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The Binding Energy, Spin-Excitation Gap, and Charged Gap in the Boson-Fermion Model

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Abstract: In this paper, by applying a simplified version of Lieb's spin-reflection-positivity method, which was recently developed by one of us [G.S. Tian and J.G. Wang, J. Phys. A: Math. Gen. 35 (2002) 941], we investigate some general properties of the boson-fermion Hamiltonian, which has been widely used as a phenomenological model to describe the real-space pairing of electrons. On a mathematically rigorous basis, we prove that for either negative or positive coupling V, which represents the spontaneous decay and recombination process between boson and fermion in the model, the pairing energy of electrons is nonzero. Furthermore, we also show that the spin-excitation gap of the boson-fermion Hamiltonian is always larger than its charged gap, as predicted by the pre-paired electron theory.

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Key words: boson-fermion model, binding energy, excitation gaps

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