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Competing Order in the Hexagonal Hubbard Model

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I will report on our studies of strongly correlated fermions on the hexagonal lattice with Hybrid Monte-Carlo simulations. In particular, we have determined the phase diagram in on-site U and nearest-neighbor repulsion V of the extended Hubbard model in the region $V < U/3$ where it can be simulated without a fermion sign problem. Several important algorithmic improvements, such as the analogue of a chiral fermion action with an exact sublattice symmetry or a complexified Hubbard field to avoid domain walls, were necessary for this unbiased study of the competition between spin-density wave and charge-density wave formation in the ground state. For $V > U/3$ or away from half filling the model is also well suited to diagnose and test approaches to circumvent the sign problem.

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