Quantum Antiferromagnetic Heisenberg Model on the Frustrated Bilayers

V. Ya. Baliha[1]

[1]Institute for Condensed Matter Physics, Lviv, Ukraine

baliha@icmp.lviv.ua

The s = 1/2 antiferromagnetic Heisenberg model on several bilayer lattices with magnon states from the flat band with lowest energy in the presence of a strong magnetic field is considered [1-4]. The standard strong-coupling perturbation theory is applied for constructing effective Hamiltonians. On the basis of an effective model, a theory for a magnetic compound $Ba_2CoSi_2O_6Cl_2$ in an external magnetic field for the description of its low-temperature properties is developed. The results of experiments for this compound have been reproduced and new predictions have been made, which require new experimental studies to confirm them [3].

Also, the ground state of the model on the bilayers with different geometries in the absence of magnetic field is investigated. A variational approach has been applied for that. By comparing the variational energies, the ground-state phase diagrams are constructed. The obtained results are compared with the ones obtained recently by more sophisticated methods [5].

1. Krokhmalskii T., et al. Frustrated honeycomb-lattice bilayer quantum antiferromagnet in a magnetic field: Unconventional phase transitions in a two-dimensional isotropic Heisenberg model. Phys. Rev. B, 2017, 95, 094419:1-11.
2. Krokhmalskii T., et al. Frustrated honeycomb-lattice bilayer quantum antiferromagnet in a magnetic field. Physica B, 2018, 536, 388-391.
3. Richter J., et al. Thermodynamic properties of $Ba_2CoSi_2O_6Cl_2$ in a strong magnetic field: Realization of flat-band physics in a highly frustrated quantum magnet. Phys. Rev. B, 2018, 97, 024405:1-7.
4. Streka J., et al. Ising versus Potts criticality in low-temperature magnetothermodynamics of a frustrated spin-1/2 Heisenberg triangular bilayer. Phys. Rev. B, 2018, 98, 174426:1-14.
5. Baliha V., et al. Ground-state phases of frustrated bilayer quantum Heisenberg antiferromagnets. Prepr. / NAS of Ukraine. Inst. for Condens. Matter Phys., 2018, ICMP-18-05E.