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Quantum critical point of Dirac fermions studied using efficient continuous-time projector quantum Monte Carlo method LEI WANG, MAURO IAZZI, ETH - Zurich, PHILIPPE CORBOZ, University of Amsterdam, MATTHIAS TROYER, ETH - Zurich — Quantum phase transition (QPT) of Dirac fermions is a fascinating topic both in condensed matter and in high energy physics. Besides its immediate connection to fundamental problems like mass generation and exotic phases of matter, it provides a common playground where state of the art numerical simulations can be crosschecked with various effective field theory predictions, thus deepen our understanding of both fields. The universality class of the QPT is fundamentally different from the usual bosonic field theory because of the coupling to the gapless fermionic mode at the critical point. We study lattice models with spinless and multi-flavor Dirac fermions using the newly developed efficient continuous-time projector quantum Monte Carlo method. Besides eliminating the Trotter error, the method also enables us to directly calculate derivative observables in a continuous range of interaction strengths, thus greatly enhancing the resolution of the quantum critical region. Compatible results are also obtained from infinite projected entangled-pair states calculations. We compare these numerical results with predictions of the Gross-Neveu theory and discuss their physical implications.

Lei Wang
ETH - Zurich

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