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# Hybrid Monte Carlo study of competing order in the extended hexagonal Hubbard model in 2+1 dimensions

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Hybrid Monte Carlo is traditionally employed in lattice QCD calculations. In principle, however, its applicability extends to a wide range of other interacting Fermion systems. One such system which can be simulated without a fermion-sign problem is the extended Hubbard model at half-filling, which describes electrons that can hop between the sites of a crystal lattice and includes on-site ($U$) and nearest-neighbor ($V$) interaction terms. This model is of great interest in condensed matter physics, as it describes a wide range of electronic systems in good approximation. The extended Hubbard model on the hexagonal lattice in 2+1 space-time dimensions is of interest also to high-energy physicists, as its low-energy excitations provide a realization of Dirac fermions. In the case of strong coupling, various types of transitions to electronic gapped phases can occur, which possess analogies to chiral-symmetry breaking. - In this work we study the competition between spin-density wave and charge-density wave order in the $U - V$ plane through HMC. Our simulations do not include any explicit symmetry-breaking terms and are thus completely unbiased. We find an extended phase of spin-density wave order and determine that its border is characterized by critical scaling in the Gross-Neveu universality class.

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