Field-induced quasiparticles driving the quantum phase transition in a Ising-like antiferromagnetic spin chain

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The nature of the excitations in spin half antiferromagnets is a topic of considerable current interest in the field of quantum magnetism. The one-dimensional (1D) case is especially interesting as quantum fluctuations melt the classical long-range Néel order and leads to more exotic physics.

BaCo2V2O8 is a realization of a spin-1/2 Ising-like quasi-one dimensional 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 actually form two interlaced long-lived Zeeman ladders with respective transverse (T) and longitudinal (L) character regarding the direction of the magnetic moments (along the chain c-axis) [2]. We have explored the influence of an external magnetic field on this spin dynamics by inelastic neutron scattering on TASP (PSI) and on ThALES and IN12 (ILL) [3]. A contrasting behavior is observed for a longitudinal and transverse magnetic field. In the former case, the Néel phase excitations keep their transverse or longitudinal character, simply showing a Zeeman behavior up to the critical field at which the Néel ordering turns into a longitudinal spin density wave.

In this talk, I will talk about the more spectacular effect which occurs when you apply a transverse field. In this situation, a mixing of the excitations occurs, hence materializing new kinds of entangled quasiparticles with both L and T characters. The lowest energy mode transforms progressively from transverse to longitudinal, before collapsing at the critical field marking a quantum phase transition to a novel phase [3].

References

[1] S. Kimura *et al.*, PRL **99**, 087602 (2007);
[2] B. Grenier *et al.*, PRL **114**, 017201 (2015); ibid., PRL **115**, 119902 (2015);
[3] Q. Faure *et al.,* in preparation.