



**S N BOSE NATIONAL CENTRE
FOR BASIC SCIENCES**

Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Condensed Matter and Materials Physics

10th July 2026

3.00 PM

BOSON

SPEAKER



**Dr. Suvadip Das, Assistant Professor,
Birla Institute of Technology & Science Pilani Hyderabad**

TITLE OF THE TALK

**Excitonic Interactions, Electron-phonon coupling and
Spin fluctuations from First principles**

ABSTRACT

Two-dimensional quantum materials such as MoS₂, WTe₂ and other transition metal dichalcogenides (TMDs) are reputed for atomically thin spintronic, valleytronic and quantum spin Hall devices. With the advent of quantum computing and superconducting devices, an exploration into the topological manifestation in 2D materials have been deemed indispensable. Desiderata fueling the search for novel two-dimensional topological materials have steered the investigation of popular layered Weyl semimetals MoTe₂ and WTe₂, and other new classes of layered materials. The common facet that unifies the above compounds is the fact that the low energy physics of these compounds is characterized by Dirac-like or Weyl-like points in the electronic spectrum and topological properties. This section of my presentation pertains to the study of the fermiology, quantum oscillations and topological properties of the recently discovered Type II Weyl semimetals MoTe₂ and WTe₂. Further, functional two-dimensional materials are promising for advanced atomically thin electronic and optoelectronic devices, such as light emitting diodes (LEDs), ultrathin solar cells, and valleytronic devices.

Recently, atomic layers of α -PbO have been successfully grown for the first time using micromechanical and sonochemical exfoliation. We performed first-principles calculations based on density functional theory and many-body perturbation theory to investigate the electronic and optical properties (utilizing the GW and BSE methodology) of monolayer, bilayer, and bulk litharge α -PbO, including spin-orbit coupling effects. Strong excitonic binding energy was observed in monolayers of newly exfoliated α -PbO due to confinement. The α -PbO monolayer is nearly transparent in the visible and near UV, and absorbs strongly in the vacuum UV range, which is promising for solar-blind UV photodetectors. A latest addition to the landscape of exotic 2D materials pertains to the discovery of not yet foretold superconducting state in monolayers of NbSe₂ dubbed 'Ising superconductivity' and constitutes the concluding section of my talk. In our study, we have investigated the energetics, magnetic moment and fully q-dependent spin susceptibility in order to pin point the location of the ferromagnetic instability in the Brillouin zone of this material. The final part of my talk involves our methodology of inverting the random-phase approximation, and utilization of first principles calculations artificially stabilized by Hubbard interactions and spin-spiral calculations for evaluation of the fluctuation renormalized spin susceptibility for the newly popular 2D Ising superconductor NbSe₂.

HOST FACULTY

Prof. Priya Mahadevan
