

Quadratic Effective Hamiltonian for Many-Body Spin $\frac{1}{2}$ Fermionic Systems with Interactions

Abstract

By recursively performing Bogolyubov transformation for each spatial orbitals of spin $\frac{1}{2}$ fermions, we demonstrate that a quadratic effective Hamiltonian with pairing terms can be derived and diagonalized exactly. We further show that when the no-double occupancy constraint is satisfied at the conclusion of the self-consistent calculation, the exact ground state wavefunction can be recovered by reversing the process that generated the quadratic effective Hamiltonian. Numerical examples are presented and comparisons with exact diagonalization results are given.