

Announcing the Final Examination of RIFFAT MUNIR for the degree of Doctor of Philosophy in Physics

Date: April 2, 2021

Time: 3:00 PM

Zoom

Link: <https://ucf.zoom.us/j/97089525753?pwd=M2hGQXBjdjNkNyOHNWcHhKaHFIVStDQT09>

Meeting ID: 970 8952 5753

Password: 483889

Dissertation title: Unusual superconductivity in topological nodal line semimetals

Abstract:

Unconventional superconductivity has attracted great interest because of the unusual pairing mechanism. In conventional or s-wave superconductor, electrons with opposite spins and momenta form Cooper pairs, mediated by the electron-phonon interaction. In unconventional superconductors, pairing mechanism is different than that of the conventional one. For example, in p-wave pairing states, electrons with parallel spins form the Cooper pairs. Unconventional superconductivity has been observed in various systems, such as heavy fermion, cuprates, and iron-based superconductors etc. In recent years, topological superconductivity has gained attention due to the combination of non-trivial topological nature in the band structures and unconventional superconductivity simultaneously. The much studied PbTaSe_2 is one of the topological superconductor candidates. This material has been found to host topological nodal lines in the band structure and superconductivity occurs at 3.72 K. Theoretically predicted, the ABSe_2 with the same structure as PbTaSe_2 be topological superconductors, where A denotes an intercalate metal (Pb, Sn, or In) and B is a transition metal (Nb, or Ta). This thesis aims at exploring superconductivity in these systems. We have grown single crystals of $\text{Sn}_x\text{NbSe}_{2-\delta}$ and polycrystals of InNbSe_2 , PbNbSe_2 and SnTaSe_2 . The transport properties of $\text{Sn}_x\text{NbSe}_{2-\delta}$ were measured to gain a new insight into the superconductivity of this system. We find unusual upper critical fields in Sn_xNbSe_2 , differing from that calculated by the conventional theory for orbital depairing in type-II superconductors. In addition, a zero-temperature value of the upper critical field is beyond the Pauli paramagnetic limit, suggestive of unconventional pairing. Our findings, along with the theoretical prediction about topological nature, suggest $\text{Sn}_x\text{NbSe}_{2-\delta}$ is a promising candidate for a topological superconductor.

Outline of Studies:

Major: Physics

Educational Career:

M. S. Ohio University, USA, 2016

B. S. University of Dhaka, Bangladesh, 2013

Committee in Charge:

Dr. Yasuyuki Nakajima (Chair)

Dr. Richard Klemn (Vice Chair)

Dr. Masahiro Ishigami

Dr. Tania Roy (External Committee Member)

Approved for distribution by Dr. Yasuyuki Nakajima, Committee Chair, on 24th March, 2021.

The public is welcome to attend remotely