



Infosys Prize Lecture

at C. V. Raman Lecture Hall

Indian Association for the Cultivation of Science by Professor Vedika
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December 9
2025
(Tuesday)
3:00 pm

**Everyone is
Welcome!**

Title: New Frontiers for Many-Body Physics

Abstract: The study of many-body physics is a defining success of quantum mechanics in the last century. From solids to superconductors to exotic topological phases, we have learned how complex collective behavior emerges from simple microscopic laws. Yet nearly all of this progress has focused on *equilibrium* systems defined on regular, *Euclidean* lattices.

A new generation of synthetic quantum devices now motivates us to move beyond these constraints. These programmable systems, where geometry and dynamics can both be engineered, offer highly controlled experimental access to nonequilibrium active quantum matter. Indeed, even the execution of a quantum algorithm is an inherently nonequilibrium process. Moreover, programmable interactions in these devices can realize non-Euclidean geometries, such as those underlying novel families of quantum error-correcting codes defined on expander graphs.

The next frontier lies in understanding how complex organization can arise and persist in these settings, where neither equilibrium nor geometry is prescribed, linking the physics of many-body organization to broader principles of information, computation, and even life. I will describe highlights of an active research program to advance many-body theory into these uncharted regimes, including examples such as time crystals, measurement-induced phase transitions, and topological quantum spin glasses. A unifying theme across these settings is that the thermodynamic and dynamical notions of order and robustness can diverge.