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Fermion Coherent State Studies of One-Dimensional Hubbard Model

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Abstract: We present a comparative study of the ground state of the one-dimensional Hubbard model. We first use a new fermion coherent state method in the framework of Fermi liquid theory by introducing a hole operator and considering the interactions of two pairs electrons and holes. We construct the ground state of the Hubbard model as $|\rangle=[f+\sum{}'\varphi c_{k_1\sigma_1}^{\dagger} h_{k_2\sigma_2}^{\dagger} c_{k_3\sigma_3}^{\dagger} h_{k_4\sigma_4}^{\dagger} \prod\exp(\rho c_{k_1\sigma_1}^{\dagger} h_{k_2\sigma_2}^{\dagger})]|\rangle_0$, where φ and ρ are coupling constants. Our results are then compared to those of variational methods, density functional theory based on the exact solvable Bethe ansatz solutions, variational Monto-Carlo method (VMC) as well as to the exact result of the infinite system. We find satisfactory agreement between the fermion coherent state scheme and the VMC data, and provide a new picture to deal with the strongly correlated system.

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