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Investigation of Quantum Phase Transitions of Spin-3/2 AKLT Systems On the Hexagonal Lattice via the Tensor-Network Method[1] TZU-CHIEH WEI, CHING-YU HUANG, C.N. Yang Institute for Theoretical Physics, Stony Brook University — The spin-3/2 Affleck-Kennedy-Lieb-Tasaki (AKLT) state on the hexagonal lattice is an example of valence-bond solid state (VBS), which is recently shown to provide resource for quantum computation and is also a nontrivial symmetry protected topologically ordered state if the translation invariance is imposed in addition to the rotation symmetry. Niggemann et al. previously studied a deformation of the AKLT model and derived a one-parameter family of ground states (parametrized by a) that are deformed from the AKLT point ($a = \sqrt{3}$). By mapping to a free-fermion eight-vertex model, they identified a VBS to Néel transition at $a_{c2} \approx 2.5425$. We employ the tensor-network method to directly compute the Néel order parameter and obtain results that agree with theirs. We also study the regime where the deformation parameter a decreases close to zero. We find that there is a transition at $a_{c1} \approx 0.58$ to an XY phase, which is characterized by algebraically decaying correlations, rotation invariance of spins in the x-y plane and the induced magnetization being aligned with the direction of the extend field.

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