Tata Institute of Fundamental Research

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

Seminar

Topological phases of matter in Ultracold Rydberg atoms

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Integer and fractional Quantum Hall States are the first known examples of topological states of matter, which occur in the presence of an external magnetic field. However, in condensed matter systems, the observation of fractional Quantum Hall States is difficult due to the strong interactions of electrons and the requirement of a high magnetic field of ~100 T. In this respect, ultracold atoms are a clean and controllable system to observe these topological states as a synthetic magnetic field of ~1000 T or more can be generated using laser fields. Further, ultracold Rydberg atoms are suitable candidates to generate artificial gauge fields due to the experimental control of long-range dipole-dipole interactions, the tunable geometry of the arranged atoms, and intrinsic spin-orbit coupling. Rydberg atom arrays have been identified as a tool to explore different quantum states of matter, such as symmetry-protected topological phases. They have recently shown evidence of quantum spin liquid states. In our work, we consider Rydberg atoms arranged in the honeycomb lattice. The excitation of Rydberg atoms hop via dipole exchange interactions throughout the whole lattice and can be described as hard-core bosons. We study this many-body Hamiltonian with an exact diagonalization method and provide the experimentally accessible parameter region to find the Bosonic fractional Chern insulator state.

Monday, Mar 27th 2023

4:00 PM (Tea / Coffee 3.45 PM)

Auditorium, TIFR-H