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Valence bond crystals in the kagome spin-1/2 Heisenberg antiferromagnet: Symmetry classification and projected wave function study YASIR IQBAL, Laboratoire de Physique Theorique UMR-5152, CNRS and Universite' de Toulouse, FEDERICO BECCA, CNR Officina dei Materiali and SISSA, DIDIER POILBLANC, Laboratoire de Physique Theorique UMR-5152, CNRS and Universite' de Toulouse — We present a hierarchical group theoretical classification and representation of Valence bond crystal (VBC) phases on the kagome lattice. Starting from the most symmetric parent VBC, we enumerate and give the ansatz for all 6, 12, and 36-site unit cell VBC's in order of increasing number of broken point group symmetry elements. We treat the VBC's within the class of Gutzwiller projected fermonic variational wave functions, which are optimized using a sophisticated implementation of the stochastic reconfiguration method. In particular, for the spin-1/2 quantum Heisenberg antiferromagnetic model, we show that the U(1) Dirac spin liquid is remarkably stable (locally and globally) with respect to all possible VBC patterns enumerated. However, upon addition of a small ferromagnetic next-nearest-neighbor coupling we find that the lowest energy state is a non-trivial generalized 36-site VBC, which can be regarded as being continuously connected to a uniform RVB spin liquid. We also communicate the ground state energy on the kagome 48 site cluster for the nearest-neighbor spin-1/2 quantum Heisenberg antiferromagnetic model, using the technique of application of a few Lanczos steps (within a variational Monte carlo scheme) on the U(1) Dirac spin liquid and the uniform RVB wave function.

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