It is related to recent works by, e.g., S. Geraedts et. al.; C. Xu and Y.Z. You; T. Neupert, S. Rachel, T. Thomale, M. Greiter; M. Metlitski and A. Vishwanath; C. Wang and T. Senthil; D.T. Son.

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Explicit derivation of duality between a free Dirac cone and quantum electrodynamics in (2+1) dimensions DAVID F. MROSS, JASON ALICEA, OLEXEI I. MOTRUNICH, Caltech — A single Dirac cone of (free) electrons famously arises on the surface of a 3D topological insulator. Recent work proposed that these metallic surfaces can alternatively be described by quantum electrodynamics in $(2+1)$ dimensions (QED_3), where charge-neutral 'dual fermions' strongly couple to an emergent photon. We explicitly derive this duality via an exact, nonlocal mapping from electrons to dual fermions on the level of path integrals. This mapping allows us to construct Hamiltonians for exotic topological-insulator surface phases, and to derive the particle-hole-symmetric field theory of a half-filled Landau level. By running the duality 'in reverse' we can constrain scaling dimensions for operators in QED_3 and establish duality between bosonic topological insulator surfaces and QED_3 with two fermion flavors.

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