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Spin-1/2 Heisenberg antiferromagnet on an anisotropic triangular lattice

OLEG STARYKH, Department of Physics, University of Utah

The Triangular lattice spin-1/2 Heisenberg AntiFerromagnet (TAF) is a prototypical model of frustrated quantum magnetism. While it is believed to exhibit long-range order in the isotropic limit, changes such as spatial anisotropy can alter the delicate balance amongst competing ground states. I will describe the static and dynamic properties of the spatially anisotropic TAF, with inter-chain diagonal exchange J' much weaker than the intrachain exchange J. Treating J' as a perturbation of decoupled Heisenberg spin-1/2 chains, I find that the ground state is spontaneously dimerized in a four-fold degenerate zig-zag pattern. This dimerization instability is driven by quantum fluctuations, which are dramatically enhanced here by the frustrated nature of inter-chain exchange. A magnetic field partially relieves frustration, by canting the spins along the field direction, and causes a quantum phase transition into a magnetically-ordered spin-density-wave phase. This is followed by cone and, finally, fully polarized (saturated) phases, as a function of increasing magnetic field. I show that many of these features are in fact observed in experiments on the celebrated material Cs_2CuCl_4 ($J'/J = 1/3$). I will also discuss the significant modification of the phase diagram by symmetry-breaking anisotropic Dzyaloshinskii-Moriya (DM) interactions, present in this interesting magnet. In addition to static and thermodynamic properties, the proposed "one-dimensional" approach offers a compelling explanation of the unusual experimentally measured dynamical structure factor of Cs_2CuCl_4 in terms of descendants of one-dimensional spinons. Quite generally, I find characteristic features of a momentum-dependent spinon bound state and a dispersing incoherent excitation in the structure factor, in agreement with experiments.