Announcing the Final Examination of Firoza Kabir for the degree of Doctor of Philosophy in Physics

Date: November 24, 2021
Time: 12:00 p.m. (Eastern Time)
Room: PSB 160
Zoom: https://ucf.zoom.us/j/95360635939
Meeting ID: 953 6063 5939

Dissertation title: Interplay between topology and magnetism in *f*-electron system

Abstract:
Topological insulators are materials, that are insulating in the bulk but permit spin-polarized electrons to flow on their surface. Till date, non-magnetic topological materials have been extensively studied, however, due to the complex symmetries of magnetic crystals and the theoretical and experimental difficulties associated with modeling and measuring quantum magnets, only a few magnetic materials have been explored so far. Therefore, by utilizing angle-resolved photoemission spectroscopy (ARPES), along with first-principles calculations, and magneto-transport properties, we have chosen one doped and four intrinsic magnetic materials to study the interplay between magnetic order and nontrivial topology in these systems. First, we have observed a single topological non-trivial surface state in a spin-orbit-induced bulk bandgap magnetic material (Gd doped Sb_2Te_3), where the surface states are possibly associated with the 4*f* -electron magnetism of gadolinium. Our subsequent research has focused on an intrinsic magnetic quantum material, $EuMg_2Bi_2$, which reveals multiple Dirac states, with the Dirac nodes located at distinct binding energies. Next, we have investigated kagome-net magnets, due to the unusual lattice geometry and breaking of time-reversal symmetry, they can support diverse quantum magnetic phases such as intrinsic Chern quantum phases, spin liquid phases, etc. We have studied $HoMn_6Sn_6$ and $ErMn_6Sn_6$ kagome net magnets, where we explored large anomalous and topological Hall effects, Dirac-like dispersions near the Fermi level indicating the existence of a Chern gapped Dirac cone. Finally, numerous fascinating topological phases discovered in the rare-earth monopnictide (REM) family led us to investigate the electronic structure of another REM magnetic topological material NdSb, which revealed significant band reconstruction due to the onset of an antiferromagnetic transition. Our results reveal a linear Dirac-like state at the zone center and two Dirac-like states at the zone corner of the Brillouin zone, indicating non-trivial topology in this material. Our detailed electronic structure study of these aforementioned 4*f* magnetic materials could potentially provide a foundation for future research investigating the interaction between topology and magnetism.

Outline of Studies:
Major: Physics
Educational Career:
M. S. University of Central Florida, U.S.A, 2017
B. S. University of Dhaka, Bangladesh, 2008
Committee in Charge:
Dr. Madhab Neupane (Chair)
Dr. Talat S. Rahman
Dr. Dr. Yasuyuki Nakajima
Dr. Krzysztof Gofryk, Idaho National Laboratory (External Committee Member)

Approved for distribution by Dr. Madhab Neupane, Committee Chair, on November 05, 2021.
The public is welcome to attend in person and remotely.