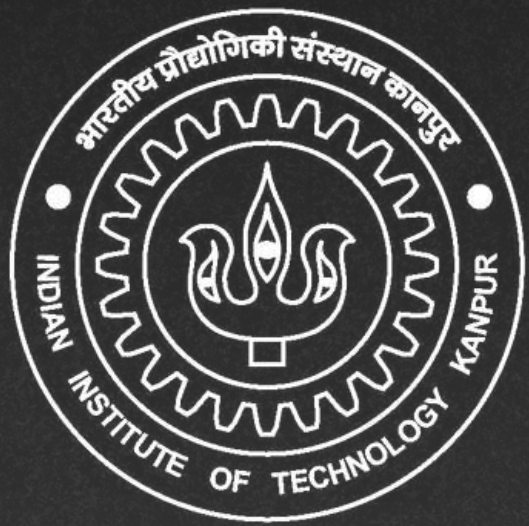




DEPARTMENT OF **PHYSICS**

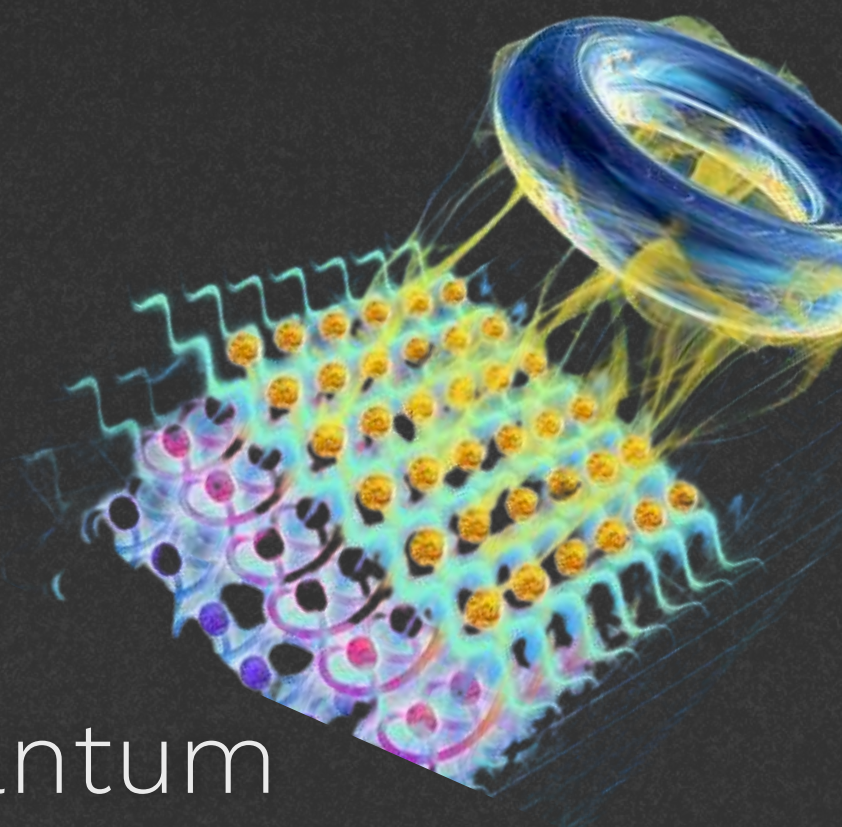
INDIAN INSTITUTE OF TECHNOLOGY

KANPUR

PHYSICS COLLOQUIUM

ON

Characterizing Unconventional Quantum Matter through Symmetry, Topology, and Quantum Geometry



ABSTRACT

How do we identify a quantum phase of matter, and what makes a phase unconventional? The Landau paradigm provides a powerful framework for classifying conventional phases of matter, where distinct states are distinguished by local order parameters and the symmetries they break. However, quantum materials can host phases and physical responses that cannot be fully captured by symmetry breaking alone, requiring additional information about the topology and geometry of their quantum states. In this talk, I will discuss how symmetry, topology, and quantum geometry provide complementary frameworks for understanding and characterizing unconventional quantum phases of matter.

I will illustrate these ideas through unconventional superconductors and magnets. In unconventional superconductors, the superconducting state can break additional crystalline or non-spatial symmetries, such as time-reversal symmetry, giving rise to pairing states with properties beyond those of conventional superconductors. I will discuss how such symmetry breaking can manifest in nonreciprocal superconducting transport, including superconducting and Josephson diode effects, and how these phenomena can provide new routes toward quantum-device functionality. I will then turn to unconventional magnets, focusing on altermagnets, which exhibit momentum-dependent, nonrelativistic spin splitting despite having zero net magnetization. I will discuss how their distinctive electronic structure and quantum geometry can give rise to unconventional charge and spin transport responses. Through these examples, I will highlight how symmetry, topology, and quantum geometry can provide experimentally accessible signatures of unconventional quantum matter and guide the development of novel quantum functionalities.

SPEAKER

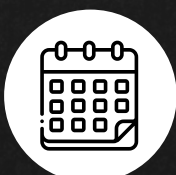


Prof. Sudeep Kumar Ghosh

*Department of Physics,
IIT Kanpur*



FB-382 (Prof. Amal Kumar
Raychaudhuri Seminar Room)



Friday, August 21, 2026, at 5:15
PM (Refreshments at 5:00 PM)

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