Abstract for a seminar by Roshan Singh on November 7, 2023

1. **Title: Dynamic Patterns and Phase Transitions in Confined Active Particle Systems**

Abstract:

This study explores the collective behaviour of self-propelled particles (SPP) interacting with attractive particles (AP) within semi-confined spaces. The SPPs exhibit repulsive interactions and directed motion toward APs with a constant velocity. By manipulating the coupling constant and noise levels (Peclet number), we uncover dynamic pattern formation and a phase transition from isotropic to organised motion to static regime. We also observe a trade-off between the coupling constant and particle packing density at fixed noise levels, revealing the delicate interplay between interactions and confinement. Even one particle shows interesting patterns in such confining geometries, highlighting that interesting dynamic patterns can be obtained by tuning specific parameters. These findings provide valuable insights into active matter systems and apparent dependence on stochastic variables with implications across various out-of-equilibrium systems.

2. **Feynman's path integral approach: a novel method to break the symmetry to study off-center confined and exohedral atoms**

Roshan Singh & Jobin Jose (IIT Patna)

Abstract:

Atoms trapped in fullerene C_{60} shell, known as confined atoms ($A@C_{60}$), show intriguing features, which makes them suitable for several applications in science and technology. A rather simple model potential approach describes the system adequately, for example, the atom trapped in the center of the annular square well (ASW) potential. Nevertheless, the confined atoms can rattle around inside the C_{60}, and therefore, the atom is not necessarily located at the center. The present work employs the celebrated Feynman's path integral approach to break the symmetry to investigate the effect of confinement on the off-centered endohedral and exohedral complexes. A systematic study of the electronic properties of the H atom as the atom location varies from center to outside the ASW cage is performed. Besides, the strength of the ASW potential is altered to investigate the effect on the electronic probability density and the ground-state energy.