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Search for Majorana fermions in Spin-Orbit Coupled Ultra-cold Fermi Gases[1]

CHUANWEI ZHANG, Department of Physics, The University of Texas at Dallas, Richardson, Texas 75080, USA

Topological quantum matter has been an active research field in physics in the past three decades with numerous celebrated examples, including quantum Hall effect, chiral superconductor, topological insulator, etc. In topological materials, Majorana fermions, first envisioned by Majorana in 1935 to describe neutrinos, often emerge as topological quasiparticle excitations of the systems. Majorana fermions are intriguing because they can be construed as their own anti-particles and follow non-Abelian anyonic statistics under a pair-wise exchange of the many-particle wave function, unlike Dirac fermions where electrons and positrons (holes) are distinct. Although the emergence of Majorana fermions in any condensed matter or atomic system is by itself an extraordinary phenomenon, they have also come under a great deal of recent attention due to their potential use in fault tolerant quantum computation. Motivated by the recent experimental realization of spin-orbit coupling for cold atoms, in this talk, I will discuss the emergence of Majorana fermions in spin-orbit coupled Fermi cold atomic superfluids. I will talk about various experimental relevant issues for the observation of Majorana fermions in such cold atomic systems.

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