S N BOSE NATIONAL CENTRE
FOR BASIC SCIENCES
Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Condensed Matter Physics and Material Sciences

15th December'2021 4.00PM FERMION

SPEAKER

Dr. Ratnadwip Singha, PhD
Postdoctoral Research Associate,
Schoop Lab, Frick Chemistry Laboratory, Princeton University

TITLE OF THE TALK

Tunable magnetic structure and topological electronic states in square-net materials

ABSTRACT

Topological semimetals (TSMs) are one of the famous examples of quantum material. Though numerous TSMs have been discovered in recent years, their band structures are rarely ideal. The linear band crossings are often obscured by trivial parabolic bands near the Fermi energy. Materials with a square-net motif in their crystal structure proved to be an exception as they host clean Dirac cones over large energy range in the band structure [1-2]. The LnSbTe (Ln=lanthanides) family of materials with an antimony square-net is one such example which also introduces magnetism into topological electronic states [3-5]. We show that in this group of compounds a high degree of tunability can be achieved by changing the electron count in the square-net [6]. Increased electron filling results in structural distortion and formation of charge density waves (CDWs). Moreover, the CDW modulation vector can be tuned continuously. These structural changes also lead to rich magnetic phase diagrams. As a specific example, we discuss CeSbTe, where a complex "Devil's staircase" magnetic structure is observed within a certain electron filling [6]. We also show that the CDW creates an idealized non-symmorphic Dirac semimetal, where all the trivial bands are gapped out near Fermi energy. Furthermore, we demonstrate that similar chemical reasoning can also be used to find new quantum materials such as 2D van der Waals compounds with unique functionalities [7,8].

References
1. L. M. Schoop, et al. Nat. Comm. 7, 11696 (2016).
2. R. Singha, et al. Proc. Natl. Acd. Sci. USA 114, 2468 (2017).
3. L. M. Schoop, et al. Sci. Adv. 4, eaar2317 (2018).
4. M. M. Hosen, et al. Sci. Rep. 8, 13283 (2018).
5. S. Yue, et al. Phys. Rev. B 102, 155109 (2020).
6. R. Singha, et al. Adv. Mater. 33, 2103476 (2021).
7. S. Lei, et al. Sci Adv. 6, eaay6407 (2020).
8. R. Singha, et al. Adv. Func. Mater. 2108920 (2021).

HOST FACULTY

Prof. Prabhat Mandal
EMERITUS PROFESSOR, DEPT. OF CONDENSED MATTER PHYSICS AND MATERIAL SCIENCES

****