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Multipolar orders and quantum criticality of a three-dimensional parabolic semimetal BITAN ROY, PALLAB GOSWAMI, University of Maryland — Motivated by the observation of multipolar ordering in many heavy fermion compounds and 227 pyrochlore iridates, we investigate the phase diagram of an interacting, three dimensional parabolic semimetal as a paradigmatic toy model for studying the interplay among electronic correlations, topology and quantum critical phenomena. The generic forms of the local order parameters and quartic interactions are constructed according to the irreducible representations of octahedral point group symmetry. Through a renormalization group analysis, we elucidate the competition between time-reversal symmetric quadrupolar and time-reversal symmetry breaking octopular ordered phases for sufficiently strong interactions. We show that the quadrupolar ordering can give rise to a correlated topological insulator phase, while the octupolar order generically leads to a Weyl semimetal phase. The quantum phase transitions between the semimetal and the broken symmetry phases are controlled by non-Gaussian, itinerant quantum critical points.

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