PHY 690T

Outline of course contents: Type-II Superconductors, Vortices, and Applications

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The course will attempt an overview of the vast field of superconductivity and its applications. The course will begin with an introduction to the phenomenon of superconductivity. It will cover a brief history of the phenomenon and discuss some seminal experiments associated with this phenomenon.

The initial part of the course will discuss classical superconductors and their types, followed by study of their thermodynamic and magnetic properties (ac and dc). An overview of the different types of superconductors discovered too date till the Pnictides will be presented. The course will discuss the BCS theory and develop the gap equation near Tc. This will be followed by an introduction to the Ginzburg landau theory for superconductivity. Properties of type I and Type II superconductors will be covered, with an introduction to the Physics of vortices in superconductors, Abrikosov vortex state, role of pinning, flux pinning, irreversible magnetization response of superconductors, current voltage relationship of a type II superconductor in the presence of a magnetic field. Study of tunneling phenomenon in N-I-S or S-I-S junctions, and Josephson effect and junctions and their applications (SQUID). Vortex state at nanoscales. Applications relating to various aspects of superconductors will be discussed along with a brief discussion on uncoventional superconductors.

Course prerequisite: Condensed Matter physics, Quantum mechanics, Electrodynamics, Thermodynamics and Statistical mechanics.