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Quantum Phase Transition from Dirac Semimetal to Quantum Spin-Hall Insulator YUAN-YAO HE, Department of Physics, Renmin University of China, XIAO YAN XU, Beijing National Laboratory for Condensed Matter Physics, and Institute of Physics, Chinese Academy of Sciences, KAI SUN, Department of Physics, University of Michigan, Ann Arbor, FAHKER ASSAAD, Institut fuer Theoretische Physik und Astrophysik,Universitat Wuerzburg, 97074 Wuerzburg, Germany, ZI YANG MENG, Beijing National Laboratory for Condensed Matter Physics, and Institute of Physics, Chinese Academy of Sciences, ZHONG-YI LU, Department of Physics, Renmin University of China — Employing determinantal quantum Monte Carlo simulations, we design and investigate a lattice model of fermions coupled with Ising fields. By turning the strength of a transverse field, the Ising spins experience a quantum phase transition from a paramagnetic phase to a ferromagnetic phase, which furthermore triggers a topological phase transition between a Dirac semimetal state and a quantum spin-Hall insulating state for the fermionic degrees of freedom. The nature of such an interaction-driven topological phase transition and the associated quantum critical region are fully revealed by the unbiased numerical approach.

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