF: 7.392**]
8. Two-step visible-light photocatalytic dye-degradation phenomena in Ag_2O impregnated ZnO nanorods via growth of metallic Ag and formation of ZnO/Ag^0/Ag_2O heterojunction structures, PayelSahu and Debajyoti Das; Langmuir **38**(2022) 4503–4520.[**IF: 4.331**]
9. Growth of diamond-like carbon films with significant nanocrystalline phases in a low-pressure high-density CH_4 plasma in ICP-CVD: Effect of negative dc substrate bias, SucharitaSaha and Debajyoti Das; *Appl. Surf. Sci.***596** (2022) 153638.[**IF: 7.392**]

NARAYAN PRADHAN, FASc, FNASc

Senior Professor

Chemistry of Physics of Semiconductor Nanocrystals

Associate:

(1) Avijit Patra, SRF (CSIR), (2) Diptam Nasipuri, SRF (CSIR), (3) Biswajit Hudait (SRF) (UGC), (4)Souvik Banerjee (JRF) (IACS), (5) Rajdeep Das (SRF) (CSIR), (6) Suman Bera (RA) (CSIR), (7) Sanjib Shyamal (NPDF), (8) Rakesh Kumar Behera (RA - IACS), (9) Suvodeep Sen (RA - IACS)

Narayan Pradhan and his research group work on semiconductor nanocrystals which include both chalcogenides and perovskites nanostructures. The major focus remains with the study of reaction chemistry for understanding the growth of these nanocrystals and tuning their optical properties. The group developed series of doped semiconductor nanocrystals and also studied the chemistry of doping foreign ions inside the crystal lattice of the host semiconductor. In addition, the group also works on developing multinary and heterostructures for solar light harvesting and water splitting. Last few years, the group focused mostly on understanding the chemistry of different halide perovskite nanostructures.

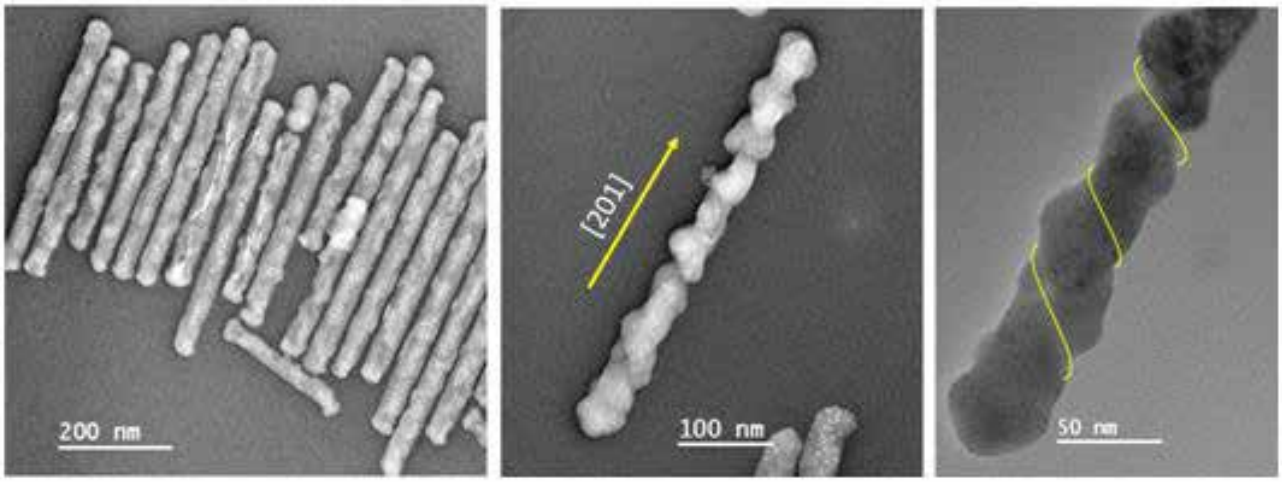


Figure. *TEM images of spiral $CsPbBr_3$ nanorods.*

Publications in Journals :

1. Hexahedron symmetry and multidirectional facet coupling of orthorhombic $CsPbBr_3$ nanocrystals - R K Behera, S Bera and N Pradhan,**ACS Nano*, **17**, 7007-7016 (2023).[IF: 18.03]
2. Chemically sculpturing the facets of $CsPbBr_3$ perovskite platelet panocrystals - S Banerjee, S Bera and N Pradhan,* ACS Nano, **17**, 678 (2023). [IF:18.03]
3. Facet engineering for amplified spontaneous emission in metal halide perovskite nanocrystals - S K Bera, S Bera, M Shrivastava, N Pradhan* and K V Adarsh,**Nano Lett.,* 22, 8908 (2022).[IF:12.26]
4. Maneuveringtellurium chemistry to design metal–telluride heterostructures for diverse applications - S Sen, S Bera and N Pradhan,**Chem. Mater.*, 34, 9329 (2022).[IF:10.05]
5. Facets-directed epitaxially grown lead halide perovskite-sulfobromide nanocrystal heterostructures and their improved photocatalytic activity - R Das, A Patra, S K Dutta, S Shyamal*and N Pradhan,**J. Am. Chem. Soc.,* 144, 18629 (2022).[IF:16.38]
6. Halide perovskite cluster precursors: A paradigm for obtaining structure- and color-tunable light-emitting nanocrystals - S K Dutta, L Peng, B Hudait, R Xie* and N Pradhan,**ACS Energy Lett.*, 7, 3177 (2022). [IF:23.99]
7. Lead halide perovskite cube coupled star nanocrystal photocatalysts - S Bera, A Patra, S Shyamal, D Nasipuri and N Pradhan* ACS Energy Lett., **7**, 3015 (2022).[IF:23.99]
8. Reasoning the photoluminescence blinking in CdSe–CdSheteronanostructures as stacking fault-based trap states - E M Thomas, N Pradhan* and K G Thomas,**ACS Energy Lett.,* **7**, 2856 (2022).[IF:23.99]
9. Tuning crystal plane orientation in multijunction and hexagonal single crystalline $CsPbBr_3$ perovskite disc nanocrystals S Bera, S Banerjee, R Das and N Pradhan,**J. Am. Chem. Soc.,***144**, 7430 (2022). [IF:16.38]

Ph.D. Degree Awarded

(1) Rakesh Kumar Behera (IACS Deemed to be University); (2) Suvodeep Sen (IACS Deemed to be University)

Sponsored Project :

» Synthesis of Highly Stable …… Water Splitting (SERB-TARE)

» Seeded Growsths in Lead…… Nanostructures

NIKHIL RANJAN JANA

Senior Professor

Biomedical application of functional nanoparticle

Associate:

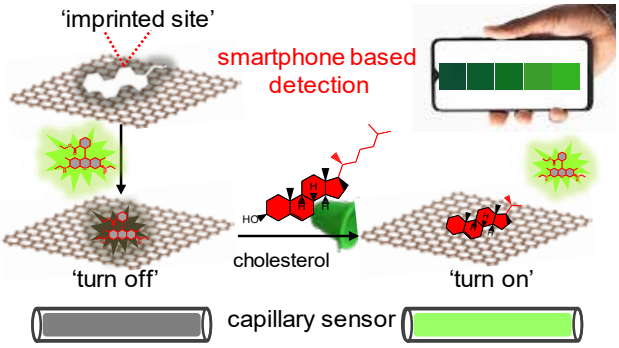
(1) Dr. Santu Ghosh (RA-DST-WTI), (2) Dr. Anupam Maity (RA-SERB project), (3) Reeddhi Ray (SRF-UGC), (4) JayantaDolai (CSIR-SRF), (5) Ankan Kumar Sarkar (CSIR-SRF), (6) Abu Raihan Sarkar (CSIR-SRF), (7) Santanu Shaw (UGC-JRF), (8) Nayana Mukherjee (JRF-insitute), (9) Uddalok Kar (UGC, JRF), (10) Puja Garai (JRF-UGC), (11) Rajkumar Sahoo (JRF-SERB project), (12) Soumi Das (MS project) and (13) Sampad Das (MS project).

i) Hemin-based colloidal nanoparticle has been designed for cell therapy via intracellular reactive oxygen species generation and autophagy induction.

ii) Nanocomposite with imprint of cholesterol has been designed for its nonenzymatic, visual, and smartphone-based detection

iii) Piezocatalytic property of calcium phosphate nanowire has been shown to enhance via gold nanoparticle conjugation

iv) Cytotoxicity of ZnO nanoparticles under dark conditions has been demonstrated due to oxygen vacancy dependent reactive oxygen species generation.



Smartphone-based cholesterol detection using molecular imprinted nanocomposite.

Publications in Journals :

1. Enhanced Therapeutic Applications of Vitamin C via Nanotechnology-Based pro-Oxidant Properties: A Review - Suman Pal, Nikhil R. Jana,*ACS Appl. Nano Mater*.**, 5**, 4583–4596(2022).[IF:6.14]
2. Cytotoxicity of ZnO Nanoparticles under dark conditions via oxygen vacancy dependent reactive oxygen species generation - Aritra Biswas, Uddalok Kar, Nikhil R. Jana, *Phys. Chem. Chem. Phys.*, **24**, 13965-13975 (2022).[IF:3.68]
3. Enhanced Piezocatalysis by Calcium Phosphate Nanowire via Gold Nanoparticle Conjugation - Jayanta Dolai, Aritra Biswas, Reeddhi Ray and Nikhil R. Jana, *ACS Appl. Mater. Interfaces*, **14**, 26443-26454 (2022).[IF:10.38]
4. Spontaneous Formation and Growth Kinetics of Lipid NanotubulesInduced by Passive Nanoparticles – Roobala Chelladurai, Koushik Debnath, Nikhil R. Jana and Jaydeep K. Basu, *Soft Matter*, 18, 7082-7090 (2022).[IF:4.05]
5. Hemin-based Cell Therapy via Nanoparticle-Assisted Uptake, Intracellular Reactive Oxygen Species Generation and Autophagy Induction - Abu Raihan Sarkar, Suman Pal, Ankan Kumar Sarkar, Nikhil R Jana, *New J. Chem.*,46, 21746-21755 (2022**).[**IF: 3.59]
6. Piezoelectric Nanoparticles for Ultrasound-Based Wireless Therapies - Jayanta Dolai, Aritra Biswas, Nikhil R Jana, *ACS Appl. Nano Mater.*,**5**, 14038–14050 (2022).[IF:6.14]
7. Nanocomposite with Imprint of Cholesterol for Its Nonenzymatic, Visual, and Smartphone-Based Detection – Jayanta Dolai, Alimpan Modak, Nikhil R Jana, *ACS Appl. Eng. Mater.*,**1**, 428–435 (2023). [IF:NA]

Publications in Book Chapter :

1. Colloidal Gold Nanorods: Science & Technology, NR Jana, CRC Press, 1-152, 2023.

Sponsored Project :

» Designed nanoparticle …… Therapeutic Performance

» Designed nanoparticle for …… aggregates from Cell

» Piezocatalytic nanocomposite-based water purification

» Design of Sound-responsive …….. for Cell Therapy

Lectures Delivered

Invited talk at (1) Midnapore College, (2) DST-STUTI Programme, IIEST Dhanbad, (3) Jadavpur University, Kolkata, (4) University of North Bengal, (5) Xt. Xavier's College, Kolkata, (6) IIT (ISM)-Dhanbad, Jharkhand and (7) TATA Steel, R&D Section.

PRAVEEN KUMAR

Assistant Professor

III-V Semiconductors, 2D-Materials/MXenes, Carbon Nanostructures, Photodetectors, Supercapacitors, Water-splitting and CO2 reduction.

Associate:

(1) Dr. Dibyendu Ghosh (RA), (2) Dr. Krishnendu Sarkar (NPDF), (3) Mr. Krishnendu Roy (Institure SRF), (4) Mr. SukhenduMaity (CSIR-SRF), (5) Mr. Shuvojit Mandal (DST-JRF) (6) Mr. Soumyjit Maitra (Institute Fellow), (7) NilayBhaumik (CSIR-JRG) (8) Prantick Shaw (UGC-JRF).

Our group is working to develop various facile, scalable and affordable synthesis processes for 2D materials, MXenes, Oxides, Carbide and Nitrides. We address the numerous fundamental and technological issues related to the heterostructuring of these materials and then explore their transport, optical, electrical, electronic, structural, morphological and physical properties. Further, we try to understand how the external field like magnetic or electrical or electromagnetic radiation will affect these properties. Based on the optimal heterostructure properties, we utilize them for addressing several existing critical issues and challengesin energy harvesting (water splitting and Photodetectors) and storage (Supercapacitor) applications.

Brief overview of the research activities

Awards/Recognitions:

- » Advisory Panel Member, IOP-2022
- » Fulbright-Nehru Academic and Professional Excellence Fellowships 2022
- » Member, Global Young Academy (GYA), Global Young Academy (GYA)
- » Chair, Career Development Working Group, Marie Curie Alumni Association (MCAA)

Patents filed/awarded :

1. S. Maity, S. Sarkar and Praveen Kumar, "A facile pH controlled, high yield and room temperature synthesis process for two-dimensional transition metal dichalcogenides. Indian Patent Filed (Application No: E-106/167/2021/KOL 2021; Date: 10/11/2021)
2. S. Maity, S. Sarkar and Praveen Kumar, "One-pot chemical synthesis of transition metal dichalcogenide alloys with elemental chalcogens. Indian Patent Filed (Application No.: E-106/208/2022/KOL, Date: 16/05/2022)

Publications in Journals :

1. S. Maity, K. Sarkar, Praveen Kumar*, Layered Heterostructures Based on MoS2/MoSe2 Nanosheets Deposited on GaN Substrates for Photodetector Applications, *ACS Applied Nano Materials*, **6** (2023) 4224.[IF:06.14]
2. S. Mandal, D. Ghosh, Praveen Kumar*, Recent Advancement in Heterogeneous CO_2 Reduction Processes in Aqueous Electrolyte, *Journal of Materials Chemistry A* 10 (2022) 19027.[IF:14.51]
3. D Ghosh, K Roy, S Maitra, Praveen Kumar*, Unrevealing Rashba-Dresselhaus splitting assisted magneto-photo-electrochemical water splitting in Asymmetric MoSSe-GaN heterostructures, *ACS Journal of Physical Chemistry Letters,* **13** (2022) 1334.[IF:6.89]
4. K Roy, S Maitra, D Ghosh, P Devi, Praveen Kumar*, 2D-Heterostructure Assisted Activation of MoS2 Basal Plane for Enhanced Photoelectrochemical

Hydrogen Evolution Reaction, *Chemical Engineering Journal*, **435** (2022) 134963.[IF:16.74]

5. D. Ghosh, P. Devi, and Praveen Kumar*, Intercalation in 2D Transition Metal Chalcogenides: Interlayer Engineering and Applications, *Progress in Energy 4* (2022) 022001.

Publications in Book Chapter :

1. Materials Advances in Photo-electrochemical Hydrogen Production from Water: Theory, Practice, and Challenges, Springer, 2524-5384, 2022.
2. Introduction to Hydrogen and World Energy Scenario"Part of the Materials Horizons: From Nature to Nanomaterials book series (MHFNN), A. Anand, P. Devi and Praveen Kumar**,** Springer, Electronic ISSN:2524-5392, 2022.

Sponsored Project :

» Development of Facile …… 2D TMDCs
» Development of Efficient Full-Color ….. LED Emitters
» DEEP : Development of an Efficient …. Hydrogen Fuel from Water

Lectures Delivered

Invited talk at (1) University of Petroleum and Energy Studies, (2) KARYASHALA, Kolkata, (3) IUMRS 2022, IIT Jodhpur, (4) University of Rajasthan, (5) IACS, Kolkata, (6) CACEE-2022, TIFR Mumbai, (7) BARC, Mumbai and (8) Technische Universitat Braunschweig, Germany (online).

SHYAMAL KUMAR SAHA

Senior Professor & School Chair

Optical, electrochemical and magnetic properties of 2D materials like graphitic carbon nitride, MoS2, WS2are investigated. We have used graphene interface to grow polysulfide to show excellent HER and supercapacitor properties.We have tuned the solubility of carbon quantum dots via functionalization of long chain alkyl amines to get interesting optical and sensing properties. We have tuned the crystal structures of copper antimony sulfides to generate structure dependent electrocatalytic applications. Graphitic carbon nitride (g-C3N4) has been decorated with sulfur atoms to investigate the induced magnetic moment in diamagnetic g-C3N4 due to proximity effect of ultrafine conducting islands (S) grown on the surface of g-C3N4 and the interaction at the interface. We have generated double metal sulfide sheet (FeNiS2) over graphene sheet to get high supercapacitive properties. To get the benefits of both electric double layer capacitance and the pseudocapacitance, we have synthesized a new mixed phase of double metal oxide (RuNi2O4) on reduced graphene oxide. We have also decorated cobalt atoms on the g-C3N lattice to study the charge transfer effect on magnetic behavior of the complex sample.

Associate:

(1) Dr. Suparna Das (RA-I); (2) Sumanta Bera (SRF, UGC); (3) Arijit Kapuria (SRF, CSIR); (4) Pratyusha Das (JRF, CSIR); (5) Sourav Singha (JRF, UGC) (6) Gouranga Mahapatra (JRF, UGC); (7) Swarnalata Maity(JRF, UGC); (8) Srija Ghosh (JRF, Institute Fellow)

Solubility tuning of alkyl amine functionalized carbon quantum dots for selective detection of nitroexplosive : The major issue of luminescent carbon quantum dots (CQDs) is the solubility in wide range of solvent and disappearance of luminescence behavior in its solid state due to aggregation caused quenching. To resolve this issue, in the present work, we have tuned the solubility of carbon quantum dots in different kinds of solvents through surface functionalisation technique. Here, we have synthesized three sets of alkyl amine functionalized carbon quantum dots from citric acid and alkyl amine by solvothermal method. We have observed that the solubility of CQDs increases from aqueous medium to organic medium with increasing length of hydrophobic alkyl chains attached at the surface of CQDs. It is seen that n-butyl amine functionalized CQDs (C_4-CQD) are soluble in any type of solvents. Here we have also observed that the C_4-CQD shows aggregation induced emission instead

of aggregation caused quenching in solid state and shows bright yellow luminescence color upon excitation. Besides this, we also report selective detection of both dinitroaniline (DNA) and dinitrophenol (DNP) using this C_4-CQD via fluorescence quenching and colorimetric methods. In organic medium both shows significant quenching with emission peak of carbon quantum dots is red shifted (~30 nm) in presence of DNP whereas no significant peak shift is observed for DNA. CQDs containing paper strip shows yellow spot in presence of DNP but no such characteristic color is appeared after addition of DNA. Using these two techniques, we have selectively identified both DNA and DNP among other nitro compounds by our as-synthesized carbon dots.

Synthesis of new mixed metal oxide $RuNi_2O_4$ phase decorated on reduced graphene oxide for supercapacitor applications : Design and fabrication of high performance energy storage devices using different mixed metal oxides decorated on conducting 2D surfaces are being investigated intensively now a days. In the present work, we have explored to synthesize a new mixed metal oxide ($RuNi_2O_4$) containing Ru and Ni and decorate the nanoparticles of these mixed metal oxides on highly conducting 2D reduced graphene oxide (rGO) surfaces to prepare efficient electrodes for high performance supercapacitors. The microstructure and compositional analyses of the composite structure are carried out by powder X-ray diffraction (XRD), transmission electron microscope (TEM) and X-ray photoelectron spectroscopy (XPS). The XRD data have been analyzed by Rietveld refinement. The electrochemical performance of the device has been investigated via galvanostatic charging-discharging (GCD), cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) analyses. It is seen that $RuNi_2O_4$/rGO composite shows a very high specific capacitance of 792 Fg^{-1} compared to the values of rGO and pristine $RuNi_2O_4$ as 235 and 367 Fg^{-1}, respectively. Due to the combined effect of the electric double layer contribution of rGO and the faradaic contribution of $RuNi_2O_4$, $RuNi_2O_4$/rGO composite results in this high value of specific capacitance in the composite structure.

Polysulfide functionalized reduced graphene oxide for electrocatalytic hydrogen evolution reaction and supercapacitor applications : Functionalized carbon based 2D materials are promising candidates for low cost and environment friendly electrocatalyst for hydrogen evolution reaction (HER) and supercapacitor applications. To overcome the limitations posed by the noble metals and transition metal based composites, we have successfully synthesized metal free polysulfide functionalized reduced graphene oxide (GPS) in a simple chemical route. Structure and morphology of the material are characterized via XRD, FTIR, Raman, TEM, XPS measurements. The material behaves as an efficient HER electrocatalyst in acidic medium as well as energy storage device. It shows an onset potential of 97 mV and overpotential of 254 mV to reach a high current density of 10 mA/cm^2. DFT calculations are carried out to understand the structural stability and identification of active sites of the material. Boosting catalytic activity via increasing the number of active sites is an elegant approach. In this material we have used the S atoms of polysulfide polymer to facilitate hydrogen adsorption and desorption, thus improving the hydrogen evolution ability. The supecapacitor attains the high specific capacitance 347 F/g at the current density of 1 A/g. The origin of such performances is due to synergistic effect of both the graphene network and the polysulfide functionalizations..

Magnetic properties in atomic Co manipulated graphitic carbon nitride : Since discovery of graphene which has unique electronic properties, much effort has been paid to invoke other properties like optical and magnetic for different applications. Considering spintronics applications, it is wise to develop magnetic properties in 2D materials as most of them are diamagnetic and have superior electronic properties. Previously, we have manipulated transition metal atoms (TM) on graphene surface and observed very interesting magnetic properties. But the limitation of graphene is to manipulate single TM atom on the hole position in carbon honeycomb structure. Therefore, to manipulate multi atoms on the hole position for investigating the effect of interaction between the TM atoms as well as with the carbon network structure, in the present work, we have manipulated single to multi atoms (Cobalt atoms) in the large cavity of graphitic carbon nitride (g-C_3N_4). We have controlled the number of atoms in the cavity by varying the concentration of 'Co' atoms. We have synthesized three samples S1, S2 and S3 with lower, medium and highest concentrations of 'Co' atoms, respectively. For lower concentration one atom/cavity is more probable. In case of medium concentration most of the cavities are filled by single atom while few cavities are filled by multi atoms and for the highest concentration most of the cavities are filled by multi atoms. It is seen that all the samples show ferromagnetism at low temperature region but at higher temperature region either paramagnetic or antiferromagticbehaviour is obtained depending upon the concentration of 'Co' atoms. The long range ordering is explained on the basis of the interaction between the magnetic moments generated in g-C_3N_4 lattice due to charge transfer from 'Co' atom to g-C_3N_4 lattice via π-electrons. We believe that TM atom embedded g-C_3N_4 having controlled magnetic properties could be a promising material for spintronics applications.

Award/Recognitions :

» Fellow of the Institute of Physics (UK), Institute of Physics (UK)

» Visiting Professor, Kun-Shan University, Taiwan

Publications in Journals :

1. Solubility tuning of alkyl amine functionalized carbon quantum dots for selective detection of nitroexplosive T.K. Mondal, A. Kapuria, M. Miah, S.K. Saha, *Carbon* (I.F.-11.307) (https://doi.org/10.1016/j.carbon.2023.03.047)
2. Synthesis of new mixed metal oxide $RuNi_2O_4$ phase decorated on reduced graphene oxide for supercapacitor applications S. Bera, M. Miah, T.K. Mondal, A. Debnath, S.K. Saha, ***Electrochimica Acta*** (I.F.- 7.336) 424, 2022, 140666**.**
3. Mixed metal sulfides (FeNiS2) nanosheets decorated reduced graphene oxide for efficient electrode materials for supercapacitorM. Miah, P Hota, T.K. Mondal, R Chen, S. K. Saha ***J.*** *Alloys Compd,* 2023, 933, 167648. *(I.F.-6.371)*,
4. Polysulfide functionalized reduced graphene oxide for electrocatalytic hydrogen evolution reaction and supercapacitor applications A. Kapuria, T.K. Mondal, B.K. Shaw, Y.K. Su, S.K. Saha, *International Journal of Hydrogen Energy* (I.F.-7.139**)** (https://doi.org/10.1016/j.ijhydene.2023.01.214)
5. Magnetic properties in atomic Co manipulated graphitic carbon nitride, S. Singha, C. Majumdar, T. K. Mondal,A Mondal, S. K. Saha. *Journal of Magnetism and Magnetic Materials***,** 2023, 566, 170259.(I.F.-3.097
6. Observation of room temperature metal free ferromagnetism in sulfur doped graphitic carbon nitrideC. Majumdar, T. K. Mondal, S. Bhattacharya, S. K. Saha, *Journal of Magnetism and Magnetic Materials,* 2022, 559, 169439.(I.F.-3.097),
7. The role of lone-pair electrons on electrocatalytic activity of copper antimony sulfide nanostructuresP. Hota, A. Kapuria, S. Bose, D.K. Maiti, S.K. Saha, *Materials Chemistry and Physics,* 2022, 291 126676**.** *(I.F.- 4.778)*

Ph.D. Degree Awarded

(1) Tuhina Mondal (CU), (2) Anup Debnath (IACS Deemed to be University) and (3) Chinmoy Majumder (CU).

SUGATA RAY

Senior Professor

Experimental material science: Structure property relationship, magnetic and dielectric studies of single and polycrystalline materials and water purification.

Associate:

(1) Samirul Islam (Part-time), (2) Sanjit Das (UGC), (3) Shuvajit Halder, JRF (CSIR), (4) Biplab Pakhuria (Int-PhD fellow) and (5) Siddhartha Soren (Int-PhD fellow).

Spin-orbit coupling (SOC) offers a large variety of novel and extraordinary magnetic and electronic properties in otherwise 'ordinary pool' of heavy ion oxides. Here we present a detailed study on an apparently isolated hexagonal 2*H* spin-chain d^4 iridate Sr_3LiIrO_6 (SLIO) with geometric frustration. Our structural studies clearly reveal perfect Li-Ir chemical order in this compound, while x-ray absorption together with x-ray photoemission spectroscopic characterizations establish pure 5+ valence of Ir. We have established a magnetic ground state with finite Ir^{5+} magnetic moments in this compound, contrary to the anticipated nonmagnetic J=0 state, through combined dc susceptibility, ^{7}Li nuclear magnetic resonance (NMR), muon spin relaxation (μSR) and ab-initio electronic structure studies. Furthermore, our dc magnetic susceptibility (χ), ^{7}Li NMR, μSR, heat capacity (C_p), and spin-polarized density functional theory (DFT) investigations unravel that despite having noticeable antiferromagnetic correlation among the Ir^{5+} local moments, the SLIO system evades magnetic long-range ordering down to 1.7 K at least due to geometrical frustration, arising from the comparable nearest- and next nearest-neighbor interchain Ir-O-O-Ir superexchange interaction strengths with opposite signs. On top of it, our zero-field (ZF) μSR analysis evidences

emergence of a considerable proportion of frozen spin dynamics within the background of an overall fluctuating highly correlated liquid-like magnetic state till down to the lowest measured temperature of 1.7 K, possibly due to large differences in the intra- and inter-column Ir-Ir magnetic exchange interaction strengths. Finally, the linear temperature dependence of the magnetic specific heat at low temperatures in both zero and applied magnetic fields plus the power-law behavior of the NMR spin-lattice relaxation rate suggest a gapless spinon density of states in this charge gapped magnetically disordered potential quantum spin liquid phase of Sr_3LiIrO_6. (*under revision in Physical Review B*)

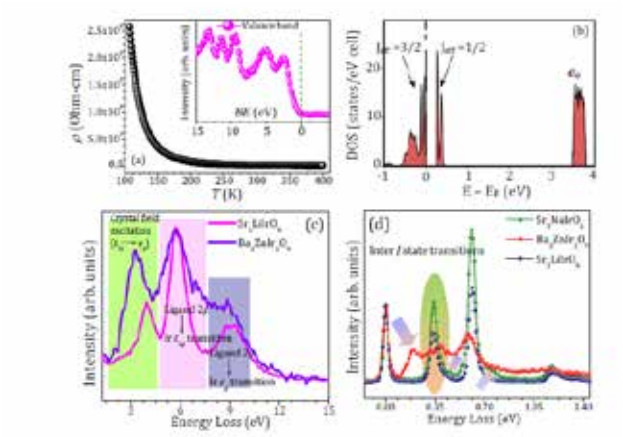
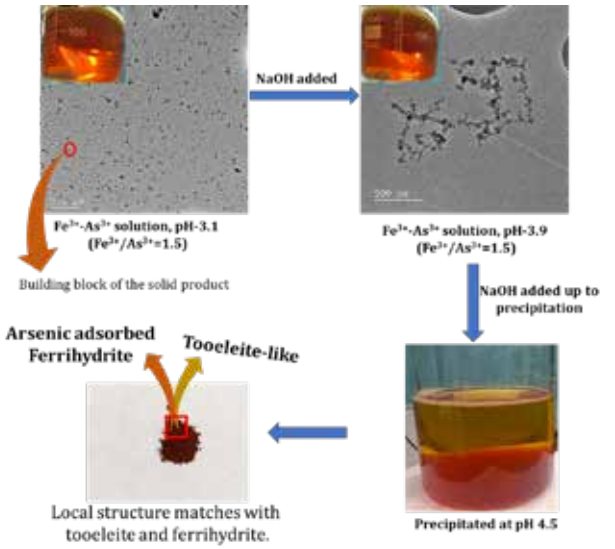


FIG. 4. (a) Temperature dependence of electrical resistivity (shaded black circles); Inset: XPS valance band spectrum (shaded violet circles), with the vertical green dashed line representing the Fermi energy position E_F; (b) The orbital resolved density of states of Ir-d orbital within GGA+SOC; Comparison of the Ir-L_3 edge RIXS spectra in (c) low-resolution high-energy features and (d) high-resolution low-energy excitations.

Simultaneous presence of Fe^{3+} and As^{3+} ions in groundwater (higher ppb or lower ppm level concentrations at circumneutral pH) as well as in the acid mine drainages (AMDs)/industrial waste-water (upto few thousand ppm concentration at strongly acidic pH) are quite common. Therefore, understanding the chemical interactions prevalent between Fe^{3+} and As^{3+} ions in aqueous medium leading to nucleation of ionic clusters/solids followed by aggregation and growth is of great environmental significance. In the present work, we attempt to probe the nucleation process of Fe^{3+} + As^{3+} clusters in solutions of various concentrations and pH (from AMD to groundwater-like), using a combination of experimental and theoretical techniques. Interestingly, our study reveals nucleation of primary FeAs clusters in nearly all of them independent of concentrations or pH. Theoretical studies performed employing density functional theory (DFT) predict the primary clusters as stable Fe4As4 units. Surprising resemblance of these clusters with known Fe^{3+} - As^{3+} minerals at the local level were observed experimentally which provides important clue about solid phase growth from a range of Fe^{3+} - As^{3+} solutions. Our experimental findings are further supported by a stepwise reaction mechanism established from detailed DFT studies. (*under revision in Inorganic Chemistry*)



Publications in Journals

1. Preferred orientation in polycrystalline colossal electroresistive hollandite $PbFe_xV_{6-x}O_{11}$, - Shuvajit Halder and Sugata Ray, *International Journal of Ceramic Engineering and Science* **4**, 309 (2022). [IF:2]
2. Fluorination Induced Asymmetry in Vacancy Ordered Brownmillerite: A Route to Multiferroic Behavior, Payel Aich et al.; *Chemistry of Materials*, **35**, 991 2023). [IF.: 10.508]
3. Short-range magnetic correlation, metamagnetism, and coincident dielectric anomaly in $Na_5Co_{15.5}Te_6O_{36}$, Rafikul Ali Saha et al.; *Phys. Rev. B*, **107**, 155105 (2023).[IF:3.908]

Sponsored Project :

» Spin-orbit interaction driven …… liquid states

Lectures Delivered

Invited talk at (1) DD-Transition in August, (2) Two lectures at Goa University, (3) IISER-Pune.

URMIMALA MAITRA

Assistant Professor

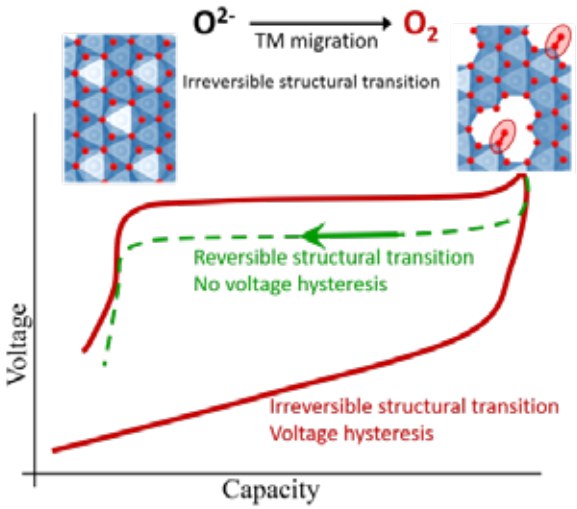
Co free sustainable cathode materials for high voltage Na and Li ion batteries.

Associate:

(1) Shubham Majumdar (NPDF), (2) Amit Ghoshal (JRF-INSPIRE) and (3) Sayandeep Guin (JRF- Institute Int. PhD), (4) Susim Sabuj Sarkar (Masters)

High energy density cathode materials for Na and Li ion batteries have been studied with an aim to make them more affordable, sustainable while at the same time keeping an eye out for cyclability and safety. Two approaches have been adopted towards this end: A) Cation disordered rock salt (LDRX) cathodes and B) Utilize redox of the anion (O-redox).

A) LDRX cathodes: Two new LDRX cathodes have been studied and have demonstrated both high capacity and high energy density with good cyclic reversibility. Being intrinsically disordered it is expected that LDRX materials will not undergo irreversible phase transitions that are seen in layered oxide cathodes. Currently, we are testing the in-situ XRD of these cathode materials to understand the structural changes if any during cycling.



B) O-redox cathodes : For this this study we designed and synthesized three new Na-ion cathodes. All of them have demonstrated high energy density compared to current state of the art lithium-ion batteries. This comes from the use of O-redox in addition to TM-redox to store charge at the cathode. Redox mechanism is being investigated spectroscopic techniques such as X-ray absorption (XAS and SXAS), X-ray photoelectron spectroscopy (XPS). Ex-situ X-ray diffraction is being studied for understanding structural aspects for voltage decay.

Publications in Journals :

1. Oxygen Redox Intercalation Cathodes: The Fundamentals and Strategies to Resolve the Challenges U. Maitra*, A. K. Das, *ACS Appl. Energy Mater.*, 2022, 5, 4522-4535. https://doi.org/10.1021/acsaem.1c04112

2. Bulk O_2 formation and Mg displacement explain O-redox in $Na_{0.67}Mn_{0.72}Mg_{0.28}O_2$, E. Boivin, R. A. House, M. A. Perez-Osorio, J. J. Marie, U. Maitra, G. J. Rees, P. G. Bruce, *Joule*, 2021, 5, 1267-1280. doi.org/10.1016/j.joule.2021.04.006

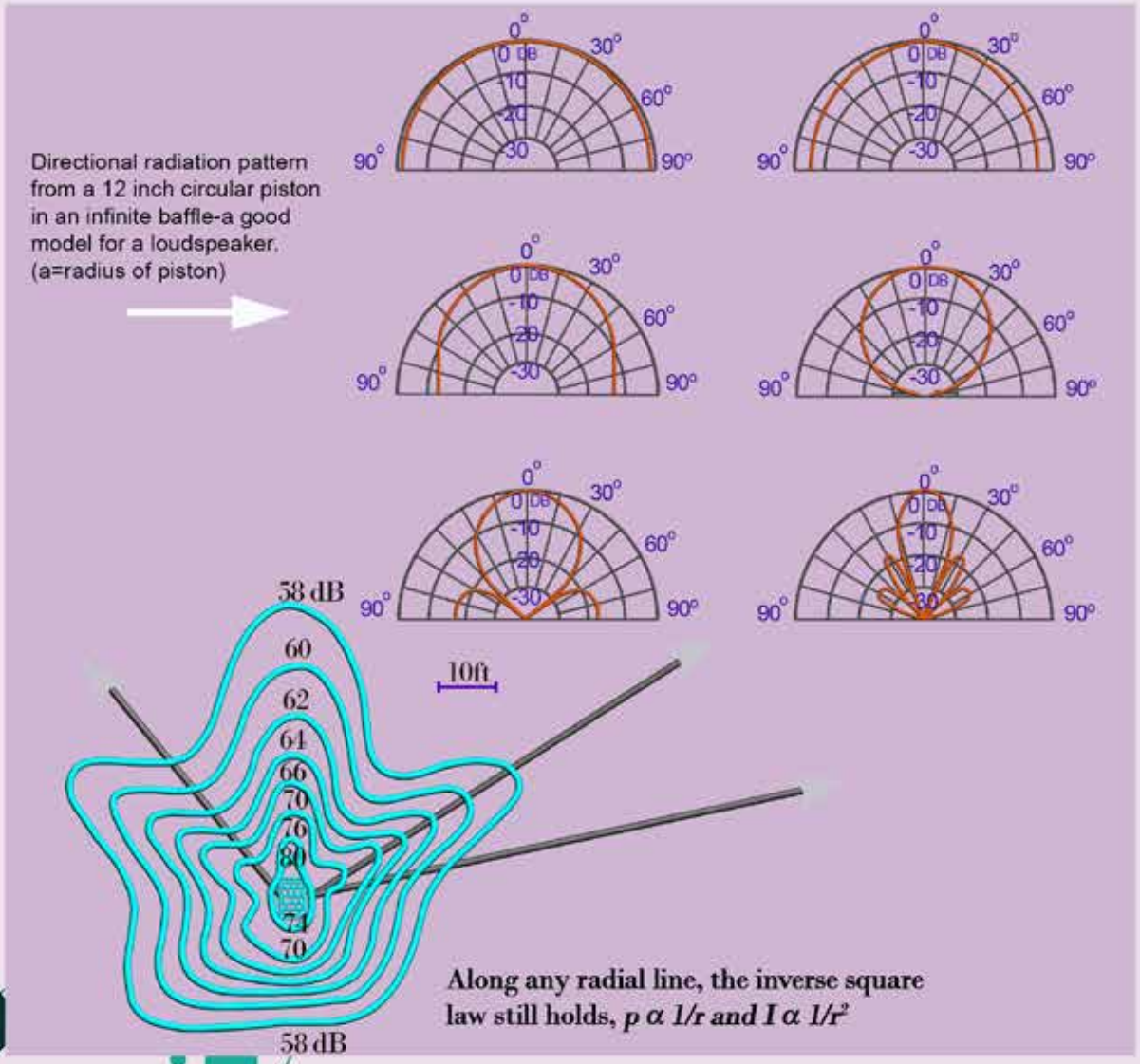
Sponsored Project :

» Structurally stable reversible ……. Na-ion Cathodes

Lectures Delivered

Invited talk at (1) Technische Universitat Braunschweig, Germany (online), (2) SAIS Symposium, IACS, Kolkata and (3) JBNSTS, Kolkata

SCHOOL OF PHYSICAL SCIENCES



School of Physical Sciences

PROFESSOR SAURAV GIRI
School Chair

SCHOOL PROFILE

People

Faculty	: 17
Post-doctoral Research Associate	: 24
Ph.D. Students	: 62
Non-Academic Staff	: 08

Extra Mural Funding

Projects (ongoing)	: 06

Research Achievements

Research papers in Journals	: 62
Ph.D. degree awarded	: 09

Academic Activities

Colloquium Lecture/Meeting organized		: 05
Talks delivered by members	National	: 24
of School in conferences/symposia	Intl	: 08

ARNAB DAS

Associate Professor

Quantum Condensed Matter and Statistical Physics, with an emphasis on Non-Equilibrium Dynamics and Phases of Quantum Matter and related areas in Adiabatic Quantum Computation.

Associate:

(1) A Das, SRF (Institute), (2) S. Chaudhuri, JRF (Institute), (3) M. Patra, NPDF (Institute)

Collaborators (in projects ongoing/winded up within the year concerned): (1) Roderich Moessner (Director, Max-Planck Institute PKS, Dresden, Germany), (2) Goutam Mandal (Professor, TIFR, Mumbai), (3) Frank Pollmann, (Professor, TU Munich), (4) Diptiman Sen (IISc Bangalore), (5) Sei Suzuki (Professor, Saitama University, Japan).

Dynamical Freezing and absence of thermalization in Infinite Many-body Floquet Systems: We investigate the stability of non-equilibrium phases of interacting quantum matter under periodic disturbances (in collaboration with the Max-Planck Institute for the Physics of Complex Systems, Dresden, Germany (MPI-PKS), and Technical Univ. Munich).

Disorder-free time crystals in the thermodynamic limit: We show the first example of a many-body time crystal in the thermodynamic limit stabilized by Dynamical Freezing (in collaboration with MPI-PKS, SINP (Kolkata)).

Experimental Realization Dynamical Freezing in an Ion-Trap Quantum Simulator: (in collaboration with IQC, Univ. of Waterloo).

Generation of Macroscopic Entanglement by Virtual Symmetry-Breaking: We provide a general framework for producing macroscopically entangled states via quantum annealing by employing "virtual symmetry-breaking". This endows us with the capability of generating various states which are invaluable for a wide range of quantum technologies in a single set-up (in collaboration with Stanford University).

Coarsening in Closed Quantum Matter: Coarsening is the mechanism of formation of a phase after crossing a phase transition point. This entails processes of fundamental importance like the formation of topological defects. While this is much studied in the context of classical phase transition, almost nothing is known when the dynamics are purely quantum mechanical. Here we employ cutting-edge tensor-network techniques to study this problem (in collaboration with MPI-PKS).

Stabilizing Many-Body Localized Phases by Dynamical Freezing: Many-Body Localized phases are characterized by Local Integrals of Motions (LIOMS). While the perpetual stability of those within equilibrium settings is under serious debate, we show they can be stabilized under periodic drives by the mechanism of dynamical freezing (in collaboration with Stanford Univ).

Publications in Journals

1. Statistical mechanics of Floquet quantum matter: exact and emergent conservation laws" A. Haldar and A. Das, J. Phys.: Condens. Matter 34 234001 (2022). [IF: 2.8]

Lectures Delivered

Invited talk at (1) SINP, Kolkata, (2) ICTS, Bengaluru, (3) Amrita University, Kerala, (4) Young Investigators Meet and (5) IIT-Kanpur

ARNAB SEN

Associate Professor & Academic Coordinator-Ph.D.

Statistical and Condensed Matter physics; spin liquids, phase transitions, entanglement in many-body systems, Monte-Carlo methods, anomalous thermalization in interacting models including lattice gauge theories

Associate:

(1) S. Samanta RA-I (2) I. Sau, SRF and (3) M. Pal, JRF, Int-PPS.

My research has been in the fields of strongly correlated systems, statistical mechanics and thermalization and transitions in certain lattice gauge theories. Some recent focus areas include frustrated magnets and spin liquids, confinement-deconfinement phase transitions in certain Z(2) lattice gauge theories, entanglement dynamics and nonequilibrium steady states of driven many-body systems and anomalous thermalization in interacting theories without disorder. In particular, the first example of weak universality in a thermal deconfinement transition of a lattice gauge theory was provided by our group. Apart from this, quantum order-by-disorder induced transitions and periodic dynamics of Rydberg chains with staggered detuning were studied. The presence of scars, including exact lego scars in the thin torus limit of the quantum dimer model, was shown in some paradigmatic models.

Publications in Journals :

1. Indrajit Sau, Arnab Sen, Debasish Banerjee, "Weak universality induced by Q = ±2e charges at the deconfinement transition of a (2+1)-d U (1) lattice gauge theory, *Phys. Rev. Lett*. 130, 071901 (2023).
2. Madhumita Sarkar, Mainak Pal, Arnab Sen, and K. Sengupta, "Quantum order-by-disorder induced phase transition in Rydberg ladders with staggered detuning, *SciPost Phys*. 14, 004 (2023).
3. Bhaskar Mukherjee, Arnab Sen, and K. Sengupta , "Periodically driven Rydberg chains with staggered detuning, *Phys. Rev. B*, 106, 064305 (2022).
4. Saptarshi Biswas, Debasish Banerjee, and Arnab Sen, "Scars from protected zero modes and beyond in U (1) quantum link and quantum dimer models", *SciPost Phys*. 12, 148 (2022).

Lectures Delivered

» Invited talk at (1) Belur Math, Howrah, (2) SNBNCBS, Kolkata and (3) ICTS, Bangalore.

BIMALENDU DEB

Senior Professor

Theoretical Quantum Optics, Quantum Information Science, Atomic, Molecular and Optical Physics

Associate:

(1) Subhanka Mal, RA-1, (2) KingshukAdhikary, extended IACS Fellow till Sept 2022 (now left IACS and joins a post-doc position abroad), (3) Abhik Kumar Saha, RA-1, (4) Anushree Dey, SRF (Integrated PhD), (5) Shubhra Mudli, JRF (INSPIRE), Katha Haldar, BS-MS project student, (6) Rahul Devorakonda, BS-MS project student, (7) Anupam Mondal, MS project student, (8) Pranoy Ranjan Char, MS project student, (9) Shouvik Mitra, BS-MS project student.

The phase diffusion, quantum fluctuations and their spectral features of a one-dimensional Bose-Josephson junction (BJJ) are studied. We have examined the dependence of the phase diffusion coefficient on the on-site interaction and temperature, demonstrating phase transition-like behavior between the Josephson oscillation and the macroscopic quantum self-trapping (MQST) regimes. We have investigated the quantum fluctuations of the relative phase and population imbalance in terms of fluctuation spectra that show a shift in Josephson frequency due to nonlinear system-reservoir coupling.

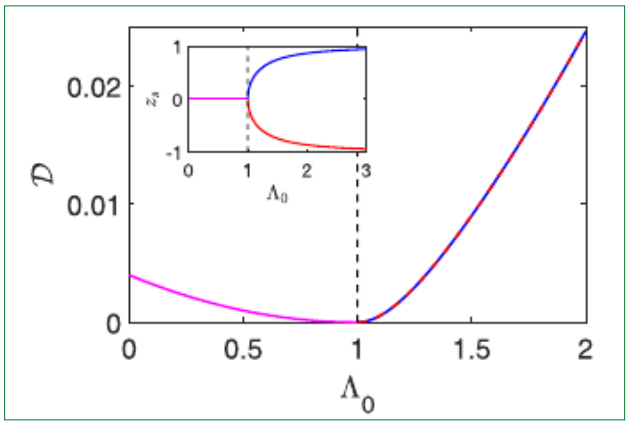


FIG. 4. Variation of diffusion constant as a function of interaction parameter in the pi-phase mode. Magenta line corresponds to zero population imbalance while blue and red lines correspond to non-zero imbalance. The vertical black dashed line corresponds to the critical parameter for transition between Josephson oscillation and MQST. Inset: Variation of the steady-state population imbalance as a function of interaction parameter. (For details, see Phys. Rev. E **107**, 034141 (2023)].

Publications in Journals :

1. Phase diffusion and fluctuations in a dissipative Bose-Josephson junction, Abhik Kumar Saha, Deb Shankar Ray and Bimalendu Deb, Phys. Rev. E **107**, 034141 (2023).[IF:2.70]

Ph.D. Degree Awarded

(1) Abhik Kr. Saha IACS Deemed to be University) and (2) Kingshuk Adhikary (CU)

Lectures Delivered

Invited talk at (1) ICTS Bangalore

DEVAJYOTI MUKHERJEE

Associate Professor

Experimental condensed matter physics and device physics of multiferroic thin film heterostructures; Interface effects in magnetocaloric and electrocaloric thin films; Surface magnetic properties of magnetic thin films using magneto-optic Kerr effect (MOKE), Ferroelectric thin films, Pulsed laser deposition of epitaxial thin films of complex oxides.

Associate:

((1) Dr. Chitra Singh, RA-1 (IACS Fellow); (2) A. Barman, SRF (UGC NET); (3) S. Chatterjee, SRF (DST-INSPIRE); (3) N. Mondal, SRF (IACS fellow); (4) K. Yadav, JRF (Integrated Ph.D.).

Collaborators:

(1) Inna Ponomareva (Professor, Department of Physics, University of South Florida, USA)
(2) Anuja Datta (Ramanujan Fellow, School of Applied & Interdisciplinary Sciences, Indian Association for the Cultivation of Science)

Researched in our group aimed toward understating effective poling field enhanced electrocaloric effect in relaxor ferroelectrics

Caloric effects allow for temperature control through adiabatic application of external fields and are actively explored for solid-state refrigeration. The common wisdom is that the application of ultrahigh fields enhances the effects, thus providing a route to their practical applications. Using the ferroelectric relaxor (Ba, Ca)(Ti, Zr)O_3 (BCZT) we demonstrated that in ferroics, which are the prime candidates for such application, this is not true in general and that caloric effects can be enhanced through the reduction of the applied field. The explanation of such a counterintuitive response is in the dependence of the electrocaloric effect on the effective poling field that can be regarded as a "hidden" variable of the caloric effects. In this work, we have reported that the electrocaloric effect in ferroics exhibits a strong and counterintuitive dependence on the effective poling field, which can be viewed as a "hidden" variable of the caloric effect. This hidden variable becomes extremely powerful at the nanoscale, where fields could reach thousands of kV/cm and could lead to "superpoling" of thin films. Once superpoled, the thin films exhibit ferroelectric behavior much above the material's Curie point, which causes deterioration of the caloric response (Figure 1) as compared to their bulk counterparts. On the positive side, this uncovered dependence on the effective poling field is an additional "knob" for the electrocaloric effect, which could be used for its enhancement.

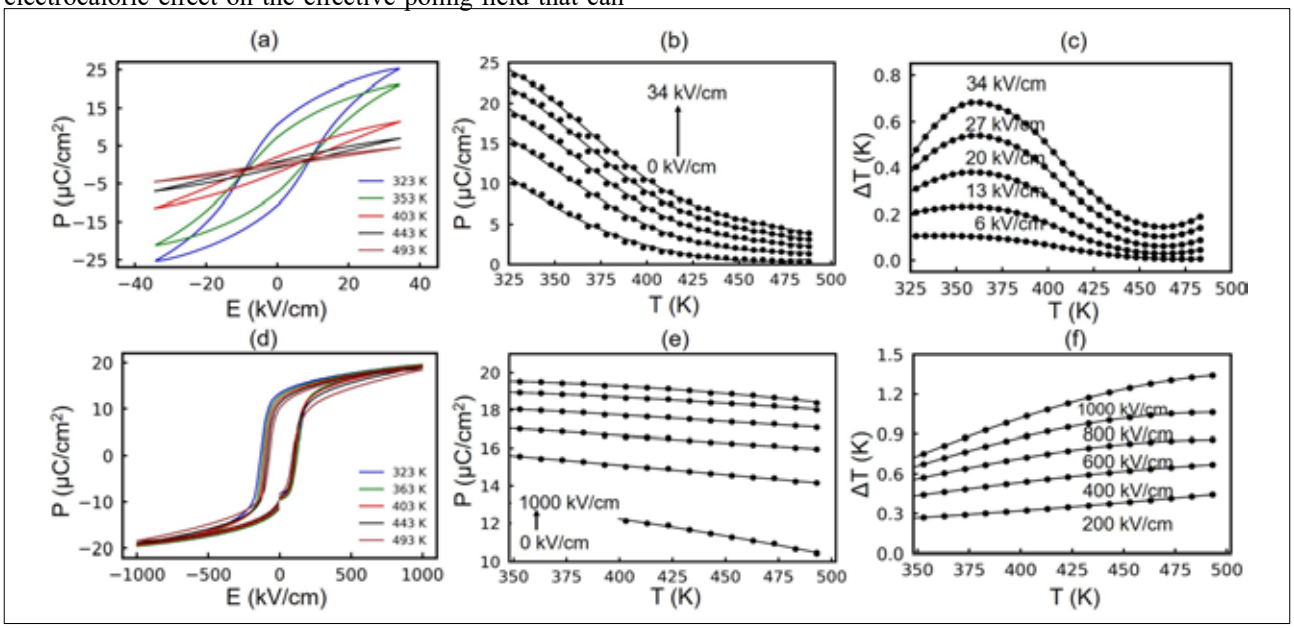


Figure 1. Polarization as a function of applied electric field (a), temperature (b), and electrocaloric change in temperature as a function of temperature in bulk BCZT (c). Panels (d)–(f) present the same dependencies but for 100-nm-thick BCZT film [Ref. Kashikar et al., Phys. Rev. Mater. 6, 124403 (2022)].

We demonstrated that a two times reduction of electric field from 1000 kV/cm to 500 kV/cm results in seven times enhancement of the electrocaloric effect in BCZT thin film (Figure 2).

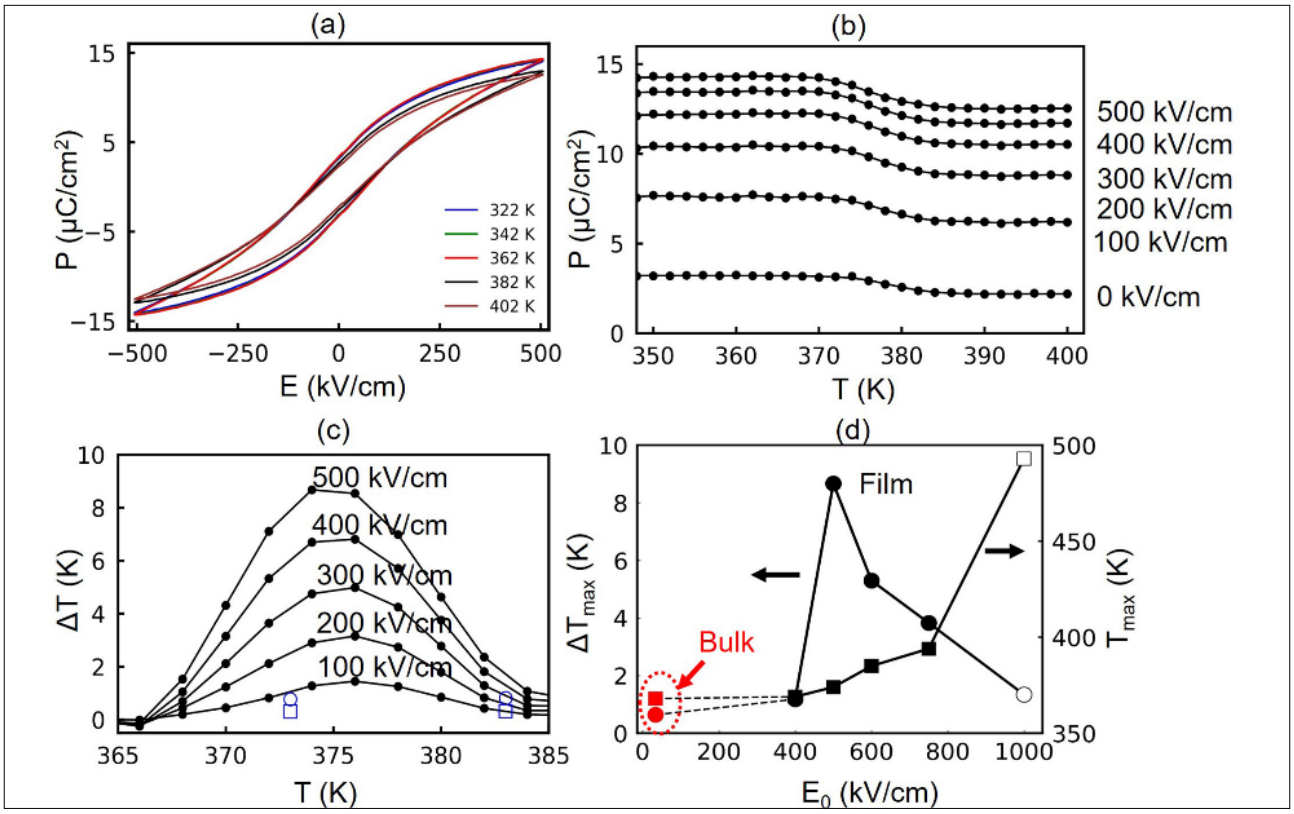


Figure 2. Hysteresis loops (a) and associated temperature dependence of polarization (b) and electrocaloric ΔT in 100-nm BCZT thin film for poling field of 500 kV/cm. The peak temperature T_{max} and its position T_{max} as a function of the poling field for both bulk ceramics and thin film (d). [Ref. Kashikar et al., Phys. Rev. Mater. 6, 124403 (2022)].

As ferroics in general exhibit similar properties, we expect that our findings would apply to this class in general and, therefore, are likely to bring new light into the entire family of caloric effects: magnetocaloric, barocaloric, multicaloric, and others, in addition to the electrocaloric effects considered here.

Influence of twin-crystal structures on the temperature dependence of magneto-optic Kerr effect and magnetic anisotropy in epitaxial Ni thin films : In this work, we reported on the enhanced Curie temperature and magnetic anisotropy in the temperature dependence of magneto-optic Kerr effect (MOKE) in epitaxial Ni (111) films grown on single-crystal c-cut sapphire Al_2O_3 (0001) substrates. X-ray diffraction (XRD) revealed the epitaxial growth of Ni (111) on Al_2O_3 (0001) substrate while XRD azimuthal scans indicated the presence of 60°-rotated twin-crystal structures of fcc Ni in ABC… and ACB… staking in the Ni/Al_2O_3 (0001) film (Figure 3 a-f). Twin-crystal structures were also revealed from the surface morphology of the Ni (111) layer in the Ni/Al_2O_3 (0001) film (Figure 3 g-h). MOKE hysteresis loops indicated higher Kerr remanence with lower coercivity for the Ni/Al_2O_3 (0001) film as compared to the polycrystalline Ni film grown on Si (100) substrate under the same conditions. Azimuthal MOKE hysteresis loops confirmed the presence of in-plane magnetic anisotropy in the Ni/Al_2O_3 (0001) film. Temperature dependent MOKE measurements in the range of 300 K to 700 K revealed power-law dependence of the Kerr remanence similar to magnetization. The Curie temperature (T_C) of the Ni/Al_2O_3 film was found to be almost 10 K higher than bulk Ni (Figure 3 i-l). In- and out-of-plane magnetization revealed a uniaxial perpendicular magnetic anisotropy with the easy axis along the Ni/Al_2O_3 film plane. The calculated values of the anisotropy constants revealed a high degree of magnetocrystalline anisotropy in the epitaxial Ni/Al_2O_3 (0001) film. A close correlation of MOKE and magnetization hysteresis is observed. The enhanced temperature dependent MOKE and magnetic anisotropy could be attributed due to the unique twin-crystal structures in the epitaxial Ni/Al_2O_3 film.

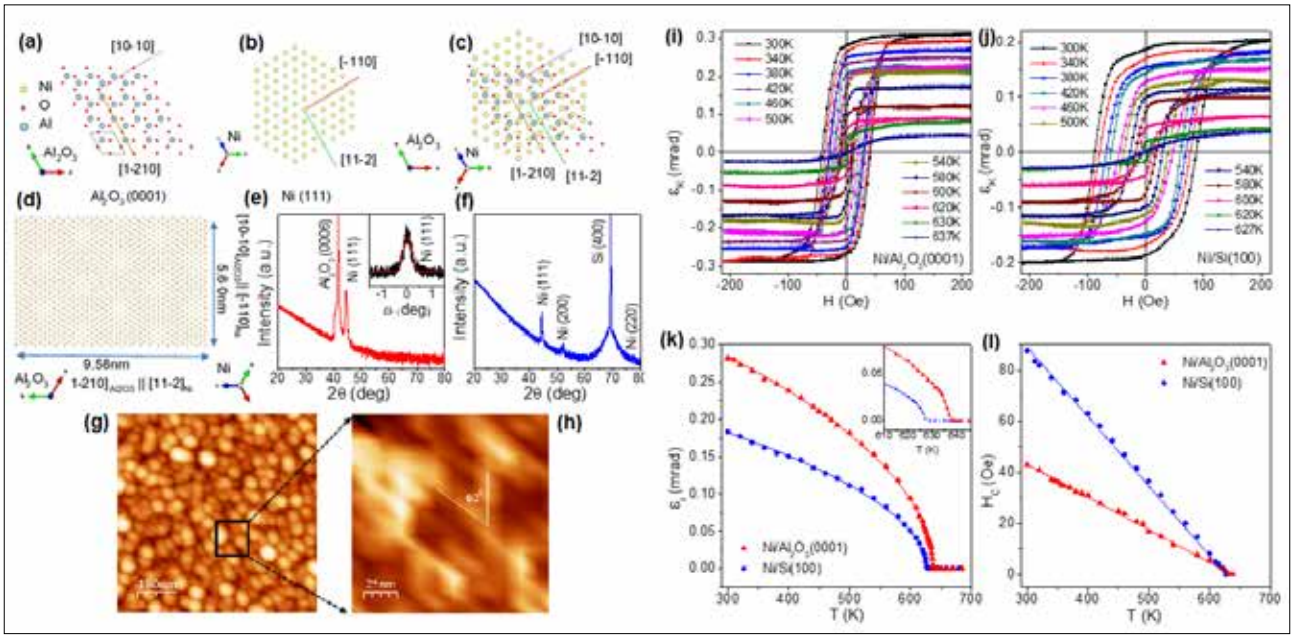


Figure 3. Atomic configurations of relevant planes of (a) Al_2O_3 (0001) substrate and (b) Ni(111) film. (c) Epitaxial relationship of fcc Ni (111) plane on hcp Al_2O_3(0001) plane along [10–10] Al_2O_3||[-110] Ni. (d) Extended atomic distance mismatch between the Ni film and Al_2O_3 (0001) substrate lattice. (e, f) XRD θ-2θ patterns for Ni/Al_2O_3 (0001) and Ni/Si (100) thin films, respectively. (g) AFM image of the Ni surface for the Ni/Al_2O_3 (0001) film exhibiting a uniformly granular surface with low roughness. (f) Zoomed-in AFM image of the Ni surface captured from an area marked by black box for the Ni/Al_2O_3 (0001) film showing the presence of the twin-crystal structures rotated by 60˚.(i, j) Longitudinal MOKE $\varepsilon_K(H)$ hystereses loops measured at different temperatures from 300 K to 640 K for the Ni/Al_2O_3(0001) and Ni/Si(100) thin films, respectively. (k, l) Temperature dependence of Kerr remanence (ε_r) and coercivity (H_C) for Ni/Al_2O_3(0001) and Ni/Si(100) thin films, respectively..

Publications in Journals :

1. Influence of twin-crystal structures on the temperature dependence of magneto-optic Kerr effect and magnetic anisotropy in epitaxial Ni thin films - N Mondal, A Barman, S Chatterjee, D Mukherjee, Journal of Magnetism and Magnetic Materials, 564,, 170118, (2022).[IF:3.097]

2. Hidden variable in the electrocaloric effect of ferroics - Ravi Kashikar, Subhashree Chatterjee, Folarin Shola Taofeek, Abhisikta Barman, Shubhankar Barman, Sohini Kar-Narayan, Anuja Datta, Sergey Lisenkov, Devajyoti Mukherjee, I. Ponomareva, Physical Review Materials, **6**, 124403 (2022).[IF: 3.989]

Ph.D. Degree Awarded

(1) Abhishikta Barman (IACS Deemed to be University)

DILIP KUMAR GHOSH

Senior Professor

Physics beyond the Standard Model, in particular, phenomenology of supersymmetric theories at colliders, CP violation, B physics, Dark matter, Neutrino physics

Associate:

(1) T. Jha, NPDF, SERB, DST; (2) P. Ghosh, RA-I (Joined on 10.01.2022); (3) N. Das, JRF, CSIR; (4) Sk. Jeesun, JRF, CSIR; (5) K. Mukherjee, JRF, Int-PPS

During the academic year 2022-2023, I collaborated with my Ph.D. students, post-doctoral fellows, and other colleagues on several research projects. Our focus was on investigating potential signatures of physics beyond the standard model, which can be experimentally tested in both particle and astro-particle physics experiments.

Signals for vector-like leptons in an S_3-Symmetric 2HDM at ILC: At the proposed International Linear Collider (ILC), we conducted an exploration of the signals originating from an S_3 symmetric two Higgs doublet model featuring two generations of vector-like leptons (VLLs). Within this framework, the lightest neutral component of the VLL emerges as a potential dark matter (DM) candidate. To ensure the validity of our model, we carefully selected representative benchmark points with varying DM masses—low, medium, and high-that not only satisfy all theoretical and experimental constraints of the model but also adhere to constraints arising from the DM sector. Our investigation focused on the pair production of VLLs, both neutral and charged, which results in multi-lepton and multi-jet final states. Comparing the ILC to the LHC, we demonstrated that the ILC proved to be a more effective and valuable machine for detecting these signals. (*with I. Chakraborty, N. Ghosh and S. K. Rai and published in EPJC* (IF:4.4))

Searching for exotic Higgs bosons at the LHC: In a model-independent manner, we investigate the possibility of detecting neutral exotic Higgs states with unconventional interactions with ordinary matter and gauge fields. We focus on the 14 TeV run of the Large Hadron Collider and also conduct comparative studies for the 13.6 and 13 TeV runs. Flavor models, which utilize discrete symmetry groups and feature extended scalar sectors, are known to produce exotic spin-0 states—both even and odd—with flavor off-diagonal Yukawa couplings. Among these states, one even state exhibits peculiar gauge interactions, differing from the Standard Model Higgs boson, as it does not couple to gauge boson pairs. These unconventional properties make these exotic states evade traditional collider and electroweak constraints, thereby possibly remaining relatively light. Without committing to any specific model, we explore the potential discovery of these exotic Higgs states by leveraging their unique Yukawa and gauge properties. Our approach involves investigating specific kinematic variables that effectively suppress backgrounds, leading to interesting topologies that could aid in identifying these elusive states.

(*with G. Bhattacharyya, S. Dwivedi, G. Saha, and S. Sarkar and published in PRD* (IF :5.0))

Long-lived inert Higgs boson in a fast expanding universe and its imprint on the cosmic microwave background: In this project we have shown how the measurement of the effective relativistic degrees of freedom at the time of CMB formation can constrain the parameter space of a specific framework of dark matter model. It is well known that the presence of any extra radiation energy density at the time of cosmic microwave background formation can significantly impact the measurement of the effective relativistic neutrino degrees of freedom or ΔN_{eff} which is very accurately measured by the Planck Collaboration. In this project we propose a scenario where a long-lived inert scalar, which is very weakly coupled to the dark sector, decays to a fermion dark matter via a "freeze-in" mechanism plus standard model neutrinos at very low temperature ($T < T_{BBN}$). We the explore this scenario in the fast expanding Universe, where it is assumed that the early epoch ($T < T_{BBN}$) of the Universe is dominated by a nonstandard species Φ instead of the standard radiation. In this nonstandard cosmological framework, such late-time decay of the inert scalar can inject some entropy to the neutrino sector after its decoupling from the standard model bath and this will make substantial contribution to ΔN_{eff}. Additionally, in this scenario, the new contribution to ΔN_{eff} is highly correlated

with the dark matter sector. Thus, one can explore such feebly interacting dark matter particles by the precise measurement of ΔN_{eff} using the current (Planck 2018) and forthcoming (CMB-S4 and SPT3G) experiments. (*with Sk Jeesun and D. Nanda and published in PRD* (IF :5.0))

Concealing Dirac neutrinos from cosmic microwave background : The consensus on the existence of prolonged radiation domination before Big Bang Nucleosynthesis (BBN), which occurs just after the inflationary epoch, has not been reached. If the universe undergoes a non-standard cosmological phase instead, it will significantly alter the Hubble expansion rate and may generate substantial entropy through non-adiabatic evolution. These changes have a profound impact on the properties of relic species that decoupled from the thermal bath before the standard radiation domination was revived around the time of BBN. In this study, we focus on the Dirac nature of neutrinos and investigate the decoupling of ultra-relativistic right-handed neutrinos (ν_Rs) in the presence of two possible non-standard cosmological phases. Both of these cases result in modified Hubble parameters, leading to faster expansions in the early universe. However, one scenario predicts non-adiabatic evolution and, consequently, a slower redshift of the photon temperature due to the expansion. We find that in a significant portion of the parameter space, the combined effect of early decoupling of ν_R and the slower redshift of the photon bath can obscure the signature of right-handed neutrinos, even with precise measurements of ΔN_{eff} from next-generation CMB experiments like CMB-S4 and SPT-3G. However, this conclusion does not apply to scenarios with only fast expansion. (*with A. Biswas and D. Nanda and published in JCAP* (IF:7.28).

Publications in Journals

1. Signals for vector-like leptons in an S_3-symmetric 2HDM at ILC Authors : Indrani Chakraborty, Dilip Kumar Ghosh, Nivedita Ghosh, Santosh Kumar Rai. *Eur.Phys.J.C* 82,6,538 (2022).[IF:4.99]
2. Searching for exotic Higgs bosons at the LHC Authors : Gautam Bhattacharyya, Siddharth Dwivedi, Dilip Kumar Ghosh, Gourab Saha, Subir Sarkar, *Phys. Rev.D*, 106,5,055032 (2022).[IF:5.40]
3. Long-lived inert Higgs boson in a fast expanding universe and its imprint on the cosmic microwave backgroundAuthors : Dilip Kumar Ghosh, Sk Jeesun, Dibyendu Nanda, *Phys.Rev.D*, 106, 11, 115001 (2022). [IF:5.40]
4. Concealing Dirac neutrinos from cosmic microwave backgroundAuthotrs : Anirban Biswas, Dilip Kumar Ghosh, Dibyendu Nanda, *JCAP*, 10, 006 (2022). [IF:7.28]

DURGA BASAK, FNASc

Senior Professor

Opto-electronic properties of 2D and 3D oxide and sulfide thin films.

Associate:

(1) S. Ghosh, RA (Institute), (2) A. Das, SRF (Institute), (3) S. Pal, SRF (Inspire), (4) S. Mondal, SRF (CSIR), (5) S. Jana, JRF (UGC) and (6) B. Patra, JRF (UGC).

We have investigated the evolution of various point defects in 100 keV lithium (Li) ion-implanted 1D ZnO nanorods (NRs) by varying the fluences experimentally and also by using a simulation stopping and range of ions in matter (SRIM). Also we have reported high broad band photosensitivity from ultraviolet (UV) to visible wavelength of sol-gel grown TiO_2 film decorated with Ag nanoparticles (NPs) as well as in a simple metal-Zn_2SnO_4 (ZTO) thin film-metal structure in a simple planar photoconductive geometry. We have investigated the effect of O_2 on the donor-acceptor compensation by comprehensive photoconductivity measurements supported by the PL studies in P doped ZnO films. Interestingly, we have demonstrated that donor–acceptor (D-A) compensation in the doped film is influenced largely by the dopant valence using trivalent Al, tetravalent Ti, and pentavalent Vanadium. In an another study, we unprecedentedly demonstrate an n^+ -ZnO/n-Si isotype heterojunction as a potential candidate for detecting light in a broad ultraviolet to infrared region with a very high

speed and >1 kHz frequency bandwidth as well. In an another study, the crossover amongst band and various hopping mechanisms has been observed in the temperature range of 300–10 K in Mo doped ZnO films deposited at various substrate temperatures.

Awards/Recognitions

» Editorial advisory board member in ACS Applied Electronic Materials, ACS

Publications in Journals

1. Drastic evolution of point defects in vertically grown ZnO nanorods induced by lithium ion implantation. Amaresh Das and Durga Basak, Phys. Chem. Chem. Phys., 2022, 24, 23858-23869.[IF:3.945]
2. Plasmon assisted high ultraviolet to visible broad band photosensitivity in lateral Ag NPs-TiO_2 nanocomposite film. Sulakshana Mondal and Durga Basak, Surfaces and Interfaces, 31, 102090 (2022). [IF: 6.137]
3. Photophysical investigation of the formation of defect levels in P doped ZnO thin films. Sourav Mondal and Durga Basak, Ceramics International, 48, 20000-20009 (2022). [IF: 5.532]
4. High performance broad-band ultraviolet-B to visible photodetection based on planar Al-Zn2SnO4-Al structure. Shuvaraj Ghosh, Sourav Mondal, Santanu Pal, and Durga Basak, Sensors and Actuators A: Physical, 347, 113898 (2022). [IF: 4.291]
5. A look into donor–acceptor compensation in ZnO thin films driven by dopant valence, Shuvaraj Ghosh and Durga Basak, Appl. Phys. A, 129, 36 (2023). [IF: 2.983]
6. Ultrafast and Ultrabroadband UV–vis-NIR Photosensitivity under Reverse and Self-Bias Conditions by n^+-ZnO/n-Si Isotype Heterojunction with >1 kHz Bandwidth. Sourav Mondal, Satwik Halder, and Durga Basak, ACS Appl. Electron. Mater,5, 1212–1223 (2023). [IF: 4.494]

Ph.D. Degree awarded

(1) Amaresh Das (JU)

Sponsored Project

A critical look at post-transition …… photophysical processes.

INDRA DASGUPTA

Senior Professor, Dean (Faculty Affairs and R&D)

Electronic structure calculations of novel magnetic systems, strongly correlated systems, low-dimensional quantum spin systems, magnetic properties of materials at nano scale and disordered systems.

Associate:

(1) Mr Ritwik Das (SRF, CSIR), (2) Mr. Kunal Dutta (SRF, CSIR), (3) Mr. Rounak Das (JRF, IACS) (4) Akram Hossain Sarkar (JRF, UGC) (5) Dr. Mohammad Rezwan Habib (RA-1, NPDF), (6) Dr. Vijeta Singh (RA-1, IACS)

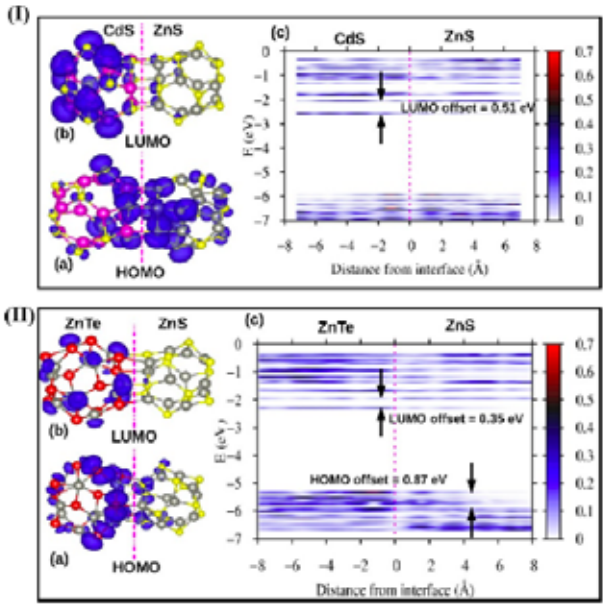
Research in our group in the past year was devoted to the calculation of electronic structure of strongly correlated systems, study of magnon Chern insulating state in the 2D ferromagnet CrI_3 and quantum transport in coupled quantum dots.

Two-dimensional (2D) ferromagnetic systems have been attracting considerable research interest due to their ability to display unusual magnetic, electronic, and topological properties. One of the notable members of this family is CrI_3, where bulk CrI_3 has been reported to crystallize in a layered vdW structure and shows ferromagnetic ordering with Tc = 61 K. It exhibits a strong out-of-plane anisotropy and is insulating with a band gap of 1.2 eV. Further the presence of heavy halogen, like iodine provides a strong spin-orbit coupling (SOC) and magnetocrystalline anisotropy in the system. In combination with strong SOC from the ligand iodine atoms, the graphene like honeycomb network that is formed by the magnetic Cr atoms also holds the potential to give rise to topological electronic and magnetic properties. In fact, recent inelastic neutron scattering (INS) experiments on CrI_3 revealed an energy gap of 2.8 meV in the spin-wave spectrum at the Dirac point (K-point), suggesting the possibility of

nontrivial band topology.Several theoretical models have been proposed to explain the experimentally observed spin gap. One possible scenario is that Dzyaloshinskii-Moriya (DM) interactions are responsible for opening up the gap, leading to a Haldane-like model for spin excitations that supports magnon Chern bands. Alternatively, it has also been suggested that a dominant Kitaev interaction can give rise to a gap at the Dirac point and may plausibly explain experimental data. In view of these competing proposals, the origin of the gap in the spin-wave spectrum of CrI3 remained an open issue. In order to address this problem we have derived the microscopic spin Hamiltonian for the rhombohedral CrI_3 using first-principles density functional theory calculations that incorporate spin-orbit coupling and Hubbard U. Our calculations indicate a dominant nearest-neighbor ferromagnetic Heisenberg exchange with weaker further-neighbor Heisenberg terms. In addition, we find a Dzyaloshinskii-Moriya interaction that primarily drives a topological gap in the spin-wave spectrum at the Dirac point, and we identify a non-negligible unusual antiferromagnetic Kitaev coupling between the S = 3/2 Cr moments. The out-of-plane magnetic moment is stabilized by weak symmetric bond-dependent terms and a local single-ion anisotropy. Using linear spin-wave theory, we find that our exchange parameters are in reasonably good agreement with inelastic neutron scattering (INS) experiments. Employing classical Monte Carlo simulations, we study the magnetic phase transition temperature Tc and its evolution with an applied in-plane magnetic field. We further demonstrate how future hi gh-resolution INS experiments on the magnon dispersion of single crystals in an in-plane magnetic field may be used to quantitatively extract the strength of Kitaev exchange.

In an another project we have investigated d^5pyrochlore based iridates that exhibit metal insulator transition. In particular, we have addressed the concomitant metal-insulator transition (MIT) and antiferromagnetic ordering in the novel pyrochlore iridate $Eu_2Ir_2O_7$. Experiments reveal that there is a sharp change in the Ir-O-Ir bond angle around the MIT possibly arising from the exchange-striction mechanism which favors an enhanced electron correlation via weakening of the Ir-Ir orbital overlap and lead to an insulating phase. The theoretical calculations indicate an insulating state for shorter bond angle validating the experimental observation. In addition our DFT calculations show the possibility of intriguing topological phase below a critical value of the Ir-O distance, which is shorter than the experimentally observed bond length. Therefore, a topological state may be realized in bulk $Eu_2Ir_2O_7$ sample if the Ir-O bond length can be reduced by the application of sufficient external pressure.

Semiconductor coupled quantum dots provide a unique opportunity for tuning band gaps by tailoring band offsets, making them ideal for photovoltaic and other applications. We have studied stability, trends in the band gap, band offsets, and optical properties for a series of coupled quantum dots comprised of II–VI semiconductors using a hybrid functional method. We have shown how the quantum confinement and interfacial strain considerably affect the band gap and band offsets for these heterostructures at the nanoscale.We have shown that the trend in band offsets obtained from our first-principles electronic structure calculations agrees with that obtained from the method of average electrostatic potential. It is found that a common anion rule for band offset is followed for these heterostructures at the nanoscale. Further, the calculated optical absorption spectra for these coupled quantum dots reveal that absorption peaks lie in the ultra-violet (UV) region, whereas absorption edges are in the visible region. In addition to electronic and optical properties, we have also explored transport properties for two representative coupled quantum dots, either having common cations or common anions, which revealed asymmetric nature in current–voltage characteristics. Therefore, these semiconductor coupled quantum dots may be useful for photovoltaic, light-emitting diode, and optoelectronic devices



Band offset engineering in a common anion (CdS-ZnS) and common cation (ZnTe-ZnS) coupled quantum dots illustrated using energy resolved charge density (See Fig. c) [Ref: Int. J. Quantum Chem. **123***, e27101 (2023)]*

Publications in Journals

1. Unlocking the electronic, optical and transport properties of semiconductor coupled quantum dots using first principles methods - Arup Chakraborty, Bidisa Das and Indra Dasgupta, Int. J. Quantum Chem. 123, e27101 (2023).[IF:2.437]
2. Exchange interactions and spin dynamics in the layered honeycomb ferromagnet CrI_3 - Subhadeep Bandyopadhyay, Finn Lasse Buessen, Ritwik Das, Franz G Utermohlen, Nandini Trivedi, Arun Paramekanti and Indra Dasgupta, *Phys. Rev. B* 105, 184430 (2022).[IF:3.908]
3. Interplay between structural, magnetic, and electronic states in the pyrochlore iridate $Eu_2Ir_2O_7$ - Manjil Das,Sayantika Bhowal,Jhuma Sannigrahi,Abhisek Bandyopadhyay,Anupam Banerjee, Giannantonio Cibin, Dmitry Khalyavin, Niladri Banerjee, evashibhai Adroja, Indra Dasgupta, and Subham Majumdar, *Phys Rev B*, 105 (13), 134421(2022).[IF : 3.908]

Lectures Delivered

Invited talk at (1) SNBNCBS, Kolkata, (2) TCMSD - 2022 IACS, Kolkata, (3) QMAT-2022, IIT-Kanpur, (4) CTTC - 2022, BARC, Mumbai, (5), IIT-Bombay, (6) IACS, Kolkata, (7) APCTP - IACS, Pohang, Korea, (8) SNS - 2022, IISc, Bangalore, (9) EESTER-2023, (10) CPMU, JNCASR, (11) DQMMA-2023, Goa and (12) IISER-TVM, (13) NCES - 2022, Goa

Sponsored Project

» Search for novel spin liquid phases in low-dimensional quantum magnets: experiment and theory (SERB)

» Optical properties of Vander Waals ….. Materials (Md. R. Habib, NPDF)

KOUSHIK RAY

Professor

String Theory and Mathematical Physics

Associate:

(1) A. Pal, SRF, (2) A. Dinda, RA-I and (3) S. Roychowdhury, RA-I.

Conformal integrals in four dimensions : We obtain analytic expressions of four-dimensional Euclidean N-point conformal integrals for arbitrary N by solving a Lauricella-like system of differential equations derived earlier. We demonstrate their relation to the GKZ A-hypergeometric systems. The conformal integrals are solutions to these expressed in terms of leg factors and infinite series in the conformal invariant cross ratios.

(With A. Pal; published in JHEP10(2022)087)

Publications in Journals :

1. Conformal integrals in four dimensions. Aritra Pal and Koushik Ray, JHEP10(2022)087

Lectures Delivered

» Invited talk at (1) University of Cologne (online) and (2) NISER-Bhubaneshwar.

KRISHNENDU SENGUPTA, FNA, FASc, FNASc

Senior Professor

Condensed Matter Physics: Graphene, Non-equilibrium dynamics of quantum critical system, Physics of Ultracold atoms, Quantum Phase Transitions

Associate:

(1) M Sarkar, SRF, (2) T Banerjee, JRF (Int-PPS; (3), S. Ghosh, SRF (CSIR), (4) A. Chattopadhyay, NPDF (SERB) and (5) A. Roy (TARE Fellow).

During 2022-23, I and my group members and collaborators have looked into several aspects of physics of strong correlations and dynamics in ultracold atom and condensed matter systems. Our finding in these areas are summarized in our research publications.

Publications in Journals

1. B. Mukherjee, A. Sen, and K. Sengupta, *Periodically driven Rydberg chains withstaggered detuning*, *Phys. Rev. B*106, 064305 (2022).
2. S. Ghosh, K. Saha, and K. Sengupta,*Hinge mode dynamics of periodically driven higher-order Weyl semimetals,Phys. Rev. B* 105, 224312 (2022).
3. S. Das, B. Ezhuthachan, A. Kundu, S.Porey, B. Roy, and K. Sengupta, *Out-of- Time-Order correlators in driven conformal field theories, JHEP*, 08, 221 (2022).
4. M. Sarkar, M. pal, A. Sen, and K. Sengupta, *Quantum order-by- disorderinduced phase transition in Rydberg ladders with staggered detuning SciPost Phys*. 14, 004 (2023).
5. S. Aditya, K. Sengupta, and D. Sen, *periodically driven model with quasiperiodic potential and staggered hopping amplitudes: engineering of mobility gaps and multifractal states, Phys. Rev. B* 107, 035402 (2023).
6. S. Ghosh, I. Paul, and K. Sengupta, *Prethermal fragmentation in a periodicallydriven Fermionic chain*, *Phys. Rev. Lett*., **130**, 120401 (2023).

Sponsored Project

» JC Bose National Fellowship

» Nonequilibrium Dynamics ….. Many Body Systems (Analabha Roy, TARE)

» Study of static and dynamical …….. body systems (Anwesha Chattopadhyay (NPDF)

MINTU MONDAL

Assistant Professor

Experimental Condensed Matter Physics.

Associate:

(1) S. Das, (2) T. Debnath, (3) D. Singha Roy, (4) SK Kalimuddin, (5) A. Bera, (6) S. Bera and (7) Dr. Hasan Afzal, PDF.

Over the last academic year, our group worked on different families of functional materials, for example, (i) family of 2D vdW magnets, Fe_nGeTe_2. (ii) family of quasi-1D compounds, $(TaSe_4)_nI$ (n =2,3) and (iii) Metal nanoparticle embedded conductive polymers.

(d.i.) Quasi -2D vdW magnetic materials: We are

investigating ferromagnets F_nGeTe_2 (n = 3, 4 and 5). The intrinsic long-range ferromagnetic order in layered ferromagnetic (FM) 2D *vdW* materials hold great promise. In this family, the Fe_nGeTe_2 series (with *n* = 3, 4 and 5) offers the flexibility of tuning the chemical composition (*n*) which results in varieties of complex magnetic orders and phase transitions. Detailed investigation of single-crystal samples of Fe_nGeTe_2(with *n* = 3, 4 and 5) is ongoing. *Satybrata Bera et al., (Submitted).*

(d.ii.) Quasi -1D vdW materials: The family of linear-chain compounds, (MSe4)nI (where M=Nb and Ta, and n= 2, 3, and 10/3) displays various phase transitions and phase coexistences. The MSe4 chains, separated by the iodine atoms, run along the c axis, giving rise to a quasi-one-dimensional structure. Recently, we have stabilized $(TaSe_4)_3I$ in a non-centrosymmetric tetragonal structure. The NCS phase of (TaSe4)3I shows a CDW transition around 150 K, then it undergoes a magnetic transition below 10 K and eventually settles in a superconducting state with coexisting ferromagnetism below 2.5K. The presence of a ferromagnetically ordered state is surprising mainly because the material does not host any magnetic element. The detailed investigation in collaboration on going. *[Arnab Bera et al, arXiv:2111.14525 [cond-mat. supr-con] (submitted)].*

(d.iii.) One-Dimensional Conducting Polymer Nanotubes: We have investigated the transport properties ofmetal-nanoparticle embedded benzene tetracarboxylic acid-doped polyaniline nanotubes for resistive switching (RS) applications. **Satyabrata Bera et al, Materials Today Nano 22, 100312(2023).**

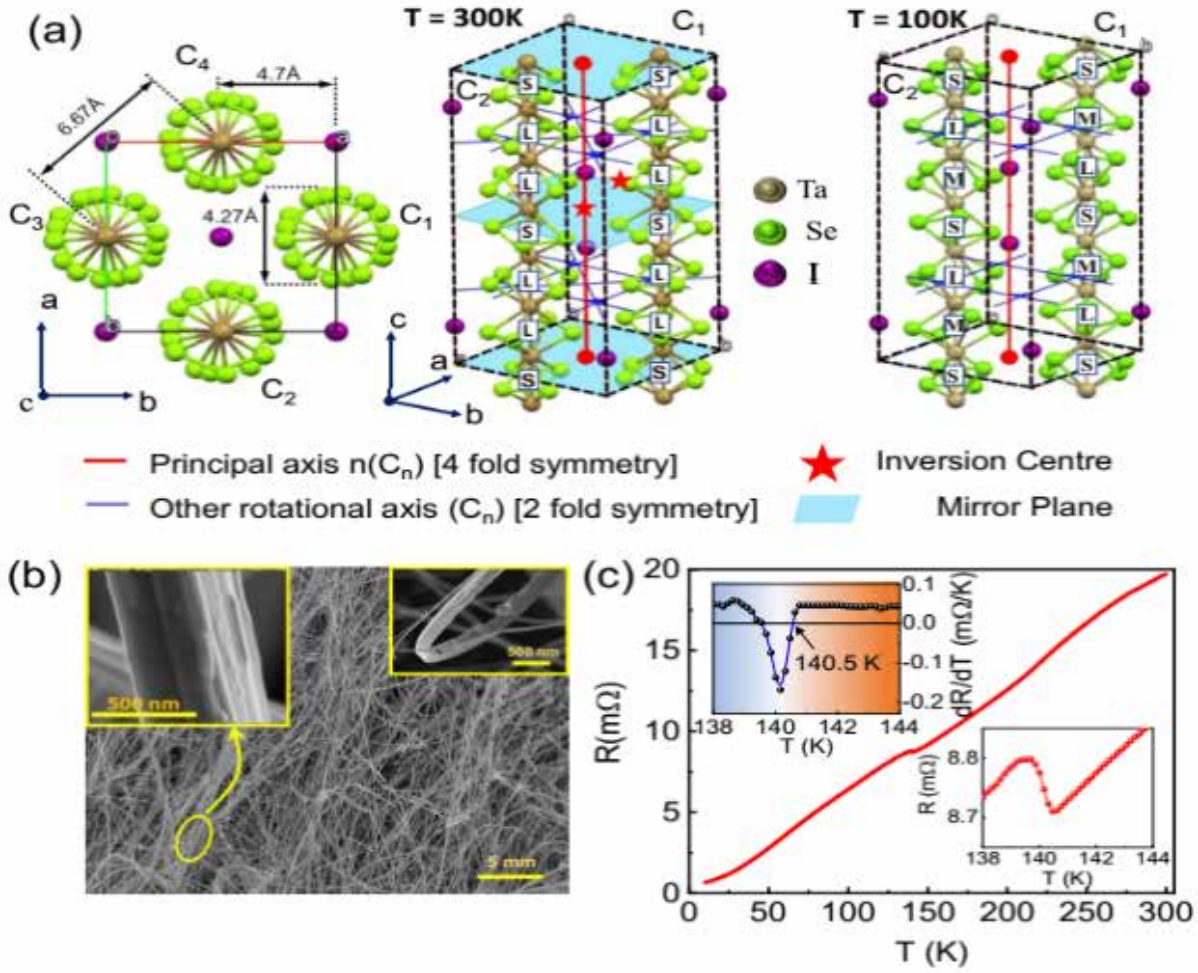


Figure 1. Temperature induced broken inversion symmetry $(TaSe_4)_3I$. (a) Pictorial representation of crystal structures obtained from SXRD data. The RT structure (at 300 K) shows 5 centers of inversion, whereas LT crystal structure (at 100 K) doesn't have any center of inversion. (b) SEM image of flexible wire-like single crystals. (c) The temperature dependent resistance reveals the inversion symmetry breaking structural phase transition at around T_S~ 145 K. Arnab Bera et al, 2023 (submitted).

Publications in Journals

1. Satyabrata Bera, Puspendu Das, Biswajit Das, Sanjoy Mondal, Praduman Kumar Gupta, Arnab Bera, Sk Kalimuddin, Sk Mustak Ahamed, Sirshendu Gayen, Mintu Mondal*, and Sudip Malik, *Charge Transport and Low-frequency conductance Noise in Metal-nanoparticle Embedded One- dimensional Conducting Polymer Nanotubes: Multiple Resistive Switching Phenomena*, *Materials Today Nano,* 22, 100312(2023). [IF: 13.364]
2. Satyabrata Bera, Suman Kalyan Pradhan, Md Salman Khan, Riju Pal, Buddhadeb Pal, Sk Kalimuddin, Arnab Bera, Biswajit Das, Atindra Nath Pal, *Unravelling the nature of spin reorientation transition in quasi-2D vdW magnetic material, Fe4GeTe2*, *Journal of Magnetism and Magnetic Materials* 565, 170257(2023). [IF: 3.097]
3. Arnab Bera, Mohan Kundu, Bikash Das, Sk Kalimuddin, Satyabrata Bera, Deep Singha Roy, Suman Kalyan Pradhan, Sanjib Naskar, Subodh Kumar De, Biswajit Das, and Mintu Mondal*, *Emergence of electric field-induced conducting states in single-crystalline MoTe2 nanoflakes and its application in memristive devices, Applied Surface Science*, 610, 155409(2023). [IF: 7.392]
4. Kalimuddin Sk, Biswajit Das, Nabamita Chakraborty, Madhupriya Samanta, Satyabrata Bera, Arnab Bera, Deep Singha Roy, Suman Kalyan Pradhan, Kalyan K Chattopadhyay, and Mintu Mondal*, *Nonlinear Coherent Light–Matter Interaction in 2D MoSe2 Nanoflakes for All-Optical Switching and Logic Applications*, *Advanced Optical Materials,* **10**, 2200791(2022). [IF: 10.05]

SATYANARAYAN MUKHOPADHYAY

Assistant Professor

(1) Cosmology of Particle Dark Matter, (2) Dark Matter Searches using Cosmological, Astrophysical and Laboratory-based Probes, (3) Elementary Particle Physics

Associate:

(1) D Ghosh, SRF (Institute), (2) A. Ghosh, RA-I and (3) S. Gope, SRF (Institute).

During the period 1st April, 2022 to 31st March, 2023, I have worked on the cosmology of particle dark matter. In the following I briefly summarize the publications during this period.

In the paper *PHYSICAL REVIEW D***106** no.4, 4 (2022), we obtained the non-thermal momentum distribution of DM produced at post-inflationary reheating – including the effects of inflaton mediated DM self-scatterings, and DM-SM elastic and inelastic scatterings. We found that these scatterings, which are necessarily present in these reheating scenarios but were not considered earlier, can alter the momentum distribution considerably, if the reheating temperature and inflaton mass are not very high. The observational consequence of this is in the constraints on light DM from structure formation. For example, the Lyman-alphaconstraints on the DM free-streaming length can be modified due to the scatterings by upto a factor of 40.

In the paper *PHYSICAL REVIEW D***106** no.10, 103515 (2022), we obtained the cosmological and astrophysical constraints on the self-thermalized scalar DM undergoing inelastic 3 DM to 2 DM transitions. We determined the coupled evolution of the DM temperature and density. Furthermore, using the constraints from CMBR anisotropies, BBN, Bullet cluster observations, and the equilibrium of the 3 to 2 processes, we determined, for a given DM mass, the upper and lower bounds on the DM temperature.

Publications in Journals :

1. Momentum distribution of dark matter produced in inflaton decay: Effect of inflaton mediated scatterings,A. Ghosh and S. Mukhopadhyay, *PHYSICAL REVIEW D***106** no.4, 4 (2022).[IF: 5.407]
2. Cannibal dark matter decoupled from the standard model: Cosmological constraints, A. Ghosh, S. Gope

and S. Mukhopadhyay,*PHYSICAL REVIEW D***106** no.10, 103515 (2022).[IF: 5.407]

Lectures Delivered

Invited talk at (1) IMSc, Chennai, (2) ICTS, TIFR Bengaluru, (3) RKMVERI, Belur Math, Howrah and (4) IACS, Kolkata.

SAURAV GIRI

Senior Professor and School Chair

Topological quantum materials, magnetoelectric coupling, multiferroics, and thermoelectric properties

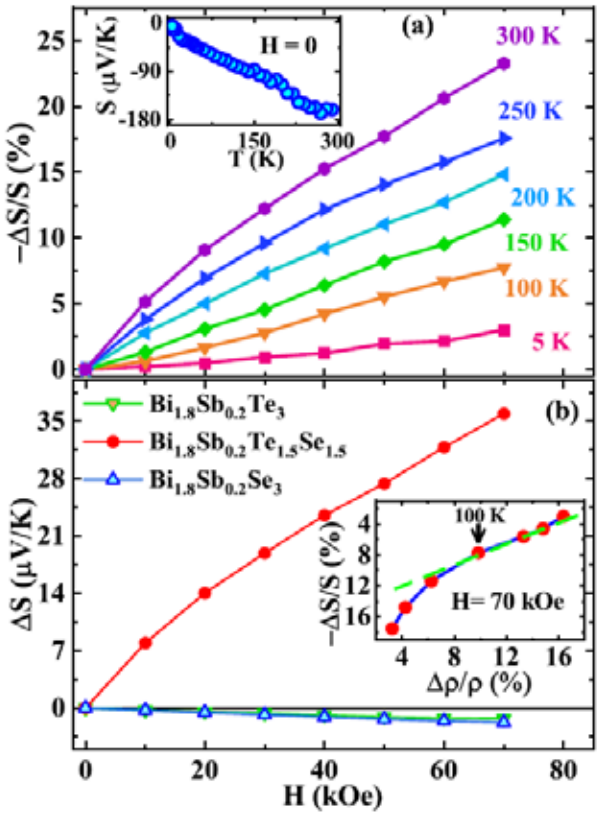
Associate:

(1)Pradeepta Kumar Ghose, SRF (Institute); (2) Tamal Kumar Dalui, SRF (INSPIRE); (3) AtanuRouchoudhury, SRF (CSIR-NET); (4) Shameek Mukherjee, SRF (Int.-PhD); (5) Arpan Hati, SRF (UGC-NET), (6) Debapriya Chatterjee JRF (CSIR-NET), (7) Dr. Moumita Das, NPDF (SERB)

Collaborators:

(1) S. Majumdar (IACS), (2) I. Dasgupta (IACS), (3) S. Chakraverty (INST, Mohali), (4) S. Panigrahi (NIT, Rourkela), (5) , K. Rossnagel (Kiel University, Germany)

High magneto-thermoelectric power at room temperature



Caption: *(a) ΔS/S (ratio of Seebeck coefficient) with magnetic field at selected temperatures. Inset depicts T variation of S. (b) Change in Seebeck coefficient (ΔS) with magnetic field. Inset highlights linearity in ΔS/S vs Δρ/ρ plot (ρ being resistivity) [Appl. Phys. Lett. 122, 022403 (2023)].*

Abstract: We report promising thermoelectric properties of $Bi_{1.8}Sb_{0.2}Te_{3-y}Se_y$ by tuning y. In contrast to the end compounds with y=0 and 3, huge magneto-Seebeck consequence is observed upto ~ 20 times for y=1.5, as highlighted in (b). The density of state at the Fermi level near room temperature correlates high Seebeck coefficient as well as magneto-Seebeck effect. High magneto-Seebeck effect at room temperature is promising for the application.

Publications in Journals :

1. Revealing spin-valve-like and exchange bias effect in $Co_3Sn_{1.9}In_{0.1}S_2$ crystal – A. Roychowdhury, P. K. Ghose, T. K. Dalui, S. Majumdar and S. Giri, Applied Physics Letters **122**,022403 (2023).[IF:4.0]
2. Effect of magnetic phase coexistence on spin-phonon coupling and magnetoelectric effect in polycrystalline $Sm_{0.5}Y_{0.5}Fe_{0.58}Mn_{0.42}O_3$ – S. Raut, S. Chakravarty, H. S. Mohanty, S. Mahapatra, S. Bhardwaj, A. M. Awasthi, B. Kar, K. Singh, M. Chandra, A. Lakhani, V. Ganesan, M. Mishra Patidar, R. K. Sharma, V. Srihari, H. K. Poswal, S. Mukherjee, S. Giri and S. Panigrahi, Physica B: Condensed Matter **651**, 414593 (2023). [IF:2.8]
3. Effect of reentrant spinglass-like states on Schottky Anomaly and exchange bias in polycrystalline $Sm_{0.5}Y_{0.5}Fe_{0.58}Mn_{0.42}O_3$ – S. Raut, S. Chakravarty, H. S. Mohanty, S. Mahapatra, S. Bhardwaj, A. M. Awasthi, B. Kar, K. Singh, M. Chandra, A. Lakhani, V. Ganesan, M. Mishra Patidar, R. K. Sharma, V. Srihari, H. K. Poswal, S. Mukherjee, S. Giri and S. Panigrahi, Journal of Magnetism and Magnetic Materials **563**, 169950 (2022).[IF:3.097].

4. Structural distortion driven enhancement of exchange bias effect in $Cu_{1-x}Co_xCr_2O_4$ – A. Chatterjee, J. K. Dey, J. C. Tseng, S. Majumdar and S. Giri - Journal of Magnetism and Magnetic Materials 562, 169770 (2022). [IF: 3.097]
5. Coexisting ferromagnetic component and negative magnetoresistance at low temperature in single crystals of the VdW material GaGeTe - A. Roychowdhury, T. K. Dalui, P. K. Ghose, S. K. Mahatha, N. Wind, K. Rossnagel, S. Majumdar and S. Giri, Journal of Solid State Chemistry **312**, 123106 (2022).[IF:3.3]
6. Ferroelectric order with a linear high-field magnetoelectric coupling in $Na_2Co_2TeO_6$: A proposed Kitaev compound – S. Mukherjee, G. Manna, P. Saha, S. Majumdar and S. Giri, Physical Review Materials **6**, 054407 (2022). [IF: 3.98]
7. Bulk Rashba Spin Splitting and Dirac Surface State in p-Type $(Bi_{0.9}Sb_{0.1})_2Se_3$ Single Crystal – P. K. Ghose, S. Bandyopadhyay, T. K. Dalui, J. Tseng, J. K. Dey, R. Tomar, S. Chakraverty, S. Majumdar, I. Dasgupta and S. Giri, *Physics Status Solidi (rapid research letter)***16**, 2100494 (2022).[IF:3.277]

Ph.D. Degree Awarded

(1) Jayjit Kumar Dey (IACS Deemed to be University)

Lectures Delivered

Invited talk at (1) Goa University.

SOUROV ROY

Senior Professor

Particle and Astro-particle Physics including Physics of Dark Matter, Neutrino Masses and Mixing, Daryogenesis via Lactogenesis, Physics of Axion-Lite particle

Associate:

(1) Ananya Tapadar (SRF), (2) Tanmoy Kumar (JRF), (3) PratickSarkar (JRF), (4) MainakChakraborty (NPDF), (5) Abhijit Kumar Saha (NPDF),(6) Arnab Paul (RA-I), (7) Tanushree Bhattacharya (BS-MS Project Student), (8)Rupsa De (BS-MSProjectStudent), (9) Sohini Pal (BS-MS Project Student).

Secluded dark sector and muon ($g-2$) in the light of fast expanding Universe:

In this work we have considered U (1) xU (1) gauge extension of the Standard Model (SM) and studied different phases of the cosmological evolution of a thermally decoupled dark sector such as leak-in, freeze-in, re-annihilation, and late-time annihilation in the presence of fast expansion. Due to the tree level kinetic mixing between two U (1) gauge bosons, the dark sector couples with the mu and tau flavored leptons of the standard model. We show that in our scenario it is possible to reconcile the dark matter relic density and muon (g-2) anomaly. For certain ranges of model parameters, relic density constraint of dark matter, constraint from muon (g-2) anomaly, and other cosmological, astrophysical constraints are satisfied.

(with S. Ganguly and A. Tapadar and published in JCAP (IF: 7.280)).

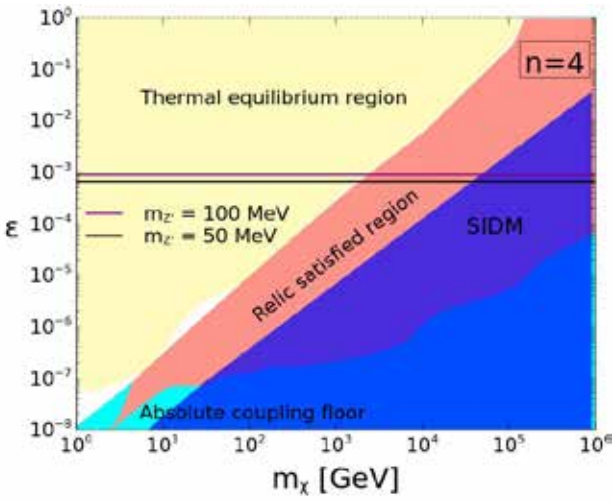


Figure caption: Constraints in the mχ − ε plane.

Imprints of Me V scale hidden dark sector at Planck data :

New light species can contribute to the number of effective relativistic degrees of freedom *Neff* at Cosmic Microwave Background (CMB) which is precisely measured by Planck. In this work, we consider an MeV scale thermally decoupled non -minimal dark sector and study the imprint of the dark sector dynamics on the measurement of *Neff* at the time of CMB formation. We have predicted the allowed region of model parameter space in the light of constraints arising from the measurements of both *Neff* and dark matter relic density by Planck. It turns out that the impact of the dark sector dynamics on *Neff* is significant in case of a non hierarchical mass spectrum of the dark sector particles.

(with S. Ganguly and A.K. Saha and published in Phys. Lett. B (IF:4.95)).

Baryon asymmetry and lower bound on right-handed neutrino mass in fast expanding Universe: an analytical approach:

The expansion rate of the Universe deviates from its standard value when the total energy density includes contribution from a new scalarfield apart from the radiation energy density. In the present study we derive analytical expressions for the solutions of set of Boltzmann equations using certain legible approximations and compare the results with those obtained through complete numerical analysis. Our study shows that starting from an identical particle physics model we will end up with a larger final baryon asymmetry in the nonstandard scenario. It hints towards the possible relaxation of the lower bound of the lightest right handed neutrino mass required to produce adequate asymmetry which is in agreement with current experimental data.

(with M. Chakraborty and published in JCAP (IF:7.280)).

Award and Recognition

» Honorary Associate Editor, Indian Journal of Physics

Publications in Journals

1. Imprints of MeV scale hidden dark sector at Planck data - S. Ganguly, S. Roy, A. K. Saha, *Phys. Lett. B*, 834, 137463 (2022).[IF:4.95]
2. Baryon asymmetry and lower bound onright-handed neutrino mass in fast expanding Universe: an analytical approach - M. Chakraborty, S. Roy, *JCAP* 11, 053 (2022).[IF:7.280]
3. Secluded dark sector and muon ($g-2$) in the light of fast expanding Universe - S. Ganguly, S. Roy, A. Tapadar, *JCAP*, 02, 044 (2023).[IF : 7.280]

Ph.D. Degree Awarded

(1) Heerak Banerjee (CU) and (2) Sougata Ganguly (IACS Deemed to be University)

Lectures Delivered

Invited talk at (1) India CMS online Lecture Series on "Motivations for Physics Beyond the Standard Model" (October 5, 2020) and (2) "Dark Matter essentials" (October 6, 2020) via Zoom online platform.

Sponsored Project

» Flavour Symmetric Grand ……. Universe (Mainak Chakraborty, NPDF)

» Starobinsky inflation ……. In NMSSM (Abhijit K. Saha, NPDF)

SUBHADEEP DATTA

Assistant Professor

Experimental Condensed Matter Physics: Molecular electronics, Nanospintronics, Nanomagnetism, Hybrid 2D materials (Graphene, 2D TMDCs, etc.)

Associate:

(1) Dr. A. Ghosh, (2) S. Maity, SRF (Inspire), (3) B. Das (Int. Ph.D.), (4) R. Pramanik, JRF, (CSIR), (5) T. Kundu, JRF (Inspire), (6) P. Kr. Hazra, JRF, (UGC), (7) P. Maji, JRF, (UGC), (8) S. Das, JRF, (UGC), (9) Dr. Koushik Dey, RA-I, (10) Dr. Mainak Palit, RA-I, (11) B. Pal (BS-MS), (12) Dr. S. Samanta, RA-I and (13) B. Karmakar (BS-Int. Ph.D.).

In our research group, we aim to inspect fundamental doubts on the presence of magnetism in two-dimension (2D). To explore magnetism at the atomic scale, we intend to combine Raman scattering and low-temperature transport measurements. Moreover, our group has initiated experiments which concern detection of pressure induced phase transition in few-layer magnetic systems. At the device level, we design, fabricate, and characterize micro-/nanoelectronic circuits with novel 2D/quasi-1D semiconductors.

In one study, we report anisotropic magnetodielectric (MD) coupling in layered van der Waals (vdW) antiferromagnetic (AFM) $FePS_3$ (Néel temperature T_N~ 120K) with perpendicular anisotropy. Above T_N, while dielectric response function along c-axis shows frequency dependent relaxations, in-plane data is frequency independent and reveals a deviation from phonon-anharmonicity in the ordered state, thereby implying a connection to spin-phonon coupling known to be indicative of onset of magnetic ordering. Significant positive out-of-plane magnetocapacitance below T_N, in contrast to a negative in-plane one, can be attributed to the anisotropic spin-texture of $FePS_3$. At low temperature (below 40 K), atypical anomaly in the dielectric constant is corroborated with temperature dependent DC and AC susceptibility. This has been explained in terms of the coexistence of different AFM orders, AFM-zigzag (AFM-z) and AFM-Néel (AFM-N), as confirmed by ab−initio calculations. Controlling relative strength of magnetodielectric coupling with magnetic anisotropy opens a strategy for tailoring the magnetic ground state with potential application to spintronic technologies. (Under review: arXiv:2208.02729)

In a related work, induced magnetic order in a topological insulator (TI) has been realized *via* stacked assembly of two-dimensional (2D) van der Waals (vdW) materials. Herein, we report the observation of spin-phonon coupling in the otherwise non-magnetic TI Bi_2Te_3, due to the proximity of $FePS_3$ (an antiferromagnet (AFM), T_N~ 120 K), in a vdW heterostructure framework. Temperature-dependent Raman spectroscopic studies reveal deviation from the usual phonon anharmonicity at/below 60 K in the peak position (self-energy) and linewidth (lifetime) of the characteristic phonon modes of Bi_2Te_3 (106 cm^{-1} and 138 cm^{-1}) in the stacked heterostructure. The Ginzburg-Landau (GL) formalism, where the respective phonon frequencies of Bi2Te3 couple to phonons of similar frequencies of FePS3 in the AFM phase, has been adopted to understand the origin of the hybrid magneto-elastic modes. At the same time, the reduction of characteristic TN of $FePS_3$ from 120 K in isolated flakes to 65 K in the heterostructure, possibly due to the interfacial strain, which leads to smaller Fe-S-Fe bond angles as corroborated by computational studies using density functional theory (DFT). Besides, our data suggest a double softening of phonon modes of Bi2Te3 (at 30 K and 60 K), which in turn, demonstrates Raman scattering as a possible probe for delineating the magnetic ordering in bulk and surface of a hybrid topological insulator. (Under review: arXiv:2212.12772)

Recently, we investigated room-temperature layer-dependent SCO and insulator-metal transition in $FePS_3$ under high pressure using micro-Raman scattering. Experimentally obtained spectra, in agreement with the computed Raman modes, indicates evidence of IMT of FePS3 started off with a spin-state transition from a high (S=2) to low spin state (S=0) with a thickness dependent critical pressure (P_c) which reduces to 1.45 GPa in 3-layer flakes compared to 10.8 GPa for the bulk counterpart. Phenomenologically, our results in few-layer flakes with strong structural anisotropy which enhances the in-plane strain with applied pressure can be understood by adopting Hubbard model and considering the spectral-range (bandwidth W) as a function of layer numbers and pressure with a power-law scaling. Reduction of the critical pressure for phase transition in few-layer vdW magnets to 1-2 GPa marks the possibility of using nano-enclosure fit for use in device electronics where the pressure is induced due to interfacial adhesion, like in vdW heterostructure or molecules trapped between layers, and thereby, avoiding the conventional use of diamond anvil cell. (Under review: arXiv:2303.01204)

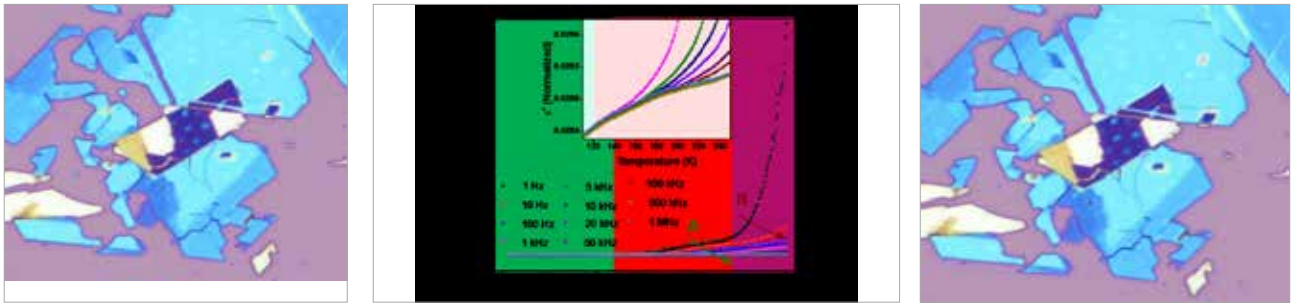


Figure 1: *(a) Microelectronic device fabricated on $FePS_3$ using e-beam lithography facility at IACS. Scale bar: 2 µm (b) Temperature dependent dielectric constant measurement on few-layer vdW magnet. (c) vdW heterostructure fabricated using home-built micromanipulated transfer stage. Scale bar: 20 µm*

Publications in Journals :

1. Metamagnetism and magnetocaloric properties in a van der Waals antiferromagnet CrOCl - B Das, S Ghosh, T Kundu, R Paramanik, S Maity, M Palit, S Das, Subhadeep Datta, *physica status solidi*, 22042 (2022).
2. Floquet Quantum Thermal Transistor - Nikhil Gupt, Srijan Bhattacharyya, Bikash Das, Subhadeep Datta, Victor Mukherjee, Arnab Ghosh, *Physical Review E* 106 024110 (2022). [Featured in Physics]
3. Magnetization reversal in chemically synthesized chains of permalloy nanospheres - Subhadeep Datta & Rajdeep Singh Rawat Pinaki Laha, Bipul Kumar Mahato, Rabindranath Gayen, *Applied Physics A* 128, 394 (2022).

Sponsored Project

» Wearable Bioelectronic …… Detection of Glucose, (Special Grant, SERB)

» Two-dimensional Magnets …… Magnetic Order, (CRG-SERB)

SUBHAM MAJUMDAR

Senior Professor

Magnetism, Strongly correlated electron system

Associate:

(1) Suman Mondal, SRF (Institute); (2) Md. Numan, SRF (CSIR-NET) ; (3) Prasanta Chowdhury, SRF (INSPIRE); (4) Tamali Roy, JRF (UGC-NET); (5) Snehashish Chatterjee (RA-I)

Collaborators:

(1) S. Giri (IACS), (2) I. Dasgupta (IACS), (3) S. Ray (IACS), (4) D. T. Adroja (Oxford)

We primarily focus on the electronic, magnetic and structural properties of solids showing strong electron-electron correlation. We try to get a comprehensive view of the materials using several experimental tools, such as, magnetization, Heat Capacity, Electrical Transport, Thermopower, Neutron Scattering, X-ray Diffraction, X-ray Absorption Spectroscopy, and so on. The work performed during 2022-23 can be summarized as follows.

We addressed the simultaneous metal-insulator transition (MIT) and antiferromagnetic ordering in the novel pyrochlore iridate $Eu_2Ir_2O_7$ by combining x-ray absorption spectroscopy, x-ray and neutron diffractions. The temperature dependent powder x-ray diffraction shows a clear anomaly in the Ir-O-Ir bond angle and Ir-O bond length at the onset of MIT. From the x-ray absorption near edge structure (XANES) spectroscopic study of Ir-L_3 and L_2edges, the effective spin-orbit coupling is found to be intermediate, at least quite far from the strong atomic spin-orbit coupling limit. Powder neutron diffraction measurement is in line with an *all-in-all-out* magnetic structure of the Ir-tetrahedra in this compound, which is quite common among rare-earth pyrochlore iridates. The sharp change in the Ir-O-Ir bond angle around the MIT possibly arises from the exchange striction mechanism, which favors an enhanced electron correlation via weakening of Ir-Ir orbital overlap and an insulating phase below MIT.

We have investigated the chiral magnetoelectric compound Ni_3TeO_6 through temperature-dependent synchrotron-based powder x-ray diffraction and x-ray absorption spectroscopy. Our work provides direct evidence for the exchange-striction in the material around the concomitant onset point of collinear antiferromagnetic and the magnetoelectric phases. The x-ray absorption near edge spectra and x-ray photoelectron spectra show that the sample consists of both Ni^{2+} and Ni^{3+} ions in the lattice. Additionally, a minority Te^{4+} state is found to coexist with the majority Te^{6+} state, which may arise from the charge disproportionation between Ni and Te ions ($Ni^{2+} + Te^{6+} \Leftrightarrow Ni^{3+} + Te^{4+}$). This mixed valency in the metal ions and the exchange-striction may be attributed to the observed magnetoelectric effect in the system.

We have observed multiple step-like jumps in a Dy-Fe-Ga-based ferrimagnetic alloy in its magnetic hysteresis curve at 2 K. The observed jumps are found to have a random character with respect to their magnitude and the field position, and the jumps do not correlate with the ramp rate of the field. The distribution of jump size follows a power law variation indicating the scale invariance nature of the

jumps. We have invoked a simple two-dimensional random bond Ising-type spin system to model the dynamics. The observed step-like jumps under a varying magnetic field is turned out to be associated with the self-organized criticality of the system.

Publications in Journals

1. Interplay between structural, magnetic, and electronic states in the pyrochlore iridate $Eu_2Ir_2O_7$ - M Das, S Bhowal, J Sannigrahi, A Bandyopadhyay, A Banerjee, G Cibin, D Khalyavin, N Banerjee, D T Adroja, I Dasgupta and S Majumdar, *Phys. Rev. B* **105**, 134421 (2022).[IF:3.908]
2. Observation of Griffiths-like phase in the quaternary Heusler compound NiFeTiSn- S Chatterjee, S Giri, S Majumdar, P Dutta, P Singha and A Banerjee, *J. Phys.: Condens. Matter* **34**, 295803 (2022).[IF:2.745]
3. Observation of magnetocaloric and magneto-electric anomalies in RCuO family of layered oxides- A Banerjee and S Majumdar, *J. Mag. Mag. Mater.***556**, 169352 (2022).[IF:3.097]
4. Magnetic Properties, Magnetocaloric and Magnetoresistance Effects in Gd_5In_3 and Tb_5In_3 Compounds- S Mondal, P Dutta, S Chatterjee, A Banerjee, S Giri and S Majumdar, *Phys. Status Solidi B,***259**, 2200200 (2022).[IF:1.782]
5. Evidence of exchange striction and charge disproportionation in the magnetoelectric material Ni_3TeO_6- Md Numan, G Das, Md S Khan, G Manna, A Banerjee, S Giri, G Aquilanti and S Majumdar, *Phys. Rev. B* **106**, 214437 (2022).[IF:3.908]
6. Self-organized criticality of magnetic avalanches in disordered ferrimagnetic material- S Mondal, M Karmakar, P Dutta, S Giri, S Majumdar and R Paul, *Phys. Rev. E* **107**, 034106 (2023).[IF:2.707]

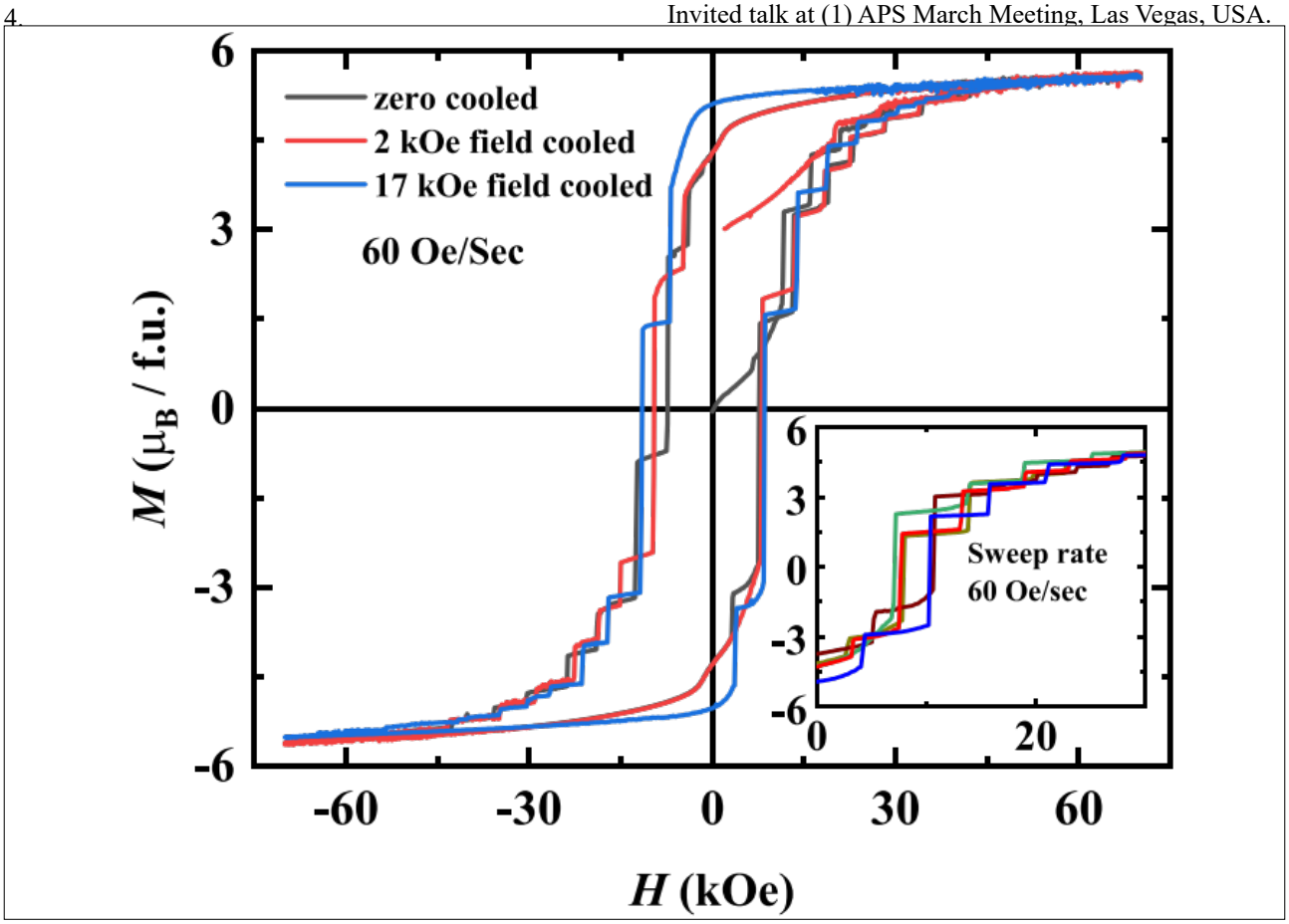
Ph.D. Degree Awarded

(1) Snehashish Chatterjee (IACS Deemed to be University)

(2) Manjil Das (IACS Deemed to be University).

Lectures Delivered

Invited talk at (1) APS March Meeting, Las Vegas, USA.



*The four-quadrant magnetization (**M**) versus magnetic field (**H**) loops at 2 K for the alloy $DyFe_{2.5}Ga_{0.5}$ after the sample being cooled in different magnetic fields. The sharp metamagnetic jumps are clearly visible. The inset depicts the fifth leg of the hysteresis loop recorded at 2 K for different cycles. [Phys. Rev. E***107**, 034106 (2023)].*

SUMANTA CHAKRABORTY

Assistant Professor

Black Hole Physics, Gravitational Waves, Quantum Physics in Curved Spacetime, Cosmology, Theories beyond general relativity, Quantum aspects of gravity.

Associate:

(1) S. Biswas, JRF (Institute), (2) V. Mondal, JRF (INSPIRE), (3) K. Das, JRF (CSIR) and (4) R. Pal, JRF (UGC), (5) R. N. Raveendran, RA-I (Institute)

I have worked on theoretical as well as observational and numerical aspects of gravitational Physics. In particular, I have worked on new frontiers in gravitational Physics, e.g., study of quantum effects near the horizon and its influence on the quasi-normal mode spectrum, as well as the stability of the regular black holes and wormholes in connection to scalar perturbations. Besides, I have also been involved in the study of memory effect and how to distinguish a black hole from a wormhole spacetime using the same. Intriguingly, for the first time we have solved the gravitational perturbation in a wormhole background and have studied its stability. I have also implemented a new numerical technique to compute quasi-normal modes in a wormhole background. It turns out that wormholes not only affect the gravitational wave signal, but also the shadow structure. I have also demonstrated that the shadow of the supermassive compact object at the center of our own galaxy actually favors wormhole spacetimes. The following question: Why astrophysical black holes do not have an electric charge, have been answered to a great satisfaction by myself and collaborators. Finally, I have presented the most general variational problem in the context of action formalism of general relativity at length.

Awards & Recognitions

» Young Scientist Award, Central Calcutta Science and Culture Org for youths and DST, Govt. of WB.

Publications in Journals

1. Strong cosmic censorship conjecture for a charged BTZ black hole – Chiranjeeb Singha, Sumanta Chakraborty and Naresh Dadhich, *Journal of High Energy Physics*, **2206**, 028 (2022).[IF:5.810]
2. Scalar perturbations around rotating regular black holes and wormholes: Quasi-normal modes, ergoregion instability and superradiance – Edgardo Franzin, Stefano Liberati, Jacopo Mazza, Ramit Dey and Sumanta Chakraborty, *Physical Review D*, **105**, 124051(2022).[IF:4.568]
3. Weiss variation for general boundaries – Justin C. Feng and Sumanta Chakraborty, *General Relativity and Gravitation*, **54**, 67 (2022).[IF:2.840]
4. Implications of the quantum nature of the black hole horizon on the gravitational-wave ringdown – Sumanta Chakraborty, Elisa Maggio, Anupam Mazumdar and Paolo Pani, *Physical Review D*, **106**, 024041 (2022). [IF:4.568]
5. Constraining extra dimensions using observations of black hole quasi-normal modes – Akash K. Mishra, Abhirup Ghosh and Sumanta Chakraborty, *European Physical Journal C*, **82**, 820 (2022).[IF:4.994]
6. Hunting extra dimensions in the shadow of Sgr A* – Indrani Banerjee, Sumanta Chakraborty and Soumitra SenGupta, *Physical Review D*, **106**, 084051 (2022). [IF: 4.568]
7. Gravitational wave memory in wormhole spacetimes – Indranil Chakraborty, Soumya Bhattacharyya and Sumanta Chakraborty, *Physical Review D*, **106**, 104057 (2022).[IF:4.568]
8. Echoes from braneworld wormholes – Shauvik Biswas, Mostafizur Rahman and Sumanta Chakraborty, *Physical Review D*, **106**, 124003 (2022).[IF:4.568]
9. Shielding a charged black hole – Justin C. Feng, Sumanta Chakraborty and Vitor Cardoso, *Physical Review D*, **107**, 044050 (2023).[IF:4.568]

Lectures Delivered

Invited talk at (1) IISER-Mohali, (2) Visbharati University, (3) IAGRG School (6 lectures), (4) ICTS, Bangalore, (5) IUCAA, Pune, (6) CUSAT, Kerala, (7) Max-Planck Institute for Physics, Munich, Germany, (8) Szczecin University, Poland, (9) Czech Astronomical Institute, Prague, Czechia, (10) XIIth FTAG, BIT MEsra, Ranchi,

(11) IIT Gandhinagar, (12) SGT University, (13) Beijing, China (3 online talks), (14) 12th Iberian GW Meeting, Portugal (online) and (15) University of Padova, Italy.

UTPAL CHATTOPADHYAY

Senior Professor

Elementary Particle Theory: Physics beyond the standard model, particularly involving physics of low energy supersymmetry. Phenomenological implications of various supersymmetry breaking mechanisms. Constraining supersymmetric models via dark matter analyses.

Associate:

(1) Md. Isha Ali, SRF,CSIR ; (2) Joydeep Roy, RA-I, IACS(3) N. Rajeev, RA-I, IACS

Collaborators:

(1)Asesh K Datta (HRI, Allahabad); (2) Manimala Chakraborti (Warsaw, Poland), (3) Samadrita Mukherjee (TIFR), (4) Abhaya Kumar Swain (Witwatersrand University, South Africa)

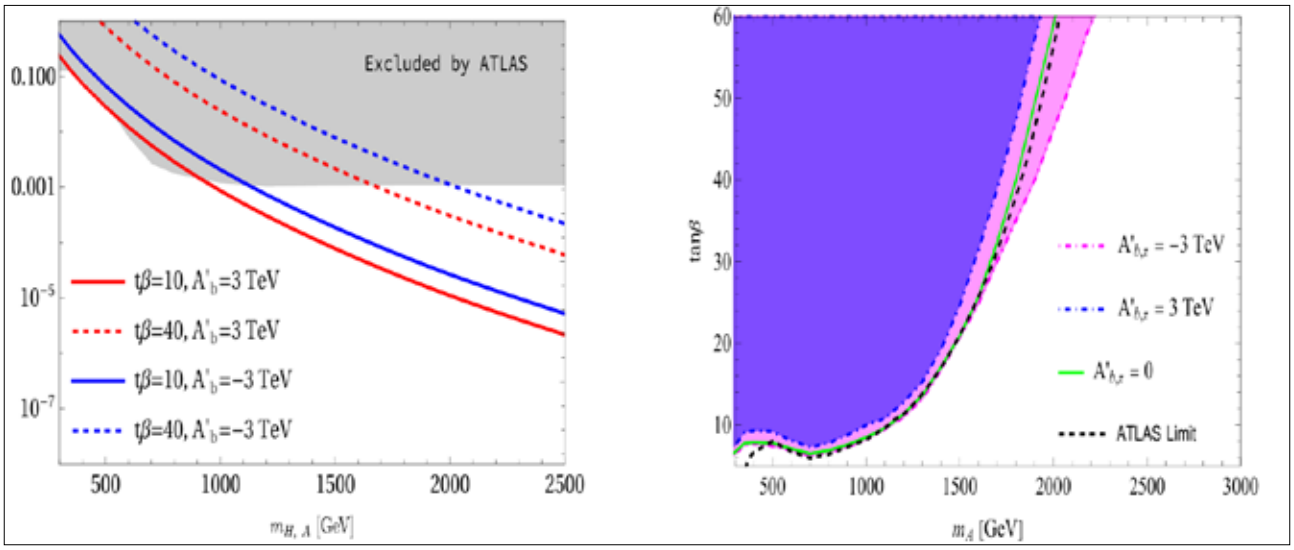
Muon and Electron (g −2) Anomalies with Non-Holomorphic Interactions in MSSM : Accommodating differing signs of the supersymmetric contributions to (g-2) values of muon and electron can be difficult in the Minimal Supersymmetric Standard Model (MSSM) in the context of Fermilab muon (g-2) data and electron (g-2) result as obtained from the fine-structure constant (α) measurement through 133-Cs matter-wave interferometry. The latter would mean a negative SUSY contribution to (g-2) for electron. The issue of simultaneously satisfying the two leptonic magnetic moments does not arise for the positive (g-2) of electron case coming from a 87-Rb based experiment to measure α . The results of the two α-experiments disagree among themselves. A future measurement may resolve the anomaly. We focus on the case of negative (g-2) for electron to explore MSSM models with non-holomorphic (NH) soft terms. A large and negative non-standard trilinear coupling A_e' value accommodates the above via bino-selectron loop contributions. On the other hand, large values of A_e' is allowed via the highly accommodative charge-breaking constraint corresponding to a four vacuum expectation value scenario where one adds the contributions from the soft terms with A_e' on the top of the terms of charge breaking potential of MSSM. Additionally, there is also radiative enhancement of electron Yukawa coupling due to A_e'. Apart from the two leptonic magnetic moments, we consider dark matter constraints via a higgsino type of lightest supersymmetric particle while having a large Wino mass and take the left and right slepton mass parameters for the first two generations to be the same. We identify the available parameter space while also satisfying the ATLAS data from slepton pair production as well as the same from compressed higgsino searches.

(With Md. I. Ali, M. Chakraborti and S. Mukherjee; Published in EPJC, 2023)

Associated production of heavy Higgs bosons with a bottom anti-bottom quark pair in the Nonholomorphic MSSM and LHC searches : In the NonHolomorphic Supersymmetric Standard Model (NHSSM), the Yukawa couplings of the bottom quark (y_b) and the tau lepton (y_τ) might receive substantial supersymmetric (SUSY) radiative corrections which have prominent dependencies on the NHSSM-specific trilinear soft parameters, A_b' and A_τ' , respectively, in addition to their well-known dependence on tanβ as is already present in the Minimal SUSY Standard Model (MSSM). We study to what extent these could affect the production cross sections of the heavy Higgs bosons (H and A) in association with a pair of b-quarks and their decay branching ratios, in particular, to a $\tau\tau^-$ pair and compare them with those obtained in the MSSM. Requiring compliance with the recently observed upper bounds on the product of their total cross-section and the branching ratio to $\tau\tau^-$ at the 13 TeV run of the Large Hadron Collider (LHC), with data worth 139 fb^{-1}, results in an altered exclusion region in the customary m_A −tanβ plane in the framework of the NHSSM when compared to what is derived by the LHC experiments within an MSSM setup. Such alterations are estimated to be pronounced only for large tanβ (≥40) and for large, negative A_b' when one finds a reinforced exclusion of the m_A −tanβ plane with an excluded m_A value larger by ≈350 GeV, compared to the MSSM case, at tanβ=60. On the other hand, the maximum

relaxation in m_A , for a similarly large but positive A_b' , barely exceeds ≈100 GeV as a result of complementary variations in production cross-sections and decay branching fractions of the heavy, neutral Higgs bosons.

(With A. K. Datta, S. Mukherjee and A.K. Swain; Published in JHEP, 2022)



Yied vs heavy/pseudoscalar Higgs mass and tanbeta vs pseudoscalar Higgs mass for varying non-standard trilinear couplings

Standard model effective field theory analysis on charged lepton flavor violating processes in view of B decays : Charged lepton flavor violation processes are very clear and important proof of physics beyond the Standard Model. In this work we have considered a few such processes in B-meson decays from the perspective of Standard Model effective field theory. We have found the relevant operators responsible for Lepton Flavor Violating (LFV) B-meson Decays and analysed their effect on many other LFV processes in a model-independent way. In view of several proposed experiments to study charged LFV processes, we have also commented on the indirect constraints on such operators coefficients.

(With J. Roy, N. Rajeev and Md. I. Ali: work in progress)

Publications in Journals

1. Associated production of heavy Higgs bosons with a b anti b pair in the nonholomorphic MSSM and LHC searches - U. Chattopadhyay, A.K. Datta, S. Mukherjee and A.K. Swain, *JHEP***08,** 113 (2022).[IF:5.81]
2. Muon and electron (g−2) anomalies with non-holomorphic interactions in MSSM - Md. Isha Ali, M. Chakraborti, U.Chattopadhyay and S. Mukherjee, *Eur. Phys.J.C **83**, 60* (2023*)*.[IF:5.407]
3. Phenomenological analyses with nonholomorphic soft supersymmetry breaking interactions – U. Chattopadhyay and S. Mukherjee, Indian Journal of Physics (published as a review paper in a peer reviewed journal online on March 31, 2023), https://doi.org/10.1007/s12648-023-02593-3, To appear within a special issue of Particle Physics in IJP Edited by D.K. Ghosh and S. Roy.[IF:1.78]

Lectures Delivered

Invited talk at (1) Institute of Physics, Bhubaneswar

Emeritus Professors & Senior Scientists

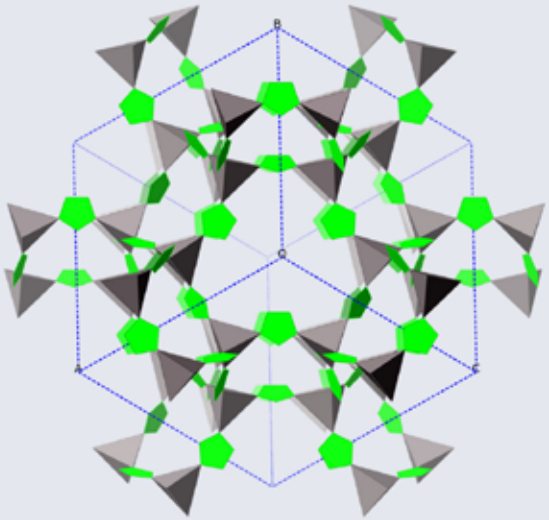
EP&SS

$C_8H_{10}Im_2N_4Zn$

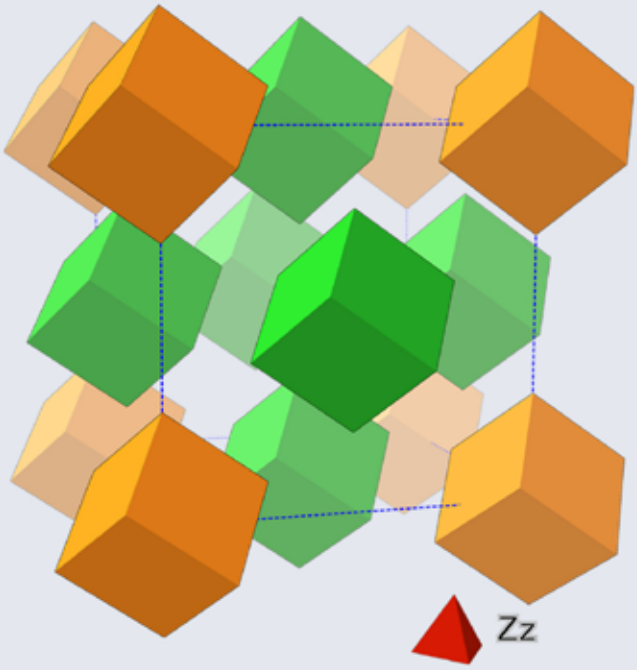
ZIF8 (sodalite analogue)
A Zeolitic Imidazolate Framework material.
In this polyhedral view, the green pentagons are the imidazolate groups (C3N2H3) and the grey tetrahedra are ZnN_4 groups.

Im

Zn



Face-Centred Cubic Model, using colour-coded rotated cubes



Structure Type: Crystal
Chemical Formula: Zz Si_8
Display Formula: Zz_{14} Si_{168}
Crystal System: Triclinic
a = b = c: 6.0000 Å
α = β = γ: 90.000°
Asymmetric Unit: 9 sites
Site Density: 0.1667 sites/Å³
Visible Atoms: 182
Cell Volume: 216.000 Å³
Density: 6.9104 g/cm³

DIPANKAR CHAKRAVORTY FASc, FNA, FTWAS

Emeritus Professor, INSA Honorary Scientist

Nanomaterials, Multiferroics, Nanocomposites, Ion conduction

Silver–Nickel Bimetallic Nanowire-Based Transparent Thin-Film Spin-Glass Systems for Magnetic Sensor Applications: ACS Applied Nano Materials, 2022 : Silver–nickel bimetallic nanowire-containing transparent thin films (TFs) were investigated for their electrical and magnetic properties. A facile sol-gel synthesis followed by electrodeposition process were adopted for the fabrication of these TFs. The state-of-the-art characterization techniques including X-ray diffraction and X-ray photoelectron spectroscopy were utilized to characterize the constituent elements whereas scanning electron microscopy and transmission electron microscopy provided the details of microstructural features.These results correlated the microstructure dependent electrical and magnetic properties.The magnetic field-dependent charge transport mechanism explained the magnetoelectric coupling and spin transport properties as a function of electric and magnetic fields. A thorough study of magnetization dynamics, phase transition, magnetodielectric effect were probed. Zero field cooled (ZFC) and field cooled (FC) studies indicated the existence of spin glass (SG) phase which was further substantiated following the Scaling law and Vogel–Fulcher law. A realistic circuit model with contributions from each component as a function of the magnetic field was also discussed considering the Nyquist plot. This study offers useful insights on bimetallic nanowire-based TFs leading to the possible fabrication of magnetic sensor devices.

Studies of magnetization dynamics in sol-gel derived nanocomposites containing transition metal ions and mesoporous templates: Journal of Non-Crystalline Solids: X, 2023 : Silica-based nanoglasses containing nickel and cobalt ions confined within mesoporous matrix of SBA-15 and mesoporous alumina were synthesized by a sol-gel method.The effect of transition ions and mesoporous template of these nanocomposites were investigated to understand their microstructure, magnetization dynamics, magnetic memory effects, and relaxation dynamics of spin glass phase near transition temperatures using state-of-the-art characterization techniques such as XRD, TEM and SQUID.The temperature and frequency dependent dielectric properties and the Nyquist diagram were also studied. The effects of transition ions and mesoporous matrices on the memory effect and relaxation dynamics of spin-glass phases are described folowing scaling law and Vogel-Fulcher's law.The mechanisms responsible for the observed properties of these nanoconfined amorphous systems have been systematically elucidated. Polarization mechanisms have also been extensively studied as a function of temperature and frequency.This work will be of fundamental and technical interest in achieving a better understanding of the magnetization dynamics and dielectric properties of nanoglass systems and supporting the tuning and fabrication of advanced functional nanomaterials.

Publications in Journals :

1. Silver–Nickel Bimetallic Nanowire-Based Transparent Thin-Film Spin-Glass Systems for Magnetic Sensor Applications - A.Maity, S. Samanta and D. Chakravorty; *ACS Applied Nano Materials*, **5**(10), 14551-14560 (2022).[IF:6.14]

2. Studies of magnetization dynamics in sol-gel derived nanocomposites containing transition metal ions and mesoporous templates - A. Maity, S. Samanta and D. Chakravorty;*Journal of Non-Crystalline Solids: X*, **17**, 100163, (2023).[IF:4.88]

Ph.D. Degree Awarded

(1) Anupam Maity (IACS Deemed to be University)

Lectures Delivered

Invited talk at (1) JNU, Delhi and (2) Science Day Lecture IAPT Eastern Zone.

BRINDABAN CHANDRA RANU, FASc, FNA

INSA Honorary Scientist

Green synthesis

The organoselenides have received much interest due to their applications in medicinal chemistry, biology, material science and organic synthesis. We have presented here a comprehensive and updated review on the recent developments of the synthesis of organoselenium compounds under solvent free condition by using conventional as well as modern techniques such as ball milling, visible light- and microwave irradiation. The reactions in the absence of solvent under heating condition and at room temperature/below room temperature have been discussed. The green aspects of these procedures have been highlighted. The significant advantages of solvent free reactions often include enhanced rate of reaction, improved selectivity, low energy consumption, reduced chemical waste and higher yield of products.

Cross dehydrogenative coupling (CDC) reactions have become a convenient synthetic strategy for the synthesis of various (het)aromatic scaffolds. In recent times ball milling has emerged as a powerful tool to perform reactions in a greener way. The current review highlights various applications of cross dehydrogenative coupling reactions under ball milling towards synthesis of useful molecules in a more efficient and convenient manner.

Benign and inexpensive metal catalyzed carbon-carbon and carbon-heteroatom bond formation reactions are of much interest in organic synthesis as these reactions provide green and cost effective routes. This account summarizes our recent contributions on the construction of carbon-carbon and carbon-heteroatom bonds using benign metal catalysts. A number of carbon-heteroatom bond formations such as C–N, C–O, C–S, C–Se, C–Te and C–P has been discussed. Mechanistic insights of several reactions are also reported.

This book chapter focused on the preparation of magnetic metal nanoparticles and their application for carbon-heteroatom bonds such as C–N, C–O, C–S, C–Se and C–Te, forming reactions and synthesis of related heterocyclic compounds. The advantages of using magnetic nanoparticles as catalyst over other homogeneous and heterogeneous ones have been highlighted. The major advantages include easy separation from the reaction mixtureby using an external magnet without any need for centrifugation, filtrationor other tedious workup processes and recyclability of the catalyst for several runs without appreciable loss of activity. In addition, large surface area and superb distribution of magnetic nanoparticles in different solvents increase their catalytic efficiency.

A variety of procedures for the carbon-nitrogen, carbon-oxygen, carbon-sulfur and carbon-selenium bond formation using copper nanoparticles in greener conditions have been highlighted in this book chapter. The synthesis of several heterocyclic compounds of biological importance has also been reported using these protocols.

In collaboration with Professor K. Panda, Calcutta University, a US patent has been obtained on in-vivo probe for real time longitudinal monitoring of inducible nitric oxide synthase in living cells and animals, that is of much potential.

Awards/Honours/Recognitions :

» Chair (Honorary), Laboratory of Advanced Materials, Green Methods & Biotechnology Chemical Engineering Institute; Ural Federal University,Yekaterinburg, Russian Federation

Patent Filed :

1. In-vivo Probe for Real Time Longitudinal Monitoring of Inducible Nitric Oxide Synthase in Living Cells and Animals – K. Panda, L.Nagpal, B C Ranu, US Patent no. US 11,591,476B2, PCT no. PCT/IB2017/057130

List of Publications :

1. Solvent Free Synthesis of Organoselenides under

Green Condition – S. Dutta, A. Saha, B. C. Ranu, *New J. Chem*, **2022,** 46, 21489-21518; DOI: 10.1039/D2NJ04068A (invited article) (IF: 3.925)

2. Mechanochemically Induced Cross Dehydrogenative Coupling Reactions under Ball Milling –I. N. Egorov, A. Mukherjee, S. Santra, D. S. Kopchuk, I. S. Kovalev, Y. Liu, G. V. Zyryanov, A.Majee, O. N. Chupakhin, and B. C. Ranu, *Adv. Synth. Catal*., **2022**, 364, 2462-2478. DOI:10.1002/adsc.202200296 (IF: 6.058)
3. Benign Metal Catalyzed Carbon-Carbon and Carbon-Heteroatom Bond Formation - B. C. Ranu, L. Adak, N. Mukherjee, and T. Ghosh, *Synlett,***2023**, *34*, 601-621. DOI: 10.1055/a-1904-0152 (invited article for a special issue on Chemical Synthesis and Catalysis in India) (IF: 2.454)

Publications in Books/Book Chapter/ Monographs:

1. Magnetic Metal Nanoparticle Catalyzed Carbon-Heteroatom Bond Formation and Synthesis of Related Heterocycles- B. C. Ranu, L. Adak, N. Mukherjee T. Ghosh, Magnetic Nanocatalysis, ed, R. Varma and B. Banerjee, De Gruyter, Germany, **2022**, pp 1-48. Doi.org/10.1515/9783110730357.001.
2. Copper Nanoparticles catalyzed carbon-heteroatom bond formation and synthesis of related heterocycles by greener procedures – S. Ahammed and B. C. Ranu, in Green Bond Forming Reactions-Carbon-Carbon and Carbon-Heteroatom" edited by R.K. Sharma and B. Banerjee, De Gruyter, Germany, **2022,** pp1-32, Physical Sciences Reviews [Online] 2022. DOI: 10.1515/psr-2021-0083 | https://doi.org/10.1515/9783110797428-001.

Sponsored Project :

» INSA Honorary Scientist fellowship.

Lectures Delivered

Invited talk at (1) Panjab University, (2) Kumayun University, Nainital, (3) Ural Federal University, Yekatarinburg, Russia and (4) IIT-Roorkee

SUBRATA GHOSH, FASc, FNA

INSA Senior Scientist

Synthesis of bioactive complex natural products.

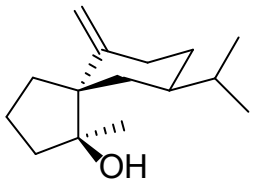
The extract of the Indian medicinal plant *Nardostachys jatamansi* has long been used extensively for the treatment of a number of disorders including epilepsy, hysteria, and convu1sions. Spirojatamol, a sesquiterpene, has been isolated from the extract of this plant. Spirojatamol possesses 5-isopropyl-2-methylene spirobicyclo[5.4] decane skeleton. Few years back we have developed a spiro cyclopentannulation strategy starting from a cyclic ketone. We have now extended this strategy for the construction of the core structure of spirojatamol starting from R-(+) carvone employing copper (I)-catalyzed [2+2] photocycloaddition and acid catalyzed rearrangement of the cyclobutane ring as the key steps.

Sponsored Project :

» Total Synthesis of Bio-active ..... Natural Products.

Lectures Delivered

Invited talk at (1) IIT-Indore



ASWINI GHOSH, FNA, FASc

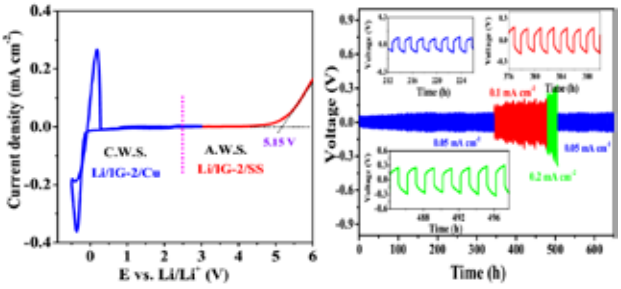
Raja Ramanna Fellow

Several perovskites were investigated to explore the fundamental aspects of relaxation mechanism of charge carriers. Quasi-solid state storage devices, fabricated using polymer gel-electrolytes, provided high specific capacity and capacity retention. Correlation of structure and ion transport of phosphate glasses was studies using magic angle spinning nuclear magnetic resonance (MAS-NMR), Raman spectroscopy and impedance spectroscopy

Associate:

(1) Subir Kumar Patla (SERB-NPDF), and (2) Anirban Chakrabarti (SERB-NPDF) and (3) Rupayan Bhattacharya (BS-MS student)

a) **Ion Dynamics and Relaxation in Cross-Linked Ionogels and Perovskites:** Highly Li^+-ion conductive and stable cross-linked network based flexible ionogels were prepared using the thermal polymerization of poly(ethylene glycol) diacrylate in the presence of an ionic liquid electrolyte composed of 1-ethyl-3-methylimidazolium tetrafluoroborate ionic liquid and lithium tetrafluoroborate salt. The interfacial stability, temperature dependent ionic conductivity, and lithium transference number of these ionogels were investigated. The all-quasi-solid-state energy storage device such as a lithium-metal battery fabricated with the ionogels delivered a high discharge specific capacity of 156 mA h g^{-1} at a current rate of C/20 at 30 °C and achieves 83% capacity retention at the 50th cycle.



b) 2D layered $Cs_2PbI_2Cl_2$ Ruddlesden-Popper halide perovskite as well as bimetallic 2D layered $Rb_4Ag_2BiBr_9$ perovskite was investigated to explore fundamental aspects of ionic conduction and relaxation mechanism over wide temperature and frequency ranges. The piezoelectric and ferroelectric properties of these perovskites were also explored. Several experimental techniques, were employed to investigate the nuances of ionic conduction and relaxation mechanisms and the results were corroborated using different theoretical models, such as the Maxwell-Wagner equivalent circuit model, the modified power law model, the Havrilliak-Negami model and the Kohlrausch-Williams-Watts model.

C) **Correlation of Structure and Ion Transport in Glasses**: Structure of phosphate glasses containing different concentrations of sodium salt (NaCl) was studied using magic angle spinning nuclear magnetic resonance (MAS-NMR) and Raman spectroscopy. The temperature dependent ionic-conductivity of these phosphate glasses was investigated using impedance spectroscopy. Influence of sodium salt on the correlation of structure and ion transport in phosphate network was established. In particular, irrespective of the temperature, sodium-ion dynamics showed that the mean-square displacement $\langle R^2(t_p)\rangle$ of sodium ions decreased with increasing NaCl concentration up to 10 mol % and then increased with a further increase in NaCl concentration.

Publications in Journals :

1. Highly ion conductive cross-linked ionogels for all-quasi-solid-state lithium-metal batteries, P. Pal and A. Ghosh, APL Energy, **1**, 016102 (2023).
2. Onset of vacancy-mediated high activation energy leads to large ionic conductivity in two-dimensional layered $Cs_2PbI_2Cl_2$ Ruddlesden-Popper halide perovskite, N. H. Makani, A. Sahoo, P. Pal, T. Paul, L. S. Tanwar, M. Singh, A. Ghosh, R. Banerjee, Physical Review Materials, **6**, 115002 (2022).
3. Correlation of structure and ionic-conductivity in phosphate glass using MAS-NMR and impedance spectroscopy: Influence of sodium salt, I. Mandal, S. R. Keshari, L. Lodhi, K. K. Dey, M. Ghosh, A. Ghosh, A. R. Allu, Physical Review Materials, **6**, 115403 (2022).

4. High ionic conduction and polarity-induced piezoresponse in layered bimetallic $Rb_4Ag_2BiBr_9$ single crystals, M. Singh, T. Paul, P. Pal, A. Sahoo, L.S. Tanwar, N.H. Makani, A. Ghosh, R. Banerjee, J. Phys. Chem. C, **126**, 21810 (2022).

5. Photoelectrochemical water oxidation over novel semiconducting zinc-based metal–thiolate framework,A. Ghosh, S. Shyamal, A. Palui, R.N. Manna, S. Mondal, M. Jana, A. Ghosh, A. Bhaumik, ACS Applied Materials & Interfaces, **14**, 37699 (2022).

Sponsored Project :

» Raja Ramanna Fellowship

DEB SHANKAR RAY, FASc, FNA

Emeritus Professor

Nonlinear Dynamics and Statistical Mechanics

Nonlinear Langevin equations widely used in various branches in physical and chemical sciences are difficult to solve analytically. Based on a multiple time scale method we have introduced a scheme for direct solution of a class of these equations with additive Gaussian white noise. Our analytical results for mean square displacement are corroborated with direct numerical solution of the Langevin equations. In another issue we have analyzed the phase diffusion, quantum fluctuations and their spectral properties of a one-dimensional Bose-Josephson junction nonlinearly coupled to a bosonic heat bath. The model incorporates phase diffusion by taking into account of the random modulations of the BJJ modes causing a phase loss of the initial coherence between the ground and excited states through introduction of interaction term linear in bath operators but nonlinear in system operators.

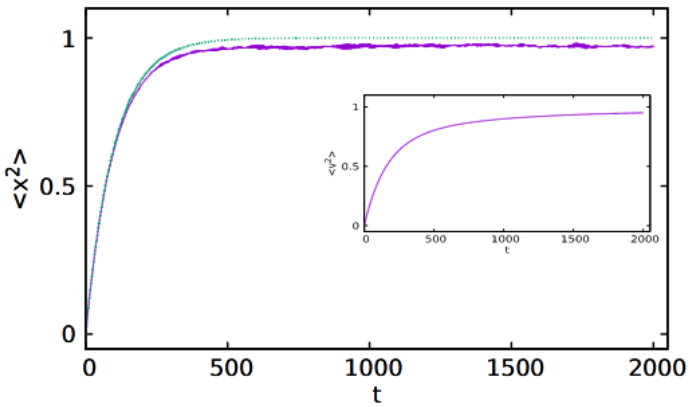


FIG. 1. The mean-square displacement $\langle x^2 \rangle$ is plotted against time t for the Duffing oscillator for the following parameter set: $\omega_0 = 1.0$, $\gamma = 0.01$, $\alpha = 1.0$, $\epsilon = 0.01$, and $D = 0.01$ (analytical, dotted line; numerical, solid line). For numerical simulation averaging is done over 10^5 trajectories. The inset refers to the variation of $\langle v^2 \rangle$ vs time t, calculated numerically to ensure the attainment of thermal equilibrium (units arbitrary).

Publications in Journals:

1) Method for direct analytical solution of nonlinear Langevin equation using multiple timescale method: Mean-square displacement, P Sarkar, D Banerjee, S Paul and D S Ray, Phys. Rev. E **106,**024203 (2022) [Impact Factor: 2.529]

2) Phase diffusion and fluctuations in a dissipative Bose-Josephson junction, A K Saha, D. S. Ray and B Deb, Rev. E **107**, 034141 (2023[Impact Factor: 2.529]

Lectures Delivered

Invited talk at (1) Science Milieu 2022, May 2022, (2) Presidency University, (3) Chemical Science Symposium, May 2022 (4) IIT Mandi, (5) Current Trends in Theoretical Chemistry, September 2022, BARC, (6) Theoretical and Computational Chemistry, November, NIT Shillong, (7) Rajsekhar Basu Memorial Lecture, March 2023,Bangiyo Biggan Parishad, Kolkata.

ARUN K NANDI, FASc

Emeritus Scientist, CSIR

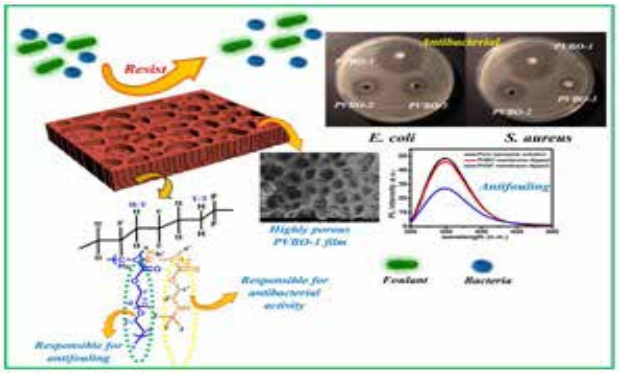
Synthesis of polythiopene graft block copolymers, Synthesis of polymer peptide conjugates

Associate:

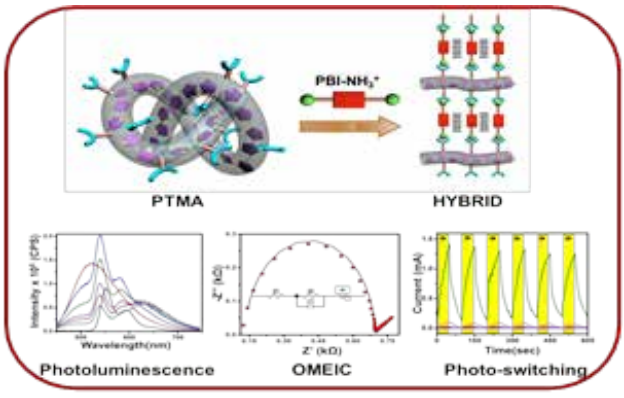
(1) M. Pakhira, SRF (UGC), (2) A. Panja, SRF (Inspire, presently working as part timer), (3) S. Mondal RA, (4) U. Basak (RA, CSIR, ES)

Polymer Synthesis: Biocidal and anti-fouling properties in the same polymeric membranes are important in biomedical field for their capability to protect serious infection and filtration of biological molecules. For this purpose we synthesised random graft copolymer of poly(vinylidene fluoride) (PVDF-graft-poly(tBAEMA-ran-OEGMA, PVBO) membranes showing both antifouling and antibacterial activity. The PVBO copolymer is synthesised using ATRP technique and the polymer membranes are produced by breath figure (PVBO-1) and phase inversion (PVBO-2) techniques. The former shows well-developed hexagonal pores (diameter 15±3.5 nm), and good hydrophilicity (contact angle 41.3º).PVBO-1 membrane exhibits good antifouling property for both lysozyme and BSA solutions. Antimicrobial activity measured from agar diffusion method indicates that PVBO-1 shows a large zone of inhibition in case of gram-negative *E coli* and gram-positive *S. aureus* bacteria, whereas PVBO-2 and its HCl treated state (PVBO-3) membranes exhibit only a moderate zone of inhibition. The MBC and MIC values indicate that the synthesized membranes are bactericidal in nature and not bacteriostatic. Live and dead cell assay indicates that PVBO-1 can significantly inhibit growth of bacteria even at high bacteria concentration confirming high antimicrobial activity. MTT assay suggests PVBO-1 is non-cytotoxic to mammalian cells and co-culturing activity result suggests high cellular selectivity of PVBO-1.

We have grafted stimuli-responsive copolymer poly(diethylene glycol methyl ether methacrylate) (PDEGMEM)-block-poly(dimethyl aminoethyl methacrylate) (PDMAEMA) from polythiophene backbone using ATRP technique. We are studying the self-aggregation behavior using DLS, and HRTEM study at different pH, and temperature. The optoelectronic properties of this block polymers are also investigated. Another block copolymer PDMAEMA-block-PDEGMEM is also grafted from PT backbone using ATRP technique and their characterization and self-assembly properties are under investigation.



Polymer-Peptide conjugate: A water soluble polymer conjugate, composed of poly(thiophene methacrylate) (PTMA) and cationic peptide appended Perylene diimide (PBI-NH_3^+) was fabricated. The dipolar interaction between PTMA and PBI-NH_3^+ helped to uncoil the polythiophene backbone, resulting into an increase of the conjugation length which was thoroughly studied by UV-Vis, Fourier Transformed Infrared (FTIR), and X-ray diffraction (XRD) spectra. The morphology of PTMA changes from vesicular to a highly entangled fibrillar network in the hybrid as evident from HR-TEM study. Fluorescence spectroscopic study and time-correlated single-photon counting (TCSPC) study were made to understand the effect of interaction on photoluminescence (PL) properties of the hybrid. The current-voltage (I-V) plots of hybrid materials showed synergistic enhancement of current with voltage showing an interesting Organic Mixed Ionic and Electronic Conductivity (OMIEC) property which was further supported through current-time (I-t) and Nyquist plot results. This conjugate material shows enhancement of photo-switching behaviour with the highest photocurrent gain of 9. 8 (I_{on}/I_{off}) for the composite with 27wt% PBI-NH_3^+. The increase in photo switching property is attributed to efficient charge (electron-hole) separation and holds a future promise for fabricating new type of macromolecular OMIEC systems along with an excellent photocurrent switching efficiency**.**



Publications in Journals :

1. Light and Solvent Effect on Isomerization and Excimer Formation of Pyrene - Schiff Base Conjugate Sensing Aromatic Analytes S. Mondal, A. Panja and A.K. Nandi, *Macromol Symp***.** 2023, *408,* DOI: 10.1002/masy.202100500 (Impact Factor 0.3)
2. Hybrid Polymer Gels for Energy ApplicationsA. K. Nandi and D.P. Chatterjee**,** *J. Mater Chem.* A, 11, 12593 (2023) *A***,** 2023 [IF 14.5]
3. Polythiophene-g-Poly(methacrylic acid) and Perylene Diimide Appended Peptide Conjugates with Tuneable Photoluminescence, OMEIC and Photo-switching PropertiesS. Hazra, R. Ghosh, A. Palui, A. Ghosh, A. Banerjee and A. K. Nandi, **J.** *Mater Chem***.** **C**2023, **11**, 4808 – 4819 (Impact Factor 8.1)
4. Organic Mixed Ion-Electron Conductivity in Polymer Hybrid Systems, S. Hazra, A. Banerjee, A.K. Nandi, *ACS Omega***,**2022, 7, 37, 32849–32862 (Impact Factor 4.1)
5. Synthesis of PVDF Based Graft Copolymeric Antifouling Membranes Showing Affinity Driven Immobilization of Nucleo bases, U. Basak, M. Pakhira, S. Sahoo, S. Majumdar, R. Ghosh, J. Kundu, T. Ghosh, T. Ghosh, A. K. Nandi and D.P. Chatterjee, *ACS Appl. Polym. Mater*. 2022,*4*, 5756-5771(Impact Factor 4.9)
6. Development of poly(vinylidene fluoride) graft random copolymer membrane for antifouling and antimicrobial applications, M. Pakhira, S. Ghosh, Surajit Ghosh, D. P. Chatterjee and A. K. Nandi, *J. Ind. Eng. Chem***.**2022, 112, 171–181 (Impact Factor 5.3)

Publications in Books/Book Chapter/ Monographs:

1. Encyclopedia of Power Sources, 2nd Edition". Ed.Dr. Peter Kurzweil , Chapter: Supercapacitors: Hybrid Technology –A. K. Nandi, Elsevier, USA, Chapter 13.6, Manuscript No. 00340, 2023.

Ph.D. Degree Awaded

(1) Mahuya Pakhira, CU

Sponsored Project:

» Tuning Properties of Electroactive ….. Block Copolymers (CSIR, ES)

Lectures Delivered

» Invited talk at (1) SPSI Thiruvananthapuram, Kerala, (2) University of Burdwan, (3) NCL/IISER-Pune and (4) Universite de Strasbourg, France (online).

SANKAR PRASAD BHATTACHARYYA, FASc

Visiting Professor

Synthesis of polythiopene graft block copolymers, Synthesis of polymer peptide conjugates

Associate:

(1) M. Pakhira, SRF (UGC), (2) A. Panja, SRF (Inspire, presently working as part timer), (3) S. Mondal RA, (4) U. Basak (RA, CSIR, ES)

Teaching:

During the period under reporting taught two courses i) Mathematics for Chemists and Computer in Chemistry (Autum Semester, 25 class, 1 and half hours each, 25 students); ii) Advanced Quantum Chemistry (Spring Semester, 20 classes, 1 and half hours each, 7 students)

Ongoing Research

The disposition and dynamics of quantum states in singular potentials are being investigated.

Publications in Journals :

1. Tunneling Dynamics of Kicked Systems : A Route to Tunneling Control – Susmita Kar and S.P. Bhattacharya, *Chem. Phys. Chem*, doi.org/10.1002/cphc-202200468 (Chemistry Europe) (An Invitee contribution)

Lectures Delivere

» Invited talk at (1) In the birth centenary symposium of Prof. Sadhan Basu, CU.

PARTHASARATHI MAJUMDAR

Visiting Professor

Gravitational Theory, Gauge Field Theory

Gravitational Larmor Precession : We model the reported existence of substantive magnetic fields in the vicinity of the central supermassive black holes in Sagitarius A* and Messier 87*, in terms of an axisymmetric, non-rotating Ernst-Melvin-Schwarzschild black hole spacetime with appropriate parameters. We compute the geodesic nodal-plane precession frequency for a test particle with mass, for such a spacetime, and obtain a non-vanishing result, surpassing earlier folklore that only axisymmetric spacetimes with rotation (non-vanishing Kerr parameter) can generate such a precession. We call this magnetic field-generated phenomenon Gravitational Larmor Precession. We discuss observational prospects of this precession in terms of available magnetic field strengths close to central black holes in galaxies.

(Work done with external collaborator Chandrachur Chakraborty. Eprint- arXiv : 2210.17162. Submitted for publication)

Lectures Delivered

Invited talk at (1) SINP Kolkata (2) Jadavpur University, Kolkata, (3) IISER-Kolkata, (4) Radboud University, Nijmegen, The Netherlands and (5) Vidyasagar University, Midnapore

SUNANDA BANERJEE
INSA Senior Scientist

Experimental High Energy Physics

He is associated with the Department of Physical Science here. He has taken part in the teaching program of the institute and also continued his active participation in the CMS experiment at CERN. He has been involved in this experiment for nearly thirty years while he was a member of TIFR, SINP, Fermilab and the University of Wisconsin, Madison. Sunanda gave one course on Computing Language (C++) and Numerical Methods to the third-year students in the joint B.Sc./M.Sc. program and the first-year students in the joint M.Sc./Ph.D. programme. In addition, one of the students from the joint M.Sc./Ph.D. pogrom is doing a small project with him. Sunanda has four responsibilities in the CMS experiment: (1) calibration of the hadron calorimeter; (2) design of the upgraded CMS detector for future high luminosity run of the CMS experiment; (3) geometrical description of the entire CMS detector which is one of the most important ingredients of CMS simulation and reconstruction software; (4) improvement and testing of the CMS simulation software. CMS started taking data in 2022 after a long shutdown of the Large Hadron Collider between 2019 and 2021. During the shutdown, the readout of the hadron calorimeter was modified and this required a new set of calibration constants to derive the energy of jets produced in the collision. Sunanda is in charge of the estimation of the energy scale factor of the hadron calorimeter. He derived the first set of calibration constants for the run period of 2022. In that process, He discovered some wrong timing synchronization of the detector and this has been rectified in a number of stages during 2022. The forward calorimeter of CMS has undergone severe damage due to high radiation during the past several years of collisions. The radiation level will be further worse during the high luminosity runs expected from 2029 onward. So CMS is planning to replace several parts of the detector to handle the new running condition. One such replacement will be a new calorimeter which will replace the current endcap electromagnetic and hadron calorimeter. The proposed detector is novel in the field of high-energy physics. It is a sampling calorimeter with silicon and scintillator detectors having several million readout channels. This will be a tracking calorimeter and needs a detailed study using the framework of Geant4 simulation. Sunanda is one of the principal designers defining the description of the detector within the CMS simulation environment. The detector layout of the CMS experiment is not static and it has changed almost every year. It happened during the long shutdown periods or during the year-ending technical stops. Sunanda has taken care of the CMS geometry description and has defined the layout for the period of 2022 and is now looking into the changes needed for the 2023 run period. The main changes are in the hadron calorimeter and in the forward muon system. CMS is also adopting a new software package, DD4hep, from CERN. This is tested for the current run but needs changes in our software system for future and legacy runs which happened during the period between 2009 and 2018. CMS is using the toolkit Geant4 for detector simulation. Sunanda is a member of the Geant4 team as well as the leading expert in the full simulation of the CMS detector. Geant4 makes continuous improvements to the software kit and provides reference releases every month. He monitors the goodness of the shower generation part by comparing Geant4 predictions with data from fixed target experiments as well as from CMS. At the same time, He detected several incompatibilities of the new software with the CMS simulation program. This work has provided important feedback to the Geant4 team. He has been doing this regularly during the last year and this made CMS confident to move to the most up-to-date version of Geant4 this year. Sunanda has written two review articles: (1) Fifty Years of Experimental High Energy Physics; (2) Detector Simulation in LHC Experiments and India. The first article was published by Springer Nature Journal Production and the second article in The European Physical Journal. He gave several colloquia based on the first topic and gave invited talks at two International Conferences based on

the second topic. The colloquia were given at IACS, SINP, Presidency University, TIFR, and IISER Pune, and the conferences were on the celebration of ten years of Higgs boson discovery (organized by TIFR) and the future of High Energy Physics (organized at ICTS, Bangalore). He gave a talk on ``Indian Involvement in CMS Software Development'' in a joint meeting of Indian and American physicists at the S. N. Bose Centre in January 2023. Sunanda gave a course on Calorimetry at the XV ICFA School on Instrumentation in Elementary Particle Physics which was held at TIFR, during February 12-23, 2023. He also gave several lectures on various aspects of Geant4 in the First National Workshop on Geant4 and its application to High-Energy Physics and Astrophysics, organized at IUCAA, Pune during December 5-9, 2022. His work has gone into a number of publications on the CMS experiment during the period between March 2022 and February 2023. A couple of them is listed here: (1) A portrait of the Higgs boson by the CMS experiment ten years after the discovery, Nature 607 (2022) 7917; (2) Search for new physics in the lepton plus missing transverse momentum final state in proton-proton collisions at $\sqrt{s}$ = 13 TeV, JHEP 07 (2022) 067.

Sponsored Project:

» INSA Senior Scientist Scheme

SOUMITRA SENGUPTA, FNASc

Amal Kumar Raychaudhuri Chair Professor

Extra dimensional Theories, Braneworld, Supergravity, String Theory, Gravity, Cosmology, Blackholes

Associate and Collaborators

1. Tanmoy Paul, 2. Subhadip Sau, 3. Indrani Banerjee, 4. Arko Bhaumik, 5. Shafaq Gulzar Elahi, 6. Soumya Samrat Mandal.

- We show that the observed angular diameter of the shadow of the ultra compact object Sgr A*, favours the existence of an extra spatial dimension. This holds irrespective of the nature of the ultra compact object, i.e., whether it is a wormhole or, a black hole mimicker, but with the common feature that both of them have an extra dimensional origin. This result holds true for the mass and the distance measurements of Sgr A* using both Keck and the Gravity collaborations and whether we use the observed image or, the observed shadow diameter. In particular, the central value of the observed shadow or, the observed image diameter predicts non-zero hairs inherited from the extra dimensions.
- With the recent release of the black hole image of Sgr A* alongside the earlier image of M87*, one can now really hope to acquire a better understanding of the gravitational physics at the horizon scale. In this paper, we investigate the prospect of the regular black hole scenario with a Minkowski core in explaining the observed shadow of M87* and Sgr A*. Regular black holes generally appear in Einstein gravity coupled to non-linear electrodynamics and are interesting as they can evade the r = 0 curvature singularity arising in general relativity. Using the previously determined mass and distance we compute the observables associated with the black hole shadow. These when compared with the observed angular diameter reveal that the shadow of M87* and Sgr A* favor the regular black hole scenario with a small but non-zero charge. The implications are discussed
- Scenario of a bouncing universe is one of the most active area of research to arrive at singularity free cosmological models. Different proposals have been suggested to avoid the so called 'big bang' singularity through the quantum aspect of gravity which is yet to have a proper understanding. In this work, on the contrary, we consider three different approaches, each of which goes beyond General Relativity but remain within the domain of classical cosmological scenario, to address this problem. The hallmark of all these approaches is that the origin of

the bouncing mechanism is somewhat natural within the geometrical framework of the model without any need of incorporating external source by hand. In the context of these scenarios ,we also discuss various constraints that these viable cosmological models need to satisfy.

- We examine the modulus stabilization mechanism of a warped geometry model with nested warping. Such a model with multiple moduli is known to offer a possible resolution of the fermion mass hierarchy problem in the standard model. A six dimensional doubly warped braneworld model under consideration admits two distinct moduli, with the associated warp factors dynamically generating different physical mass scales on four 3-branes. In order to address the hierarchy problem related to the Higgs mass, both moduli need to be stabilized around their desired values without any extreme fine tuning of parameters. We show that it is possible to stabilize them simultaneously due to the appearence of an effective 4D moduli potential, which is generated by a single bulk scalar field having non-zero VEVs frozen on the 3-branes. We also discuss how the entire mechanism can possibly be understood from a purely gravitational point of view, with higher curvature f(R) contributions in the bulk automatically providing a scalar degree of freedom that can serve as the stabilizing field in the Einstein frame.
- Black holes carrying a magnetic monopole charge are a subject of interest for a long time. In this work we explore the possibility of an observational evidence of such black holes carrying a magnetic monopole, namely the Bardeen rotating black holes. We derive the theoretical spectrum from the accretion disk surrounding a Bardeen black hole using the thin-disk approximation. We compare the theoretically derived spectrum in comparison to the optical data of eighty Palomar Green quasars to constrain the monopole charge parameter \g\ and the spin parameter a of the quasars. From our analysis we note that the Kerr-scenario in General Relativity is observationally more favored than black holes with a monopole charge. We arrive at such a conclusion using error estimators like $\chi 2$, the Nash-Sutcliffe efficiency, the index of agreement and their modified forms. In particular, black holes with $g \geq 0.03$ are outside 99% confidence interval. The implications are discussed.

Publications in Journals :

1. Hunting extra dimensions in the shadow of Sgr A* - Indrani Banerjee , Sumanta Chakraborty , Soumitra SenGupta, *Phys.Rev.D* 106 (2022) 8, 084051
2. Signatures of regular black holes from the shadow of Sgr A* and M87* - Indrani Banerjee ,Subhadip Sau, Soumitra SenGupta, *JCAP* 09 (2022) 066
3. Aspects of non-singular bounce in modified gravity theories - Indrani Banerjee, Tanmoy Paul, Soumitra SenGupta, Gen.Rel.Grav. 54 (2022) 10, 119
4. Moduli stabilization with bulk scalar in nested doubly warped braneworld model, Arko Bhaumik , Soumitra SenGupta, Eur.Phys.J.C 82 (2022) 11, 1079
5. Quasar continuum spectrum disfavors black holes with a magnetic monopole charge - Indrani Banerjee ,Vijay ShersinghChawan, Bhaswati Mandal, Siddharth Kumar Sahoo, Soumitra SenGupta, Phys.Rev.D 105 (2022) 6, 064073

Ph.D. Degree Awarded

(1) Bhaswati Mandal (IACS Deemed to be University)

Lectures Delivered

» Invited talk at (1) IISER-Kolkata, (2) Invited talk at Harishchandra Research Institute, Allahabad, (3) Saha Insitute of Nuclear Physics, Kolkata

Academic Programs of the IACS Deemed to be University

Academic Programs of the IACS Deemed to be University

The MHRD, Government of India vide the Gazette Notification No.F.9-7/2017-U.3 (A) dated May 26, 2018 has declared IACS as an Institution Deemed to be University under de novo category for a provisional period of five years with effect from disaffiliation of IACS from its affiliating Universities. The status of Deemed-to-be-University shall be confirmed after five years based on the review report of UGC Expert Committee and the recommendation of the Commission, as per the provisions of the prevailing Regulations.

With the approval of the Governing Council IACS as a Deemed to be University has started its Integrated Bachelor's-Master's Program in Science from the Academic Year 2018-19, which is a research-oriented de-novo BS-MS Program that has successfully run through its 4th year of existence and has attracted some of the best young students aspiring for building research career in Science from all over the country. IACS is offering MS/Integrated MS-PhD and Regular PhD programs in Science in the emerging areas in the disciplines of Biological Sciences, Chemical Sciences, Applied and Interdisciplinary Sciences, Materials Sciences, Mathematical and Computational Sciences and Physical Sciences; the courses being designed by the Boards of Studies comprising renowned experts and academicians in the fields are truly de-novo in structure and spirit. The Academic Programs are being run under the Academic Administration of the Academic Office under the Dean (Academic) and the Dean (Students' Affairs), and also the Academic Coordinators (PhD, BS-MS and Results). IACS has given its best efforts to ensure that highest quality is maintained in terms of students, teaching and other resources and infrastructure for all the programs, while not compromising with the research quality and productivity of the faculty members as sustained over the years.

The syllabus and the curriculum of each one of the courses is unique in the sense that the students from one discipline can opt for elective courses from other disciplines which without doubt will help in widening their scientific outlook, commensurate with the renowned institutes all over the world. The courses are versatile and wide, allowing flexibility without compromising stress on the fundamental science education. There are courses on Scientific Ethics, Communicating Skills and History of Indian Science, which even being an integral part of any Science education system in India often does not get adequate coverage in a formal way.

The administrative structure of the deemed university is:

Chairman

Director

Academic Council

Board of Studies

Core Committee

Faculty Board

The MOA of the IACS Deemed to be University has been duly approved by the Hon'ble Minister of Science and Technology and has been registered with the Registrar of Societies.

Conferred with a new status of de novo Science Research University in 2018 by the Government of India, IACS envisages many new programs. The founding of IACS-Deemed to be University represents a renaissance in its initiatives and ruminates to host an International Center for Fundamental Research and Teaching offering de-novo courses which will be a multi-disciplinary initiative to promote cutting edge research in various fundamental and applied sciences.

In the 3rd Annual Convocation of IACS dated July 15, 2023, which was presided over by Padma Shri Professor Vinod K Singh, Chairman, Governing Council and graced by the august presence of Dr. Subhas Sarkar, Minister of State for Education, Government of India as the Chief Guest and Padma Shri Professor M R S Rao, ex-President, JNCASR, Banaglore as the Guest of Honor; one hundred sixteen (116) students was conferred degree (PhD:37, MS:47, BS-MS:32). The Convocation was special since the first BS-MS batch graduated this year; most of whom got PhD offers from Centers of Excellence all over the country and abroad.

Summary of the degree recipients:

School	PhD	MS	BS-MS
School of Applied and Interdisciplinary Sciences (SAIS)	5	12	-
School of Biological Sciences (SBS)	3	-	9
School of Chemical Sciences (SCS)	14	11	5
School of Materials Sciences (SMS)	5	6	-
School of Mathematical and Computational Sciences (SMCS)	1	9	1
School of Physical Sciences (SPS)	9	9	17
Total number of degree recipients	37	47	32

Medal winners:

Name	School	Achievement	Medal
Supriyo Das	SCS	Highest CGPA among MS degree recipients of all Schools	Gold
Sangita Dey	SAIS	Highest CGPA among MS degree recipients of SAIS	Silver
Soumi Das	SMS	Highest CGPA among MS degree recipients of SMS	Silver
Devdan Dey	SMCS	Highest CGPA among MS degree recipients of SMCS	Silver
Uddipan Pal	SPS	Highest CGPA among MS degree recipients of SPS	Silver
Sohini Pal	Major in Physics	Highest CGPA among all BS-MS degree recipients	Gold
Asmita Majumdar	Major in Biology	2nd Highest CGPA among all BS-MS degree recipients	Silver
Akshay Pal	Major in Physics	3rd Highest CGPA among all BS-MS degree recipients	Silver

Detail of the PhD degree recipient from IACS Deemed to be University

Sl. No.	Name	Supervisor	School	Thesis Title
1	Koushik Mondal	Tapas Chakraborty	SCS	Laboratory investigation of atmospheric photochemical and thermal reactions of selected VOC's, involving NO2 and OH
2	Manjil Das	Subham Majumdar	SPS	Role of crystal structure on the electronic and magnetic properties of transition metal oxides
3	Abhik Kumar Saha	Bimalendu Deb	SPS	Some theoretical studies on Josephson oscillations, macroscopic quantum self-trapping and collective excitations in Bosonic Josephson junctions
4	Ananta Garai	Jyotirmayee Dash	SCS	Design and synthesis of biologically active azoles for quadruplex recognition
5	Bidhan Chandra Patra	Santanu Bhattacharya	SAIS	Reticular synthesis of porous covalent organic frameworks (COFs); Fundamental design and applications
6	Joy Dutta	Satrajit Adhikari	SCS	Molecule-surface scattering and Jahn-teller effect on phase transition of solid
7	Bhaswati Mandal	Soumitra Sengupta	SPS	Studies in modified gravity theories in astrophysical scenario
8	Rajib Ghosh	Pradyut Ghosh	SCS	Design and syntheses of receptors for selective binding and extraction of perrhenate from aqueous medium via hydrogen and halogen bonding interactions
9	Soumya Mukherjee	Satrajit Adhikari	SCS	Non-adiabatic processes in molecular spectroscopy and scattering

Sl. No.	Name	Supervisor	School	Thesis Title
10	Pranay Saha	Santanu Bhattacharya	SAIS	Synthesis and characterization of stimuli-responsive bio-materials and their applications in theranostics
11	Umesh	Santanu Bhattacharya	SAIS	Design, synthesis, and characterization of self-assembled soft materials and their applications in nanotechnology
12	Tilak Nasakr	Amit Majumdar	SCS	Reactivity of binuclear transition metal complexes with thiolates and sulfide
13	Jayjit Kumar Dey	Saurav Giri	SPS	Unexplored multiferroic orders in AB2O4-type oxide with high temperature spinel structure
14	Arpana Singh	Prosenjit Sen	SBS	Significance of non-conventional organelles in triggering monocyte to macrophage differentiation and its implications in
15	Sougata Ganguly	Sourov Roy	SPS	Some studies on the phenomenology of non-standard production mechanisms of dark matter
16	Apurba Sarkar	Raja Paul	SMCS	Numerical and mathematical modelling of biological and activity driven processes
17	Abhijit Bera	Tapan Kanti Paine	SCS	Biomimetic applications of supported metal complexes and their potential in oxidation catalysis
18	Manotosh Bhakat	JoyramGuin	SCS	Light induced aerobic radical functionalization of azaarenes
19	Sayan Saha	Raju Mondal	SCS	Synthesis of pyridine pyrazolebased complexes and their various applications
20	Anudeepa Ghosh	Subhadeep Datta	SPS	Phonon and dielectric properties of layered antiferromagnets
21	Suvodeep Sen	Narayan Pradhan	SMS	Tuning reaction chemistry for designing dimensioncontrolled nanocrystal heterostructures
22	Deep Ghosh	S. Mukhopadhyay	SPS	Asymmetric dark matter from scattering
23	Abhisikta Barman	Devajyoti Mukherjee	SPS	Investigation of caloric effects in magnetic and ferroelectric thin film heterostructures
24	Subhadip Sau	Soumitra Sengupta	SPS	Search for modified gravity theories through the shadow of compact objects
25	Arnab Kumar Nath	Somdatta Ghosh Dey	SCS	Spectroscopic characterization of the intermediates formed in the reactivites of heme and copper bound amyloid peptides associated with alzheimer's disease
26	Abhishek Das	Tapan Kanti Paine	SCS	Bioinspired iron and copper complexes of amide-functionalized pyridylamine ligands: influence of second coordination sphere on selective oxygenation and catalytic dioxygen reduction
27	Srijon Ghosh	Amitava Patra	SMS	Ultrafast photoinduced dynamics of π-conjugated organic nanomaterials
28	Madhumita Rano	Debashree Ghosh	SCS	Renormalization and machine learning approaches for strongly correlated systems - development and applications
29	Santu Ruidas	Asim Bhaumik	SMS	Exploration of nanoporous covalent organic frameworks for green energy and environmental applications
30	Paramita Saha	Abhishek Dey	SCS	Synthesis of small inorganic molecules for catalysis relevant to sustainable energy and environment
31	Avik Chowdhury	Asim Bhaumik	SMS	Organic and organic-inorganic hybrid nanoporous materials for energy and environmental application

Sl. No.	Name	Supervisor	School	Thesis Title
32	Soumyajit Hazra	Arindam Banerjee	SBS	Nanohybrids of peptide appended perylenebisimides and c-dots/ metal nanocluster/ionicpolymers: fabrication to optoelectronic properties
33	Joy Kar	Siddhartha Sankar Jana	SBS	Role of actomyosin complex in endocytosis and endocytic trafficking
34	Ujjwal Ghosh	Surajit Sinha	SAIS	Exploring pmos from different perspectives: a novel synthesis strategy of 5′-thiol functionalization and incorporation of guanidinium groups in their delivery
35	Biswajit Hudait	Narayan Pradhan	SMS	Noncube shaped cspbbr3 perovskite nanocrystals
36	Anwesha Chakraborty	Suhrit Ghosh	SAIS	Controlled supramolecular polymerization by externally regulated specific molecular recognition
37	Sourabh Bera	Parthasarathi Dastidar	SCS	Designing of inorganic-organic hybrid systems for drug delivery applications: A supramolecular approach

Detail of the PhD degree recipient from other Universities:

Sl. No.	Name	Supervisor	Thesis Title	University
01.	Ranajit Barman	Suhrit Ghosh	Self-assembled Biomaterials Based on Foldable Polyurethane Scaffold	Jadavpur University
02.	Chandra Bose	Surajit Sinha	Regulation of Hedgehog Signaling by Chemical Tools	Calcutta University
03.	Mahuya Pakhira	Sudip Malik & Arun Kr. Nandi	Properties of Graft Copolymers From Electroactive Polymers	Calcutta University
04.	Deblina Sarkar	Prasanta Kr. Das	Synthesis and development of stimuli responsive self-aggregates for task specific applications	Jadavpur University
05.	Tanushree Mana	Rupa Mukhopadhyay	Molecularly Resolved Label-Free Analysis Of Gene Sequences Using Xeno Nucleic Acid (XNA) Probes	Calcutta University
06.	Parijat Biswash	Deepak Kr. Sinha	A Study of cytoplasmic macromolecular crowding, ROS, and microrheology from the perspective of mammalian cell volume regulation	Jadavpur University
07.	Suparna Banerjee	Prosenjit Sen	An investigation to understand the role of key facets involved in the coagulation/anticoagulation process by employing computational and molecular approaches	Jadavpur University
08.	Sarmistha Bunia	Abhishek Dey	Synthesis and Reactivity of Iron-porphyrins with Basic distal Second sphere Residues	Calcutta University
09.	Munia Sultana	Ankan Paul	Topical Theoretical Studies on Reaction Mechanisms of Small Molecule Activation	Calcutta University
10.	Paulami Ghosh	Debashree Ghosh	Application and Development of Quantum Chemical Methods in Biological Systems	Calcutta University
11.	Raj Paul	Jyotirmayee Dash	Insights into Nucleic Acid Secondary Structures and Biomimetic Synthetic Ion Channels by Molecular Probes	Jadavpur University
12.	Krishna Sundar Das	Raju Mandal	Exploration Of Hybrid Metal-Organic Materials: Multifunctionalities And Applications	Calcutta University
13.	Ishita Pal	Somdatta Ghosh Dey	Characterization of the intermediates of heme bound peptides and synthetic analogues associated with amyloidogenic diseases	Jadavpur University
14.	Palash Banerjee	Tarun Kumar Mandal	Poly(ionic liquid)s: synthesis, stimuli-responsive properties and their material applications	Jadavpur University

Sl. No.	Name	Supervisor	Thesis Title	University
15.	Tuhina Mondal	Shyamal Kumar Saha	Synthesis and characterization of Metal Organic Frameworks for multifunctional applications	Calcutta University
16.	Chinmoy Majumder	Shyamal Kumar Saha & Dipankar Chakravorty	Spin polarized charge transport and charge transfer induced magnetism in 2D materials	Calcutta University
17.	Amaresh Dey	Debajyoti Das	Nanocrystalline Silicon-Germanium Alloy Thin Films: Synthesis, Characterization and Optimization for Silicon Solar Cells	Jadavpur University
18.	Chandralina Patra	Debajyoti Das	Growth, Characterization And Optimization Of Doped Nanocrystalline Silicon Thin Film By Plasma CVD For Device Applications	Calcutta University
19.	Amaresh Das	Durga Basak	Ion implantation in nanostructured ZnO: A study on defect evolution	Jadavpur University
20.	Heerak Banerjee	Sourov Roy	Some studies on the phenomenology of gauged U (1) extended Supersymmetric Theories	Calcutta University
21.	Anupam Maity	Dipankar Chakravorty	Dielectric and Magnetodielectric Properties of Nanocomposites Comprising of Mesoporous Oxide-Metal Nanowires and Mesoporous Oxide-Nanoglasses suitable for Supercapacitor or Magnetic Sensor Application	Jadavpur University

Detail of the MS degree recipients:

Sl No	Name	Degree	Credit	CGPA
		School of Applied and Interdisciplinary Sciences (SAIS)		
1	Arpita Das	Biological Sciences (Molecular Biosystems and Biomedicine)	100	8.24
2	Biswadeep Paul	Biological Sciences (Molecular Biosystems and Biomedicine)	100	6.67
3	Gargy Sarkar	Biological Sciences (Molecular Biosystems and Biomedicine)	100	8.02
4	Sampad Das	Biological Sciences (Molecular Biosystems and Biomedicine)	100	8.59
5	Sangita Dey	Biological Sciences (Molecular Biosystems and Biomedicine)	100	9.22
6	Archishman Sarkar	Chemical Sciences (Polymer Science and Soft Matter)	100	8.26
7	Debayanti Saha	Chemical Sciences (Polymer Science and Soft Matter)	100	8.39
8	Mampi Biswas	Chemical Sciences (Polymer Science and Soft Matter)	100	8.48
9	Shria Chatterjee	Chemical Sciences (Polymer Science and Soft Matter)	100	8.26
10	Susmita Pratihar	Chemical Sciences (Polymer Science and Soft Matter)	100	7.41
11	Shrabani Karmakar	Physical Sciences (Soft Matter)	100	7.74
12	Soham Ash	Physical Sciences (Soft Matter)	100	7.93
		School of Chemical Sciences (SCS)		
1	Ananya Hazra	Chemistry	100	8.61
2	Asmita Saha	Chemistry	100	7.38
3	Kousik Maji	Chemistry	100	8.20
4	MaheswarTantubay	Chemistry	100	8.07
5	Rahul Saha	Chemistry	100	7.83
6	Saumik Sarkar	Chemistry	100	9.11
7	Somnath Das	Chemistry	100	8.33
8	Subhojit Nayak	Chemistry	100	8.04

Sl No	Name	Degree	Credit	CGPA
9	Suman Das	Chemistry	100	8.41
10	Supriyo Das	Chemistry	100	9.33
11	AtreyoPalit	Chemistry	100	8.2
		School of Materials Sciences (SMS)		
1	Ayan Sikdar	Physical Sciences (Materials)	100	8.76
2	Pritam Ghosh	Physical Sciences (Materials)	100	7.87
3	Riddhi Mitra	Physical Sciences (Materials)	100	7.93
4	Sangram Kumar Sadhu	Chemical Sciences (Materials)	100	8.26
5	Soumi Das	Chemical Sciences (Materials)	100	9.13
6	SusmitaPramanik	Chemical Sciences (Materials)	100	8.39
		School of Mathematical and Computational Sciences (SMCS)		
1	Devdan Dey	Mathematics and Computing with Specialization in Computer Science	100	9.24
2	Shounak Saha	Mathematics and Computing with Specialization in Computer Science	100	8.00
3	Smita Sarkar	Mathematics and Computing with Specialization in Computer Science	100	7.89
4	Suklav Ghosh	Mathematics and Computing with Specialization in Computer Science	100	8.43
5	Ayan Dutta	Mathematics and Computing with Specialization in Mathematics	100	7.65
6	Mrittika Nandi	Mathematics and Computing with Specialization in Mathematics	100	7.85
7	SayantanSarcar	Mathematics and Computing with Specialization in Mathematics	100	8.67
8	SwetlinaHota	Mathematics and Computing with Specialization in Mathematics	100	7.59
9	Sandip Mandal	Mathematics and Computing with Specialization in Mathematics	100	8.91
		School of Physical Sciences (SPS)		
1	Anupam Mondal	Physics	100	8.04
2	Jayashis Das	Physics	100	8.70
3	Krishanu Sengupta	Physics	100	8.02
4	Pranoy Ranjan Char	Physics	100	8.59
5	Sukanya Jana	Physics	100	7.67
6	Uddipan Pal	Physics	100	8.93
7	Anupam Dhibar	Physics	100	7.09
8	Sarbarish Sen	Physics	100	7.57
9	Bipul Karmakar	Physics	100	7.78

Detail of the BS-MS degree recipients:

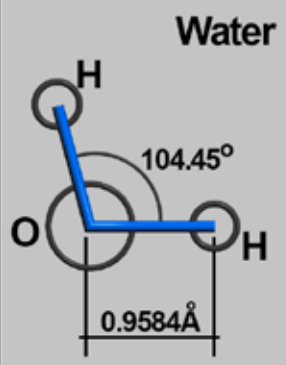
Sl No	Name	Course	Credit	CGPA
1	Anup Hazra	Major in Biology	238	8.64
2	Asmita Majumdar	Major in Biology	238	9.41
3	Debasrija Mondal	Major in Biology	238	8.62
4	Jagaran Sharma	Major in Biology	238	8.18
5	Jita Das	Major in Biology	238	7.36
6	Madhusree Seal	Major in Biology	238	8.94
7	Ridita Ray Basunia	Major in Biology	238	8.17
8	Shreyasi Mazumder	Major in Biology	238	8.55
9	Swagata Char	Major in Biology	238	7.55
10	Arismita De	Major in Chemistry	238	7.61
11	Bishnu Prasad Rakshit	Major in Chemistry	238	8.13
12	Saptarshi Biswas	Major in Chemistry	238	7.34
12	Sucharita Ghara	Major in Chemistry	238	7.14
14	Tithi Lai	Major in Chemistry	238	8.5
15	Sarthak Das	Major in Mathematics and Computing (Specialization in Computer Science)	238	9.04
16	Akshay Pal	Major in Physics	238	9.27
17	Arkamitra Sen	Major in Physics	238	7.79
18	Katha Haldar	Major in Physics	238	8.45
19	Labani Roy	Major in Physics	238	9.17
20	Mihika Banerjee	Major in Physics	238	9.15
21	Rahul Devarakonda	Major in Physics	238	7.96
22	Rishav Chaudhuri	Major in Physics	238	9.04
23	Ritesh Purushottam Harshe	Major in Physics	238	8.81
24	Rupayan Bhattacharjee	Major in Physics	238	7.88
25	Rupsa De	Major in Physics	238	9.15
26	Sayam Bandyopadhyay	Major in Physics	238	8.1
27	Shafaq Gulzar Elahi	Major in Physics	238	9.11
28	Shramana Ghosh	Major in Physics	238	8.57
29	Sohini Pal	Major in Physics	238	9.46
30	Soumya Samrat Mandal	Major in Physics	238	9.14
31	Tanushree Bhattacharya	Major in Physics	238	8.74
32	Anupam Banerjee	Major in Physics	238	8.85

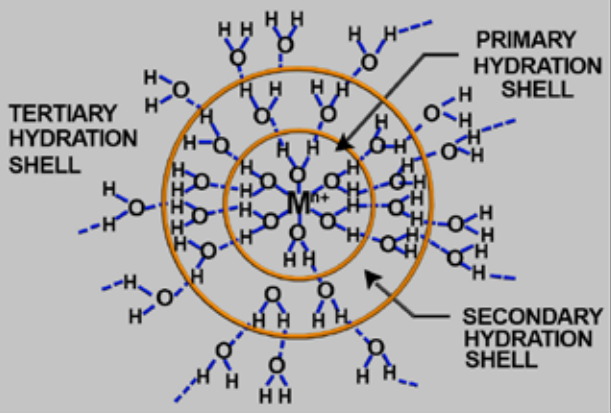
Details of Students admitted in 2022 - 2023

YEAR	Total Student			General Student			OBC Student			SC Student		
	BS	MS	PhD	BS	MS	PhD	BS	MS	PhD	BS	MS	PhD
2022-2023	27	53	84	18	39	84	4	9	0	5	5	0
Total	27	53	84	18	39	84	4	9	0	5	5	0

M.Sc IntPBS	Total Student	General Student	OBC Student	SC Student
	6	5	0	1

Technical Research Centre for Molecules and Materials

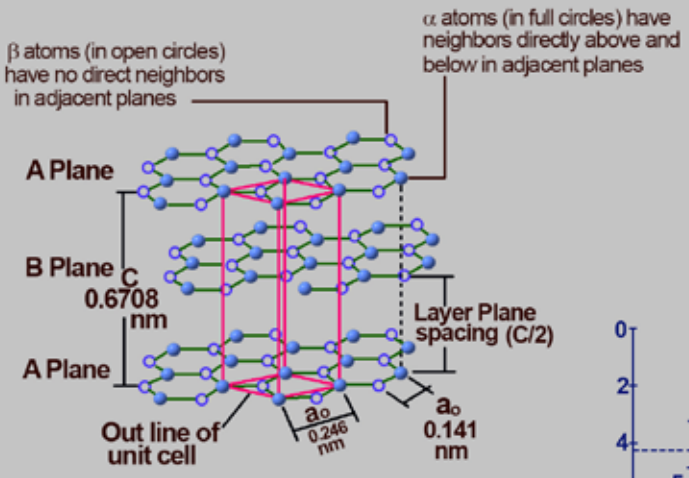




Water: Density ~1.0gcm^{-3}, [H_2O]=55.4mol L^{-1}, self-ionization 1.0x10^{-7} mol L^{-1} → [H_3O^+]/ [H_2O]=2x10-7

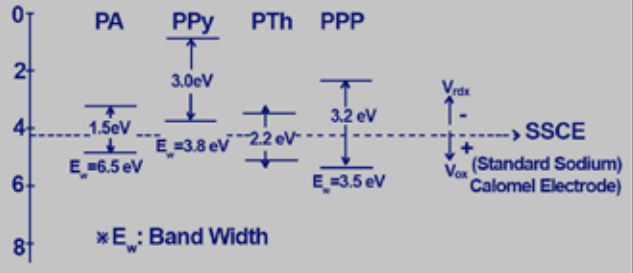
Porton: is several orders of magnitude smaller than the water molecule, thus attracted immediately to to water molecules and surroundedby them(usu. 4): $H(H_2O)_4^+$

Ions: Dissolved in water forms **hydration shell** and weaken the structure of H-bonding of water→ lowers the Tm; freezing point depression → salt water has a lower freezing point than water water is polar (ε=78) H- bond forming solvent



Electronic Parameters(PA,Ppy,PPP•)

	I_p(eJ)	E.A.(eJ)	Eq(eV)	V_{ox}	V_{rdx}
PA	4.7	3.2	1.5	0.4	-1.1
PPy	3.8	0.8	3.0	-0.6	-3.6
PPP	5.6	2.3	3.3	1.2	-2.1
PTh			2.2	1.1	



TRC Report

1. Title of the Project: Setting up of Technical Research Centre at the Indian Association for the Cultivation of Science (IACS), Kolkata 700032 (West Bengal)

Duration

Phase-1: 01.01.2016 to 31.03.2021 (The project got extension till 31.3.2023 vide DST emails dated 31.03.2021 and 05.07.2021); Phase-2: 01.04.2023 – till date

2. Objectives:

Indian Association for the Cultivation of Science (IACS) is well known for its outstanding accomplishments in original research in basic science for more than a century. Some of the major discoveries in Physics and Chemistry took place here. Faculty members are continuing to be creative even now as evident from various metrics. Hence utilization of such talent pool toward translation into something useful for the society and industry would be highly desirable. However, this is a challenging task. Against this backdrop, the Technical Research Centre project at IACS is being launched. The project is expected to promote and increase research collaboration in interdisciplinary areas, bringing about an emphasis on experimental research having strong foundation, foraying into emerging and frontier areas of quantum materials, advanced materials, nanomaterials, biologically inspired materials and molecules, biomaterials, photovoltaic materials, polymeric materials and exploring materials and biological investigations for societal, environmental and therapeutic utilities and applications. The project has a translational goal of taking basic research findings to industry by developing technology through PPP model.

As is clear now, the next decades would continue to belong to the materials, molecules, medicine, pharmaceuticals and biology because all technological innovations will be driven by developing such molecules and materials and there appears to be a fantastic period ahead when biology, chemistry, physics and technology will meet together to define molecules and materials with new functionalities and properties that could not have been conceived earlier. The Technical Research Centre (TRC) at IACS is further envisaged to increase research collaboration with industries in the interdisciplinary areas, foraying into new vistas of translational research.

Keeping this in mind the TRC in IACS plans to cover a variety of areas such as design and synthesis of new nanomaterials, quantum materials, functional polymers and other organic/organometallic molecules and systems, materials with spintronics applications, strongly correlated electron systems, biomaterials and biology-inspired materials. Under this initiative, IACS plans to put together and install several advanced instruments and develop facilities that would promote multidisciplinary research in materials, both in terms of syntheses of molecules and materials and investigation of their properties and functionalities, with the translational goal of developing applications and technologies based on such molecules and materials and make such research useful for industries and society.

3. TRC Project Team:

a. Human Resource

Director, IACS overall Coordinator

Work Package-I. Quantum Materials for Application

Professor Indra Dasgupta - Workpackage Coordinator

Professor Amitava Patra

Professor Sugata Ray

Professor Somobrata Acharya

Dr. Devajyoti Mukherjee

Dr. Subhadeep Dutta

Work Package-II. Materials for Energy and Environment

Professor Somobrata Acharya - Workpackage Coordinator

Professor Ankan Paul

Professor Narayan Pradhan

Dr. KDM Rao

Prof. Ayan Dutta

Work Package-III. Polymers, Disordered, Soft and Nanobio Materials for Devices, Diagnostics and Therapeutics

Professor Suhrit Ghosh - Workpackage Coordinator

Professor Santanu Bhattacharya

Professor Siddhartha S Jana

Professor Nikhil Ranjan Jana

Dr. Anindita Das

Work Package-IV. Molecules: Understanding, making and exploring commercial viability

Professor Tapas Chakraborty - Workpackage Coordinator

ProfessorProfessor Pradyut Ghosh

Professor Tapan Kanti Paine

Professor Surajit Sinha

Prof. Jyotirmayee Dash

b. Infrastructure created

Name of the Instrument	PI Involved	Charges			Current status
		Internal	External Institute	Industry	
IVC and work station for animal house	Prof. Siddhartha S Jana	Rs. 300/- per cage per week (maximum of 5 mice)	Rs. 500/- per cage per week (maximum of 5 mice)	Rs. 1500/- per cage per week (maximum of 5 mice)	Installed
Field Emission Scanning Electron Microscope (FESEM)	Prof. Nikhil R Jana	Rs. 500/- per 1.5 hour session	Rs. 3000/- per 1.5 hour session	Rs. 6000/- per 1.5 hour session	Installed
High Performance Computing Cluster	Prof. Indra Dasgupta and Prof. Ankan Paul	For faculty group users – Rs. 30000/- per year for 4 nodes Rs. 15000/- per year for 2 nodes Rs. 700/- minimum charge for each job Rs. 700/- charge for 24 core job / 3 days Rs. 1700/- charge for 24 core job / 7 days		Rs. 1000/- minimum charge for each job Rs. 1000/- charge for 24 core job / 3 days Rs. 2500/- charge for 24 core job / 7 days	Installed
Liquid Chromatography – Mass Spectrometry with Proteomics software for Structure Analysis	Prof. Tapas Chakraborty	For only LC separation – Rs. 400/- For LC-MS – Rs. 700/- For LC-MS + Compound formula + Database structure search – Rs. 1200/-		For only LC separation – Rs. 1500/- For LC-MS – Rs. 2500/- For LC-MS + Compound formula + Database structure search – Rs. 3000/-	Installed
Advanced Polymer Chromatography	Prof. Suhrit Ghosh	Rs. 100/- per sample	Rs. 250/- per sample	Rs. 500/- per sample	Installed
Mossbauer Spectrometer with Cryogen Free Cryostat System	Prof. Tapan Kanti Paine	Rs. 2000/- for RT and 4000/- for LT per sample	Rs. 3000/- for RT and 5000/- for LT Per sample	Rs. 7000/- for RT and 10000/- for LT per sample	Installed
Ultrafast Transient Absorption Spectroscopy	Prof. Amitava Patra	Rs. 1000/- per sample	Rs. 2000/- per sample	Rs. 5000/- per sample	Installed
Time-of-Flight Secondary Ion Mass Spectrometry	Prof. Tapas Chakraborty	Per sample charges: Mass profile – Rs. 500/- +2D images – Rs. 700/- +3D depth profiling – Rs. 1000/-	Per sample charges: Mass profile – Rs. 700/- +2D images – Rs. 1000/- +3D depth profiling – Rs. 2000/-	Per sample charges: Mass profile – Rs. 1000/- +2D images – Rs. 2000/- +3D depth profiling – Rs. 4000/-	Installed
Nucleic Acid Synthesizer	Prof. Surajit Sinha	Rs. 500/-	Rs. 1000/-	Rs. 2000/-	Installed

Name of the Instrument	PI Involved	Charges			Current status
		Internal	External Institute	Industry	
Multiphoton Confocal Laser Scanning Spectroscopy	Prof. Siddhartha S Jana	Confocal/hour – Rs. 150/- 2 photon/hour – Rs. 150/- Super resolution/hour – Rs. 150/-	Confocal/hour – Rs. 500/- 2 photon/hour – Rs. 600/- Super resolution/hour – Rs. 1000/-	Confocal/hour – Rs. 1000/- 2 photon/hour – Rs. 1200/- Super resolution/ hour – Rs. 2500/-	Installed
Muffle furnace	Prof. Sugata Ray				Installed
Low Temperature and High Magnetic Field Measurement System	Dr. Devajyoti Mukherjee				Installed
Silicone Release Agent-free Blue Adhesive Plastic Film, Full function Multimeter, Probe Positioner and optical chopper	Prof. Indra Dasgupta				Installed
EDAX Digi View EBSD Off-line	Prof. Somobrata Acharya				Installed
Coaxial Electrospinning	Dr. Shinto Varghese				Operational

4. Summary of the achievements made so far:

[1] Novel Materials for Agricultural Pest Management:

Selective and quantitative detection of female sex pheromone of certain agricultural insects by the suitably functionalized MEMS devices have been achieved. Separate nanosensors were generated for the pests like Helicoverpa armigera, Scirpophaga incertulas and Bactrocera oleae. The recognition of pheromone molecules even before the visual onset will alert the farmers to take necessary actions in a localized manner and thus this approach will economically useful in agricultural farms to significantly and efficiently reduce crop and attendant financial losses. Multiple patents on the invention have been granted and applied and a start-up industry (GR AGRI-TEK LABS for Complete solutions of Instrumentation, Automation and Biotechnology) has taken them up for commercialization.

[2] Flocculent for Sequestration of Cyanide and Chloride ions from Industrial and Mine water

The project gave lead Metallo cage as 'trappers' for Cyanide and Chloride ions from industrial and mine water for remediation in Jamshedpur area and furnaces for the TATA Steel plants. Patents on the invention have been granted and applied for collaboration with TATA Steel plants for commercialization.

[3] Bio-sensing Applications for Kidney disorder:

New turn-on HSA sensitive probe has been developed and validated on biological fluids, like urine, blood, serum, CSFs, collected from patients suffering with clinical conditions like Systemic Lupus Erythematosus (SLE), Type 2 Diabetes Mellitus (T2DM), nephritic syndrome, nephrotic DM, antiphospholipid antibody syndrome (APLS) etc. A patent on the invention has been granted and a start-up industry (Heilen Meditech) has taken it up for possible commercialization.

[4] Soft Nanomaterials for Modern-day Therapeutics:

Multi-drugs resistance (MDR) is one of the major challenges faced by the cancer patients during their chemotherapeutic treatments. New cis-platin-based pro-drugs were developed comprising a

biocompatible tripeptide. They were demonstrated for the co-delivery of anticancer drugs, cisplatin and doxorubicin, both under in vitro and in vivo conditions. A patent application on the invention has been submitted and acquisition by healthcare/ biotech startup industry is being attempted.

[5] Organogels and Slow Release Formulations of Kairamones for Efficient Pest Management:

New organogels and slow release formulations developed encapsulating insect pheromones which will then be used for pest management in agricultural field. Following insect species are targeted:

1. Fall armyworm (Spodoptera frugiperda): Z11-14Ac (pheromone); 2. Tea mosquito (helopeltis theivora): Z3-6Ac (pheromone) and E2-6OH (pheromone) in 50:50 molar ratio; 3. European grapevine moth (lobesia botrana): Z7,E9-12Ac (pheromone)
2. Noctuid moth (Noctuidae spp.): Noctovi active (food-based attractant for lepidopteran pests). Collaboration has been initiated and funded by ATGC Biotech Pvt. Ltd., Hyderabad.

5. No. and list of Startups supported: 2

#1 Management of crop diseases via drone detection of pheromones and kairomones in a cotton farming land

#2 Pheromone nanogels for the effective management of whitegrubs in different agricultural pests (Actual title is: Pheromone nanogels for the effective management of whitegrubs in Rajasthan)

6. Employment generated / Manpower trained.69

7. Amount of Funding / Investment raised / Revenue generated. INR 90.34 lakhs

8. No. of need based technologies developed and commercialized with specific S&T areas.

No. of translational research projects completed: 21

No of Technologies / Products developed: 13

9. Infrastructure created major areas of startups supported

Clean Room Class 1000, 100 sq ft. with accessories like ambiant air encapsulation, Glove box

Laboratory for taking upto PPP, including space for inmcubation centre, prototyping etc

Liquid Nitrogen Storage Facility

Animal House

IVC and work station for animal house

Field Emission Scanning Electron Microscope (FESEM)

High Performance Computing Cluster

Liquid Chromatography – Mass Spectrometry with Proteomics software for Structure Analysis

Advanced Polymer Chromatography

Mossbauer Spectrometer with Cryogen Free Cryostat System

Ultrafast Transient Absorption Spectroscopy

Time-of-Flight Secondary Ion Mass Spectrometry

Nucleic Acid Synthesizer

Multiphoton Confocal Laser Scanning Spectroscopy

Muffle furnace

Low Temperature and High Magnetic Field Measurement System

Silicone Release Agent-free Blue Adhesive Plastic Film, Full function Multimeter, Probe Positioner and optical chopper

EDAX Digi View EBSD Off-line

Coaxial Electrospinning

10. IPR / Patent filed / accepted (National & International).

No. of patents filed: 12

No. of patents granted : 3

11. Technology/Products transferred to Industries: 1

12. Publications: 209

13. Impact created on society / outreach activities taken up for the awareness creation of the developed technologies.

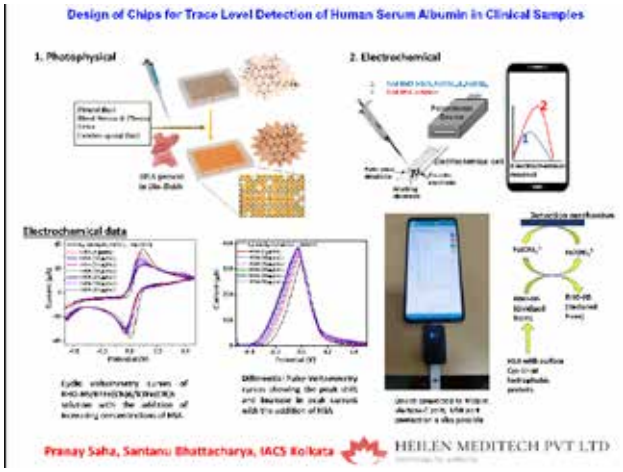
The TRC program at IACS is of very high quality, there is excellent science which has real potential for major breakthrough and the scientists involved in the first phase of TRC at IACS have developed truly impressive and path-breaking processes and products which are indeed world class. In involving such high level science for translation, and for their likely impact in markets it will take time and it is by no means it can be considered as a long time from 1st April 2016, whatever progress that is achieved so far. Since the objective is to commercialize, and these are truly sophisticated technologies, it will take longer time to commercialize them than the ones which involve rather routine or simpler processes or products.

The progress made by the TRC at IACS is characterized by its excellent outputs (products, patents, original papers) spurring opportunities for revenue generation, establishment of new equipments for translational research and efficient fund utilization, infrastructural turnover & IPR Protection of public funded research work. Many projects are in TRL-4 or TRL-5 levels or even higher stages of TRL-7/8 level. Some of them will indeed create promising product(s). Professor Asim Bhaumik, Ayan Datta and Jyotirmayee Dash may be included as new investigators since they are carrying out commendable translational research.

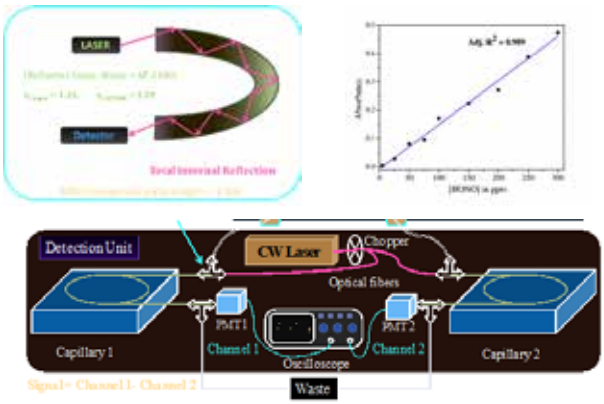
Initiation of new work culture at an outstanding institution like IACS on translational research targeted for the society has been achieved and the lingua franca of the Institution has changed by creating new opportunities for various stakeholders including the younger generation of scientists. Under this initiative, IACS has successfully installed and fabricated several advanced instruments and developed incubation facilities, clean rooms that will further promote multidisciplinary research and investigation of the properties and functionalities in such systems, with the goal of developing applications and technologies useful for industries and society. This translational research project has further helped in building the capacity in sophisticated instrumentation in IACS for the use in the industry and brings in scientific returns. The returns must not be merely translated in monetary terms although IACS has been able to generate clean revenue (of about Rs. 3.3 Crores) from the industries under the umbrella of TRC project.

15. Some pictorial highlights

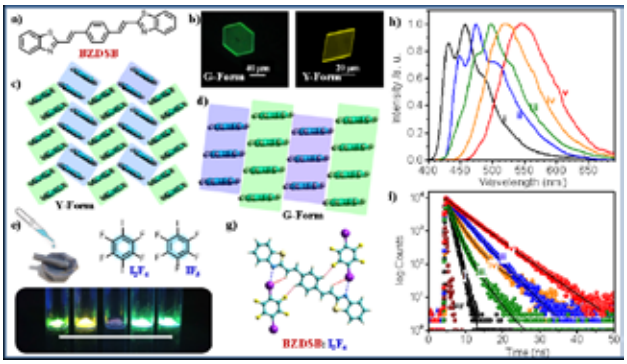
1. Chips are designed at IACS, based the principle of electrochemical approach, for the trace level detection of the protein, human serum albumin, in clinical samples.



2. An ultrasensitive absorption method has been developed based the principle of liquid core optical wave guide for the detection of trace dye contaminants (ppb to ppt levels) in aqueous fluids.

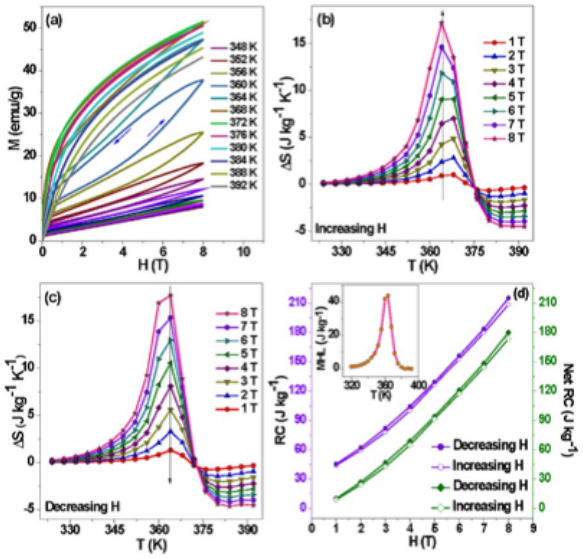


3. Development of lead-free multiferroic heterostructures for data storage and solid-state cooling applications



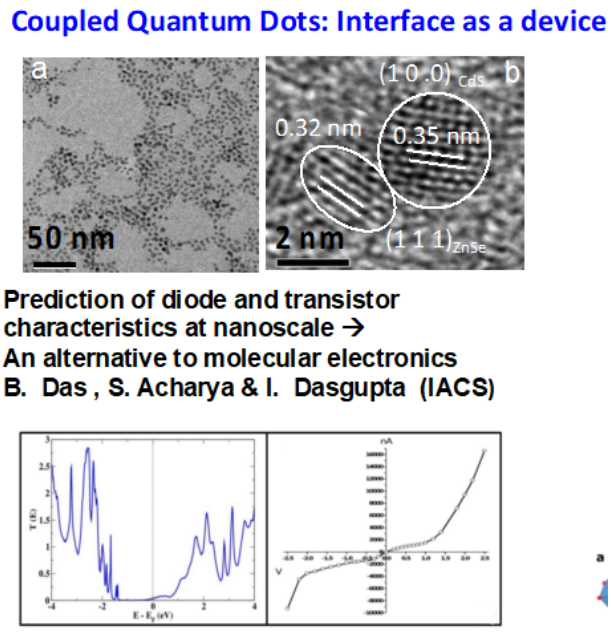
4. Designing functional quantum devices using heterostructures at nano-scale

Effects of transitional hysteresis on the large magnetocaloric and magnetoresistance properties of Ni-Mn-Co-Sn Heusler alloy



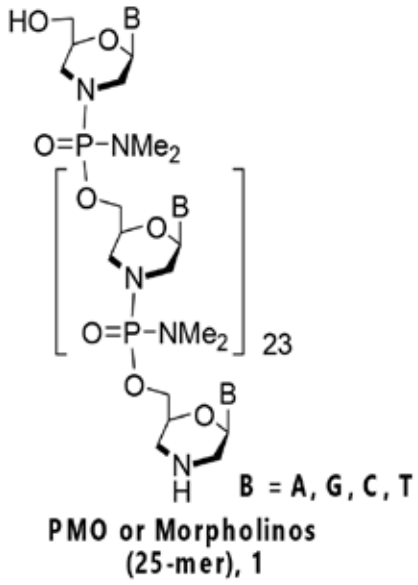
Journal of Alloys and Compounds 863, 158485 (2021)

5. Development of a chemical sensor for the detection of volatile organic compounds in breath exhalation.



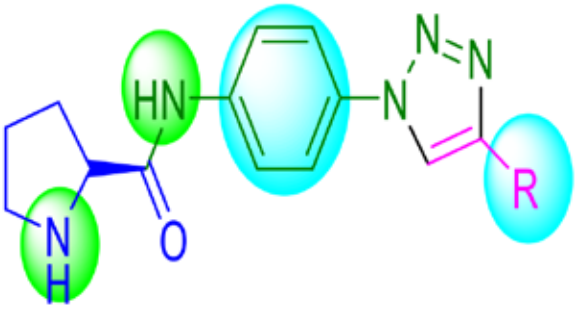
S. Varghese* et. al. Chem. Phys.Chem. 2020,10.1002/cphc.201901223

6. Development of delivery vehicles (internal guanidinium transporter) for improved cell permeability of phosphorodiamidate morpholino oligonucleotides (PMOs) based drugs for the purpose of treating Duchenne Muscular Dystrophy (DMD).



Sinha, S. et. al. OLIGO-GUANIDINES based cellular transporter comprising heterocyclic rings with hydrophobic and /or lipophilic group at N-terminal for effective delivery of nonpenetrable cargos in vitro and in vivo, US 10,919,857 B2, date of patent Feb 16, 2021.

7. A prolinamide catalyst has been developed for Cu(I) catalyzed transformations. The catalyst has been used for Ullman type cross coupling and asymmetric aldol reaction, and it has immense potential for commercialization.

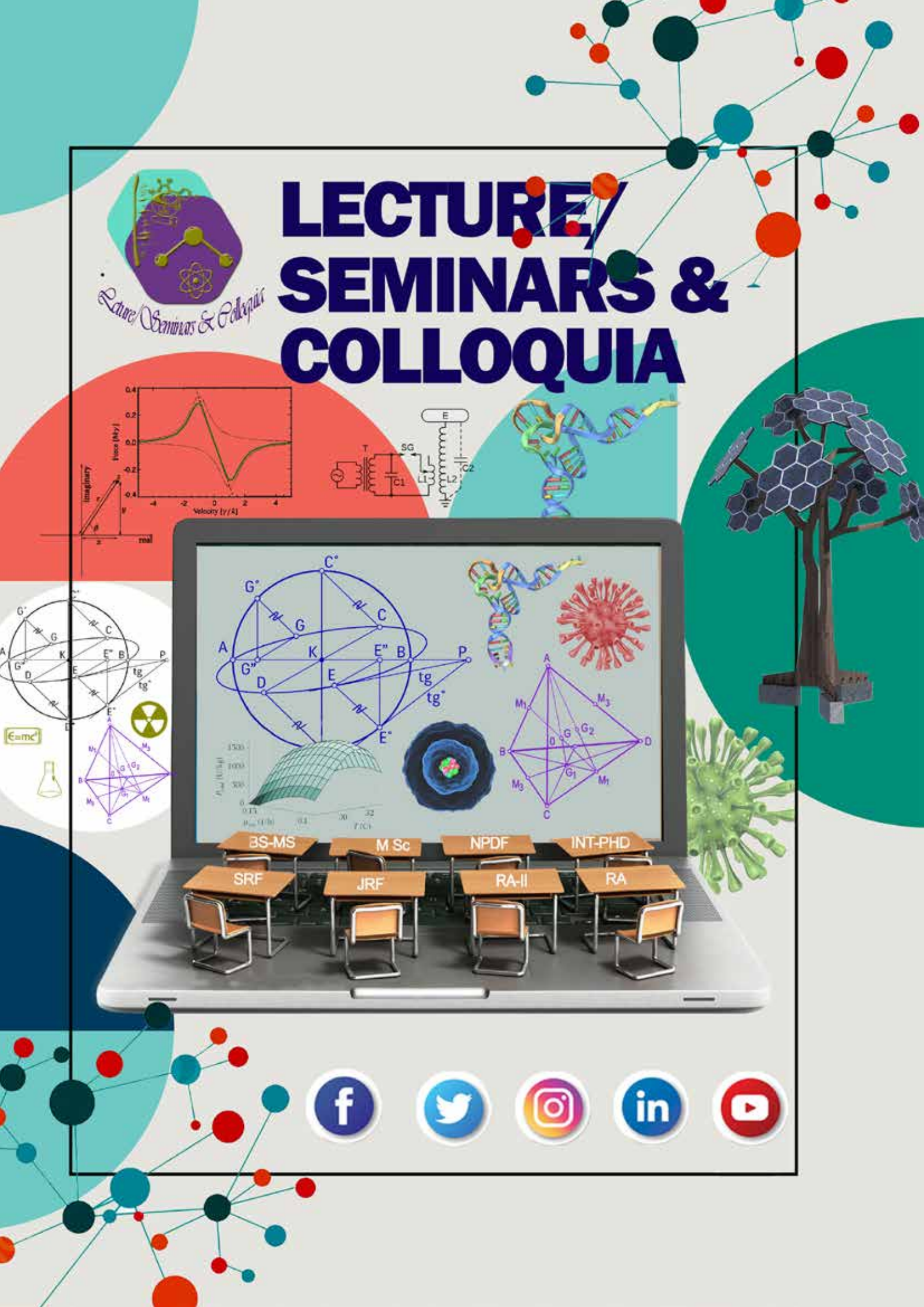


Dash et al. Green Chem. 2022, 24, 911-915, Org. Chem. Front. 2021, 8, 2434-2441

8. A series of water-soluble iron(II) complexes of polydentate nitrogen donor ligands have been developed, which can degrade polyhalogenated phenolic contaminants in water.

Paine et al, Dalton Trans., 2021, 50, 5590–5597, Dalton Trans., 2022, 51, 870–884

LECTURE/ SEMINARS & COLLOQUIA



Endowment Lecture - 2022-2023

Title	Speaker	Name of the Lecture
Resonant X-ray scattering from quantum materials	Prof. Bernhard Keimer Affiliation: Max Planck Institute for Solid State Research, Stuttgart, Germany	Mahendra Lal Sircar Memorial Endowment Lecture
Sustainable Chemistry in Drug Discovery: A Few Concepts and Applications	Prof. Asit Kumar Chakraborti	Dr Nitya Anand Endowment Lecture of the Indian National Science Academy (INSA)

Lecture/Seminars Organized at IACS

Name and organization of the Speaker	Title of the lecture
Dr.SubhraKanti Das, Head of Research and Technology, Thales India.	Introducing Thales Research and Technology
Dr. Ranjan Kumar Barik, Technical Lead (Hardware verification)	Driving SV-UVM verification activities for RISC-V cores
Dr. Arnab Sarkar, Assoc. Professor, Advanced Technology Development Centre (ATDC) Jointly with Centre of Excellence in Artificial Intelligence Indian Institute of Technology (IIT) Kharagpur	Artificial Intelligence for Cyber-Physical Systems.
Dr. Ranjan Kumar Barik, Technical Lead (Hardware verification)	Redundant binary number (RBN) based computational blocks and its applications
Professor Debabrata Goswami, Department of Chemistry & Center for Lasers and Photonics, Indian Institute of Technology Kanpur, Kanpur (S. Adhikari)	Femtosecond Spatiotemporal Control for Quantum Information Processing and Computation
Invited presentation at the International conference at JNU, New Delhi for organizing a great International Symposium on “Mitochondria, Cell Death and Human Diseases” Feb 18-19th 2023.	Title: Mitochondrial DNA damage and neurological disorders
Invited lecture and Institute colloquium at Regional Center for Biotechnology in Faridabad, 2023. 17th Feb, 2023	Title: The interplay between arginine dimethylation and ubiquitylation coordinates TDP1 proteostasis for the repair of topoisomerase I covalent complexes.
Invited talk for ENB2023 international meeting at Banaras Hindu University, Banaras. Feb10th -12th,2023.	Title: MOF-Irinotecan induced selective poisoning of mitochondrial Topoisomerase 1 (Top1mt) promotes tumor regression through nuclear perturbation”
4th International Symposium "Interdisciplinary approach to biological Sciences-2023" (#IABS2023) from February 1-3rd of 2023	Title: “PRMT5-Mediated Arginine Methylation of TDP1 for the Repair of Topoisomerase I Covalent Complexes"
Indian Association for Cancer Research (IACR) meeting at ACTREC Mumbai. January 13-15 th, 2023	Insight into the DNA breaks-induced genomic instability and the underpinning cause of human diseases
Invited talk CRG2023, meeting at IISC, Bangalore, January 9-10 th, 2023	Zooming into DNA breaks and Human diseases.

Name and organization of the Speaker	Title of the lecture
Invited Talk and institute colloquium at BSBE department, IIT Kanpur. January 3th, 2023	The interplay between arginine dimethylation and ubiquitylation coordinates TDP1 proteostasis for the repair of topoisomerase I covalent complexes.
Invited talk at the International Chromosome Stability meeting at IISER Trivundrum, Dec 13-15, 2022	Selective poisoning of mitochondrial Topoisomerase 1 (Top1mt) promotes tumor regression through nuclear perturbation"
Invited talk at the national meeting Kasturba Medical College, Manipal, organized the IEM Metabolic Meet based on the theme "Mitochondrial Cytopathies: A minuscule initiative, 30th October, 2022	Insight into the DNA breaks-induced genomic instability and the underpinning cause of human diseases
Invited Talk talk at the Nano@Chem Bio 2022 meeting organized by the Bio division at the Institute of Nano Science and Technology (INST), Mohali	Insight into the DNA breaks-induced genomic instability and the underpinning cause of human diseases

Meeting/Conference held in the Schools

Name of the Conference/Symposia-Convener	Duration	Funding Authority
Beyond Standard Models of Particle Physics and Gravity	22nd to 23rd December, 2022	IACS
Recent Trend in Condensed Matter Physics - 2023	January 12-13, 2023	IACS
InAdvanCS: Annual SCS conference	5th to 7th January 2023	IACS & Sponsors
Designing Catalysts on Computers 2022, Ankan Paul	02.12.2022	IACS, IISER-K
Theoretical Chemistry Meeting: Structure and Dynamics (TCMSD-2022, S. Adhikari	26th-29th May, 2022	IACS, Kolkata; IISER Kolkata
IABS 2023	1st-3rd Feb 2023	IACS,DST,DBT,CSIR, Private
CRSI Symposium-2022		CRSI, Kolkata Chapter
SAIS Symposium - 2023	February 27-28, 2023	IACS

Colloquium Lecture Series

Title of the Lecture	Speaker with affiliation
Fifty Years of Experimental High Energy Physics	Prof. Sunanda Banerjee INSA Senior Scientist, IACS, Kolkata
EVOLUTION OF QUANTUM THEORY & A SIMPLE DERIVATION OF BELL'S INEQUALITY	PROFESSOR AJOY GHATAK, Optics & Photonics Centre, IIT Delhi
Photonic quantum science and technologies	Professor Urbasi Sinha, RRI, Bangalore
Why has it been so difficult to arrive at a consistent theory of superconductivity in the high Tc cuprates?	Prof. Sumitendra Mazumdar, Department of Physics, University of Arizona, USA
How to design polymers to fulfil functions in solar cells, biosensors, and batteries?	Prof. Mukundan Thelakkat, Applied Functional Polymers, University of Bayreuth Bavarian Polymer Institute (BPI), Bavarian Centre for Battery Technology (BayBatt) Bayreuth, Germany
Living in the World of RNA Therapeutics	Dr. M. Manoharan, Alnylam Pharmaceuticals, Cambridge, MA02142

Title of the Lecture	Speaker with affiliation
Crystal Engineering. Its Potential in Modern Chemistry and Society	Prof Gautam R Desiraju, Solid State and Structural Chemistry Unit, IISC Bangalore
Quest for High Voltage Redox in Intercalation cathodes for Na and Li-ion batteries	Dr. Urmimala Maitra, IACS
Nonlinear vibrational spectroscopy of aqueous solutions and its relations to underlying structure and dynamics	Prof. Amalendu Chandra, Department of Chemistry, IIT Kanpur

Inter-Institute Collaboration

Solar Energy Research is being conducted with MNRE. A continuous Ambient Air Quality Monitoring Station (ACAAQMS) is in operation in collaboration with the West Bengal Pollution Control Board at IACS.

IACS remains as Nodal institute for India in Asia Pacific Center for Theoretical Physics (APCTP) based in Seoul, South Korea. There is a Co-Publishing Agreement between Springer Pvt. Ltd. and IACS to run the Indian Journal of Physics. Tripartite water research agreement has been in operation between IACS, University of Roma Tre and University of Cagliari, Italy. There are Japan-India Collaborative Research Projects in Molecular Sciences with the Institute for Molecular Science (IMS), Japan; National Institute of Natural Sciences (NINS), Japan; SERIIUS (Solar Energy Research Institute for India and the United States); TWAS-IACS Postdoctoral Fellowship Programme which are currently underway.

In order to foster strategic partnership with industries to conduct advanced applied research of translational scope, the following activities have been initiated. Collaboration with GK Machineries and Robotics Pvt. Ltd. for the development of drone assisted pheromone dispersal through nanosensors for the early detection of pest infestation in cotton farming land. A start-up grant was sanctioned from Biotechnology Industry Research Assistance Council (BIRAC), DBT, for the development of point-of-care device for the selective detection of human serum albumin, creatine kinase and kidney injury molecule-I for the accurate determination of acute kidney injury. BIRAC, DBT has funded the formation of a start-up company, GR Agritek Labs through Biotechnology Ignition Grant-13 where the scientists from IACS are part of the team members in this project. A private industry sponsored research program has been initiated with ATGC Biotech Pvt. Ltd. for the development of semiochemical loaded organogelators for the management of certain agricultural pests. Collaborative Research Project is going on with Unilever Research Centre, Bangalore; Research agreement between IACS-TATA Steel Ltd has been signed. Collaborative Research Project with Unilever Industries Pvt. Ltd., Mumbai, between IACS and Dystrophy Annihilation Research Trust, Bangalore between IACS and CSIR-IICB Kolkata are in operation. A joint inter-institutional Integrated M.Sc.Ph.D. programme in Chemical and Cell Biological Sciences between IACS and IIT-Kharagpur is ongoing, in which several students from various parts of country are inducted.

Patents list for 2022-23

Patents filed:

1. Indian Patent Application No.202231028114 with filing date 16/05/2022

   One-pot chemical synthesis of transition metal dichalcogenide and their alloys with elemental chalcogens

   by Dr. Praveen Kumar et al.

2. Indian Patent Application No. 202231042899 with filing date 27/05/2022

   Modified morpholino oligonucleotides incorporating 5- substituted pyrimidines to improve binding stability, hydrophobicity or lipophilicity useful for antisense applications

   By Prof. S Sinha et al.

3. Indian Patent Application No. 202231052854 with filing date 15/09/2022

   Coumarin conjugated thiazole peptide that binds to SARS-CoV-2 RNA G-quadruplex

   By Prof. J Dash et al.

4. Indian Patent Application No. 202231064387 with filing date 10/11/2022

   Ultra- small drug nano-conjugates (MTC-AUNPS) and process of its synthesis

   By Prof. J Dash et al.

5. Indian Patent Application No. 202331002606 with filing date 12/01/2023

   PCR-independent detection of DNA sequences using fluorescent label-free, INA-probe-based single molecule force spectroscopy approach

   By Prof. R Mukhopadhyay et al. Application No. 202331002606, Publication Date 09/06/2023

Patent granted:

1. Indian Patent No. 401773 dated21/07/2022

   Oligo-guanidine based cellular transporter comprising heterocyclic rings with hydrophobic and/or lipophilic groups at n-terminal for effective delivery of nonpenetrable cargos in-vitro and in-vivo by Prof. S Sinha et al.

2. Indian Patent No. 408183dated 30/09/2022

   Diaguanosine derivatives as synthetic membrane channels for drug delivery applications by Prof. J Dash et al.

3. Indian Patent No. 418923 dated23/01/2023

   Substituted internal oligoguanidines as cellular penetrating agents by Prof. S Sinha et al.

Annual Activity Report of IACS

Indian Association for the Cultivation of Science (IACS), founded in the year 1876 by Dr. Mahendralal Sircar, an acclaimed medical practitioner of his time, is the oldest scientific institution in Asia funded by the Department of Science & Technology, Government of India and the Government of West Bengal. Sir C V Raman made his historic discovery of the 'Raman Effect' at IACS. IACS continues to adorn the mantle of academic and intellectual excellence in India and abroad and now stands at the crossroad of a critical era. Apart from fundamental researches in the various frontier areas of physics and chemistry, IACS has ventured in a significant way, for the past few years, into the emerging multidisciplinary areas such as non-conventional energy sources, advanced and novel nano-materials, chemical biology and interdisciplinary sciences. At present, IACS has more than 400 research students/associates working under the guidance of about 67 faculty members working in physics, chemistry and biology. The Institute has dynamic programmes for the pursuit of research leading to the doctoral degree and for post-doctoral work and has Visiting Scientists Scheme. There is an excellent library, good computing facilities and the campus is equipped with all modern facilities and amenities.

Apart from all these, IACS is also involved in multiple talk/popular lectures on different scientific topics, cultural events such as Cultvision, various competitions, different health and safety programs, Colloquia and many more national and international level programmes throughout the year. Below is the list of programs month-wise held during the Year 2022-23.

APRIL-2022

» CSS symposium held on "Recent trends in Measurement and Computational Sciences" on 22nd April, 2022 at IACS.

» Blood Donation Camp organized by Science Association Club (SAC) on 28th April, 2022 at IACS.

MAY-2022

» Lecture on title “Yoga & Breath work - Fight depression & anxiety” as part of celebration of 8th International Yoga Day at IACS on 6th May, 2022.

» Materials Science Colloquium on title “Quest for High Voltage Redox in Intercalation cathodes for Na and Li-ion batteries” held on 13th May, 2022 at IACS. Details can be found on the link http://www.iacs.res.in/modules/event/images/event_10-05-227512.pdf

» Talk on Alzheimer's disease on title “Interaction with Apolipoprotein E modulates the function of Amyloid-β in Alzheimer's disease” held on 19th May, 2022 at IACS.

» Institute Colloquium on title “Crystal Engineering. Its Potential in Modern Chemistry and Society” held on 24th May, 2022 at IACS.

» An Advanced Scientific Training Program for ST Graduate Students has been organized by IACS. The aim of the program is to identify graduate students from the Scheduled Tribe (ST) community from the eastern and north eastern region to inspire them in science and research. The program will provide the requisite facilities to arouse research and scientific interests for the sustainable development of young manpower. The program is undertaken for the scientific capacity building in the young ST community for their sustainable future. For more details click on http://www.iacs.res.in/modules/event/images/event_10-05-227321.pdf

» Theoretical Chemistry Meeting:Structure and Dynamics (TCMSD-2022) organized by IACS from 26th-29th May, 2022. For more details click here http://iacs.res.in/tcmsd2022/home.html

JUNE-2022

» IACS organized a Mass Meditation programme as its second program to Celebrate the 8th International Yoga Day 2022 on 3rd June, 2022.

» One day Symposium in Chemical Sciences organised by Chemical Research Society of India (CRSI) Kolkata Chapter & School of Applied and Interdisciplinary Sciences, IACS, Kolkata on 4th June, 2022. For details click on http://www.iacs.res.in/modules/event/images/cdiv1_26-10-227067.pdf

» Dr. Nitya Anand Endowment Lecture of the Indian National Science Academy (INSA) with title “Sustainable Chemistry in Drug Discovery: A Few Concepts and Applications” on 10th June, 2022 at IACS.

» "Rabindra-Nazrul Sandhya" celebrated at IACS on 17th June, 2022.

» Celebration of 8th International Yoga Day at IACS on 21st June, 2022.

JULY-2022

» Seminar on Suicide Prevention held at IACS on 6th July, 2022.

» Professor Abhishek Dey, Chair, School of Chemical Science has been awarded the James Hoeschele-AsBIC award from the Aisian Biological Inorganic Chemistry.

» Institute Colloquium on title "Living in the World of RNA Therapeutics" held on 12th July, 2022 at IACS.

» 146th Foundation Day Celebration Programme and "Har-Ghar-Tiranga" Programme celebrated at IACS on 29th July, 2022.

» 2nd Annual Convocation Program celebrated at IACS on 29th July, 2022. For details on the program click on the following link http://www.iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=403

AUGUST-2022

» A workshop on the following techniques was organized on August 04, 2022- 1) "CRISPR and Gene Editing" by Dr. VenkatKoushikPulla, 2) "Western blotting" by Dr. Sumeer Raina, 3) "Cell culture" by Dr. VenkatKoushikPulla.

» Dr. Anindita Das, Assistant Professor in the School of Applied and Interdisciplinary Sciences has been conferred the the DAE Young Scientists Research Award.

» Professor Suhrit Ghosh, Dean-Academic and Senior Professor in the School of Applied and Interdisciplinary Sciences has been awarded the C.N.R. Rao National Prize for Chemical Research by the Chemical Research Society of India.

» Professor Pradyut Ghosh, Senior Professor in the School of Chemical Science has been awarded the J C Bose National Fellowship of DST.

» Professor KrishnenduSengupta, Senior Professor in the School of Physical Science has been awarded the J C Bose National Fellowship of DST.

» 75th Independence Day celebration under the aegis of "AzadiKaAmritMahotsav" on 15th August, 2022.

» Institute Colloquium on title "How to design polymers to fulfil functions in solar cells, biosensors, and batteries?" at IACS on 29th August, 2022.

SEPTEMBER-2022

» 58th Annual Social & Cultural Meet was organized by the Science Association Club (SAC) during 1st and 2nd September, 2022.

» Open thesis (PhD) Colloquium on title "Investigation of caloric effects in magnetic and ferroelectric thin film heterostructures" at IACS on 2nd September, 2022.

» The Medical Cell of IACS has organized a free vaccination camp for all eligible IACS members and their immediate family members at M. R. BangurGovt Hospital on Sept 8 and 9, 2022.

» Freshers Welcome and Felicitation Ceremony 2022 celebrated at IACS on 9th September, 2022.

» Invited talk on title "Principled Structure Discovery from Graph Data" at IACS on 15th September, 2022.

» Mahammad ANAS (SRF), a student of Prof. Tarun Mandal in the School of Chemical Sciences, IACS has been awarded the Best Poster Prize for the poster entitled "(P001) SYNTHESIS OF CATIONIC POLYCYSTEINE FOR STIMULI-RESPONSIVENESS AND DNA POLYPLEXATION" in 14th International Symposium on Ionic Polymerization (IP'22), held at Ghent, Belgium, on September 11-16, 2022.

» 'Cleaning up the corridors' and Disposal Activity as part of Special Campaign 2.0 of DST, GoI starting from end of the month, September.Some photographs of the Cleanliness Drive may be found on link http://www.iacs.res.in/modules/texteditor/imagesfiles/Cleanliness_Photos.pdf

» Professor Narayan Pradhan, Senior Professor in the School of Materials Science has been elected to Fellowship of INSA.

OCTOBER-2022

» IACS organized a popular talk through online mode as its first program to celebrate the Cyber Jaagrookta Diwas for the year 2022-23 on 19th October, 2022.

» Dr. Anindita Das, Assistant Professor in the School of Applied and Interdisciplinary Sciences has received the Associateship of the Indian Academy of Sciences 2022.

» Observance of RashtriyaEkta Diwas (National Unity Day) on 31st October, 2022 as a part of the Vigilance Awareness Week celebration from 31st October - 6th November. For photos, videos and more information on this topic, click on http://www.iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=327

NOVEMBER-2022

» Lecture on "Enterprise Information Security and e-Vigilance" on 4th November 2022 on account of Vigilance Awareness Week celebration. For photos and videos click on http://iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=333

» Essay Writing Competition on account of Vigilance Awareness Week celebration. For more information, click on http://iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=334

» Workshop on Preventive Vigilance by Shri Sowmendra Chanda, Deputy Secretary (Vigilance), DST as a part of the Vigilance Awareness Week celebrations at IACS. For more details click on http://iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=335

» Professor Debashree Ghosh in the School of Chemical Sciences, IACS has been awarded the Walter Kohn Prize 2022 by ICTP Trieste. The citation reads "The 2022 Walter Kohn prize is awarded to Dr. Debashree Ghosh for her pathbreaking work in developing novel quantum chemical tools for materials design and the study of biological function. Combining techniques from physics, chemistry and biology, her work has made important advances in our understanding of strongly correlated materials and complex biological systems".

» Workshop on Green Energy Harvesting and Storage : Materials, Methods and Applications organized at IACS from 16th-22nd November, 2022. For more details, please click on http://www.iacs.res.in/modules/event/images/cdiv1_12-10-228568.pdf

» APCTP-IACS-SNBNCBS Workshop on Computational Methods for Emergent Quantum Matter organized jointly at S. N Bose National Center for Basic Sciences, Kolkata and at IACS, Kolkata from 17th-25th November, 2022. For more information, click on https://www.bose.res.in/Conferences/APCTP22/program/

» Constitution Day Celebrations at IACS on 26th and 28th November, 2022. For photos and live videos, click on http://www.iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=340

» Popular Talk on “Multifaceted Treatment for Obsessive Compulsive Disorder (OCD) held at IACS on 28th November, 2022.

DECEMBER-2022

» A meeting commemorating the life and work of Professor N.C. Sil in the Indian Association for the Cultivation of Science held on 1st December, 2022.

» Conference on Designing Catalysts on Computers – 22 held from 2nd-3rd December, 2022.

» Institute Colloquium on title “Why has it been so difficult to arrive at a consistent theory of superconductivity in the high Tc cuprates?” held at IACS on 7th December, 2022.

» A Campaigning Programme on Postal Life Insurance (PLI) organized by the Department of Posts, Government of India, at IACS on 6th December, 2022.

» Celebration of Ambedkar Jayantion December 14, 2022 at IACS. For more details, photos and videos, click on http://www.iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=355

» Talk on "Coping With Sexual Harassment at Work Place” at IACS on 28th December, 2022. For photos and more details, click on http://www.iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=358

JANUARY-2023

» Program for InAdvanCS 2023organised by School of Chemical Sciences at IACS between 5th-7th January, 2023. For details, click on http://www.iacs.res.in/modules/event/images/cdiv1_03-01-233540.pdf

» Invited lectures on title “Query Performance Prediction: the past, the present and the future’ at IACS on 9th January, 2023.

» Professor Somobrata Acharya, Senior Professor in the School of Applied and Interdisciplinary Sciences has been inducted as a Fellow of the Indian Academy of Sciences, Bangalore and the National Academy of Scienes India, Allahabad.

» Professor Abhishek Dey, Senior Professor in the School of Chemical Sciences has been inducted as a Fellow of the Indian Academy of Sciences, Bangalore.

» The School of Physical Sciences, IACSorganized a two-day conference on “Recent trends in Condensed Matter Physics-2023” on the 12th and 13th of January, 2023. For details, check the link http://www.iacs.res.in/modules/event/images/event_11-01-231152.pdf

» The Curtain Raiser event of IISF-2022, mandated by DST, being organized under the auspices of the Management Committee of IACS, on 16th January 2023. For photos and videos, click on http://www.iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=367

» Open thesis colloquium on title “Renormalization and machine learning approaches for strongly correlated systems - development and applications” at IACS on 19th January, 2023.

» Open thesis colloquium talk on title “Role of actomyosin complex in endocytosis and endocytic trafficking” at IACS on 25th January, 2023.

» 74th Republic Day Celebration at IACS Premises on 26th January, 2023. For photos and videos, click on http://iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=370

» Colloquium lecture on title “EVOLUTION OF QUANTUM THEORY &A SIMPLE DERIVATION OF BELL'S INEQUALITY” at IACS on 30th January, 2023.

FEBRUARY-2023

» 4th International symposium "Interdisciplinary approach to biological Sciences-2023" (IABS-2023) from February 1-3rd of 2023 held at IACS. For photos, click on http://iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=374

» "International Mother Language Day" celebration at IACS on 21st February, 2023. For more details and photos and videos, click on http://www.iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=376

» ANNUAL MEETING OF SCHOOL OF BIOLOGICAL SCIENCES organized at IACS on 24th February, 2023. For details, check the link http://www.iacs.res.in/modules/event/images/cdiv1_18-02-232321.pdf

» School of Applied and Interdisciplinary Sciences, IACS organized two days “SAIS Symposium 2023” from 27-28th February, 2023. For more details click on the link http://www.iacs.res.in/modules/event/images/cdiv1_25-02-236401.pdf

» National Science Day Programme celebration at IACS on 28th February, 2023. For photos, videos and report on this event, check the link http://www.iacs.res.in/maincontroller.php?navid=24&subnavid=110&resubnavid=378

MARCH-2023

» Session on Meditation and Mental Health, held on 3rd March, 2023 at IACS.

» Institute Colloquium on title “Photonic quantum science and technologies” held at IACS on 3rd March, 2023.

» Annual Cultural Programme celebration at IACS-'Cultvision 2023' held on 17th and 18th of March 2023.

» Talk on "Reconfiguring shortest paths in graphs" held at IACS on March 30, 2023.

Indian Journal of Physics

Indian Journal of Physics is a pioneering journal founded by Sir C V Raman in 1926, devoted to the publication of significant, original and current scientific research results with ISSN is 0973-1458. It is the official publication of the Proceedings of Indian Association for the Cultivation of Science.

Starting from January 2009, Indian Journal of Physics is being published in collaboration with Springer (www.springer.com/12648). Springer also distributes the print version of the Journal since January 2013.

In 2022(January - December)total 1389 No. of papers have been submitted by authors in online Editorial Manager System. During this period 14 issues of Vol. 96 have been published that contain 406Nos. of research articles. Impact Factor for 2021 is **1.778.**No. of downloads in 2022 is 86,311. We have received **Rs. 64,29,229.00** (Sixty four lakh twenty nine thousand two hundred ninety eight only) as income on A/c. of IJP (from M/s. Springer India Pvt. Ltd. for Volume 95, No. 1 - 14, January to December 2021). Acceptance rate of submitted articles for 2021 is 29%.

A special issue titled "Physical Views of Cellular Processes" has been published in August 2021.

Scope

Astrophysics, Atmospheric & Space Physics / Atomic & Molecular Physics/ Biophysics/ Condensed Matter & Material Physics / General & Interdisciplinary Physics / Nonlinear Dynamics &Complex Systems / Nuclear Physics / Optics &Spectroscopy / Particle Physics / Plasma Physics / Relativity & Cosmology / Statistical Physics

Abstract / Index Service

Other than Springer, this journal is abstracted /indexed in:Web of Science, SCOPUS, INSPEC, Chemical Abstracts Service (CAS), Google Scholar, Academic OneFile, Indian Science Abstracts, INIS Atomindex, INSPIRE, International Bibliography of Book Reviews (IBR),International Bibliography of Periodical Literature (IBZ), OCLC, SCImago, and Summon by Serial Solutions.

Editor-in-Chief &Honorary Secretary

Professor S Majumdar

Outreach Programme Carried Out in 2022-23

Due to Covid 19 Pandemic followed by national-wide lock down, outreach programme as was being organized by the societal component of IACS on regular interval, could not be planned for a considerable period. Gradually pandemic was turned to endemic and for thus few outreach proogramme could be arranged in 2022-'23 as follows :-

a) Pre-IISF 2022 Public Outreach Progamme

In accordance with the directive of the Ministry of Science & Technology and Ministry of Earth Science, the Pre-IISF 2022 Public Outreach Programme was organized at IACS on 16th January, 2023.

Popular Lectures, Interactive Science Activities were arranged in a day-long programme for the students of neighbouring schools. Altogether one hundred thirty students from four schools including girl students attended the day-long programme. A Kit containing stationeries was handed over to each students on registration for the programme along with light refreshement. Prof. Tapas Chakraborty, the then Director (Additional Charges) inaugurated the programme welcoming participating students and their accompanied teachers at 10.30 a.m. There were two invited lectures in the forenoon session, delivered by Prof. Alok Goswami on "Reflection in Counting and other Things" and Prof. Soumitra Sen Gupta on "Gravitational Wave – the Song of the Cosmos". In the post-lunch session, Prof. Surajit Sinha discoursed on "Therapy for Genetic Disorder Diseases using Watson-Crick Base Pairing Concept of DNA" followed by Quiz Contest. Participants enthusiastically participated in the Quiz Content for which instant prizes were arranged for the right answers to the quiz. In the valedictory session, Participation Certificates were handed over to students followed by Vote of Thanks by Dr. K D M Rao, Co-ordinator of the Programme. The programme met a grand success.

b) Celebration of National Science Day 2023:

In pursuance of directives of the Department of Science & Technology, Government of India, IACS celebrated the National Science Day 2023 to mark the discovery of the ***Raman effect*** by Indian physicist Sir C. V. Raman on 28 February 1928. A Committee comprising of faculty, non-faculty and scholars was formed vide OM No. 1.2/161 dated 09.02.2023 to oversee and organize the event on 28th February 2023 on this year's theme "Global Science for Global Wellbeing" as announced by the Government of India. The celebration programme provided a valuable platform to the invited students from classes VIII to XI from various schools in and around Kolkata to learn, network and collaborate with some of the eminent faculty members of IACS, Bose Institute and IISER Kolkata who attended the whole day programme.

Registration of the school students along with their teachers was done in front of MLS Hall where registration kit and refreshments were provided to them after successful completion of the registration process.

The programme commenced with the Welcome Address by the Chairperson, Organizing Committee, Prof. Debashree Ghosh which was followed by the inaugural

speech by Prof. Tapas Chakraborty then Acting Director (Additional Charges), IACS. Prof. Tapan Kanti Paine, Sr. Professor, School of Chemical Sciences, gave a talk on *"Cholorocarbons: From Boon to Bane"* where the students had in-depth knowledge and an interactive session with Professor Paine. It was followed by a very interesting Quiz Contest Session organized by the scholars of IACS where the students participated very actively and the winners were awarded with gift hampers instantly. This was followed by lunch break and photograph sessions for the participating students.

The afternoon session had a talk by Prof. Gautam Basu, Professor, Bose Institute on *"Can sCienCe progress without ArT?"* in the 1st session. Students were elated by Prof. Basu's presence and had a very fun filled session through various activities organized by him. It was followed by a talk by Prof. Somnath Basu, Associate Professor, IISER Kolkata on *"Games on Graphs"*. This again being a very interactive session consisting of activities requiring immense active participation from the students led them to learn and understand many complex topics in science in a simpler manner which may be beyond the scope of regular notebooks.

The programme concluded with a Vote of Thanks by the Registrar, IACS, Smt. Sarbani Saha who wished the students for their participation and congratulated the Organizing Committee for making the programme a grand success. All the participants will be given a Certificate of Participation which will be sending to their respective schools.

Lecture & Article for Science Popularization

» **Ayan Datta :** ChemShala for IISER Berhampur for chemistry students.

» **Debashree Ghosh :** Pedagogical lecture on artificial intelligence, St. Xavier's College, Kolkata; Organized National Science Day, IACS

» **Joyram Guin : Asymmetric Organocatalysis: A Powerful Technique for Asymmetric Synthesis**, Department of Chemistry, Serampore College, West Bengal, April 26, 2022; **Concept of Asymmetric Synthesis and Asymmetric Organocatalysis"** Department of Chemistry, Chandernagore College, West Bengal, August 23, 2022

» **Surajit Sinha** : Therapy for Genetic Disorder Diseases Using Watson-Crick Base Pairing Concept of DNA. 16th January 2023, IISF (India International Science Festival)

» **Devajyoti Mukherjee** : Participation in India International Science Festival IISF 2022- MEGA SCIENCE AND TECHNOLOGY EXHIBITION, 21 - 24 January 2023, MANIT, Bhopal

Extra Mural Funding:

Name of PI	Project Titles	Duration of Project	Total Sanctioned amount	End date
Dr. Urmimala Maitra	Structurally stable reversible oxygen redox for high-voltage and high capacity Li- ion cathodes	3 Years	50,54,400/-	28.06.2024
Dr. Somobrata Acharya	Stimulating scientific quality improvement program in young ST human resources for self-sustainable empowerment	3 Years	2,11,75,986/-	11.03.2024
Dr. Raju Mondal	Nanometric sensitizer-polyoxometalaie tandem system for photocatalytic water splitting	2 Years	28,26,220/-	05.10.2023
Dr. Tarun Kumar Mandal	Stimuli-responsive block copolymer based nanostructured single-/multi-component micelles: material applications	3 Years	28,80,975/-	27.09.2023
Dr Asim Bhaumik	Development of green bio-conjugation chemistry to synthesize biopolymer based materials	2 years	10,99,360/-	21.05.2023

Name of PI	Project Titles	Duration of Project	Total Sanctioned amount	End date
Prof. Prasanta K Das	Fabrication of conjugates of supramolecular self-agregated structures;potentials in diagnosis and combination therapy	3 Years	52,44,026/-	30.11.2024
Dr. Narayan Pradhan	New facets in perovskite nanocrystals and their heterostructure	3 Years	59,98,080/-	27.12.2024
Dr. Partha Basuchowdhuri	AI based detection of Acute Respiratory Distress Syndrome (AI-DARDS):An artificial intelligence aided non-contact framework for detecting acute repiratory distress syndrome using microwave sensors	3 years	49,33,873/-	12.01.2023
Prof. Rajib Kumar Goswami	Total synthesis of marine macrocyclic natural products and exploration of their anticancer relevance with structural variations	3 Years	38,40,000/-	26.12.2024
Dr Sudip Malik	Nova Surface care Pvt. Ltd.	1 year	12,00,000/-	
Dr. Asim Bhaumik	Dr Partha Pratim Bag (TARE)	3 Years	18,30,000/-	27.12.2025
Dr Sudip Malik	Dr Tanmoy Kar (TARE)	3 Years	18,30,000/-	13.12.2024
Dr Avhishek Dey	3rd Programme advisory committee	3 days	16,50,360/-	
Dr Krishnendu Sengupta	J C Bose Fellowship	5 years	95,00,000/-	06.03.2027
Dr Debashree Ghosh	SERB Power fellowship	3 years	38,10,000/-	08.03.2025
Dr Pradyut Ghosh	J C Bose Fellowship	5 years	95,00,000/-	06.03.2027
Dr. Subhadeep Datta	Two-dimensional magnets under extreme condition: manipulation of electronic and magnetic order	3 Years	49,12,920/-	07.03.2025
Prof. Narayan Pradhan	Seeded Growths of Perovskite Nanocrystals	3 Years	43,10,388/-	10.03.2025
Dr Jyotirmoyee Dash	Targeting and mimicking nucleic acid quadruplexes: A synthetic organic chemistry paradigm	5 years	3,07,98,400/-	21.05.2022
Dr. Avisek Das	The Ramanujan fellow	5 Years	38,00,000/-	16.03.2023
Dr. Anuja Datta	Award of Ramanujan Fellowship to Dr Anuja Dutta, PSU (The project transfer from CSIR)	5 years	89,00,000/-	07.06.2023
Dr. Benu Brata Das	Exploring the molecular of PARPI-DNA Trapping and the rationale for combination chemotheraphy of PARP-Topoisomerasel inhibitors in Homologous Recombination Stratified Ovarian Cancer	3 Years	25,35,000/-	
Dr. Tapas Chakraborty, Co. PI: Dr. P.C. Singh	Development of QCL-Based Robust and Portable Infrared Spectrometer for Measurements of HONO at Atmospheric Levels and Probing HONO Production in Trace Quantities in Some Laboratory Reactions	3 Years	1,00,89,600/-	12.03.2022

Name of PI	Project Titles	Duration of Project	Total Sanctioned amount	End date
Dr. Kajari Dutta (TARE)	Design of Ag decorated oxide Quantum Dot/ Graphen nanocomposites : Highly efficient eco-friendly visible light photocatalyst	3 Years	18,30,000/-	28.02.2022
Prof. Amitava Patra	Design and Understand of the Nanomaterial Based Light Harvsting Systems	3 Years	35,96,400/-	11.03.2022
Dr. Uttam kumar Ghorai(TARE)	Controlling the favourable alignment of metal phthalocyanine molecules in nanorods to improve their carrier mobility	3 Years	18,30,000/-	
Prof. Santanu Bhattacharya	Efficacious Management of Wood Borers in Protected Areas of Forest by Pheromone Loaded Organogel	3 Years	94,73,080/-	15.03.2022
Prof. Asim Bhaumik	Design and Synthesis of Novel Porous Nanomaterials for Chemical Fixation of CO2	3 Years	22,25,530/-	
Dr. Anindita Das	Supramolecular Engineering in biodegradable polymers by directional halogen-bonding interactions: A strategy towards new class of biodegradable polymeric materials	3 Years	18,92,000/-	15.03.2022
Dr. Surajit Sinha	Design, synthesis and cellular uptake of non-peptidic cellular transporters and their application in the delivery of siRNA and antisense morpholine oligonucleotides for gene silencing in cancer cells	3 Years	50,31,720/-	
Prof. Amlan Jyoti Pal	Anisotropy of Spin-Diffusion Length in Layered Transition Metal Dichalcogenides: Spin Valve Devices	3 Years	51,79,333/-	26.03.2022
Dr. Siddhartha Sankar Jana (DIA)	Understanding the regulation of C2 exon splicing in neuronal cells	3 Years	5,40,000/-	29.03.2022
Dr. Ayan Datta (DIA)	Phosphorene and its analogues as substrates for single atomcatalysis(SAC): Computational Investigations	3 Years	54,21,317/-	29.03.2022
Dr. Praveen Kumar	DEFINE: Development of Efficient Full Color InGaN Nanostructured LED Emitters	3 Years	46,04,429/-	alloted date 31.03.2023
Dr. Santanu Bhattacharya	Organogelation and slow release formulations for inspect pheromones	3 Years	29,90,000/-	30.06.2022
Prof Asim Bhaumik	Indo-Russian/CO2 as a building block for synthesis of fine chemical and fuel over functionalized materials	3 Years	63,12,032/- (Total Project Cost)	28.05.2022
Dr. Abhishek Dey	Bio-Inspired Hydrogen Evolution from Water: Troubleshooting Practical Limitations	3 Years	91,26,000/-	05.09.2022
Dr. Praveen Kumar	DEEP: Development of an efficient photoelectrode for hydrogen fuel from water	3 Years	56,17,080/-	08.10.2022
Dr. Abhishek Dey	Development of solar to chemical fuel generation device/process based on earth abundant materials	3 Years	84,06,356/-	29.02.2022
Dr. Debashree Ghosh	Multi-Refence Methods with hybrid QM/MM approaches	3 Years	91,90,000/-	03.10.2022

Name of PI	Project Titles	Duration of Project	Total Sanctioned amount	End date
Dr. Raju Mondal	Pyridine-Pyrazole based Multifunctional Metal-organic Hybrid Materials and their Applications	3 Years	21,91,210/-	29.03.2022
Dr. Parthasarathi Dastidar	Developing Self-drug-delivery systems from coordination complexes/polymers	3 Years	16,30,800/-	12.01.2023
Dr. T.K. Paine	Tuning Reactivity and Selectivity in Bioinspired Oxidations Catalysed by Nonheme Iron Complexes	3 Years	42,31,525/-	05.06.2023 (Extended)
Dr. Prashant Chandra Singh	Molecular Basis of Structural/Conformational Change of Protein, Membranes and DNA Damage Induced by Fungicides: Investigation by State of Art Vibrational Sum Frequency Generation and other Spectroscopic Techniques	3 Years	28,72,800/-	04.02.2023
Dr. Rajib Kumar Goswami	Total Synthesis of Macrocyclic Polyketide Natural Products with Conjugated olefins and their relevant analogues and evaluation of their anticancer activities	3 Years	36,28,800/-	04.02.2023
Prof. Satrajit Adhikari	Beyond Born-Oppenheimer Approaches on Spectroscopy, Reactive and Surface Scattering	3 Years	26,56,800/-	04.02.2023 (extended upto 04.08.2023)
Dr. Jyotirmayee Dash	Regulation of Non-Canonical Nucleic Acids Structure and Function by Molecular Probes	5 Years	4,49,62,500/-	16.01.2025
Prof. Sugata Ray	Spin-orbit Interaction Driven Novel Quantum Spin Liquid States	3 Years	25,64,325/-	03.02.2023
Prof. B.C. Ranu (INSA)	Functionalization of useful aromatic and heteroaromatic molecules via C-H activation using Bengin and less expensive metals	3 Years	3,00,000/-	01.12.2024
Prof. Pradyut Ghosh	Development of Organo-and Transition Metal based Supramolecular Scaffolds toward Recognition, Sensing and Catalytic Organic Transformations	3 Years	51,92,725/-	10.08.2023
Prof B. C Ranu	INSA Honorary Scientist project	3 years	3,00,000/-	01.12.2024
Prof. Nikhil Ranjan Jana	Designed Nanoparticle for Clearing Toxic Protein Aggregates from Cell	3 Years	52,46,725/-	18.02.2023
Dr. Avisek Das	Understanding the role of protein protein interactions in cellular copper trafficking	3 Years	43,23,610/-	05.08.2023
Dr. Benubrata Das	Exploring the role of Tyrosyl DNA Phosphodiesterase I (TDP1) in Transcription-induced DNA damage and resolution of R-Loop	3 Years	17,00,000/-	19.02.2023
Dr. Abhijit Kumar Das	Theoretical Exploration of Catalytic and Non-catalytic Coke Gasification Reaction with Carbon Dioxide	1 Year	15,00,000/-	05.03.2023
Prof. Somobrata Acharya and Prof. Indra Dasgupta	Fabrication of flexible and transparent high performance photodetectors using perovskite nanocrystals	3 Years	40,60,800/-	09.08.2023

Name of PI	Project Titles	Duration of Project	Total Sanctioned amount	End date
Prof. Ankan Paul	Decoding the Mechanism of Photochemical & Electrochemical Splitting of Water and CO2 reduction using theoretical approaches	3 Years	36,00,720/-	11.02.2023
Prof. Abhisek Dey	Proton and Electron Transfer Control for Oxidase and Peroxidase Reactivity in Synthetic from Porphyrin Complexes	3 Years	38,50,000/-	22.03.2023
Prof. Asim Bhaumik	Co2 and biomass as feedstock for the production of fuels and chemical intermediates (Co2BioFeed)	3 Years	4,06,60,000/-	29.04.2023
Dr. Somdatta Ghosh Dey	Interaction of metal-amyloid peptide complexes relevant to alzheimer's disease in micellar environment	3 years	32,50,800/-	02.12.2023
Prof. Suhrit Ghosh and Dr. Anuja Datta	Supramolecular Polymers of Ambipolar π-Systems for Organic Ferroelectrics.	3 Years	50,47,920/-	03.12.2023
Dr, N.R. Jana	Piezocatalyic Nanocomposite-based water purification	3 Years	52,18,080/-	11.01.2024
Dr. Joyram Guin	Asymmetric N-Heterocyclic Carbene (NHC) Catalysis via Non-Covalent Interactiions	3 Years	36,28,800/-	18.12.2023
Dr. Ayan Datta	Computational Design of Two-dimensional Surfaces Beyond Graphene for Electrochemical Transformation of CO2 of Useful Chemicals	3 Years	39,34,828/-	21.12.2023
Dr Biman Jana	Characterizing the effect of IBS and non-IBS of ice binding proteins on ice nucleation and growth	3 Years	26,46,000/-	10.01.2024
Dr. Somobrata Acharya	Unveiling Mechanism of AIE phenomen by designing two-dimensional crystals at confined air-water interface towards efficient electroluminescence devices.	3 Years	38,50,000/-	18.12.2023
Dr. Sumanta Chakrabory	Observational avenues to search for theories beyond General Relativity	2 Years	15,92,563/-	21.12.2023
Dr. Ritesh Ranjan Pal	Membranous nanotube : The unrevealed CORE associated conduit of bacterial intra-and inter-kingdom Interactions	5 Years	42,50,000/-	08.02.2026
Dr.Siddhartha Sankar Jana	Role of actomyosin complex in endocytosis and endocytic trafficking	3 Years	43,87,057/-	08.03.2024
Dr. Santanu Bhattacharya	Carbon conjugated 2D-Covalent organic Frameworks based on alternative D-A-D/A-D-A Systems with exceptional optoelectronic properties	3 Years	46,42,740/-	10.01.2024
Dr.Surojit Sinha	Synthesis of Fmoc protected morpholino monomers and their use in the synthesis of morpholino oligomer	2 Years	30,10,000/-	18.04.2023

Name of PI	Project Titles	Duration of Project	Total Sanctioned amount	End date
Dr. Suhrit Ghosh	Molecular interaction driven Co-Assembly of telechelic polydimethylsiloxane (PDMS) and highly emissive J-Aggregate of Napthalene-Diimide (NDI)	3 years	62,04,000/-	31.03.2024
Dr. Urmimala Mitra	Structually stable reversible oxygen redox for high-voltage and high-capacity Li- & Na-ion cathodes	3 years	50,54,400/-	28.06.2024
Dr. Raju Mondal	Nanometric sensitizer-Polyoxometalate tandem system for photocatalytic water splitting	3 Years	28,26,220/-	05.10.2024
Dr. T.K. Mondal	Stimuli- responsive block coplymer based nanostructured single/multi-component micelles: Materials and applications	3 years	28,80,975/-	27.09.2023
Dr. Debarshi Kr. Sanyal	Extraction organization and query of scholarly information	3 Years	23,68,575/-	10.03.2025
Prof. Indra Dasgupta	Search for novel spin liquid phases in low-dimensional quantum magnets: experiment and theory	3 Years	20,70,792/-	07.03.2025
Dr. Jyotirmayee Dash	Design and construction of nucleic acid based transmembrane nanopores	3 Years	68,55,148/-	21.03.2025
Dr. Sunanda Banerjee	Experimental High Energy Physics	2 years	4,60,000/-	02.03.2025 (Extendable)
Dr. N R Jana	Desigining Sound- responsive Nanodrug for cell therapy	3 years	70,75,550/-	30.05.2025
Dr. H P Rath	Mutant heterocyclic macrocycles as conformationally regulated Flurescent Molecular Probes	3 years	22,10,604/-	12.07.2025
Dr. Avishek Dey	Porphyrin Iron Sulpher Conjugates: Synthesis, Electronic structure and Control of Multi-electron Chemical Reductions	3 Years	1,34,17,888/-	13.07.2025
Dr Anindita Das	Halogen-bonded Chiral Luminescent Co-Assemblies: A Modular Design for Versatile Organic Materials	3 Years	24,52,376/-	11.07.2025
Dr Subrata Ghosh	INSA Honorary Scientist project	3 years	3,00,000/-	
Dr Aswini Ghosh	Raja Ramanna Fellowship	1 year	4,60,000/-	11.04.2023
Dr. Asit Chakraborty	Raja Ramanna Fellowship	3 years	13,50,000/-	05.12.2024
Dr Praveen Kumar	Green energy harvesting and storage; materials, methods and applications	1 year	5,00,000/-	26.07.2023
Dr Somdutta Ghosh	Power Fellow	3 Years	38,10,000/-	08.11.2025
Dr Mintu Mondal	Exploring the magneto-optical response of low dimensional magnetic materials	1 year	45,000/-	04.04.2023
Dr Subhadeep Dutta	Wearable Bioelectronic Circuit arrays for the detection of Glucose	3 years	35,03,520/-	08.12.2025

Name of PI	Project Titles	Duration of Project	Total Sanctioned amount	End date
Dr Amit Majumder	Reactivity of Nitric Oxide, Thiolate and Hydrosulphide with Diiron Complexes	3 years	32,83,200/-	22.12.2025
Dr Tapas Chakraborty	Laser-Chemistry of sunscreen compounds by multi-photon ionization mass spectrometry	3 years	27,68,428/-	22.12.2025
Dr Ritesh Ranjan Pal	Response against starvation as the determinant of infection by pathogenic bacteria and the target for the therapy	2 years	29,95,400/-	22.12.2024
Dr Shinto varghese	Exploring single crystals, doped crysttals and crystalline thin films of conjugated molecular materials for organic light-emitting field-effect transistors.	3 years	45,36,000/-	22.12.2025
Dr Asim Bhaumik	Porous Organic and Inorganic Hybrid Materials for capture and utilization of CO2	3 years	45,57,600/-	25.12.2025
Prof Tarun Kumar Mondal	Ionically functionalized Polypeptides and Amino Acid-Based Acryl/Styryl polymers for various applications including antifouling	3 years	51,49,526/-	26.12.2025
Prof Subrata Ghosh	Synthesis of Natural Products containing α-Methylene-γ-butyro lactone unit	3 years	3,00,000/-	17.11.2025
Dr Anindita Das	A versatile methodology for synthesis of functioinal polyesters and their stimuli-responsive self-assemblies	3 years	34,77,578/-	06.01.2026
Dr Benu Brata Das	Exploring the role of mitochondria and trapped mitochondrial topoisomerase 1-DNA covalent complexes	3 Years	35,63,000/-	20.01.2026
Dr Amlan Jyoti Paul	Charge and spin-blokade in ultrathin layers of single molecule magnets	2 years	5,61,000/-	12.03.2025`
Dr Praveen Kumar	Exploring challenges related to 2D materials/ MXene heterostructures for green hydrogen generation and selective CO2 reduction	2 years	8,90,000/-	19.02.2025
Dr Durga Basak	A critical look at post-transition metal chalcogenides: Exciton-phonon interactions and defects induced phoyophysical processess	3 years	24,84,000/-	19.02.2025
Dr T.K Paine	Dr Satadal Paul (TARE)	3 years	18,30,000/-	03.11.2025
Dr Abhishek Dey	Dr Susovon Bhowmik (TARE)	3 years	18,30,000/-	19.10.2025
Dr Suhrit Ghosh	Custom designed supra molecular polymers as bacterial antiadhesion agent	3 years	32,04,110/-	03.05.2026
Dr N R Jana	In-Vivo Bio-imaging application of Graphene Quantum Dots	2.5 years	19,50,000/-	21.03.2025
Dr T K Paine	turning reactivity and selectivity in bioinspired oxidation catalyzed by non-heme Iron complexes	3 years	42,31,525/-	05.02.2023
Dr Sourav Giri	Exploring ferroelectric order and multicaloric effect	3 year	45,000/-	29.06.2026

Private Project

Name of PI	Project Titles	Duration of Project	Total Sanctioned amount	End Date
Prof. Suhrit Ghosh	Specific molecular interaction driven co-assembly of telechelic polydimethylsiloxane (PDMS) and highly emissive J-aggregate of naphthalene-dimide (NDI)	3 Years	62,04,000/-	31.03.2024
Prof. Asim Bhaumik	Development of green bio-conjugation chemistry to synthesize biopolymer based materials	1 Year	11,00,000/-	21.05.2023
Dr. Sudip Malik	Investigation of electronics film, the fabrication of devices and subsequent optimization of parameters for the industrial application	6 Months	12,00,000/-	23.06.2022
Dr.K D Mallikarjuna Rao	Ultrapure Envirocare Pvt Ltd	3 years	5,00,000/-	27.03.2025
Prof. Tapas Chakraborty	TSL/Assessment of the level of OH radical atmosphere's detergent, in the ground level air of Jamshedpur and surrounding areas	2 Years	17,69,520/-	21.12.2019
Prof. Asim Bhaumik	Co2 and biomass as feedstock for the production of fuels and chemical intermediates (Co2BioFeed)	3 Years	84,80,000/-	29.04.2023
Dr. Pradyut Ghosh	Modification of cage complex receptor for cyanide removal	3 Years	19,99,400/- + GST	
Dr. Tapas Chakraborty	OH radical treatment for removal of the colorants in the coke plant effluent-water	3 Years	16,57,500/- + Tax	Running
Prof. Santanu Bhattacharya, Co. PI: Dr. Parikshit Moitra	Organogelation and slow release formulatins for insect pheromones	3 Years	89,70,000/-	30.06.2022

NPDF Fellowship

Name Of The Pi	Project Tittle	Duration of The Project	Total Sanctioned Amount	End Date
National Post Doctoral Fellowship to Dr. Sanjib Shyamal, Dr. Narayan Pradhan	Exploration of new facets in Halide perovskite Nanocrystals Photocatalysts for enhanced and product selective CO2 reduction woth simultaneous methanol oxidation	24 MONTHS	22,36,800	23.01.2024
National Post Doctoral Fellowship to Dr. Joyshree Karmakar, Dr. Jyotirmayee Dash	Targeting c-MYC G quadruplex of host cells during Leismania Donovani infection for the modulation of immune response: A promising approach for treating infecttious disease	24 MONTHS	22,36,800	03.01.2024
National Post Doctoral Fellowship to Dr. Abu Saleh Musha Islam, under Dr. Pradyut Ghosh	Design based Flurorescent prodes for the selective sensing and removal of arsenic in biotic and abiotic samples along with the in vivo/vitro Fluorescence Bio-imaging studies.	30 MONTHS	26,46,000	05.07.2022
National Post Doctoral Fellowship to Dr. Moumita Das, under Dr. Sourav Giri	NA	24 MONTHS	22,36,800	20.02.2024

Name Of The Pi	Project Tittle	Duration of The Project	Total Sanctioned Amount	End Date
National Post Doctoral Fellowship to Dr. Anwesha Chattopadhyay, under Prof. Krishnendu Sengupta	Study of static and dynamical properties of some quantum many body systems	24 MONTHS	14,40,000	20.02.2024
National Post Doctoral Fellowship to Dr. Subir Kumar Patla, under Dr. Aswini Ghosh	NA	24 MONTHS	22,36,800	24.02.2024
National Post Doctoral Fellowship to Dr. Siba Prasad Midya,under Dr. Pradyut Ghosh	UNIMOLECULAR BIMETALLIC COMPLEX IN DUAL PHOTOCATALYSIS	24 MONTHS	22,36,800	31.01.2023
National Post Doctoral Fellowship to Dr. Utsab Manna, under Dr. Parthasarathi Dastidar	DESIGN AND DEVELOPMENT OF NEW AMIDE THIO UREA FUNCTIONALIZED SUPRAMOLECULAR LMWGS QUEST FOR THEIR GELATION PROPERTIES STRUCTURAL DIVERSITIES AND BIOMEDICAL APPLICATIONS	24 MONTHS	22,36,800	18.01.2023
National Post Doctoral Fellowship to Dr. Joydeep Datta, under Dr. Somobrata Acharya	FABRICATION OF RESISTIVE SWITCHING DEVICES USING HALIDE PEROVSKITE NANOCRYSTALS	24 MONTHS	22,36,800	01.02.2022
National Post Doctoral Fellowship to Dr. Abhijit Kumar Saha, SPS Dept. under Dr. Sourov Roy	STAROBINSKY INFLATION RAPID THERMALISTATION OF THE UNIVERSE AND NON THERMAL HIGGSINO DARK MATTER PRODUCTION IN NMSSM	24 MONTHS	22,36,800	24.12.2022
National Post Doctoral Fellowship to Dr. Mohammad Rezwan Habib, under Dr. Indra dasgupta	Study of magnetism and optics in 2D ferromagnates and their heterostructures with functional materials.	24 MONTHS	22,36,800	16.02.2024
National Post Doctoral Fellowship to Dr. Krishnendu Sarkar, under Dr. Praveen Kumar	NEXT GENERATION BROADBAND SELF POWERED AND FLEXIBLE PHOTODETECTORS FOR REAL TIME RESPONSE MONITORING	30 MONTHS	26,46,000	09.07.2022
National Post Doctoral Fellowship to Dr. Tapoja Jha, under Dr. Dilip Kumar Ghosh	VENTURING THE TERRA INCOGNITA OF BEYOND STANDARD MODEL PHYSICS	24 MONTHS	22,36,800	17.01.2023
National Post Doctoral Fellowship to Dr. Debasis Saha, under Dr. Biman Jana.	DECODING THE AMYLOID-β AGGREGATION MECHANISM FOR PLAUSABLE DRUG DESIGN FROM COMPUTATIONAL APPROACH	30 MONTHS	26,46,000	30.06.2022
National Post Doctoral Fellowship to Dr. Mainak Chakraborty, SPS Dept. under Dr. Sourov Roy	FLAVOUR SYMMETRIC GRAND UNIFIED THEORIES FOR NEUTRINO PHYSICS, DARK MATTER AND BARYON ASSYMETRY OF THE UNIVERSE	24 MONTHS	22,36,800	22.03.2023

Name Of The Pi	Project Tittle	Duration of The Project	Total Sanctioned Amount	End Date
National Post Doctoral Fellowship to Dr. NUR AMIN HOQUE, SAIS Dept. under PROF SOMOBRATA ACHARYA(File 71).	N/A	24 MONTHS	22,36,800	17.11.2024
National Post Doctoral Fellowship to Dr. ANIRBAN CHAKRABARTI, SPS Dept. under PROF A GHOSH (File 72).	N/A	24 MONTHS	22,36,800	15.12.2024
National Post Doctoral Fellowship to Dr. POULAMI PAL, SCS Dept. under PROF T K PAINE (File 73).	Visible light assisted Dioxygen activationby non-Heme Iron (II) complexes: Mechanistic studies and catalytic potentials	24 MONTHS	22,36,800	11.12.2024
National Post Doctoral Fellowship to Dr. SUBHAM GHOSH, SMS Dept. under DR. URMIMALA MAITRA (File 74).	N/A	24 MONTHS	22,36,800	31.12.2024
National Post Doctoral Fellowship to Dr. ANIRUDHA MENON, SPS Dept. under PROF KRISHNENDU SENGUPTA (N-75).	N/A	24 MONTHS	22,36,800	31.12.2024
National Post Doctoral Fellowship to Dr. Moumita Patra, SPS Dept. under PROF ARNAB DAS (N-76).	N/A	24 MONTHS	22,36,800	15.01.2025
National Post Doctoral Fellowship to Dr. Utsab Manna, SCS Dept. under PROF Parthasarathi Dastidar (N-77).	Nano science and technology scheme	24 MONTHS	21,76,000	28.02.2025
National Post Doctoral Fellowship to Dr. Arkadeb Pal, SCS Dept. under PROF Sourav Giri (N-78).	N/a	24 MONTHS	22,36,800	11.05.2025

CSIR Project

SL No.	Name of the Project/Scheme/Award	Funding Authority, Sanction no, Date	Date of Commencement	Date of Termination	Sanction Amount (Rs.)
10	CSIR Emeritus Scientist Scheme entitled "Tuning properties of electroactive polymers by grafting stimuli-responsive block copolymers, PI: Dr. Arun Kumar Nandi, PSU (78).	CSIR; 21 (1055)/18/ EMR-II, 31.08.2018	01.03.2019	28.02.2022	23,16,000/-
11	Nonheme Dinuclear Transition Metal Complexes with sulfide and Hydrosulfide Ligands, PI: Dr. Amit Majumdar, IC (79)	CSIR; 01 (2972)/19/ EMR-II, 20.05.2019	01.05.2019	30.04.2022	14,00,000/-
12	Programming Macromolecular Assembly by Directional Dipole-Dipole Interaction, PI: Dr. Anindita Das, PSU, (80)	CSIR; 02 (0360)/19/ EMR-II, 17.05.2019	01.04.2019	31.03.2022	26,96,000/-
13	Developing Supramolecular.... Application, PI: Dr. P S Dastidar,SCS,(81)	CSIR;02 (0402)/21/ EMR-II, 19.04.2021	12.08.2021	11.08.2024	17,00,000/-
14	Chemical modification ...Cells,PI: Prof. Surajit Sinha,SAIS(82)	CSIR;02 (0401)/21/ EMR-II, 19.04.2021	01.04.2021	31.03.2024	32,98,000/-
15	Designed nanoparticle with direct cell membrane penetration property for enhanced therapeutic performance,PI: NR Jana,SMS(83)	CSIR; 01 (3022)/21/ EMR-II dated 18.08.2021	01.08.2021	31.07.2024	5,09,333/-
16	Stabilizing the red emitting a-CsPBL3 nanocrystals with near unity photoluminescence quantum yield, PI: Prof. Narayan Pradhan,SMS(84)	CSIR; 01(3020)/21/ EMR-II dated 17.08.2021	01.08.2021	31.07.2024	26,98,080/-

Implementation of the Official Language

During the financial year 2022-23,under the Chairmanship of Senior Prof. Tapas Chakraborty, Director of the Institution was successfully implemented the Official Language Policy of the Government of India. The Institution celebrated Hindi Pakhwada from 14.09.2022 to 29.09.2022 and started with the Hindi Diwas on 14.09.2022. During the Hindi Pakhwada, on 16th September, 2022,IACS organized a Hindi Workshop for effective use of Official Language in official work under the guidance by Shri Navin Kumar Prajapati, Centre In-charge, Hindi Translation Bureau, Kolkata. Finally, on 29thSeptember, 2022, IACS concluded the enthusiastic program in a very interesting manner by presenting attractive prizes to the winning participants in the closing program of 'Hindi Pakhwada'.

A total of 32 employees from the institute participated in the Hindi training program 'Praveen' and 'Pragya' courses in the sessions 2022 under the Hindi Teaching Scheme, Government of India and all employees obtained excellent marks and passed the examination.

The annual meeting held by The Town Official Language Implementation Committee, Kolkata, Office-2 on April 28, 2022 and September 21, 2022 was attended by Part-Time Hindi Officer and valuable suggestions were given for effective use of Official Language.

IMPLEMENTATION OF "RIGHT TO INFORMATION ACT 2005"

In order to promote transparency and accountability in its functioning, IACS has been making constant efforts for successful implementation and enforcement of Right to Information (RTI) Act 2005 promulgating by the Government of India. As per provision of the Act, IACS mandates timely response to any Indian citizen requesting for information. The RTI Cell at IACS by making its Pro-active Disclosure available online in the Public Doman has been a Gateway to the citizens for quick search of information relating to IACS.

The following Officers are responsible to properly implement the RTI Act at IACS :-

1. Smt. Sohinee Motilal, UDC, Central Secretariat – CPIO
2. Shri Rajesh Mondal, UDC-I, Administration – ACPIO
3. Smt. Purbasha Banerjee, Deputy Registrar – Appellate Authority

RTI report for the Financial Year 2022 -2023

No. of RTI appeals received	28
No. of RTI appeals "disposed off"	27
Remarks : 1 RTI appeal disposed in April 2023	
No. of First Appeals received	5
No. of First Appeals "disposed off"	4
Remarks : 1 First appeal disposed in April 2023	

Annual Report of Internal Complaints Committee

Members:

Prof. Rupa Mukhopadhyay	Chairperson
Prof. Tanusree Kar	Advisor and Permanent Invitee
Prof. Srimonti Sarkar	External member
Prof. Somobrata Acharya	Member
Prof. Siddhartha Sankar Jana	Member
Dr. Somdatta Ghosh Dey	Member
Dr. Harapriya Rath	Member
Dr. Miratun Nahar	Lady NGO Member
Mr. Sutapa Sanyal	Lawyer Member
Ms. Purbasha Banerjee	Secretary

During 2022-23

No. of Complaints Received	No. of Complaints disposed	No. of cases pending	No. of awareness programme carried out
Nil	Nil	Nil	Nil

Status of Reservation for SC/ ST/OBC/ Physically Disabled Persons/EWS

Consequent upon adoption of the principle of reservation for SC/ST/OBC/PWD/EWS by the Governing Council, the Association has been following the policy of the Government in the matter of the recruitment of Academic and Non-Academic staff.

A brief statement in regard to the recruitment in the post of reserved categories till 31st March, 2023 is appended below:-

Category	No. of post identified	No. of vacancy available	No. of post filled up	No. of post advertised	No. of post to be advertised	Post to be filled up against future vacancy
Group A	01	01	-	-	01	-
Group B	53	30	23	-	30	-
Group C	81	43	28	10	33	-
Total	135	74	51	10	64	-

1. After implementation of 6th CPC's recommendation, all cadres of PB-2, Grade Pay of Rs. 4600 have been merged with Group B and Cadres of PB-1, below Grade Pay of Rs. 1900 (erstwhile Group D) have been merged and designated as Multi Tasking Staff (MTS) in Group C and accordingly shown above.

Library

The IACS Library is one of the richest and oldest reference & Information Centre in the field of basic sciences in Eastern India. It came into existence in 1876. It is originally accommodated on the ground floor of Centenary Building and occupied about 15000 square feet area. The library having a huge resource of books, serials, thesis, manuscripts, photographs and 81757 bound volumes of books/journals. The users can access to more than 8500 online journals/database being an Institutional member of DST-CSIR Consortium New Delhi (NKRC) and lab- label subscriptions. The library remains open five days a week except for Saturday, Sunday and holidays. The library has also provided remote access facility of e-resources for the faculty members and special users. In 2018 the new archive museum has been included. Library has automated all its routine activities through library software called "LIBSYS 10" and also extended the scope of various services like database search and OPAC (online public access catalogue).

Library Resources & Services

I. Large number of Rare books since 17th & 18th century.

II. Bibliographic services.

III. Reprography Services.

IV. Inter Library Loan.

V. E Document Delivery Services.

VI. Web OPAC in network

VII. New arrivals.

VIII. Plagiarism checker software (iThenticate).

IX. Tools for Grammar Checking.

X. E-resources

XI. Library User Training Programme.

Library Membership Details

Description	Number of Books	Period of Loan
Faculty	15	3 Months
Research Scholar	04	3 Months
Student	02	15 days
Staff	01	1 Month

Library Consortium/Membership:

Library enrolled its membership for following consortium,

I. National Knowledge Resource Consortium (NKRC)

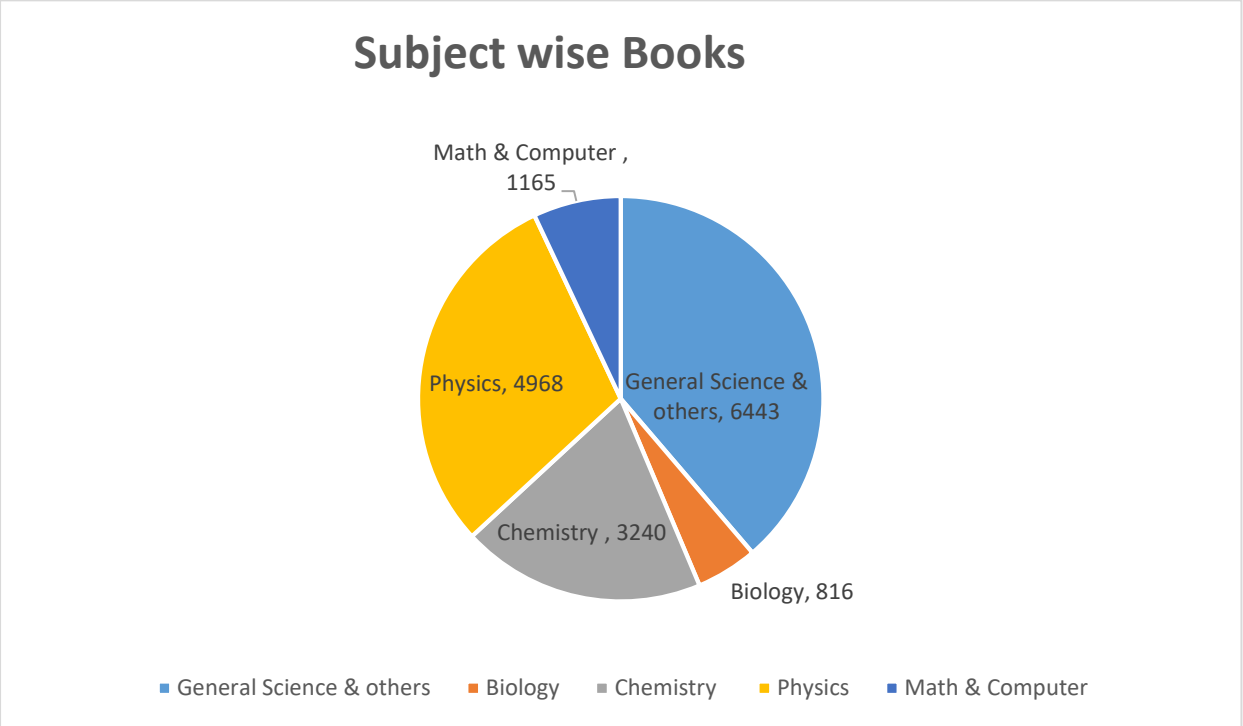
Library Statistics

Bound Volumes : 65021

Print books:

Total Titles : 14639

Total Volumes : 16864



Details of Online Journals/Databases:

Sl. No.	Publisher
1	American Association for Cancer Research
2	American Association for the Advancement of Science
3	American Chemical Society
4	American Institute of Physics
5	American Mathematical Society
6	American Physical Society
7	CSD-Enterprise
8	Derwent Innovation Index
9	Elsevier
10	Emerald
12	Grammarly
13	IEEE
14	Institute of Physics
15	J-Gate
16	Nature Publishing Group
17	Oxford University Press
18	PNAS(Proceedings of the National Academy of Sciences of the United States of America)
19	Royal Society of Chemistry
20	Sci-Finder
21	Scopus
22	Springer
23	Taylor and Francis
24	Thieme
25	Thomson Innovation
26	Web of Science
27	Wiley

Meetings/Conference/Workshop attended by Library Staff:

Debojyoti Nath (Assistant Librarian)

- Attended International Conference on Knowledge Management in Higher Education Institutions (ICKHI 2022) held online on 11th & 12th April 2022.

CSS Instruments

Department of Central Scientific Services

Heads of the Department

Prof. Indra Dasgupta

Prof. Somobrata Acharya

Prof. Rupa Mukhopadhyay

Co-ordinator

Dr. Anindita Das

Dr. Mintu Mondal

Dr. Nabanita Deb

Spectroscopic Unit

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location (Extn. No.)
1	Circular Dichroism Spectrometer (JASCO Make, Model -J-1500)	Prof. Suhrit Ghosh (psusg2@iacs.res.in)	Mr. Chanchal Kumar Das	cd@iacs.res.in	Room no.10 Biological Chemistry Bldg.1st. Floor 1509)
2	EPR Spectrometer	Prof. Tapan Kanti Paine (ictkp@iacs.res.in)	Dr. Bhola Nath Mondal	epr@iacs.res.in	Room no M-066 Main Bldg. Ground Floor (1808)
3.	FT-IR (New)	Dr. Subhadeep Datta (sspsdd@iacs.res.in)	Mr. Subrata Das	ftir@iacs.res.in	Room No. M-117 Main Bldg. 1st Floor (1203)
4.	FTIR (Old)	Dr. Subhadeep Datta (sspsdd@iacs.res.in)	Mr. Subrata Das	ftir@iacs.res.in	Room No. M-117 Main Bldg. 1st Floor (1203)
5	FT-NMR (300MHz, 500MHz & 400MHz)	Prof. Tapan Kanti Paine (ictkp@iacs.res.in) Prof. JoyramGuin (ocjg@iacs.res.in) Prof. Rajib Goswami (ocrkg@iacs.res.in)	Mr. Sumit Ray Mr. Sachin Das	nmrfacility@iacs.res.in	Room No. M-033 Main Bldg. 1st Floor (1173)
6	HR-MS	Prof. Rajib Goswami (ocrkg@iacs.res.in)	Mr. Swapan Kr Sarkar Mr. Goutam Biswas	hrms@iacs.res.in	Room No. M-135 Main Bldg. Gr. Floor (1180)
7	MALDI Mass Spectrometer	Dr. Anindita Das	Ms. Champa Bag	maldi@iacs.res.in	Room No. 301 Centenary Bldg. 2nd Floor. (2126)
8	Laser Raman Spectrometer	Prof. Abhishek Dey (icad@iacs.res.in)	Dr. Manas Ghosh	raman@iacs.res.in	Room No. M-120 Main Bldg. 1st. Floor (1260)
9	TCSPC	Prof. Narayan Pradhan (camnp@iacs.res.in)	Mr. Subrata Das	tcspc@iacs.res.in	Room No. 85 Main Bldg. 1st. Floor (1274)
10	UV-VIS- NIR Spectrophotometer (Agilent carry 5000 UV-VIS- NIR)	Dr. Subhadeep Datta (sspsdd@iacs.res.in)	Mr. Subrata Das	uvvis@iacs.res.in	Room No. M-117 Main Bldg. 1st Floor (1274)
11	Steady State, Fluorescence and Phosphorescence Lifetime Measurement Spectrometer (Model: FLS1000-DD-stm)	Prof. Sudip Malik (psusm2@iacs.res.in)	Ms. Sujata Gupta	ocsg5@iacs.res.in	Room No. M-253 Main Bldg. 2nd Floor (Beside SAIS office) (1564)

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location (Extn. No.)
12	Fluorescence Spectrometer	Dr. Shinto Varghese (trcsv@iacs.res.in)	Operated by students	trcsv@iacs.res.in	Room No. M-258 Main bldg. 2nd floor (1145)
13	ICP-OES System	Prof. Sugata Ray (mssr@iacs.res.in)	Operated by students: Sanjit Das	mssr@iacs.res.in	Room no. M-274 Mail Bldg. 2nd floor, opposite to the S N Bose Hall (1414)
14	NMR (600 MHZ)	Prof. Suhrit Ghosh (psusg2@iacs.res.in)	Mr. Gour Gopal Paul	nmr600@iacs.res.in	Room No. 004 CRAFT Building Gr. Floor (2324)
15	Gas Chromatography- Mass Spectroscopy	Prof. Amit Majumdar (icam@iacs.res.in)	Operated by the students	gcms@iacs.res.in	Room no. M-036, Main bldg. Ground floor (1165)
16	DLS (Zeta-Potential Particle Size and Molecular Weight) [Zetasizer ZEM 3600 Instrument]	Prof. Tarun Kumar Mandal(psutkm@iacs.res.in)	Ms. Champa Bag	dls@iacs.res.in	Room No. M-255 Main Bldg., 2nd floor (1562)
17	Electrochemical Cell/ Diode Array Spectrophotometer	Prof. Asim Bhaumik (msab@iacs.res.in)	Operated by students	msab@iacs.res.in	Room No. 79 Main Bldg. 1st Floor (1453)

Microscopy Unit

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
1	Fluorescence Microscope (Leica DMi8 Digital Microscope)	Prof. Benu Brata Das (pcbbd@iacs.res.in)	Mr. Sanjay Sarkar	pcbbd@iacs.res.in	Room 23B Biological Chemistry Bldg. 1st floor (2108)
2	LSM880/ Axio Observer7 [Confocal Microscope]	Prof. Deepak Kr. Sinha (bcdks@ics.res.in) Prof. Prof. S. S. Jana (bcssj@iacs.res.in)	Mr. Sanjay Sarkar	bcdks@ics.res.in	Room 14 Biological Chemistry Bldg. 1st floor (1106)
3	Confocal FLIM (Olympus IX71 & Picoquant)	Prof. Deepak Kr Sinha (bcdks@iacs.res.in)	Mr. Sanjoy Sarkar	bcdks@iacs.res.in	Room No. 93 Main Bldg.1st Floor (1106)
4	Optical Microscope & Micro hardness Test	Dr. Subhadeep Datta (sspsdd@iacs.res.in)	Dr. Manas Ghosh	ommd@iacs.res.in	Room No. M-120 Main Bldg. 1st Floor (1260)
5	Olympus Upright Microscope [Model BX53M with MAG. Range 50X-1000X]	Dr. Subhadeep Datta (sspsdd@iacs.res.in)	Dr Manas Kr. Ghosh	ommd@iacs.res.in	Room No. M-120 Main Bldg. 1st Floor (1260)
6	FE-SEM (JEOL MAKE,Model: JSM-7500F)	Prof. Tarun K. Mandal (psutkm@iacs.res.in)	Mr. Rabindranath Banik and Dr. Sasanka Maji	sem@iacs.res.in	Room No. M-018 Main Bldg. Gr. Floor (1181)

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
7	AFM (OXFORD)	Prof. Somobrata Acharya (camsa2@iacs.res.in)	Mr. Sanjib Naskar	afm@iacs.res.in	Computer Center Bldg.1st. Floor (1586)
9	UHR-FEG-TEM	Prof. Narayan Pradhan (camnp@iacs.res.in)	Mr. Arunim Paul Mr. Suman Guchhait	fegtem@iacs.res.in	Room No. M-015 Main Bldg. Bldg. Ground Floor (1251)
10	CRYO-TEM	Prof. Prasanta K Das (bcpkd@iacs.res.in)	Mr. Supriya Chakraborty	bcpkd@iacs.res.in	Room No. M-049 Main Bldg. Gr. Floor (1373)
11	Thermal System for Optical Imaging Devices (Purchased for Olympus upright Microscope-machine no. 5 in this list)	Dr. Subhadeep Datta (sspsdd@iacs.res.in)	Dr. Manas Ghosh	ommd@iacs.res.in	Room No. M-120 Main Bldg. 1st Floor (1260)

Magnetic Measurement Units

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
1	Dielectric setup measurement system (previously Mini VSM [4 Tesla])	Prof. Subham Majumdar (sspsm2@iacs.res.in)	Mr. Prasad Modak	sspsm2@iacs.res.in	Room No. 16B [Main Bldg.] (1172)
2	Squid VSM MPMS (3)	Dr. Devajyoti Mukherjee (sspdm@iacs.res.in)	Mr. Prasad Modak	sspsm2@iacs.res.in	Room No. M-011 Main Bldg.Grd. Floor

Electrical/Electrochemical Measurement Units

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
1	Cryogen Free CFMS Cryomagnetic system with DC resistivity and Hall Effect module.	Prof. Subham Majumdar	-	sspsm2@iacs.res.in	Room No. M-028 Mai n Bldg. Ground floor

Furnaces and Deposition Units

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
1	Vacuum Coating Unit (OLD)	Dr. K.D.M Rao (trckdmr@iacs.res.in)	Operated by students Mr. Subrata Das	vcu@iacs.res.in trckdmr@iacs.res.in	Room No. M-117 Main Bldg. 1st. Floor (1203)
2	PLD	Dr. Devajyoti Mukherjee (sspdm@iacs.res.in)	Mr. Tapas Dutta	pld@iacs.res.in	Room No. 101 ERU Bldg. Grnd. Floor (1616)
3	RF/DC Sputtering System	Dr. Devajyoti Mukherjee, (sspdm@iacs.res.in)	Mr. Ranojit Sardar	sputter@iacs.res.in	Room No. M-112 Main Bldg. 1st Floor (1220)

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
4	Vacuum Coater (New)	Dr. K.D.M Rao (trckdmr@iacs.res.in)	Operated by students and Mr. Subrata Das	trckdmr@iacs.res.in vcu@iacs.res.in	Room No. M-117 Main Bldg. 1st Floor (2177)

Structural/Elemental Characterization Units

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
1	XPS	Prof. Sugata Ray (mssr@iacs.res.in)	Mr. Indranath Bhaumik	xps@iacs.res.in	Room No. M-019 Main Bldg. Gr. Floor (1253)
2	XRD (Micro Focus Single Crystal X-ray Diffractometer) [NEW]	Prof. Amit Majumdar (icam@iacs.res.in)	Dr. Bhola Nath Mondal	sxrd@iacs.res.in	Room No. M-061, Main Bldg. Gr. Floor (1368)
3	(a) Old XRD (BRUKER) [D8 advance] (b) New Automated XRD Bruker [Purchase against Buy Back of Old Instrument]	Dr. Mintu Mondal (sspmm4@iacs.res.in)	Mr. Subrata Balti	xrdbruker@iacs.res.in	Room No. M-066 Main Bldg. Gr. Floor (1365)
5	HR-XRD (Rigaku)	Prof. Sugata Ray (mssr@iacs.res.in)	Mr. Sutapesh Dutta	mssr@iacs.res.in	Room no. M-009 Main Bldg. Gr. Floor.(1215)
6	UHV-Moke System	Dr. Devajyoti Mukherjee (sspdm@iacs.res.in)	Mr. Ranojit Sardar	sspdm@iacs.res.in	Room No. M-112 Main Bldg. 1st Floor (1220)
7	BET (Surface area analyzer)	Prof. Tarun Kumar Mandal (psutkm@iacs.res.in	Mr. Srideep Bera	bet@iacs.res.in	Room No. 11 Main Bldg. Ground Floor (1710)
8	DSC 8000 (Perkin Elmer Make)/ Diamond DSC (Perkin Elmer Make)/DSC Q 2000 TA Instrument	Prof. Sudip Malik (psusm2@iacs.res.in)	Mr. Arup Bandyopadhyay	thermal@iacs.res.in	Room No. M-116 Main Bldg. 1st Floor (1262)
9	(TGA 4000) [Perkin Elmer Make] (NEW)	Prof. Sudip Malik (psusm2@iacs.res.in)	Mr. Arup Bandyopadhyay	thermal@iacs.res.in	Room No. M-116 Main Bldg. 1st Floor (1262)
10	Rheometer with Dynamic Mechanical Thermal Analysis System (Model No.: MCR 702e MultiDrive, Anton Paar Pvt. Ltd.)	Prof. Sudip Malik	-	psusm2@iacs.res.in	Room No. M-258 Main Building 2nd floor
11	CHNS Analyzer	Prof. Amit Majumdar (icam@iacs.res.in)	Mr. Srideep Bera	chns@iacs.res.in	Room No. M-143 Main Bldg. 1st. Floor (1370)

Bio-Science Characterization Units

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
1	(-) 20 degree C Deep Freezer	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Room no. 5 Biological Chem. Bldg. 1st. Floor. (1518)
2	FACS-Cell Sorter	Prof. Benu Brata Das (pcbbd@iacs.res.in)	Mr. Chanchal Kumar Das	pcbbd@iacs.res.in	Room no. 14 Biological Chemistry Building 1st. Floor. (1508/9)
3	Deep Freezer (-80°C)	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Room no. 13 Biological Chemistry Bldg. 1st. Floor (1266)
4	Microplate Spectrophotometer	Dr. Ritesh Ranjan Pal (ritesh.pal@iacs.res.in)	Operated by students	ritesh.pal@iacs.res.in	Room No. M-059 ain Building Gr. Floor (2202)
5	Micro Volume UV-VIS Spectrophotometer (Model- Nano Drop One C with Cuvette)	Dr. Ritesh Ranjan Pal (ritesh.pal@iacs.res.in)	Operated by students	ritesh.pal@iacs.res.in	Room No. 5 Biological Chemistry Bldg, 1st floor (2202)
6	PCR Instrument (T100TM Thermal Cycler)	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Room No. 5 Biological Chemistry Bldg. 1st. Floor.(1518)
7	Ultra Centrifuge Instrument	Prof. Prosenjit Sen	Operated by students	bcps@iacs.res.in	Room No. 5 Biological Chemistry Bldg. 1st. floor (1518)
8	Bench Top Shaker Incubator with Temp. Control.	Dr. Ritesh Ranjan Pal (ritesh.pal@iacs.res.in)	Operated by students	ritesh.pal@iacs.res.in	Room No. 5 Biological Chemistry Bldg. 1st floor (2202)
9	Spectra Max ID5 Multi-Mode Microplate Reader Platform	Dr. Deepak Sinha (bcdks@iacs.res.in)	Operated by students	bcdks@iacs.res.in	Room no. 5 Biological Chemistry Bldg. 1st Floor (1106)
10	Ultra Microtome for Biological Samples including EMUC7module with Cryo upgradation facility.	Prof. Benu Brata Das (pcbbd@iacs.res.in)	Mr. Ranojit Sardar	pcbbd@iacs.res.in	Room No. M-017 Main Bldg. Gr. Floor (2108)
11	Table Top Centrifuge System	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Room No. 23B Main Bldg. (1266)
12	Chemidoc Multiplexing Imaging system	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Room no. 5 Biological Chemistry Bldg. 1st Floor (1518)

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
13	Real-Time PCR	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Room No. 13 Biological Chemistry Bldg. 1st Floor (1518)
14	High Performance Centrifuge System	Prof. Benubrata Das (pcbbd@iacs.res.in)	Operated by students	pcbbd@iacs.res.in	Room No. 13 Biological Chemistry Bldg. 1st floor (1266)
15	Bacterial Culture System (incubator and shaker)	Prof. Deepak K Sinha (bcdks@iacs.res.in)	Operated by students	bcdks@iacs.res.in	Room No. 13 Biological Chemistry Bldg.1st floor (1266)
16.	Seahorse Analyzer	Dr. Ritesh R Pal (ritesh.pal@iacs.res.in)		ritesh.pal@iacs.res.in	Room No.M-017 Main Bldg. Ground floor (2202)

Common Facilities

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
1	Clean Water Plant. Type-I &Type-II	Prof. Abhishek Dey (icad@iacs.res.in)	Mr. Thakurdas Biswas	icad@iacs.res.in	Workshop
2	Liq. N2 Plant	Prof. Abhishek Dey (icad@iacs.res.in)	Mr. Pijush Das & Mr. Ramesh Pratap Singh	icad@iacs.res.in	In front of workshop [Behind MLS Hall] (1171)
3	Table Top Mini He Liq. System	Prof. Subham Majumdar (sspsm2@iacs.res.in)	Mr. Subrata Balti	sspsm2@iacs.res.in	Room No. 14 Main Bldg. Ground floor

CSS Small Equipments

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
1	Mobile Spectrofluorometer System	Prof. Narayan Pradhan	No operator	camnp@iacs.res.in	Room No. M-215 Main Bldg. 2nd Floor
2	Cary 60 Spectrophotometer Bundle Instrument.	Prof. Narayan Pradhan	No operator	camnp@iacs.res.in	Room No. 17 Main Bldg. Gr. Floor (1218)
6	Image Analysis Workstation for JEOL TEM JEM-F200	Prof. Narayan Pradhan	No operator	camnp@iacs.res.in	N/A
7	Source Measure unit	Dr. Subhadeep Datta.	No operator	sspsdd@iacs.res.in	-

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
8	Interactive Digital Source Meter (Keithley make)	Dr. Mintu Mondal	Student in charge:Sk. Kalimuddin intdydt@gmail.com	sspmm4@iacs.res.in	Room No. 81 Main Bldg, 1st Floor; (1320)
9	Battery Cycler	Dr. Urmimala Maitra.	No operator	"urmimala.maitra@iacs.res.in" <urmimala.maitra@iacs.res.in>	Room No. M-222 Main Bldg. 2nd Floor (1216)
10	SR830 DSP Dual Phase Lock in amplifier, SR554 Lock in Transformer preamplifier, SIM900 mainframe with RS-232 Computer interface SR540 Optical Chopper	Dr. Mintu Mondal	No operator	sspmm4@iacs.res.in	Room No. 81 Main Bldg, 1st Floor; (1320)
11	HP Z4 Workstation	Prof. Narayan Pradhan	No operator	camnp@iacs.res.in	Room No. M-215 Main Bldg. 2nd floor (1208)
12	GPU Workstation. Supermicro 7049AT (Model SuperServe-7049A.T.) [Installed 12-07-2021] (Mat. Studio)	Prof. Narayan Pradhan	No operator	camnp@iacs.res.in	Room No. M-215 Main Bldg. 2nd floor (1208)
10	HP Workstation [Installed 22-03-2021] (FEG TEM)	Prof. Narayan Pradhan	No operator	camnp@iacs.res.in	Room No. M-215 Main Bldg. 2nd floor (1208)
11	USB-2405 [4CH 24 Bit128Ks/s Dynamic Signal acquisition USB 2.0 module]	Dr. Mintu Mondal	Student in charge:Mr. Deep Singha Roy deep.rkmrc97@gmail.com	sspmm4@iacs.res.in	Room No. 81 Main Bldg, 1st Floor; (1320)
12	Muffle Furnace (working Temp. 1250 Degree C Temp.)	Dr. Urmimala Maitra. (urmimala.maitra@iacs.res.in)	No operator	urmimala.maitra@iacs.res.in	Room No. M-222 Main Bldg.2nd Floor (1216)
13	Vacuum Oven	Dr. Urmimala Maitra. (urmimala.maitra@iacs.res.in)	No operator	urmimala.maitra@iacs.res.in	Room No. M-222Main Bldg.2nd Floor (1216)
14	1200 degree C High temp Horizontal Split Tube Furnace.	Dr. Subhadeep Datta	No operator	sspsd@iacs.res.in	Room No. M-222 Main Bldg. 2nd Floor (1607)
15	1200 Degree C Tubular furnace.	Dr. Urmimala Maitra.	No operator	urmimala.maitra@iacs.res.in	Room No. M-222 Main Bldg. 2nd Floor (1216)

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
16	Double Zone 1400 degree C Tubular Furnace	Dr. Mintu Mondal	Student in charge:Deep Singha Roy deep.rkmrc97@gmail.com	sspmm4@iacs.res.in	Room No. 76 Main Bldg, 1st Floor
17	Nabertherm High Temp. Lab Furnace	Dr. Devajyoti Mukherjee (sspdm@iacs.res.in)	No operator	sspdm@iacs.res.in	Room No. M-112 1st Floor of Main Bldg. (1220)
18	20 Ton Pellet maker with 10mm and 13mm Die.	Dr. Urmimala Maitra (urmimala.maitra@iacs.res.in)	No operator	urmimala.maitra@iacs.res.in	Room No. M-222 Main Bldg. 2nd Floor (1216)
19	Lab Compact Manual Roller Press for Battery Electrode Sheet Calendaring.	Dr. Urmimala Maitra (urmimala.maitra@iacs.res.in)	No operator	urmimala.maitra@iacs.res.in	Room No. M-222 Main Bldg. 2nd Floor (1216)
20	Planetary Ball Mill	Dr. Urmimala Maitra. (urmimala.maitra@iacs.res.in)	No operator	urmimala.maitra@iacs.res.in	Room No. M-222 Main Bldg.2nd Floor (1216)
31	BIOVIA Materials Studio research Suit [BIOVIA, Materials Studio Academic Research Suit (2020)]	Prof. Narayan Pradhan	No operator	camnp@iacs.res.in	Room No. M-215 Main Bldg. 2nd Floor Installed with GPU Workstation (1208)
32	Impedance Analyser.	Dr. Kunala Durga Mallikharjuna Rao	No operator	trckdmr@iacs.res.in	Room No. 19, Main Bldg, Gr.Floor (1735)
33	Glove Box I	Prof. Pradyut Ghosh (icpg@iacs.res.in)	Operated by students	icpg@iacs.res.in	Room No. M-065, Ground Floor of Main Bldg.
	Glove Box II	Prof. Pradyut Ghosh (icpg@iacs.res.in)	Operated by students	icpg@iacs.res.in	Room No. M-065, Ground Floor of Main Bldg.
34	Surface Tensiometer	Prof. Prashant C. Singh	Student volunteer: Ms. Asim Bisoi	(prashantchem@gmail.com)	Room Number 80 1st floor, Main Bldg
39	Liquid He4 flow Cryostat	Dr. Mintu Mondal (sspmm4@iacs.res.in)	Student in charge:Sk. Kalimuddin	intdydt@gmail.com sspmm4@iacs.res.in	Room No. M-031ain Building, Gr. Floor (1320)
40	Ice Flake Instrument (NEW)	Prof. Tapan Kanti Paine	Operated by students	ictkp@iacs.res.in	Room No. 93 Main Bldg. 1st Floor ( )
	Ice Flake Instrument (OLD)	Prof. Tapan Kanti Paine	Operated by students	ictkp@iacs.res.in	-

Sl. No	Name of the instrument	In-charge	Operator	Contact	Location
41.	Autoclave (Vertical) Pressure Cut	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Biological Chemistry Bldg. 1st. Floor. (1518)
42.	Worthington LS3000 Dewars with canister Storage System	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Room No. M-132 Main Bldg. 1st Floor (1518)
43.	Worthington LS3000 Dewars with canister Storage System	Prof. Prosenjit Sen (bcps@iacs.res.in)	Operated by students	bcps@iacs.res.in	Room no. M-134 ain Bldg. 1st Floor (1518)
44.	CO2 Incubator	Prof. Deepak Sinha (bcdks@iacs.res.in)	Ms. Priyanka Ray (Student Representative)	bcdks@iacs.res.in	Biological Chemistry Bldg. 1st Floor
45.	High Performance Liquid Chromatography	Prof. Surajit Sinha (ocss5@iacs.res.in)	Operated by students	ocss5@iacs.res.in	Room No. M-154 Main Bldg. 1st floor (1400)

Departmental Publications :

1. Adsorption of 4-Mercapto Pyridine with Gold Nanoparticles Embedded in the Langmuir–Blodgett Film Matrix of Stearic Acid: SERS, XPS Studies Aided by Born–Oppenheimer on the Fly Dynamics, Time–Resolved Wavelet Transform Theory, and DFT, S Saha, B Dutta, M Ghosh, J Chowdhury, *ACS omega,* 7 (32), 27818-27830, (2022)
2. Fabrication of gold nanoparticles tethered in heat-cooled calf thymus-deoxyribonucleic acid Langmuir-Blodgett film as effective surface-enhanced Raman scattering sensing platform, R Sinha, S K Das, M Ghosh and J Chowdhury, *Frontiers in Chemistry,* **10**, 15 Nov, (2022)
3. Self-assembled gold nanoparticles on the serpentine networks of Calf Thymus-DNA Langmuir-Blodgett films as efficient SERS sensing platform: Fabrication and its application in thiram detection, R Sinha, SK Das, M Ghosh , J Chowdhury *Materials Chemistry and Physics,* **295,** 127140, February (2023)

Centre for Computer Research, Education and Services (CCRES)

The IACS Computer Centre provides all network related services to its Faculty Members, Staffs and Students. It has a state of the art Data Centre (DC) with well maintained servers in a cluster environment. Email services (SMTP and IMAP) are running on Exchange server with fail-over mode to minimise the downtime and Proxy servers run on RedHat Enterprise Linux platform. In the Data Centre we have high end Firewall, Router, WLC (Wireless Controller) and Core switches. Computer Centre manages the mail system for IACS with SAN (Storage Area Network) storage for authorised users including web-mail facility. All incoming mails are filtered through FortiMail Gateway (Email security). The Web-server and day-to-day maintenance of IACS Website is done by CCRES. The cluster of servers includes proxy-servers for authentication which adds to security and accountability. Other servers in the cluster are being used for local DNS (Domain Name System). Mail services are integrated with Active Directory (AD) for seamless use. Institutional Repository (IR) for IACS is implemented and being maintained by the Computer Centre in which research publications, theses and reports are uploaded either in pre-print or post-print form adhering the copyright policy of the publishers as per the mandate from NKN (National Knowledge Network) and NKRC (National Knowledge Resource Consortium). The IR of IACS is implemented with handle registration for interoperability. The documents are globally searchable with DOI (Digital Object Identifier) and other key words. Back volumes of Indian Journal of Physics are available in the IR. Management with multi-ISP (Internet Service Provider) configuration setup in failsafe mode with preferential load balancing is done by the Computer Centre. The Centre runs on a dual bandwidth setup for better reliability. One Gbps link from NKN is primarily used for internet, online journals and video conferencing etc. The other link from Tata Communications (500 Mbps) with filtered bandwidth is being used for IACS mail system, IACS Website and Gateway server. The Centre is connected through Fiber Optic cable with ISPs for better stability. Campus-wide Wi-Fi services are provided with adequate network security. The Computer Centre also provides remote connectivity via Virtual Private Network (VPN). LAN has been extended to Rangit and Churni Hostels during 2019-20. Eduroam, an international roaming service has been implemented at IACS during this period.

The list of services provided by CCRES is as follows:

1. Provides Internet (through Ethernet as well as Wi-Fi) in the entire IACS campus for Faculty Members, Staffs, Scholars and all bonafide users including visitors and guests.
2. Web-mail facility.
3. Remote connectivity through VPN and gateway server.

4. Secure web access through proxy authentication.
5. Design and day-to-day maintenance of IACS website (www.iacs.res.in).
6. Maintains and uploads tenders in CPP Portal.
7. Implementation and maintenance of Institutional Repository.
8. Configuration and maintenance of network equipment like Router, Firewall, WLC, Core Switch and L2/L3 switches.
9. Regular Back-up of user data.
10. FTP service for sending/receiving large sized files.
11. Gateway service to faculty members and students to access remote servers.
12. Eduroam service for users
13. Provides online teaching platform to the students for online classes through Zoom software.

Workshop

Engineering Workshop and Stores

Workshop

- Carpentry
- LV and MV Electrical
- Electronics
- Glass Blowing
- Mechanical
- Refrigeration and AC

Civil and Plumbing

Electrical

- 3 MVA Substations with DG set (24x7)
- Electromechanical Service
- EPABX
- Scientific and Graphic Design

Liquid N_2

Stores

- Electrical
- Civil
- Mechanical

In FY 2022-23 **Workshop** rendered essential services to the user scientists by manufacturing, repairing and modifying scientific apparatus in Mechanical, Glass Blowing, Carpentry Electronics sections and maintenance services in Electrical, & Refrigeration & Air Conditioning sections in Workshop of IACS. **Mechanical Section** – Mechanical works like machining & fabrication small parts made of steels, stainless steels, brass, copper, aluminum & many non-metals required for lab works. **Electrical Section** –Electrical maintenance works of L T distribution system and electrical appliances were done along with arrangement of audio- visual –lighting system in seminars in Auditoriums and Seminar rooms. **Electronics section** – Electrical renovations in laboratories and repairing of electronic appliance were done. **Refrigeration & Air-Conditioning section** – Repair & maintenance of all Air Conditioners, refrigerators, chillers, cold water baths &AC plant for auditorium were maintained directly and partly through AMC along with new installation of ACs as per requisitions. **Carpentry Section**- Making& repairing different types of wooden laboratory fixtures, requirements related to scientific equipment etc. were done. **Glass Blowing section** –Manufacturing & repairing of glass apparatus were done with borosilicate & quartz glass for the jobs like distillation units, condensers, sealing tubes, and conical beaker, round bottom flask, glass funnels, droppers, capillary tubes and different Manifolds etc.






Activities of the Civil Engineering Section

The Civil Engineering Section of IACS is playing an important role behind the maintenance of campus and various basic works in the IACS. A group of Engineers are involved in different kind of civil maintenance, including repairing, renovation and sanitary & plumbing works of building, laboratories, hostels, guest houses, auditorium, conference halls etc. Day-to-day cleaning and housekeeping campus building, providing fire extinguishers at designated locations are also done by the section. Civil Engineering Section is also involved in various annual maintenance like fire fighting and detection systems at the Centenary Building, Fume Hoods for different laboratories, Kitchen equipment for IACS Canteen, Industrial R.O. treatment plants etc. The Civil Engineering Section had successfully completed various works in the last financial works like roof treatment for the major part of the Main Building and the Centenary building, refurbishment and modernization of various class rooms and laboratories.

The expenditure made for the financial year 2022-23 was of Rs. 3,57,30,603/-

Activities of the Electrical Engineering Section

» Round the clock (24x7) operation & maintenance of 6KV, 4.2 MVA Indoor type Substation and DG sets including operation of Drinking Water Pumps. The above job includes monitoring of energy in regard to various electrical parameters viz. Voltage, Current, Power factor, Demand, Core Temperature of Dry Type Transformer etc. so that, quality power can be delivered. Intensive monitoring of the power system helps the consumerto maintain the desired power factor for earning power factor rebate (PFR) to the maximum possible extent.

» Day-to-Day maintenance of various Electro-Mechanical services (viz. Internal & external Electrical installation), Air-Conditioning Systems (viz. Package, VRF & Precision), Passenger lifts, Addressable Automatic Fire Detection System etc.

» Day-to-Day Operation & maintenance of EPABX cum Reception Centrei/c Up-gradation of the same.

» Providing Electrical Infrastructure for laboratories & Offices.

» Recording of Energy meter readings for IACS Staff Quarters, SBI ATM, Construction Power etc. and preparation &distribution of monthly electricity bills thereon.

» Planning, Design, Estimation & Costing including preparation of Tender documents, calling of tender, award of work, execution of work, recording of measurements, bill certification *etc.*.

» Liaison with Government & Statutory Bodies, Supply Company etc. viz. Central Electricity Authority (CEA), West Bengal Pollution Control Board, CESC Ltd.

» Introduction of Solar PV Standalone LED Street Lighting System in the campus of IACS, Jadavpur.

Liquid Nitrogen Facility

» Presently there are three Plants that are installed at IACS namely, PLN106 : capacity: 6-7 lit/hr; MNP 9/01, capacity : 10 lit/hr; SPC01, capacity : 9-10 lit/hr. Total production capacity = 288 lit/day = 250 lit/day (considering evaporation loss).

» No. of Groups using LN_2 = 30 approx.

» CSS Instruments covered = NMR, BET, XRD, EPR, TEM, SEM, Helium Plant etc.

» External supply : 346 lit; Internal supply : 37,970 lit

» Sales against money receipt (accounts section) rate Rs. 35/lit. + GST

Non Faculty Members as on 31st March, 2023

Administration

Smt. Sarbani Saha Registrar	**Smt. Purbasha Banerjee** Deputy Registrar
Shri Sujoy Kr. Mukhopadhyay Fin. & Accounts Officer-I	**Shri Debatosh Majhi** Office Supdt. (F&A)-II
Shri Biswanath Hazra Fin. & Accounts Officer-II	**Shri Amit Kr. Sarkar** Asst. Engineer-I
Shri Prasanta Kr. Kundu Office Supdt. (F&A)-II	**Smt. Suchismita Mallik** Asst. Registrar
Shri Arup Kr. Saha Office Supdt. (F&A)-I	**Shri Amit Kr. Majumdar** Office Supdt.-II
Smt. Ankeeta Chakraborty Upper Division Clerk	**Shri Abhijit Basak** Assistant-II
Shri Ananda Karmakar Technical Asst. A	**Shri Gopal Krishna Manna** Tech. Asst. B – II
Shri Sujit Kr. Biswas Asst. (F&A)-I	**Shri Arka Mukherjee** Technical Officer
Shri Tapan Sardar Upper Divison Clerk-I	**Shri Swapan Thakur** Office Supdt. (F&A)-II
Shri Soumik Mitra Assistant	**Shri Soumen Kr. Ghosh** Assistant-I
Shri Sohag Kumar Patra Assistant	**Shri Sanjib Chongdar** Sr. Doc. Assistant-I
Smt. Sohinee Motilal Upper Division Clerk	**Shri Satinath Paul** Tech. Asst. B-II
Shri Sandip Mukherjee Junior Store Keeper	**Shri Manoj Kr. Behura** Upper Division Clerk
Shri Soumyadipta Ghosh Assistant	**Shri Gopal Gond** Assistant
Shri Suresh Ch. Ghosh Upper Divison Clerk	**Shri Prabir Das** Senior Technician-I
Shri Prithu Singha Roy Multi Tasking Staff (General)	**Shri Pritam Ghosh** Upper Division Clerk
Shri Raj Kumar Routh Helper A-II	**Shri Prolay Mondal** Upper Division Clerk
Shri Raju Mondal Multi Tasking Staff (General)	**Shri Rajesh Mondal** Upper Divison Clerk-I
Shri Samir Kr. Barua Helper A-II	**Shri Rana Biswas** Multi Tasking Staff (Technical)
Smt. Debdutta Mitra Multi Tasking Staff	**Shri Madhab Pusti** Multi Tasking Staff (General)

Shri Sanjoy Prasad Multi Tasking Staff (General)	**Shri Sanjit Roy** Staff Car Driver
Shri Gautam Chakraborty Helper B-I	**Shri Gopal Ghosh** Multi Tasking Staff (General)
Shri Bijan Krishna Chandra Helper B-1	**Shri Hari Kishan Ray** Head Jamadar B-II
Smt. Sakhi Mondal Sweeper-III	**Shri Soumen Seal** Helper B-I
Shri Rakesh Kr. Balmiki Sweeper-I	**Shri Debasish Banerjee** Helper A-II
Shri Subrata Naskar Multi Tasking Staff (General)	**Shri Subrata Basu** Junior Technician-II
Shri Amarnath Dey MTS (Technical)	**Shri Srimanta Dutta** Multi Tasking Staff (General)
Shri Sumanta Bagchi Multi Tasking Staff (General)	**Shri Pranab Chakraborty** Multi Tasking Staff (Technical)
Shri Swapan Majumdar Senior Technician-I	**Shri Amit Kr. Harijan** Sweeper-I
Shri Sweta Kishor Behura Senior Record Keeper-II	**Shri Anil Harijan** Sweeper-II
Shri Soumen Mandi Assistant	**Shri Shauryadip Das** Malti Tasking Staff (General)
Shri Sailendranath Bhowmik Multi Tasking Staff (General)	**Shri Sujit Bag** Helper - B-I

Academic Office/School of Udergraduate

Shri Prabir Manna Assistant-I	**Shri Bibhas Roy** Helper B-I
Smt. Basudha Mukherjee Upper Divison Clerk	**Shri Swastik Sinha** Tech. Asst. B
Shri Pranab Ch. Kar Upper Division Clerk-II	**Smt. Saswati Bhattacharya** Upper Divison Clerk-I
Shri Sujit Kr. Das Tech. Supdt.-I	**Shri Pramod Kumar Balmiki** Multi Tasking Staff (General)
Shri Joydeb Mondal Tech. Asst. A-I	**Smt. Saumita Das Kar** Technical Asst.-B
Shri Chanchal Banerjee Multi Tasking Staff	

School of Applied and Interdisciplinary Sciences

Shri Amit Chakraborty Office Supdt.-II	**Sri Siddhartha Mistri** Helper A-I
Shri Kamal Das Book Shorter	**Shri Subir Sikder** Tech. Asst.-B-I

School of Biological Sciences

Shri Shovon Mallick Upper Division Clerk-I	**Shri Gour Chandra Bairagi** Helper A-II
Shri Ashok Kumar Multi Tasking Staff	**Shri Prosenjit Ghosh** Multi Tasking Staff (General)

School of Chemical Sciences

Smt. Dipanwita Chakraborty Assistant-II	**Shri Ashis Kr. Pal** Tech. Asst. B-I
Smt. Mahua Bhattacharya Assistant-I	**Smt. Ujwala Das** Tech. Asst. A-I
Shri Tarak Nath Helper B-1	**Shri Sajal Barua** Wash Boy Cum Bearer-I
Shri Amit Kr. Ghosh Multi Tasking Staff (Tech.)	**Shri Sonai Sardar** Mali-I

School of Mathematical and Computational Sciences (SMCS)

Smt. Mridula Majumdar Assistant-I	**Shri Partha Ganguly** Multi Tasking Staff (General)

School of Materials Sciences

Shri Subhasish Guha Roy Helper B-I	**Shri Mahadev Das** Multi Tasking Staff (General)

School of Physical Sciences

Shri Niranjan Kurmi Technical Asst-A-II	**Shri Prasad Kr. Modak** Tech. Asst.-A-I
Shri Tarun Kr. Kabasi Office Supdt.-I	**Shri Prabir Kr. Roy** Tech. Supdt.-I
Shri Bikash Darjee Helper-A-I	**Shri Suresh Mandal** Tech. Asst.-A-II
Smt. Suman Sharma Upper Division Clerk	**Shri Ajit Pandit** Helper-A-II

Library/Indian Journal of Physics

Shri Debojyoti Nath Asst. Librarian	**Smt. Suhita Neogi** Tech. Asst.-A-I
Dr. Gayatri Paul Doc. Asst.-I	**Shri Basudev Dafadar** Doc. Asst.-I
Shri Sankar Kr. Chanda Doc. Assistant-I	**Shri Ranjit Ray** Senior Doc. Asst.-I

Central Scientific Services

Shri Swapan Kr. Sarkar Technical Officer-I	**Dr. Bholanath Mondal** Technical Supdt.-I
Shri Supriya Chakraborty Tech. Asst.-B-II	**Shri Sachin Das** Technical Supdt.-I
Shri Sutapesh Dutta Technical Officer-II	**Shri Indranath Bhowmik** Technical Officer-II
Shri Arup Kr. Bandopadhyay Tech. Supdt.-II	**Shri Sanjib Naskar** Tech. Asst.-B-I
Smt. Champa Bag Tech. Asst.-B-I	**Shri Sumit Ray** Tech. Asst.-B
Shri Pijush Kumar Das Tech. Asst.-B-I	**Shri Tapas Bala** Tech. Asst.-B-I
Dr. Manash Kumar Ghosh Tech. Supdt.-II	**Shri Sridip Kumar Bera** Tech. Asst.-A-I
Smt. Sujata Gupta Tech. Asst.-A-II	**Shri Arunim Pal** Tech. Asst.-A-I
Shri Ranajit Sardar Tech. Asst.-B-I	**Shri Tapash Kr. Dutta** Tech. Supdt.-II
Shri Subrata Das Tech. Supdt.-II	**Shri Rabindra Nath Banik** Tech. Asst.-B-I
Chanchal Kr. Das Tech. Asst-B-I	**Shri Partha Kumar Rana** Senior Technician-I
Ramesh Pratap Singh Multi Tasking Staff (General)	**Shri Sanjoy Kumar Sarkar** Tech. Asst.-A-II
Dr. Sasanka Maji Tech. Officer-I	**Shri Subrata Ghosh** Tech. Asst.-A-I
Shri Tapas Kr. Das Helper-B-I	**Shri Mithu Mondal** Helper-B-I
Shri Gour Gopal Paul Tech. Assistant-B	**Shri Goutam Biswas** Tech. Assistant-A-I
Shri Suman Guchhait Malti Tasking Staff (Technical)	**Shri Mithun Sardar** Multi Tasking Staff

Centre for Computer Research, Education and Services (CCRES)

Shri Abhra Paul Technical Asst.-B	**Shri Asish Dhar** Assistant
Ms. Rimi Chakraborty Tech. Asst-B	**Shri Rajesh Sharma** Multi Tasking Staff (General)

Workshop

Shri Somnath Bandyopadhyay Workshop In-Charge-II	**Shri Shekhar Mallik** Tech. Supdt.-I
Shri Arup Dhar Junior Engineer (Civil)-I	**Shri Rajib Debnath** Junior Engineer-I (Civil)
Shri Dharmendra Singh Yadav Senior Technician-I	**Shri Dibakar Majumdar** Junior Engineer-I (Civil)
Shri Pratap Tarafdar Senior Technician-I (Electrical)	**Shri Samar Krishna Paul** Senior Technician
Shri Ramesh Kumar Senior Technician-I	**Shri Prabir Mondal** Helper-A-II
Shri Manoj Saha Helper-A-II	**Shri Biswajit Saha** Helper-A-II
Shri Prabir Kr. Debnath Helper-A-II	**Shri Khageswar Karan** Helper-A-I
Shri Subhas Bose Multi Tasking Staff (General)	**Shri Goutam Das** Helper-A-I
Shri Tarapada Maity Senior Technician-I	**Shri Thakur Das Biswas** Helper-A-I

Canteen

Shri Subhash Mondal Wash-Boy-Cum Bearer-i	**Shri Tapan Kr. Bera** Washboy Cum Bearer-I
Shri Sambhu Nath Mitra Wash Boy cum Bearer-I	**Shri Arindam Sarkar** Multi Tasking Staff (General)
Smt. Bishaka Barik Wash Boy Cum Bearer-I	**Shri Surya Prakash Yadav** Multi Tasking Staff (General)
Shri Biswarup Ghosh Multi Tasking Staff (General)	

ANNUAL ACCOUNTS AUDIT REPORT & BUDGET

Indian Association for the Cultivation of Science

BALANCE SHEET AS AT MARCH 31st, 2023

(Amount in Rupees)

PARTICULARS	SCHEDULE	CURRENT YEAR	PREVIOUS YEAR
CORPUS/CAPITAL FUND AND LIABILITIES			
Corpus/Capital Fund	1	2,09,67,96,056.00	2,13,89,78,308.00
Reserves and Surplus	2	32,97,92,504.00	33,14,29,769.00
Earmarked/Endowment Fund	3	41,84,13,705.00	26,16,69,881.00
Secured Loans and Borrowings	4	-	-
Unsecured Loans and Borrowings	5	-	-
Deferred Creadit Liabilities	6	-	-
Current Liabilities and Provisions	7	7,38,21,538.00	23,77,71,955.00
Total :		2,91,88,23,803.00	2,96,98,49,913.00
ASSETS			
Fixed Assets at written down value	8	2,16,52,99,350.00	2,00,04,39,653.00
Investments - For Earmarked/Endowment Fund	9	1,13,400.00	1,13,400.00
Investments - Others	10	-	-
Current Assets, loans, Advances etc	11	75,34,11,053.00	96,92,96,860.00
Miscellaneous Expenditure (to the extent not written off or adjusted)			
Total :		**2,91,88,23,803.00**	**2,96,98,49,913.00**

Significant Accounting Policies Note. 1 - -
Schedule 1 to 23 forming Part of Accounts
As per our attached report of even date.

S. PALIT
PARTNER
SPAN & ASSOCIATES
Chartered Accountants
FRN: 320092E
M. No. : 057072
UDIN: 23057072BGUREQ8612

Sarbani Saha
Registrar, IACS
Jadavpur, Kolkata - 700 032

Ranjan Sen
Director, IACS
Jadavpur, Kolkata - 700 032

Indian Association for the Cultivation of Science

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED MARCH 31st, 2023

(Amount in Rupees)

PARTICULARS	SCHEDULE	CURRENT YEAR	PREVIOUS YEAR
Income form Sales/Services	12	14,23,218.00	6,30,200.00
Grants/Subsidies	13	1,01,79,63,515.00	1,08,74,00,000.00
Fees/Subscriptions	14	9,37,824.00	36,65,685.00
Income from Investments (Income on Investment from Earmarked/Endowment Funds transferred to funds)	15	27,69,038.00	12,71,118.00
Income from Royalty, publication, etc.	16	-	67,73,725.00
Interest Earned	17	49,10,246.00	32,96,961.00
Other Income	18	1,03,36,059.00	2,97,962.00
Increase/Decrease in stock of Finished goods and work-in-progress	19	-	-
Overhead money transferred from Overhead acccount		2,93,76,474.00	-
Overhead money received from Project		39,11,996.00	46,73,496.00
TOTAL (A)		**1,07,16,28,370.00**	**1,10,80,09,147.00**
EXPENDITURE			
Establishment Expenses	20	88,06,56,587.00	77,20,37,579.00
Other Administrative Expenses etc.	21	32,40,47,209.00	17,98,74,224.00
Expenditure on Grants & Subsidies	22	-	-
INTEREST	23	-	68,34,859.00
Consumables		5,16,70,063.00	5,68,33,073.00
Prior Period Expenses			
Annual Maintenance Expenses		2,65,12,453.00	1,79,49,113.00
Overhead money received from Project		-	-
Depreciation (Net total at the year end-corresponding to Sch.8)		13,24,03,705.00	12,13,94,064.00
Overhead Money Transferred to IACS Overhead A/C as per Sch 3		-	-
TOTAL (B)		**1,41,52,90,017.00**	*1,15,49,22,912.00*
Balance being excess of Income over Expenditure (A-B)		(34,36,61,647.00)	(4,69,13,765.00)
Transfer to Special Reserve (Specify)			
Transfer to/from General Reserve			
Balance being Surplus (Deficit) Carried to Corpus/Capital Fund		**(34,36,61,647.00)**	**(4,69,13,765.00)**

S. PALIT
PARTNER
SPAN & ASSOCIATES
Chartered Accountants
FRN: 320092E
M. No. : 057072
UDIN: 23057072BGUREQ8612

Sarbani Saha
Registrar, IACS
Jadavpur, Kolkata - 700 032

Ranjan Sen
Director, IACS
Jadavpur, Kolkata - 700 032

Indian Association for the Cultivation of Science

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED MARCH 31st, 2023

(Amount in Rupees)

Receipts	Current Year	Payments	Current Year
Opening Balance			
1. Bank Balances :		**Expenses**	
With Scheduled Banks:		a) Establishment Expenses	
a) General :		(corresponding to Schedule-20)	88,06,56,587.00
Current Account with :		b) Administrative Expenses	
SBI, Jadavpur Univ.	2,00,53,850.84	(corresponding to Schedule-21)	32,40,47,209.32
SBI, Kolkata Main	648.50	c) AMC for Laboratories - General	2,65,12,453.39
SBI, Jadavpur Univ. Flexi A/C	-	d) Consumables - General	5,16,70,062.61
Union Bank Ballygunj Br.	13,66,01,400.05	e) Revenue Expenses on A/C of Project	10,58,37,703.05
Union Bank Main Branch	5,20,885.90	f) Revenue Expenses on A/c of TRC	3,04,25,038.69
Reserve Bank of India A/C-General	-	Contribution to Medical Scheme : TRC	-
		Income Tax Deducted (194C) : TRC	-
		Sales Tax Deducted At Source : TRC	-
		Labour Welfare Cess : TRC	-
		Security Deposit : TRC	-
		Income Tax Deducted From Salary : TRC	-
		Professionl Tax - TRC	-
b) Project Fund:		**Payments made against fund for various projects**	
Current Account with:		Expenses incurred for Spl. End. Fund - IACS	
SBI, Jadavpur Univ.	(32,53,499.37)	(corresponding to Schedule-22)	-
Cheques in hand	-	Interest	
Union Bank - Ballygunj Br.	1,26,11,356.48	(corresponding to Schedule-23)	-
Union Bank - TDR A/c Project	11,70,00,000.00	Refunded to DST on A/c of TRC Project	10,71,924.00
SBI-SERB Account, Jadavpur University	4,46,63,398.63		
SBI IACS A/C ITDD, Project	1,26,43,387.00		
Bank of Maharashtra A/C 2562	-		
Bank of Maharashtra A/C 8238	-		
c) TRC A/c:		Investments and Deposits made	
Union Bank Ballygaunge Branch	80,00,000.00	Out of Earmarked/Endowment funds	
Union Bank Ballygaunge Branch -Fexi A/C	8,10,355.77	Others (to be specified)	
Union Bank A/C 8585 - Project	-		
		TDR with SBI -(Fixed Deposit with Bank)	
2. Cash Balances :			
a) General :		Out of Own funds (Investments-Others)	
Imprest Cash	8,13,608.00	TDR with Union Bank	
Cash in hand	-	Income Tax Receivable A/c TRC	
Sundry Debtors	41,95,000.00		
Grants Received :		Expenditure on Fixed Assets & Capital Work-in-Progress	
1. Central Government - Plan	1,33,00,63,514.98	Purchase of Fixed Assets	39,76,56,507.37

Indian Association for the Cultivation of Science

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED MARCH 31st, 2023

(Amount in Rupees)

Receipts	Current Year	Payments	Current Year
Non-Plan	-	Expenditure on Capital Work-in-Progress	(8,07,62,279.10)
2. State Government - Plan	-	Capital Expenditure Account Project	2,63,55,305.27
Non-Plan	-		
		Refund of Surplus Money/Loan	
Grant received on account of Project	12,04,71,365.74	To the Government of India (General Fund Interest)	15,65,711.00
IACS Supporting Grant received on account of Project	3,41,06,380.00	To the State Government	
		To the other providers of funds	
Grant received on A/C TRC	5,17,010.00	Infrastructure A/c TRC (Deposit with CPWD)	(19,00,00,000.00)
		Equipment A/c TRC	1,91,279.30
Interest Received :			
General A/C's:		**Amount Borrowed**	
Interest on TDR (Project)	33,74,878.98	Term Deposit	
Interest receieved from SBI IACS A/C ITDD	3,43,469.00		
Interest on House Building	17,72,921.00	**Any other receipts**	
Interest on Research Endowment Fund	8,675.80	**General A/C's : (Loans and Advances)**	
Interest on Vehicle Advance	15,461.00	Advance - General	85,05,252.12
Interest on TDR against Margin Money	27,70,349.00	Advance - LTC	32,37,574.00
Interest on Computer Advance	40,054.00	Advance - Medical	-
Interest on Security Deposit (CESC)	-	Advance - Vehicles	3,000.00
Interest on TDR on Short Term Deposit	17,55,991.50	Advance - Computer	-
Interest on Term Deposit A/c - TRC	-	Advance - Puja	-
Interest on TDR against Margin Money - TRC	-	Advance - House Building	2,05,296.00
		Advance against Consumables	-
Other Income: Income from Sales and Services		Advance - A/c TRC	-
		Other Current Assets / Liabilities	3,65,65,711.00
General A/C's :		Accounts Receivable	(16,21,77,354.18)
Analytical Charges	10,94,590.00	Contribution to GSLI	2,25,220.00
Sale of Liquid Nitrogen	10,570.00	Security Deposit by IACS	-
Photo Copy charges	-	TDR with Union Bank	-
Income from Liquidated damage	-	TDR with SBI	-
Miscellaneous Income	27,94,526.54	Margin Money A/c TRC	-
Hall Rent	68,000.00	Receivables	-
Admission Fees For Int. Ph.D.	-	Accounts Receivable - Project	2,83,11,150.00
S & T Consultancy	9,37,824.00	Overhead money transferred from Overhead acccount	-
Garage Rent (Basundhara)	3,000.00	Overhead money received from Project	-
Ordinary Membership Subscription	-	Imprest Cash addition	-
Income from TDS Refund	1,21,180.00	Margin Money	15,49,27,759.20
Intellectual Fees	-	GST ITC Receivable	-

Indian Association for the Cultivation of Science

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED MARCH 31st, 2023

(Amount in Rupees)

Receipts	Current Year	Payments	Current Year
Overhead money transferred from Overhead acccount	2,93,76,474.00	GST Adjustment	-
Creche Receipts	6,910.00	Income Tax Receivable (TDS on A/C of S&T Consultancy)	-
Rent For Guest House	3,11,148.00	Advance - Project	-
Overhead from Project	39,11,996.00	Performance Security Deposit - Project	-
Income from Technoprenureship	-	TDR - Project	-
Hostel seat rent	27,57,362.00	Margin Money (Project)	18,33,434.00
Publication Income - IJP	-	Unclaimed GPF	-
Income from Scientific & Technical Consultancy	-	Advance for TRC Project A/C CPWD	(1,79,93,561.90)
Analytical Charges - Project	-		
Analytical Charges - TRC	-		
Scientific & Technical Consultancy - TRC	-	**General A/C's (Current Liabilities)**	
Income from Royalty	-	Caution Money - Integrated Phd.	10,000.00
Prior Period Income	74,73,532.00	Earnest Money written back	-
		Earnest Money	10,29,999.00
Amount Borrowed	-	**Security Deposit from Contractors**	15,53,721.00
Any Other Receipts		Security Deposit written back	-
General A/C's (Loans and Advances)		Security Deposit A/C Project:	-
Advance General	2,80,20,509.45	IISF A/c (2019)	2,65,984.00
Advance - LTC	30,15,410.00	Earnest Money A/c TRC	-
Advance - Medical	-	Secutiry Deposit A/c TRC	-
Advance - Vehicles	11,000.00	Contribution towards Corpus/Capital Fund Govt. of W.B Plan Grant	-
Advance - Computer	45,588.00	**General A/C's (Other Liablities)**	
Advance - Puja	-	General Fund	-
Advance - House Building	7,30,548.00	GST Liability of other A/C paid from general fund	-
Advance against Consumables	-	Advance received on other A/C of General fund	-
		House Building Loan from Union Bank	43,45,829.00
Margin Money A/C TRC	71,54,400.00	Income Tax Deducted from Salary	10,62,38,165.00
Receivables	-	Income Tax Deducted U/S 194C	21,45,941.00
Other Current Assets / Liabilities	4,17,32,314.02		
Accounts Payable	(17,27,97,409.20)	Income Tax Deducted U/S 194J	46,22,718.00
Contribution to GSLI	2,28,790.00	Income Tax Deducted U/S 195	-
Security Deposit by IACS	-	Insurance Premium under SS Scheme	37,23,296.00
TDR with Union Bank	1,80,00,000.00	Professional Taxes	7,97,030.00
TDR with SBI	-	Profession Tax (Project)	-
Accounts Payable - Project	3,50,00,000.00	SAE Co-operative Credit Society	2,34,49,326.00
Imprest Cash A/C TRC	-	SAE Benefit Society	29,320.00
Margin Money	-	SAE Provident Fund	3,87,21,172.00

Indian Association for the Cultivation of Science

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED MARCH 31st, 2023

(Amount in Rupees)

Receipts	Current Year	Payments	Current Year
GST ITC Receivable	-	Income Tax Deducted from Pension	1,19,05,734.00
GST Adjustment	-	TDS on GST (TRC)	-
		GST Liability (TRC)	-
Performance Security Deposit - Project	35,000.00	Sales Tax Deducted from Contractors	1,00,000.00
Advance - Project	5,92,950.09	Labour Welfare Cess	2,29,181.00
TDR - Project	-	Attachment of Pay	-
Margin Money (Project)	-	Service Tax	-
		Goods & Service Tax	3,47,68,618.10
Contribution to GSLI - Project	-	Income Tax Receivable	15,10,986.09
		RCM GST	1,14,850.00
Outstanding Liabilities	97,62,164.00	Deputation Remittance	2,50,052.00
Hostel Seat Rent - Project	-	Outstanding Liabilities	1,57,95,207.00
		Hostel Seat Rent - Project	6,092.00
General A/C's (Current Liabilities)		Income Tax (Project)	16,634.00
Caution Money - Integrated Phd.	-	Contribution to GSLI - Project	-
Earnest Money	18,63,718.00	Unallocated Payments - Project	-
Earnest Money written back	-	CMS (Project)	750.00
Security Deposit from Contractors	25,36,560.00	Grant transferred to TRC from Project	-
Security Deposit written back	-	Capital Grant transferred to IACS Project	2,58,66,875.00
IISF A/c (2019)	30,643.00	Accrued Income from Publication	73,11,764.00
Contribution towards Corpus/Capital Fund Govt. of W.B Plan Grant	-	Life Membership Fees	15,592.00
General A/C's (Other Liabilities)			
General Fund	-	**Closing Balances:**	
GST Liability of other A/C paid from general fund	-		
House Building Loan From Union Bank	43,14,588.00	1. Bank Balances:	
Income Tax Deducted from Salary	10,62,38,165.00	With Scheduled Banks:	
Income Tax Deducted U/S 194C	19,07,640.00		
Income Tax Deducted U/S 194J	34,61,867.00		
Income Tax Deducted U/S 195	-	**a) General :**	
Income Tax Deducted from Pension	1,19,05,734.00	Current Account with:	
Insurance Premium under SS Scheme	37,23,296.00	SBI, Jadavpur Univ.	7,81,475.86
Professional Taxes	7,97,030.00	SBI, Main Br.	-
SAE Co-operative Credit Society	2,34,49,526.00	Union Bank Ballygunj Br.	16,28,891.51
SAE Benefit Society	29,320.00	Union Bank Main Branch	5,20,795.15
SAE Provident Fund	3,87,21,172.00	SBI, Jadavpur Univ. Flexi A/C	-
		Reserve Bank of India A/C-General	-
Sales Tax deducted from Contractors	1,00,000.00		
Labour Welfare Cess	2,07,961.00	**b) Project Fund:**	
Attachment of Pay	-	SBI, Jadavpur Univ. Branch	64,27,232.90
Profession Tax (Project)	168.00	Union Bank - TDR A/c Project	-
Service Tax	-	Union Bank Ballygunj Br.	12,52,71,193.13
Goods & Service Tax	1,64,45,404.50	SBI-SERB Account, Jadavpur University	2,20,15,164.13

Indian Association for the Cultivation of Science

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDED MARCH 31st, 2023

(Amount in Rupees)

Receipts	Current Year	Payments	Current Year
		SBI IACS A/C ITDD, Project	1,28,70,609.00
		Bank of Maharashtra A/C 2562	93,76,236.00
		Bank of Maharashtra A/C 8238	28,25,605.00
TDS on GST (Project)	(51,962.00)	c) TRC A/c:	
Deputation Remittance	2,50,052.00	Union Bank Ballygunj Br.	-
Income Tax Receivable	12,71,654.00	Union Bank Flexi	13,88,945.58
RCM GST	2,04,106.00	Union Bank A/C 8585 - Project	28,01,505.67
CMS - TRC	-		
Income Tax Salary TRC	7,460.00	Grant Receivable from Govt. of W.B.	-
Income Tax U/s 194C - TRC	-	Grant Receivable from Central Goverment A/c	-
TDS on GST (TRC)	6,960.00		
GST Liability (TRC)	-		
Income Tax (Project)	-		
Income Tax U/s 194J - TRC	-	**2. Cash Balances:**	
Grant Receivable from Govt. of West Bengal	-	**a) General:**	
Grant Receivable from Central Goverment A/c	-	Imprest Cash	6,10,185.94
Income Tax Receivable S & T	-	Cash in hand	-
Accrued Income from Publication	1,24,78,164.00	Imprest Cash TRC	-
Life Membership Fees	15,592.00	Sundry Debtors	-
Outstanding Liabilities	-		
CMS (Project)	-	**3. Bank Balance - General (O/D)**	
Bank Balance - Union Bank Flexi A/C (Closing)		SBI - JU (Opening)	
		Union Bank Ballygunj Br.	
	2,10,02,13,658.20		**2,10,02,13,658.20**

Sarbani Saha
Registrar, IACS
Jadavpur, Kolkata - 700 032

S. PALIT
PARTNER
SPAN & ASSOCIATES
Chartered Accountants
FRN: 320092E
M. No. : 057072
UDIN: 23057072BGUREQ8612

Ranjan Sen
Director, IACS
,Jadavpur, Kolkata - 700 032

Indian Association for the Cultivation of Science

SCHEDULE 8 : FIXED ASSETS

(Amount in Rupees)

SL No	Particulars	GROSS BLOCK				DEPRECIATION			NET BLOCK AS ON 31.03.23	Depreciation Rate
		Balance as on 01.04.2022	Addition during the year	Deduction during the year	Total	Depreciation as on 01.04.22	Depreciation for the year	Total Depreciation		
1	Land (Jadavpur)	31,55,11,000.00	-	-	31,55,11,000.00	-	-	-	31,55,11,000.00	
2	Land (Baruipur)	34,70,82,598.00	-	-	34,70,82,598.00	-	-	-	34,70,82,598.00	
3	Software - Oracle	6,66,24,850.51	70,560.00	-	6,66,95,410.51	6,57,44,571.00	5,49,335.44	6,62,93,906.44	4,01,504.07	60%
4	Building and Sheds	30,45,43,061.00	19,00,00,000.00	-	49,45,43,061.00	22,85,99,587.00	1,70,94,347.41	24,56,93,934.41	24,88,49,126.59	10%
5	Building and Sheds (Baruipur)	-	-	-		-	-			10%
6	Residential Building	17,34,000.00	-	-	17,34,000.00	9,70,820.00	38,159.00	10,08,979.00	7,25,021.00	5%
7	Plant & Machinery	1,13,65,70,924.06	18,09,55,122.38	-	1,31,75,26,046.44	73,16,37,119.00	7,89,53,183.45	81,05,90,302.45	50,69,35,743.99	15%
8	Computers	19,61,98,610.75	1,47,23,523.26	-	21,09,22,134.01	18,25,23,628.00	1,43,89,598.11	19,69,13,226.11	1,40,08,907.90	60%
9	Electrical Installation	10,00,43,638.58	21,68,218.30	-	10,22,11,856.88	7,40,52,353.00	41,05,081.81	7,81,57,434.81	2,40,54,422.07	15%
10	Vehicles	40,73,545.00	-	-	40,73,545.00	29,92,978.00	1,62,085.05	31,55,063.05	9,18,481.95	15%
11	Tubewell & W. Supply	47,36,791.80	10,75,499.20	-	58,12,291.00	27,87,924.00	2,60,034.42	30,47,958.42	27,64,332.58	10%
12	Capital Work-in-progress (CPWD)	63,64,70,841.00	-	9,87,55,841.00	53,77,15,000.00	-	-	-	53,77,15,000.00	
	Sub Total	**3,11,35,89,860.70**	**38,89,92,923.14**	**9,87,55,841.00**	**3,40,38,26,942.84**	**1,28,93,08,980.00**	**11,55,51,824.69**	**1,40,48,60,804.69**	**1,99,89,66,138.15**	
13	Furniture & Fixture (Incl. other Furniture & Fixture)	3,25,79,703.70	55,18,872.50	-	3,80,98,576.20	2,18,60,992.00	14,55,420.72	2,33,16,412.72	1,47,82,163.48	10%
14	Office Equipment	2,07,69,795.40	15,90,469.60	-	2,23,60,265.00	1,66,19,031.00	7,80,920.68	1,73,99,951.68	49,60,313.32	15%
	Sub Total	**5,33,49,499.10**	**71,09,342.10**	**-**	**6,04,58,841.20**	**3,84,80,023.00**	**22,36,341.40**	**4,07,16,364.40**	**1,97,42,476.80**	
15	Books	51,16,68,629.42	80,208.00	-	51,17,48,837.42	38,45,50,909.00	1,27,17,547.81	39,72,68,456.81	11,44,80,380.61	10%
16	Subscription to e-journal	4,45,49,865.49	14,74,035.13	-	4,60,23,900.62	1,03,78,290.00	35,35,256.46	1,39,13,546.46	3,21,10,354.16	10%
	Sub Total	**55,62,18,494.91**	**15,54,243.13**	**-**	**55,77,72,738.04**	**39,49,29,199.00**	**1,62,52,804.27**	**41,11,82,003.27**	**14,65,90,734.77**	
	Cumulative Total	**3,72,31,57,854.71**	**39,76,56,508.37**		**4,02,20,58,522.08**	**1,72,27,18,202.00**	**13,40,40,970.36**	**1,85,67,59,172.36**	**2,16,52,99,349.72**	
	Previous Year	**3,63,34,61,426.30**	**8,96,96,428.41**	**-**	**3,72,31,57,854.71**	**1,59,95,06,165.00**	**12,32,12,037.00**	**1,72,27,18,202.00**	**2,00,04,39,652.71**	

Note:

a) On the basis of the decision of the Finance Committee of IACS in its meeting held on 19.06.2007, the updated value of Fixed Assets has been adopted in the Final Accounts of 2006-07

b) Total amount of Depreciation calculated during the year has been charged to Income & Expenditure A/C Rs. 132403705/- and Rs. 1637265/- against Revaluation Reserve.

c) Depreciation other than Books has been charged at the rate as provided by the Income Tax Act, Depreciation on books has been charged @ 10% p.a.

Sarbani Saha
Registrar, IACS
Jadavpur, Kolkata - 700 032

S. PALIT
PARTNER
SPAN & ASSOCIATES
Chartered Accountants
FRN: 320092E
M. No. : 057072
UDIN: 23057072BGUREQ8612

Ranjan Sen
Director, IACS
Jadavpur, Kolkata - 700 032

INDEPENDENT AUDITOR'S REPORT

To the Members of the Council

Qualified Opinion

We have audited the accompanying financial statements of Indian Association for Cultivation of Science- General Accounts (IACS) which comprise the Balance Sheet at 31st March, 2023, and the Income & Expenditure account, Receipts & Payment Account for the year then ended, together with notes to the Financial Statements, including a summary of significant Accounting Policies and other explanatory information. In our opinion and to the best of our information and according to the explanations given to us, except for the effect of the matter described in the Basis for Qualified Opinion section of our report, the accompanying financial statements give a true and fair view of the financial position of the Institute as at 31stMarch, 2023, and of its financial performance for the year then ended.

Basis for Qualified Opinion

1. Term Deposits to the tune of Rs. 9,69,67,613.13 which are in the nature of Non-Current Assets have been reflected under Schedule 11- Current Assets, Loans & Advances as on 31.03.2023. The same should have been reflected under Schedule 9- Investments for Earmaked/ Endowment Fund (Fixed Deposits with Bank).

2. Following margin money are pending adjustment for more than one year as on 31.03.2023. IACS is yet to review whether ordered items against the said Letter of Credit has been received within end of FY 22-23 and has not accounted for corresponding liability.

Vendor Name	Margin Money (Rs.)
M/s Ekspla UAB Luthuania	7,60,400.00
Biologic SAS	1,25,000.00
Thermo Fisher	42,00,000.00
Anto Paar Pvt Ltd	7,20,430.00
Ekspla UAB	3,62,700.00

3. Refer Schedule 11 – Balance of Rs. 9,96,107.45 reflected against Publication Income from IJP (Includes income due unrealised) is erroneously lying as on 31.03.2023. Royalty income on accrual basis for FY 2021-22 has been wrongly booked under this ledger with Rs. 61,99,680.00 instead of Rs. 51,66,400.00. The difference amounts to Rs. 10,33,280.00 which has not been reconciled. Royalty income of FY 2020-21 actually received during FY 2021-22 was to the tune of Rs. 43,16,270.55 against the accrued royalty income of FY 2020-21 of Rs. 42,79,098.00 booked as on 31.03.2021. The differential amount of Rs. 37,172.00 which has not been reconciled. The net balance after adjusting all differences amounts to Rs. 9,96,107.45

4. As per Schedule of Deposit Works submitted by CPWD till March, 2023, it was observed that the total deposit paid by IACS till 31.03.2023 for various works was Rs. 72,77,15,000.00 As per the statement certified by Executive Engineer, value of work to the tune of Rs. 61,75,65,053.00 has been declared to be settled / completed as on 31.03.2023. However, except for Rs. 19,00,00,000.00, other completion certificates were not obtained and capitalization process has not been initiated.

5. Refer Schedule 11 – GST ITC Receivable of Rs. 13,93,145.00 & GST Input Tax Credit of Rs. 8,55,26,364.50 shown under Current Assets has not been reviewed by management to determine unmatched ITC pertaining to the period March, 2022 and before. Balance appearing as per Electronic Credit Ledger in GST Portal as on 31.03.2023 is of Rs. 8,39,10,632.00. Difference with balance appearing in books of accounts as on 31.03.2023 have not been reconciled.

6. Liability towards shortfall of Interest between interest earned and interest paid by the IACS Provident Fund Trust during the year 2022-23 amounting to Rs. 76,29,247.00 not provided for in the accounts.

7. IACS is following the practice of booking Interest on Term Deposit on cash basis. Interest income on the following Term Deposits appearing as per 26 AS has not been recognized in books of Accounts during FY 22-23. This is in contravention to the Accounting Policy (Note 1B).

8. IACS is not maintaining detailed schedules related to the following balances appearing in books of accounts as on 31.03.2023. Hence we cannot vouch the authenticity of stated balances.

» Schedule 11 – Rs. 98,38,586.96 (Advance – General)

» Schedule 11 – Rs. 47,28,773.22 (Advance A/C TRC)

» Schedule 7- Rs. 53,29,000 (Caution Money – University)

9. Physical Verification of Fixed Assets for FY 2021-22 & 2022-23 has not been conducted.

10. A pending CBI Case for fraudulent legal payment amounting to Rs. 57.00 lakhs is going on against IACS which Rs. 57.00 lakhs of Gratuity & Leave Salary Encashment of concerned employee has been withheld by the organisation.

11. Following erroneous balances appearing in Receipt and Payment A/c as on 31.03.2023 which are unsettled contra entry need to be reconciled.

Receipt Side:

» Interest on TDR on Short Term Deposit – Rs. 17,55,991.50 (Refer Sch-17, The same should have been Rs. 1,90,280.50).

» Other Current Assets / Liabilities – Rs. 4,17,32,314.02.

» Accounts Payable - Rs. (17,27,97,409.20).

» Accrued Income from Publication – Rs. 1,24,78,164.00 (Refer Sch-16, The same should have been Rs. 67,73,725.00)

» Payment Side:

» Expenditure on Capital Work-in-Progress – Rs. (8,07,62,279.10)

» Government of India (General Fund Interest) – Rs. 15,65,711.00

» Infrastructure A/c TRC (Deposit with CPWD) – Rs. (19,00,00,000.00).

» Other Current Assets / Liabilities – Rs. 3,65,65,711.00

» Accounts Receivable – Rs. (1,62,177,354.18)

» Accounts Receivable – Project – Rs. 2,83,11,150.00

» Advance for TRC Project A/C CPWD – Rs. (1,79,93,561.90)

12. As per the TRACES portal of Income Tax Department as on 08.05.2023, Total Income Tax TDS demand of Rs. 77,330.00 is pending against the name of Institute during the period from the year 2007-08 to 2015-16. Financial year wise demand was stated below.

Particulars	Amount Rs.
2008-09	33,590.00
2009-10	7,730.00
2007-08	1,180.00
2015-16	3,140.00
2012-13	250.00
2010-11	31,440.00
Total	**77,330.00**

Observation on Project and TRC:

1. IACS is not following the practice of capitalizing Fixed Assets created out of Project Fund since the same has been treated as a revenue expenditure. Total value of Fixed Assets charged to revenue during FY 2022-23 was to the tune of Rs. 2,63,55,305.00. As per GAAP, the same should have been capitalized and depreciation to be charged on the same from the date of ready to use.

2. The following observations were noted in relation to SBI, Jadavpur Univ. under Project Fund (Sch -11)

» The following cheque payment not enchased have been mentioned in BRS as on 31.03.2023. From the date of issue of cheque it is evident that the same have become stale and are pending to be adjusted in books of accounts for FY 2022-23.

Cheque No & issue date	Cheque Amount (Rs.)
769803 / 09.03.2015	330.00
770033/ 24.04.2015	3,740.00
768367 / 28.07.2015	7,175.00

» The following NEFT failed payments have been shown under cheque payment not enchased in BRS as on 31.03.2023. The same are pending to be adjusted in books of accounts for FY 2022-23.

NEFT date	NEFT Amount (Rs.)
20.03.2017	1,100.00
27.02.2018	20,626.00
12.09.2018	3,000.00
01.08.2019	16,165.00
24.02.2021	16,785.00
24.03.2021	2,546.50
31.03.2021	6,300.00
Total	**66,522.00**

» The following cheques deposited but not credited by bank appearing in BRS for considerable period of time. Details of the cheques were not available for audit purposes. The same are pending to be adjusted in books of accounts for FY 2022-23.

Cheque No	Cheque Amount (Rs.)
253101	36,400.00
485651	32,500.00
Total	**68,900.00**

» As per BRS wrong debit by Bank of Rs. 2,04,466.05 was being carried forward since 2020 without any adjustment.

3. Refer Schedule 11 - Balance appearing against SBI IACS A/C ITDD, Project of Rs. 1,28,70,609.00 under

Project Fund not supported by balance confirmation by bank as on 31.03.2023.

4. Refer Schedule 11 - Balance of Rs. 2,20,15,164.13 appearing against SBI-SERB Account, Jadavpur University in books of accounts as on 31.03.2023. Balance as per Bank Confirmation letter on 31.03.2023 was of Rs. 2,32,30,895.13. Difference of Rs. 12,15,731.00 not reconciled.
5. Refer Schedule 11 - Balance of Rs. 28,25,605.00 appearing against Bank of Maharashtra A/C 8238 in books of accounts as on 31.03.2023. Balance as per Bank Statement on 31.03.2023 was of Rs. 1,72,600.00. The same was not supported by balance confirmation by bank as on 31.03.2023. Difference of Rs. 26,53,005.00 has not been reconciled.
6. Refer Schedule 11 - Balance of Rs. 93,76,236.00 appearing against Bank of Maharashtra A/C 2562 in books of accounts as on 31.03.2023. Balance as per Bank Statement on 31.03.2023 is of Rs. 14,69,420.00. The same is not supported by balance confirmation by bank as on 31.03.2023. Difference of Rs. 79,06,843.00 has not been reconciled.
7. Refer Schedule 11 - Balance of Rs. 13,88,945.58 appearing against Union Bank Ballygaunge Branch in books of accounts as on 31.03.2023. Balance as per Bank Statement on 31.03.2023 was NIL. Difference of Rs. 13,88,945.58 has not been reconciled.
8. IACS was not maintaining detailed schedules related to the following balances appearing in books of accounts as on 31.03.2023. Hence we cannot vouch the authenticity of stated balances.

» Schedule 7 - Rs. 4,59,360.00 (Security Deposit)

9. Negative fund balance to the tune of Rs. 1,81,26,516.78 was appearing under several projects as on 31.03.2023 as per Project Fund Statement.
10. Refer Schedule 11 - Margin Money to the tune of Rs. 97,93,434.00 as on 31.03.2023 were not supported by balance confirmation by bank.

Observation on Pension Fund:

1. Closing cash at bank of Rs. 9,451.34 as on 31.03.2023 not supported by balance confirmation by bank
2. We are unable to vouch the authenticity of balance of Rs. 39,867.00 appearing against Suspense A/c in Balance Sheet as on 31.03.2023 on account of non-availability of information. As per manual ledger the said balance was lying unadjusted since 31.03.2019.

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by ICAI. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the Institute in accordance with the ethical requirements that are relevant to our audit of the financial statements in India, and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our qualified opinion.

Emphasis of Matter

We draw attention to the following matters:

1. Referring to clause 46 of MOA which inter-alia includes that The accounts shall be subject to Internal Audit by an Independent Qualified Chartered Accountants or a firm of Chartered Accountants". No such Internal Audit was conducted so far.
2. General Ledger balances and Schedule balances as on 31.03.2023 related to Earnest Money and Security Deposit appearing in Schedule 7 has not been reconciled. Details are as follows:

Particulars	Balance as per General Ledger as on 31.03.2023	Balance as per Schedule as on 31.03.2023
Earnest Money	9,91,289.00	19,43,277.00
Security Deposit	55,77,521.60	46,25,534.00

3. Internal control in respect of Accounting entries and records needs improvement.

Our opinion is not modified in respect of these matters.

Key Audit Matters

Key audit matters are those matters that, in our professional judgment, were of most significance in our audit of the Financial Statements of the current period. In this audit we have not determined any specific Key Audit Matter to be addressed separately.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with the aforesaid Accounting Standards, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error. In preparing the financial statements, management is

responsible for assessing the Institute ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Institute or to cease operations, or has no realistic alternative but to do so. Those charged with governance are responsible for overseeing the Institute financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion.

Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

S. PALIT
PARTNER
SPAN & ASSOCIATES
Chartered Accountants
FRN: 320092E
M. No. : 057072
UDIN: 23057072BGUREQ8612

Place: Kolkata
Date: 13.07.2023

Indian Association for the Cultivation of Science

BUDGET AT A GLANCE

EXPENDITURE	Actual Expenditure 2022-23			Projected Budget 2022-23 as approved by F.C. Dt-16/09/2021		
	Non Plan	Plan	Total	Non Plan	Plan	Total
ESTABLISHMENT Salary,Fellowship,Pension,Superannuation,etc	-	8,964.69	8,964.69		10,941.34	10,941.34
ESTABLISHMENT Other essential Establishment expenditure (electricity,telephone,medical etc,)		1,195.04	1195.04		1,321.45	1,321.45
CONTINGENCIES (Office Expenses)	-	956.46	956.46		760.94	760.94
CONSUMABLES (Laboratory Expenses, Library, Workshop, Research Publication, Civil Maintenance,etc.)	-	700.52	700.52		1,490.72	1,490.72
TOTAL :	**-**	**11,816.71**	**11,816.71**		**14,514.46**	**14514.46**
Books & Journals		15.54	15.54		250.00	250.00
Equipment & Research Facilities (including AMC for High Value Equipment)		2,039.34	2,039.34		1,200.00	1,200.00
Building (Works with CPWD and Development of Present campus & Baruipur Campus)		-	-		6,400.00	6,400.00
Electrical augmentation ,etc.		21.68	21.68		180.00	180.00
Implementation of Open Acess Publication					500.00	500.00
Office Computerisation,Software/ Digitisation of Old Record		399.62	399.62		300.00	300.00
Installation of Safety Measures		-	-		100.00	100.00
Science Outreach		-	-		50.00	50.00
Solar Panel at present Campus			-		100.00	100.00
GRAND TOTAL :	**-**	**14,292.89**	**14,292.89**	**-**	**23,594.46**	**23,594.46**

RECEIPTS (Expected figures for 2022-23 & 2023-24)	Actual Receipt (Audited) 2022-23			PROJECTED BUDGET 2023-24		
	Non-Plan (A)	Plan (B)	Total (A+B)	Non-Plan (A)	Plan (B)	Total (A+B)
Opening Balance		1751.76	1751.76			
Government of India Grant received for 2022-23		13300.63	13300.63		19211.87	19211.87
Government of West Bengal		0.00	0.00	0.00	350.00	350.00
IACS Income		136.09	136.09			
Overhead money transferred from Overhead acccount		333.00	333.00			
Loan from project		350.00	350.00			
Less:Increase in margin money		1549.28	1549.28			
Less: Closing Balance		29.31	29.31			
TOTAL :	**0.00**	**14292.89**	**14292.89**	**0.00**	**19561.88**	**19561.88**

Sarbani Saha

Sarbani Saha
Registrar, IACS
Jadavpur, Kolkata - 700 032

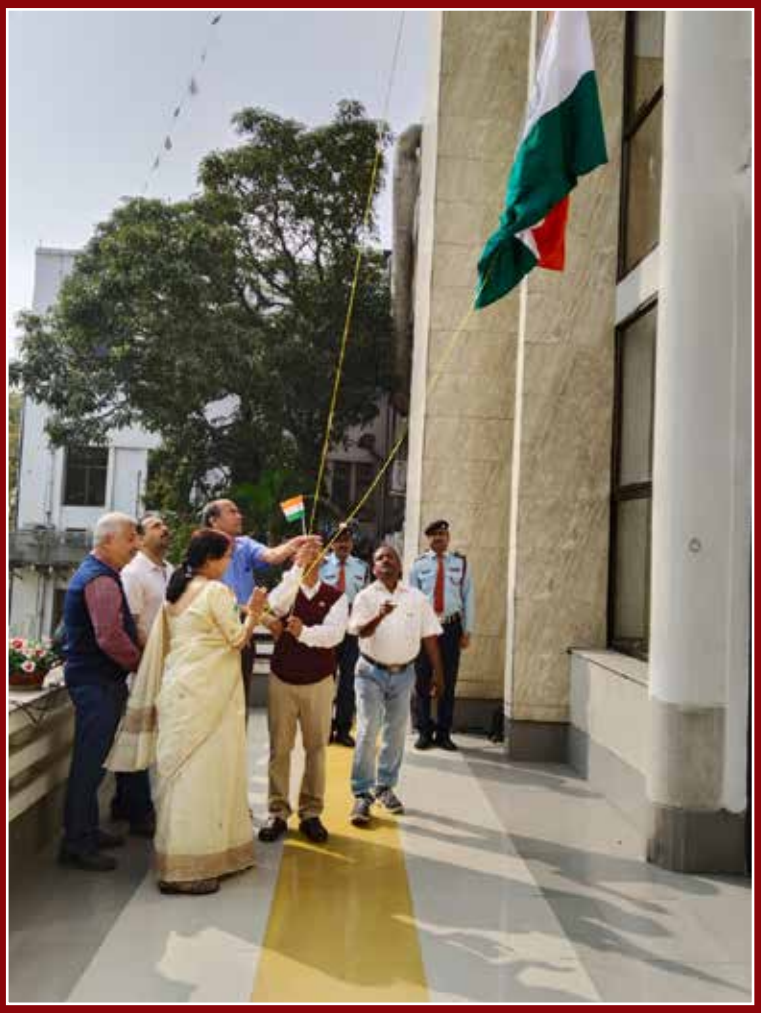
Projected Budget 2023-24 as approved by F.C Dt			Projected Revised Budget 2023 24			Projected Budget 2024-25		
Non Plan	**Plan**	**Total**	**Non Plan**	**Plan**	**Total**	**Non Plan**	**Plan**	**Total**
-	10,448.93	10,448.93	-	11,845.47	11845.47		13,298.69	13,298.69
-	1,319.60	1,319.60	-	1475.45	1475.45		1,701.59	1,701.59
-	628.87	628.87	-	1288.74	1288.74		1,539.79	1,539.79
	1,657.42	1,657.42		1190.94	1190.94		1,385.11	1,385.11
-	**14,054.83**	**14054.83**	**-**	**15,800.60**	**15,800.60**	**-**	**17,925.20**	**17925.19**
	130.05	130.05		130.05	130.05		156.07	156.07
	2,426.00	2,426.00		2,426.00	2,426.00		2,911.20	2,911.20
	2,001.00	2,001.00		2,001.00	2,001.00		2,401.20	2,401.20
	100.00	100.00		100.00	100.00		180.00	180.00
	300.00	300.00		300.00	300.00		500.00	500.00
	300.00	300.00		300.00	300.00		300.00	300.00
	100.00	100.00		100.00	100.00		100.00	100.00
	50.00	50.00		50.00	50.00		50.00	50.00
	100.00	100.00		100.00	100.00		100.00	100.00
-	**19,561.88**	**19,561.88**	**-**	**21,307.66**	**21,307.66**	**-**	**24,623.67**	**24,623.66**

PROJECTED REVISED BUDGET 2023-24			PROJECTED BUDGET 2024-25(Provisional)		
Non-Plan (A)	**Plan (B)**	**Total (A+B)**	**Non-Plan (A)**	**Plan (B)**	**Total (A+B)**
	20554.61	20554.60		24273.67	24273.66
0.00	350.00	350.00	0.00	350.00	350.00
0.00	**21307.66**	**21307.66**	**0.00**	**24623.67**	**24623.66**

Ranjan Sen

Ranjan Sen
Director, IACS
,Jadavpur, Kolkata - 700 032

Photo Gallery




ऑफ साइंस
कार्यक्रम


Azadi Ka
Amrit Mahotsav

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