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=M2hGQXBJdkNyOHNWcHhKaHFlVStDQT09
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 forms 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 the a transition metal (Nb, or Ta). This thesis aims at exploring superconductivity in these systems. We have grown single crystals of Sn$_x$NbSe$_2$-$\delta$ and polycrystals of InNbSe$_2$, PbNbSe$_2$ and SnTaSe$_2$. The transport properties of Sn$_x$NbSe$_2$-$\delta$ were measured to gain a new insight into the superconductivity of this system. We find unusual upper critical fields in Sn$_x$NbSe$_2$, 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 Sn$_x$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

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

The public is welcome to attend remotely