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Induce a magnetic monopole on the surface of topological insulator

XIAOLIANG QI, Microsoft Station Q

Topological insulators are new states of matter which are gapped in the bulk but have gapless, topologically protected surface states. In recent years, time reversal invariant topological insulators have been discovered in HgTe quantum wells and bulk crystals Bi₂Se₃, Bi₂Te₃ and Bi_{1-x}Sb_x alloy. The three-dimensional topological insulator is described by a topological term $E \cdot B$ in the effective field theory, leading to a topological magneto-electric effect. As a consequence, an image magnetic monopole is induced by a point charge near the surface of the topological insulator. Electrons near the surface of topological insulator become dyons with anionic statistics. If in addition an antiferromagnetic order is established in the topological insulator phase, a topological coupling is induced between spin-wave excitations and photons, leading to the design of a tunable optical modulator.