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Spin liquid ground state on the honeycomb Heisenberg spin 1/2 model with nearest and next nearest neighbor interaction ZHENYUE ZHU, STEVEN WHITE, University of California, Irvine, DAVID HUSE, Princeton University — We numerically investigate the $S=1/2$ Heisenberg model on the honeycomb lattice with nearest (J_1) and next-nearest neighbor (J_2) interactions with the density matrix renormalization group (DMRG). We are able to study open cylinders with widths up to 12 lattice spacings. For J_2/J_1 near 0.3, we find a spin liquid phase, bordered by an antiferromagnetic phase for smaller J_2 and a valence bond crystal for larger J_2 . For the spin liquid phase we find finite spin singlet and triplet gaps and short spin-spin and bond-bond correlation lengths. We also find that the energy splitting between the two different topological sectors decays exponentially with the system width, consistent with a gapped Z_2 spin liquid.

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