SEMINAIRE AXE 1 du LLB, jeudi 17 Décembre 11h00

ATTENTION, exceptionnellement,
le séminaire aura lieu au SPEC
Bât 466 p.111 (1er ét.) CEA-Saclay

Exotic field-induced magnetic orders and zero-field excitations in the Ising-like chain antiferromagnet $BaCo_2V_2O_8$

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$BaCo_2V_2O_8$ is a remarkable example of a quasi-1D Ising-like antiferromagnet, that can be described, in its gapless phase induced by a longitudinal magnetic field, in terms of Tomonaga-Luttinger liquid physics [1]. It consists of Co^{2+} effective spin-1/2 screw chains running along the Ising c axis. The quasi-1D and Ising-like characters of this system yields very exotic static and dynamical properties.

At zero field, a Néel antiferromagnetic ordering occurs below $T_N = 5.4$ K. At very low temperature, the application of a longitudinal magnetic field ($H \parallel c$) induces a quantum phase transition at $H_c = 3.9$ T, where the energy gap closes. In a usual Heisenberg antiferromagnet, this would cause the magnetic moments to flip perpendicularly to the field. However, as $BaCo_2V_2O_8$ is of the Ising-like type, the incommensurate (IC) longitudinal correlations are first expected to dominate the transverse ones above H_c, before an inversion occurs above H^*, yielding the establishment of a transverse staggered ordering. Concerning the zero-field magnetic excitations, they consist in a gapless continuum of transverse spinons in a Heisenberg 1D system. Nevertheless, in $BaCo_2V_2O_8$, these excitations are predicted to be gapped, because of the Ising-like character, and to be discretized, because of the spinon confinement caused by the interchain attractive linear potential.

I will first present a complete exploration of the magnetic field-temperature $H - T$ phase diagram of $BaCo_2V_2O_8$, up to $H = 12$ T and down to $T = 50$ mK, by single-crystal neutron diffraction [2,3]. Our phase diagram, together with the magnetic structures determined in the three low temperature magnetic structures (below H_c, between H_c and H^*, and above H^*) will be discussed with respect to NMR results and to the theoretical predictions.

I will then present our inelastic neutron scattering study in the Néel phase of $BaCo_2V_2O_8$ [4,5]. This study does reveal the expected unconventional discrete spin excitations, so called Zeeman ladders. But, in addition to the transverse ones, a series of longitudinal modes, interlaced to the first one, was also observed. These results will be discussed in the light of various theoretical works.

References:

[1] F. D. M. Haldane, Phys. Rev. Lett. **45**, 1358 (1980).
[2] E. Canévet *et al.*, Phys. Rev. B **87**, 054408 (2013).
[3] B. Grenier *et al.*, Phys. Rev. B **92**, 134416 (2015).
[4] B. Grenier *et al.*, Phys. Rev. Lett. **114**, 017201 (2015).
[5] B. Grenier *et al.*, Phys. Rev. Lett. **115**, 119902 (2015).