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Quantum criticality of topological phase transitions in 3D interacting electronic systems BOHM JUNG YANG, RIKEN Center for Emergent Matter Science, EUN GOOK MOON, Kadanoff Center for Theoretical Physics and Enrico Fermi Institute, University of Chicago, HIROKI ISOBE, Department of applied physics, University of Tokyo, NAOTO NAGAOSA, RIKEN Center for Emergent Matter Science — Topological phase transitions in condensed matters accompany emerging singularities of the electronic wave function, often manifested by gap-closing points in the momentum space. In conventional topological insulators in three dimensions (3D), the low energy theory near the gap-closing point can be described by relativistic Dirac fermions coupled to the long range Coulomb interaction, hence the quantum critical point of topological phase transitions provides a promising platform to test the novel predictions of quantum electrodynamics. Here we show that a new class of quantum critical phenomena emanates in topological materials breaking either the inversion symmetry or the time-reversal symmetry. At the quantum critical point, the theory is described by the emerging low energy fermions, dubbed the anisotropic Weyl fermions, which show both the relativistic and Newtonian dynamics simultaneously. The interplay between the anisotropic dispersion and the Coulomb interaction brings about a new screening phenomenon distinct from the conventional Thomas-Fermi screening in metals and logarithmic screening in Dirac fermions.

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