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A continuum of compass spin models on the honeycomb lattice HAIYUAN ZOU, BO LIU, Department of Physics and Astronomy, University of Pittsburgh, ERHAI ZHAO, Department of Physics and Astronomy, George Mason University, W. VINCENT LIU, Department of Physics and Astronomy, University of Pittsburgh — Quantum spin models with spatially dependent interactions, known as compass models, play an important role in the study of frustrated quantum magnetism. One example is the Kitaev model on the honeycomb lattice with spin-liquid ground states. Another example is the geometrically frustrated quantum 120° model whose ground state has not been unambiguously established. To generalize the Kitaev model beyond the exactly solvable limit and connect it with other models, we propose a new model, dubbed "the tripod model," which contains a continuum of compass-type models. It not only unifies paradigmatic spin models, but also enables the study of their quantum phase transitions. We obtain the phase diagram of the tripod model numerically by tensor networks in the thermodynamic limit. We show that the ground state of the quantum 120° model has long-range dimer order. Moreover, we find an extended spin-disordered (spin-liquid) phase between the dimer phase and an antiferromagnetic phase. The unification and solution of a continuum of frustrated spin models as outline here may be useful to exploring new domains of other quantum spin or orbital models.

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