Spin dynamics of the longitudinal spin density wave phase in the quasi-1D Ising-like antiferromagnet $BaCo_2V_2O_8$

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$BaCo_2V_2O_8$ is a realization of a spin-1/2 Ising-like quasi-one dimensional (1D) antiferromagnet with remarkable static and dynamical behaviors [1]. In zero-field, the excitations of the Néel phase consist in confined two spinon excitations stabilized by weak interchain interactions. They form two interlaced long-lived Zeeman ladders with respective transverse and longitudinal character regarding the direction of the magnetic moments (along the chain caxis) [2]. We have explored the influence of an external magnetic field on this spin dynamics by inelastic neutron scattering. A contrasting behavior is observed for a transverse and longitudinal magnetic field (i.e. perpendicular and parallel to the direction of the moments respectively). The former case has revealed a very interesting physics as a topological quantum phase transition occurs between two types of solitonic topological objects [3].

The present talk is devoted to our results obtained under the application of a longitudinal field in $BaCo_2V_2O_8$. We show that the Néel phase excitations keep their transverse or longitudinal character, simply showing a Zeeman splitting up to µ0Hc ≈ 3.9 T at which the Néel ordering turns into a longitudinal spin density wave (LSDW) [2,4]. This phase has raised a strong interest as it is a unique example of the Tomonaga-Luttinger liquid (TLL) physics experimentally accessible under moderate magnetic field [2,4,5]. The TLL longitudinal fluctuations expected in the purely 1D system [6], lacking long-range order, are transformed in a LSDW stabilized in $BaCo_2V_2O_8$ through the anisotropy and the weak interchain couplings. The dispersion spectrum in this exotic phase and the magnetic field dependence of the excitations have been investigated by neutron scattering on TASP (PSI) and through numerical calculations.

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