Magnetic Topological Quantum Matter

M. Zahid Hasan[1]

[1] *Laboratory for Topological Quantum Matter, Princeton University*

Electrons organize in ways to give rise to distinct phases of matter such as insulators, metals, magnets, superfluid or superconductors. In the last ten years or so, it has become increasingly clear that in addition to the symmetry-based classification of matter, topological consideration of wavefunctions plays a key role in determining distinct or new quantum phases of matter [see, for an introduction, Hasan & Kane, Reviews of Modern Physics 82, 3045 (2010)].

In this talk, I briefly introduce these new topological concepts in the context of their experimental realizations in three dimensional magnetic matter. As examples, I present how tuning a topological insulator whose surface hosts an unpaired Dirac fermion can give rise to emergent Weyl fermion and “fractional” Fermi surfaces; and strongly correlated magnetic, Chern or many-body states of matter. These “magnetic topological matter” harbor novel and unprecedented properties that may lead to the development of next generation quantum technologies.