Mechanics of Quantum Materials

Pradeep Sharma*[1]

[1]University of Houston – United States

Abstract

Quantum materials refer to a specific class of materials that exhibit strong electronic correlations and order, resulting in often exotic emergent behaviors that can only be understood by taking cognizance of the underlying quantum nature of these materials. Examples include materials that demonstrate lossless transmission of electricity, such as superconductivity, advanced cryptography, exquisite sensing, artificial intelligence, quantum computing, and information storage and retrieval at science-fiction-like speed and capacity. One example of a quantum material is well-designed high-temperature superconductors, which hold the potential to revolutionize human technological capabilities, including controllable nuclear fusion, levitating vehicles, and next-generation power grids, among others. In this presentation, I will discuss a field theory formulation for quantum materials that connects continuum mechanics concepts with an appropriate quantum mechanical-based order parameter. Our formulation epitomizes the remarkable capacity of the continuum mechanics framework to construct phenomenological models for complex materials systems even with distinctly quantum mechanical underpinnings. I use superconductors as a case study to highlight several novel physical insights.

*Speaker