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Phase Diagram of a Frustrated Quantum Antiferromagnet on the Honeycomb Lattice: Magnetic Order versus Valence-Bond Crystal Formation DAVID SCHWANDT, FABRICIO ALBUQUERQUE, Laboratoire de Physique Théorique, Université de Toulouse, UPS (IRSAMC), CNRS, F-31062 Toulouse, France, BALAZS HETÉNYI, Department of Physics, Bilkent University, Ankara, Turkey, SYLVAIN CAPPONI, MATTHIEU MAMBRINI, Laboratoire de Physique Théorique, Université de Toulouse, UPS (IRSAMC), CNRS, F-31062 Toulouse, France, ANDREAS LÄUCHLI, Institut für Theoretische Physik, Universität Innsbruck, A-6020 Innsbruck, Austria — We present a comprehensive computational study of the phase diagram of the frustrated $S = 1/2$ Heisenberg antiferromagnet on the honeycomb lattice, with second-nearest (J_2) and third-neighbor (J_3) couplings. Using a combination of exact diagonalizations of the original spin model, of the Hamiltonian projected into the nearest neighbor short range valence bond basis, and of an effective quantum dimer model, we determine the boundaries of several magnetically ordered phases in the region $J_2, J_3 \in [0, 1]$, and find a sizable magnetically disordered region in between. We characterize part of this magnetically disordered phase as a *plaquette* valence bond crystal phase.

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