University of Miami, Physics Department Colloquium

Date: Wednesday, Mar 22, 2023
Time: 4:00 pm – 5:00 pm
Location: Wilder Auditorium – Rm 112, Knight Physics Building

The Tao of Topological Matter

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Abstract

The concept of topology is ubiquitous in physics. Topology serves as the mathematical structure that pervades the Standard Model and provides us with our basic understanding of the structure of the universe from the smallest quanta of matter to its most massive. Within the past three decades, these high-energy concepts have gradually diffused into the low-energy realm of condensed matter providing a convenient vehicle through which to study fundamental phenomena of physics that are normally found in high-energy colliders. What initially started as only a few condensed matter systems has now exploded into a veritable cornucopia of materials that possess different symmetries, interactions, and dimensionalities. Along the path from novelty to ubiquity, many new phenomena have been theoretically predicted and experimentally actualized yet the study of topological phases in condensed matter materials continues to provide new twists and surprises. These surprises arise from the study of both emergent materials and a reexamination of "well-understood" materials. In this talk, I will introduce the basics of topological condensed matter materials and discuss some of the canonical results that have been observed. Subsequently, I will present recent work that demonstrates the appearance of new gravitational effects in magnetic topological metals. Finally, I will conclude by discussing some of the issues and challenges associated with future study of topological phases within condensed matter systems pointing to unexplored territories that occupy the space between esoteric theories and experimental reality.

Biosketch

Matthew J. Gilbert is an Associate Professor in the Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign (UIUC). He is affiliated with the Micro and Nanotechnology Laboratory, the Department of Physics and the Institute for Condensed Matter Theory, and the Institute for Quantum Information Science and Technology at UIUC. He is a member of the Technical Advisory Group (TAG) for topological science with the Department of Defense advising on future directions in DoD related research in topology and reviewing ongoing programs. Professor Gilbert has won the Young Investigator Prize from the Army Research Office, the CAREER award from the NSF, and the Bando International Prize Fellowship from the University of Pisa. His current research broadly focuses on theoretically elucidating new phenomena in emergent materials with the goal of developing new types of next-generation quantum information processing and quantum computing systems. Professor Gilbert has published papers in many different areas of physics, engineering, and materials science. His current work reflects diverse interests within engineering and physics that include: understanding the properties of topological materials, including insulators, semimetals, photonic materials, circuits and superconductors, topological electronic and magnetic devices, the strain engineering of 2D materials, designer imprinted topological heterostructures, and the connection between gravitational physics and topology in heavy fermion magnetic materials.