

## Topological Insulators and Topological Band Theory

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A topological insulator is a material that is an insulator on its interior, but has special conducting states on its surface. These surface states are unlike any other known two dimensional conductor. They are characterized by a unique Dirac type dispersion relation and are protected by a topological property of materials' underlying bulk electronic band structure. These materials have attracted considerable interest as a fundamentally new electronic phase with applications from quantum transport to quantum computing. In this talk we will outline the theoretical discovery of this phase and describe recent experiments in which its signatures have been observed in both two and three dimensional systems. We will close by arguing that the proximity effect between an ordinary superconductor and a 3D topological insulator leads to a novel two dimensional interface state which may provide a new venue for realizing proposals for topological quantum computation.