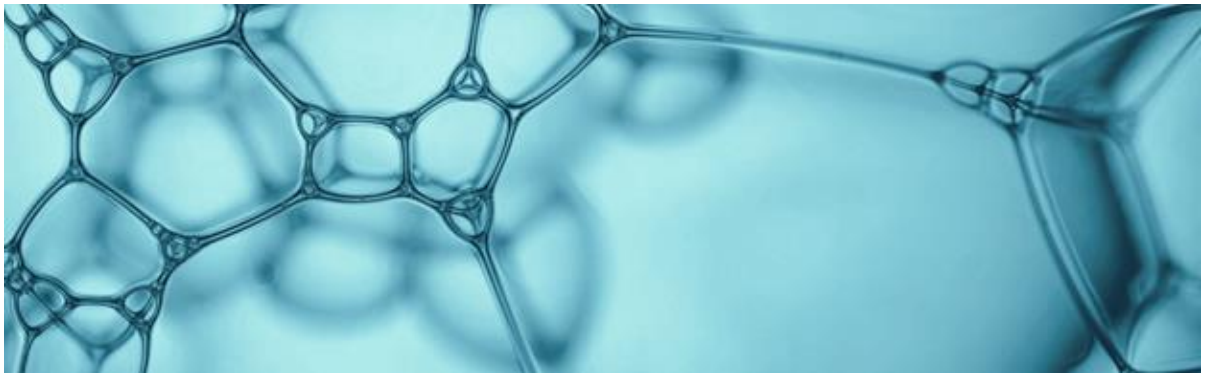

Topological phases of matter

Abstract

Condensed matter physics studies phases of matter that exhibit superconductivity, quantization of resistivity, and "repetitive motion. " This talk will describe the basic ideas in condensed matter physics from the concept of emergence by comparing it with reductionism, leading us to an intuitive idea of what a phase means and some exotic phases we come across in condensed matter physics. A phase transition occurs when the parameters of the system are changed. Traditionally, phase changes are associated with Landau's theory of symmetry breaking. However, experiments like the Quantum Hall Effect (QHE) revealed the existence of topological phases where phase transitions occur without symmetry breaking. In a topological phase, specific properties, such as the Hall conductance or the number of edge modes (equal to Chern number) in a QH system, are independent of material details and insensitive to smooth deformation of the system (such as small density change or disorders) unless the system passes through a quantum phase transition. The system's external deformations are considered gentle enough– namely" adiabatic" as long as they are sufficiently smaller than the gap so as not to create excitation above the ground state. In this talk, we will discuss the classical Hall effect, its quantum version, some of the basics required to understand this effect, and some real-life applications that may come out of studying them.