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Oliver E. Buckley Condensed Matter Prize Lecture: Topological Insulators[1]

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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 the material's underlying electronic band structure. In this talk we will outline our path to the theoretical discovery of this phase and describe the physical properties of the two dimensional topological insulator - also known as a quantum spin Hall insulator - as well as its three dimensional generalization. We will then go on to discuss more recent developments, including the topological classification of point and line defects in topological insulators and superconductors. The latter may provide a venue for observing Majorana fermion states and for realizing proposals for topological quantum computation.

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