

Topological Surface States in Topological Insulators and Superconductors: Discovery and the New Frontiers

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Three dimensional topological insulators (originally called “Topological Insulators”) are a new phase of matter which realizes a non-quantum-Hall-like topological state in bulk matter and unlike the quantum Hall liquids can be turned into superconductors and magnets ^{1,2,3}. In this talk, I will briefly review the basic theory and experimental discovery of topological insulators. I will then discuss experimental results that demonstrate the Topological-Order via the properties of topological insulators such as spin-momentum locking, non-trivial Berry’s phases, mirror Chern number, absence of backscattering or no U-turn, protection by time-reversal symmetry and the existence of room temperature topological order. I will also report the possible exotic roles of superconductivity and magnetism in doped topological insulators and their potential applications.

¹M.Z.H. and C.L. Kane; Rev. of Mod. Phys. 82, 3045 (2010).

²M.Z.H. and J.E.Moore; Ann. Rev. of Cond.Mat.Phys. (2011).

³M.Z.H., D. Hsieh, Y. Xia, L.A. Wray, S.-Y. Xu and C.L. Kane; A new experimental approach for the exploration of topological quantum phenomena: Topological Insulators and Superconductors arXiv:1105.0396 (Review Article) (2011).

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