

Abstract Submitted  
for the MAR15 Meeting of  
The American Physical Society

**Fermion-sign-free Majorana-quantum-Monte-Carlo studies of quantum critical phenomena of Dirac fermions in two dimensions** ZIXIANG LI, YIFAN JIANG, HONG YAO, Institute for Advanced Study, Tsinghua University, Beijing, 100084, China — Quantum critical phenomena may be qualitatively different when massless Dirac fermions are present at criticality. Using our recently-discovered fermion-sign-free Majorana quantum Monte Carlo (MQMC) method, we investigate the quantum critical phenomena of *spinless* Dirac fermions on the honeycomb lattice having  $N_s = 2L^2$  sites with largest  $L = 24$ , at their charge-density-wave (CDW) phase transitions. By finite-size scaling, we accurately obtain critical exponents of this so-called Gross-Neveu chiral-Ising universality class of two (two-component) Dirac fermions in 2+1D:  $\eta = 0.45(2)$ ,  $\nu = 0.77(3)$ , and  $\beta = 0.60(3)$ , which are qualitatively different from the mean-field results but are reasonably close to the ones obtained from renormalization group calculations.

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Date submitted: 14 Nov 2014

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