Tata Institute of Fundamental Research

Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Colloquium

On the Consistent and Unified Microscopic Theory of the Quantum Hall Effects

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The baffling phenomenon of the Fractional Quantum Hall Effect (FQHE) in a two-dimensional electron gas was discovered within two years of the discovery of the Integer Quantum Hall Effect (IQHE). Both are phenomenologically identical, and happens intermingled as the relevant parameters like the strength of the external magnetic field is varied. Yet, the FQHE is considered as a very different physical phenomenon, not yet microscopically understood. Currently, there are only effective theories of the FQHE, with arbitrarily postulated quasiparticles and gauge fields, and complex hierarchical phenomena involving them. In this talk, I present the solution to the understanding of both the integer and fractional quantum Hall effects, in a unified single particle theory, without quasiparticles, postulated gauge fields, or arbitrary hierarchical complexity. The physical premise of this unified solution is entirely unfamiliar and surprising in condensed matter physics, and involves the factual gravitational interaction on the cosmic scale and magnitude. I show that the crucial quantum degeneracy of physical states of charge carriers in Landau orbits is determined by both the external magnetic potential and the cosmic gravitational potential. The full pattern of QHE, both integer and fractional, follows naturally from this discovery, agreeing with all experimentally observed features. Four decades after the discovery of the quantum Hall effects, we finally have a consistent and unified microscopic theory of the spectacular 2D-phenomena.

Monday, April 17th 2023

05:00 PM (Tea / Coffee 04.45 PM)

Auditorium, TIFR-H