Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally Mandal, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Quantum geometry in flatland: from high-Tc superconductivity to Mott semimetals

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Columbia University, New York

The momentum-space structure of electronic wavefunctions can influence material response in ways that go beyond conventional band dispersion, and can play an important role in controlling correlated quantum states. I will start from the most practical question one can ask of a superconductor, namely what sets its critical temperature. Rigorous sum rules bound the superfluid stiffness that controls Tc, and by conventional reasoning a flat band should have no stiffness and therefore no superconductivity at all, yet flat-band superconductors exist. I will show that quantum geometry resolves this paradox, supplying a geometric contribution to stiffness that dispersion cannot, and turning into a design principle for raising Tc. I will then argue that quantum geometry is a generic feature of electronic structure, and that a simple separation of scales predicts when it should matter. Introducing the notion of cell-natural orbitals, I will show how quantum-geometry constrains interactions and gives rise to new correlated phases, including the Mott semimetal. I will close with a path toward probing these effects in real materials and engineered platforms.

Tuesday, Jul 14th 2026

16:00 Hrs (Tea / Coffee 15:45 Hrs)

Seminar Hall, TIFRH