SPONTANEOUS MAGNON DECAYS AT FINITE MAGNETIC FIELDS IN A SPIN-1/2 COUPLED TWO-LEG LADDER ANTIFERROMAGNET $C_9H_{18}N_2CuBr_4$

Tao Hong[1], Y. Qiu[2], K. Coester[3], K. P. Schmidt[3], F. F. Awwadi[4], M. M. Turnbull[5], and D. A. Tennant[1]

[1]*Quantum Condensed Matter Division, Oak Ridge National Laboratory, Oak Ridge, TN, USA*
[2]*National Institute of Standards and Technology, Gaithersburg, MD, USA*
[3]*Lehrstuhl fur Theoretische Physik I, TU Dortmand, Dortmand, Germany*
[4]*Department of Chemistry, The University of Jordan, Amman, Jordan*
[5]*Carlson School of Chemistry, Clark University, Worcester, MA, USA*

"Magnon" is notation of an elementary quasiparticle of a collective magnetic excitation. Magnons are often weakly interacting with each other thus have long-lived excitations. However, this picture breaks down in the unconventional quantum magnet where the three-magnon interactions are present and lifetime of magnons becomes finite [1].

Here we present the neutron scattering study of the static and dynamic magnetic properties of an S=1/2 coupled two-leg ladder antiferromagnet $C_9H_{18}N_2CuBr_4$. At zero field, a long-range magnetic order coexists with a spin gap and the magnetic structure is collinear [2]. When a magnetic field was applied perpendicularly to the ordered moment direction, spins become gradually canted towards the field direction and it is expected from a semi-classical picture.

The spin dynamics, by contrast, undergoes dramatic changes with magnetic field. The bandwidths of one-magnon excitation collapse at H=4 and 6 T. At H=10 T, the one-magnon excitation spectra seems already smeared out. The observed magnon instability is expected from the theoretical prediction where the spontaneous magnon decay occurs between a threshold field H^* and the saturation H_s [3]. This effect originates from the magnetic field-induced hybridization of single-magnon state with two-magnon continuum.

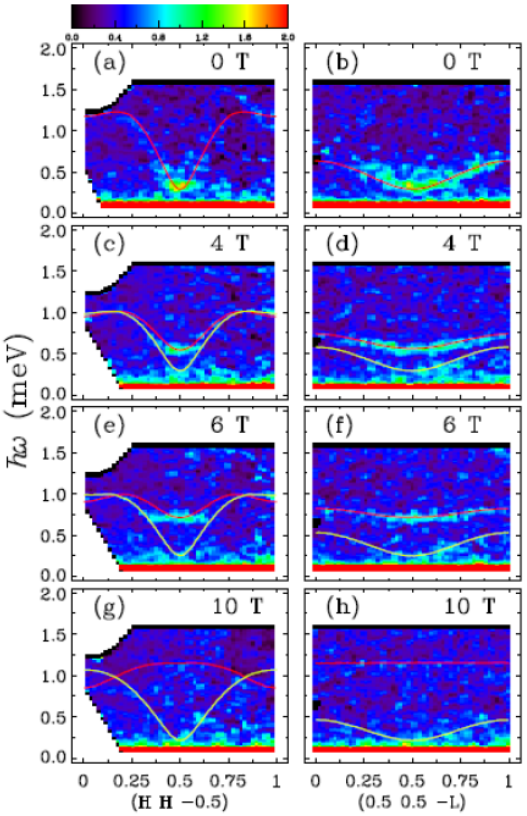

Figure 1. Neutron excitation spectra along two high-symmetry directions measured at 100 mK. The solid lines are calculations by the spin-wave theory.

[1] M. E. Zhitomirsky and A. L. Chernyshev, Rev. Mod. Phys. **85**, 219 (2013).
[2] T. Hong, *et al*., Phys. Rev. B **89**, 174432 (2014).
[3] M. E. Zhitomirsky and A. L. Chernyshev, Phys. Rev. Lett. **82**, 4536 (1999).

Category: LD and QC
Email: hongt@ornl.gov