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Studying Cold Atomic Systems with Monte Carlo Simulation and Random Phase Approximation PATRICK KELLY, California State University, Fresno — We used complementary numerical techniques to study exotic phases in a cold atomic Fermi gas, modeled with a Hubbard Hamiltonian. We focus on a system on a two-dimensional optical lattice that is at half-filling, where on average one fermion occupies each lattice site, and is spin-balanced, where equal numbers of spin-up and spin-down particles are present on the lattice. With these conditions, the system forms the elusive supersolid phase: a superfluid with a checkerboard density modulation. Using Quantum Monte Carlo (coupled with state-of-the-art analytic continuation techniques) we calculate unbiased results for the dynamical structure factor. Generalized Random Phase Approximation provides a comparison with Monte Carlo. Though it is not an unbiased method like Monte Carlo, it allows for larger calculations with finer resolution in the momentum domain. Cold atomic systems and their properties are of interest because they have been suggested as experimentally realizable models of exotic systems in nature, such as superconductors and the superfluid interiors of neutron stars.

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