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

Seminar

From Design and Crystal Growth to Unveiling Exotic Magnetic Phases

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Quantum materials offer a fascinating platform to explore new states of matter and emergent phenomena that push the boundaries of our understanding of fundamental physics. Among these, quantum spin liquids (QSLs), magnetic states that remain disordered even at the lowest temperatures, and altermagnets, a recently proposed class of magnets with unique spin-split band structures, are especially intriguing for both fundamental research and potential quantum technology applications.

In this talk, I will introduce the key concepts of frustrated magnetism and quantum spin liquids, highlighting their theoretical importance and the experimental challenges in realising them. I will discuss why these materials are exciting and the difficulties in identifying clean examples in nature. A central part of this search is the ability to grow large, high-quality single crystals, which I achieve using several growth techniques, including the floating-zone (FZ) method, a crucible-free approach that melts and recrystallises materials to produce nearly defect-free crystals.

The second part of my talk will focus on my research contributions. I will share my efforts in materials design, crystal growth, and the discovery of new rare-earth triangular-lattice compounds. Notably, I will discuss $YbZn_2GaO_5$, which shows no magnetic ordering down to 60 mK. Our inelastic neutron scattering results reveal a continuum of excitations and heat capacity behaviour consistent with a U(1) Dirac QSL ground state. I will also present its sister compound, $TmZn_2GaO_5$, which exhibits strong Ising anisotropy and a gapped excitation spectrum, placing it in the quantum-disordered regime of the transverse-field Ising model, as confirmed by both theory and experiment. These compounds serve as exceptionally clean platforms for investigating frustrated magnetism, multipolar order, and anisotropic quantum excitations.

Thursday, Oct 30th 2025

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

Auditorium, TIFRH