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Charge-4e superconductors: a Majorana quantum Monte Carlo study YI-FAN JIANG, ZI-XIANG LI, Tsinghua University, STEVEN KIVELSON, Stanford University, HONG YAO, Tsinghua University — Many features of charge-4e superconductors remain unknown because even the "mean-field Hamiltonian" describing them is an interacting model. Here we introduce an interacting model to describe a charge-4e superconductor (SC) deep in the superconducting phase, and explore its properties using quantum Monte Carlo (QMC) simulations. The QMC is sign-problem-free, but only when a Majorana representation is employed. As a function of the chemical potential we observe two sharply-distinct behaviors: a "strong" quarteting phase in which charge-4e quartets are tightly bound (like molecules) so that charge-2e pairing does not occur even in the temperature $T \to 0$ limit, and a "weak" quarteting phase in which a further transition to a charge-2e superconducting phase occurs at a lower critical temperature. Analogous issues arise in a putative Z4 spin-liquid with a pseudo-Fermi surface and other interacting models with composite order parameters. Under certain circumstances, we also identified a stable $T = 0$ charge-4e SC phase with gapless nodal quasiparticles. We further discuss possible relevance of our results to various experimental observations in 1/8-doped LBCO. (ref: Y.-F. Jiang, Z.-X. Li, S. A. Kivelson, H. Yao, arXiv:1607.01770)

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