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Superconductivity in Topological Insulators[1]

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Topological phases of matter such as three-dimensional topological insulators have been discovered and found to exhibit fascinating quantum phenomena. These materials have shown robust quantized properties i.e. bulk insulating phase but surface conducting phase with Dirac excitations. Three-dimensional topological superconductors have been theoretically proposed recently. These hypothetical topological superconductors (TSCs) are predicted to possess itinerant massless Majorana fermions which are charge neutral and spin 1/2 quasiparticles that only emerge and propagate on the surface. The Bogoliubov-de Gennes (BdG) Hamiltonian for the quasiparticles of a TSC is analogous to the Hamiltonian of a TI, with the superconducting gap corresponding to the band insulating gap. However, TSCs and the associated Majorana quasiparticles have not been conclusively established in real materials so far. Hence, this presentation will show by chemical doping, a TI can change into a bulk superconductor which could be a TSC. The first example i.e. $Cu_xBi_2Se_3$ was discovered few years ago to be a promising TSC. Several other promising candidates of TSCs will also be shown.

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