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Abstract Submitted

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Hunting down magnetic monopoles in 2D topological insulators?[1]

XUGANG HE, Stony Brook University and BNL, CMPMSD AT BNL TEAM — Contrary to the existence of electric charge, magnetic monopole does not exist in nature. It is thus extraordinary to find that magnetic monopoles can be pictured conceptually in topological insulators. For 2D topological insulators, the topological invariant corresponds to the total flux of an effective magnetic field (the Berry curvature) over the reciprocal space. Upon wrapping the 2D reciprocal space into a compact manifold as a torus, the non-zero total flux can be considered to originate from magnetic monopoles with quantized charge. We will first illustrate the intrinsic difficulty via extending a 2D problem to a 3D reciprocal space, and then demonstrate that analytical continuation to the complex momentum space offers a natural solution in which 1) the magnetic monopoles emerge naturally in pairs each forming a string above and below the real axis possessing opposite charge, and 2) the total charge below the real axis gives exactly the topological invariant. In essence, the robustness of the topology is mapped to the robustness of the total charge in the lower complex plan, a mapping intriguing even mathematically. Finally, we will illustrate the evolution across the topological phase transition, providing a natural description of the metallic nature in the phase boundary, and offering a clear explanation why a change of global topology can be induced via a local change in reciprocal space.

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