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Quantum phase transitions in generalized J-Q models ARNAB SEN, ANDERS SANDVIK, Boston University — The "J-Q" model is an extension of the Heisenberg model which contains multi-spin interactions that suppress Néel order and lead to a valence-bond-solid (VBS) ground state. It is free from quantum Monte Carlo (QMC) sign problems. There is now good evidence from QMC studies for a continuous Néel–VBS transition with non-trivial features like a large anomalous exponent η and an emergent U(1) VBS symmetry at the quantum-critical point in this model. We study various generalizations of the J-Q model, with both SU(2) and U(1) symmetric interactions, to further elucidate unusual aspects of the Néel-VBS transition. In the SU(2) case, we construct a model which stabilizes a staggered VBS instead of the columnar pattern obtained in previous studies. This type of VBS does not harbor an emergent U(1) symmetry near the transition. We find that the transition is strongly first-order, unlike in the original J-Q model. This illustrates the importance of the emergent U(1) symmetry for the possibly exotic transition in the standard J-Q model. We also investigate a new U(1)-symmetric generalization of the J-Q model to explore such unconventional transitions in the easy plane case.

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