I3

Orbital magnetization, geometric phase, and the modern theory of magnetic breakdown

Aris Alexandrinata
Yale University, USA

The semiclassical theory of a Bloch electron in a magnetic field now encompasses modern notions that lie beyond the Peierls-Onsager theory - namely, the orbital magnetization and geometric phase play crucial roles in our refined understanding of magnetic phenomenon. Lying beyond this semiclassical theory is the quantum description of field-induced tunneling between semiclassical orbits, known as magnetic breakdown. I will show how to synthesize the modern semiclassical notions with quantum tunneling, into a single Bohr-Sommerfeld quantization condition. Such generalized quantization conditions encode a new type of topological invariant that characterizes the Fermi surfaces of metals, and is measurable in de-Haas-van-Alphen oscillations. Specific case studies are discussed for deformed graphene, 3D Dirac metals, topological metals near a metal-insulator transition, topological crystalline insulators, as well as over-tilted Dirac fermions.