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Attractive fermions in a 2D optical lattice with spin-orbit coupling: Charge order, superfluidity, and topological signatures[1] PETER ROSENBERG, HAO SHI, SHIWEI ZHANG, William Mary Coll — Exotic states of matter, including high-T_c superconductors, and topological phases, have long been a focus of condensed matter physics. With the recent advent of artificial spin-orbit coupling in ultracold gases, and the remarkable experimental control and enhanced interactions provided by optical lattices, a broad range of novel strongly correlated systems are quickly becoming experimentally accessible. One system of particular interest, given its potential impact on spintronics and quantum computation, is a 2D optical lattice of fermionic atoms with attractive interaction. Here we examine the combined effects of Rashba spin-orbit coupling and interaction in this system, with a focus on the pairing, charge, and spin properties of the ground state, which are computed using the numerically exact auxiliary-field quantum Monte Carlo technique. In addition to illuminating the behavior of this exotic charge-ordered superfluid state, our results serve as high-accuracy benchmarks for the coming generation of precision experiments with ultracold gases.

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