An introduction on topological matter

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Topological insulators are materials, which are conducting at their edge, though not in the bulk. Their essential physical properties take the form of an index, often associated to a Hamiltonian. "Topological" simply refers to the fact that indices remain invariant under continuous changes of the insulator.

The lecture will begin by reviewing some basic prerequisites, both from quantum mechanics and differential geometry (vector bundles). It will cover the historical developments, beginning with the Quantum Hall effect, both in terms of physical content as well as a source of various mathematical developments. Concepts such as Chern numbers (for periodic systems), as well as more general indices (for disordered systems) originating in non-commutative geometry, will be discussed in terms of their bulk and edge realizations.

More recent developments, including the twists brought about by symmetries and the extension to time-dependent (Floquet) systems, will also be addressed.