

Antiferromagnetism and High T_C Superconductivity: A Close Connection between the t - J Model and the Projected BCS Hamiltonian

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A connection between quantum antiferromagnetism and high T_C superconductivity is theoretically investigated by analyzing the t - J model and its relationships to the Gutzwiller-projected BCS Hamiltonian. After numerical corroboration via exact diagonalization, it is analytically shown that the ground state of the t - J model at half filling (i.e., the 2D antiferromagnetic Heisenberg model) is entirely equivalent to the ground state of the Gutzwiller-projected BCS Hamiltonian with strong pairing. Combined with the high wave function overlap between the ground states of the t - J model and the projected BCS Hamiltonian at moderate doping, this equivalence provides strong support for the existence of superconductivity in the t - J model. The relationship between the ground state of the projected BCS Hamiltonian and Anderson's resonating valence bond state (i.e., the projected BCS ground state) is discussed.

Keywords : high T_C superconductivity, t - J model, Gutzwiller projection, RVB state