Spin correlations on a frustrated honeycomb

Dorota Gotfryd and Andrzej M. Oleś

Marian Smoluchowski Institute of Physics, Jagellonian University, Reymonta 4, PL-30059 Kraków, Poland

We present a detailed analysis of the Heisenberg and Kitaev–Heisenberg models on a single hexagon. For frustrated Heisenberg interactions with nearest neighbor ($J_1$) and next–nearest neighbor ($J_2$) antiferromagnetic couplings various types of order have been suggested which compete with disordered states: (i) valence-bond crystal [1], or (ii) plaquette resonating valence-bond state [2]. We derive the energy spectra using an exact diagonalisation of a single hexagon as well as spin–spin correlation functions for different parameter regimes. For the Heisenberg $J_1$-$J_2$ Hamiltonian we recover the lowest part of the energy spectrum for a single hexagon presented in [2]. We also investigate the evolution of the energy spectra and spin correlations between Ising and Kitaev, Ising and Heisenberg, as well as between Heisenberg and Kitaev model for a spin liquid. Finally, we consider a single hexagon within a cluster mean-field approximation introduced in [1] and demonstrate the tendency towards symmetry breaking away from the Kitaev limit.

References: