Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Topological phase transitions with SO(4) symmetry in (2+1)d interacting Dirac fermions[1] XIAO YAN XU, Beijing National Laboratory for Condensed Matter Physics and Institute of Physics, Chinese Academy of Sciences, K. S. D. BEACH, Department of Physics and Astronomy, The University of Mississippi, KAI SUN, Department of Physics, University of Michigan, F. F. ASSAAD, Institut fr Theoretische Physik und Astrophysik, Universitt Wrzburg, ZI YANG MENG, Beijing National Laboratory for Condensed Matter Physics and Institute of Physics, Chinese Academy of Sciences — Interaction-driven topological phase transitions in Dirac semimetals are investigated by means of large-scale quantum Monte Carlo (QMC) simulations. The interaction among Dirac fermions is introduced by coupling them to Ising spins that realize the quantum dynamics of the two-dimensional transverse field Ising model. The ground state phase diagram, in which the tuning parameters are the transverse field and the coupling between fermion and Ising spins, is determined. At weak and intermediate coupling, a second-order Ising quantum phase transition and a first-order topological phase transition between two topologically distinct Dirac semimetals are observed. Interestingly, at the latter, the Dirac points smear out to form nodal lines in the Brillouin zone, and collective bosonic fluctuations with SO(4) symmetry are strongly enhanced. At strong coupling, these two phase boundaries merge into a first-order transition.

[1]We acknowledge the support from the National Natural Science Foundation of China (NSFC Grant Nos. 11421092 and 11574359) and the National Thousand-Young-Talents Program of China.

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Date submitted: 27 Oct 2016 Electronic form version 1.4