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Multi-spin exchange model for a quantum spin liquid on the honeycomb lattice YI-FEI WANG, Zhejiang Normal Univ. and California State Univ. Northridge, DONNA SHENG, California State Univ. Northridge, CHANG-DE GONG, Zhejiang Normal Univ. — Recently, a possible quantum spin liquid (QSL) state has been found through quantum Monte Carlo studies of Hubbard model on the honeycomb lattice. The obtained QSL does not show long range correlation of any known type, which has a finite spin gap and a short range dimer-dimer correlation pattern resembling the short range resonant-valence-bond (RVB) state. Given the intensive current interest in such an exotic QSL, it is natural and timely to ask a question: what is the effective spin model to capture the essential low-energy physics near this QSL region? We report here a comparative numerical study based on finite-size exact diagonalizations (ED) of the Hubbard model, and a multi-spin exchange model with two-, four- and six-spin exchange terms. The latter model is derived from the strong coupling expansion of the former one. Through extensive ED calculations of low-energy spectra and ground-state correlation functions of both models, we try to establish connections between them, especially near the QSL region. Furthermore, the phase diagram of the multi-spin exchange model is explored in details.

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