Classification of quantum phases for the star-lattice antiferromagnet via a projective symmetry group analysis TING-PONG CHOI, YONG BAEK KIM, University of Toronto — We study possible quantum ground states of the Heisenberg antiferromagnet on the star lattice, which may be realized in the recently discovered polymeric Iron Acetate, Fe$_3$(µ$_3$-O)(µ-OAc)$_6$(H$_2$O)$_3$[Fe$_3$(µ$_3$-O)(µ-OAc)$_7$]$_2$·7H$_2$O. Even though the Fe$^{III}$ moment in this material carries spin-5/2 and the system eventually orders magnetically at low temperatures, the magnetic ordering temperature is much lower than the estimated Curie-Weiss temperature, revealing the frustrated nature of the spin interactions. Anticipating that a lower spin analog of this material may be synthesized in future, we investigate the effect of quantum fluctuations on the star-lattice antiferromagnet using a large-$N$ Sp($N$) mean field theory and a projective symmetry group analysis for possible bosonic quantum spin liquid phases. It is found that there exist only two distinct gapped $Z_2$ spin liquid phases with bosonic spinons for non-vanishing nearest-neighbor valence-bond-amplitudes. In particular, the spin liquid phase which has a lower energy in the nearest-neighbor exchange model can be stabilized for relatively higher spin magnitudes.

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