High field study of the low dimensional quantum spin system

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The quantum spin systems in magnetic fields are the most promising objects to explore the quantum phase transitions (QPTs). Field-induced magnetic order in the spin gap systems, which was demonstrated as a realization of the Bose-Einstein condensation of magnon quasiparticles, is an example of intense study for the QPT. In contrast to this field-induced order, another curious phenomenon, in which the long range order is destroyed in presence of applied magnetic fields, was found in the quasi one-dimensional (1D) antiferromagnet $BaCo_2V_2O_8$ [1]. In this study, from the high field magnetization and ESR measurements up to 55 T, we show that the QPT from the Neel ordered phase to the spin liquid one in a 1D $S = 1/2$ anitiferromegnetic XXZ model with Ising-like anisotropy in longitudinal fields is responsible for this field-induced order to disorder transition in $BaCo_2V_2O_8$ [2]. Furthermore, from the specific heat and neutron scattering measurements by using a dilution refrigerator, we have found a new ordered phase in field-induced region at very low temperature [3, 4]. We revealed an appearance of a novel type of an incommensurate order, which reflects peculiar quantum critical nature inherent in 1D quantum spin system.

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[2] S. Kimura *et al*., Phys. Rev. Lett. **99** (2007) 87602.
[3] S. Kimura *et al*., Phys. Rev. Lett. **100** (2008) 057202.
[4] S. Kimura *et al*., Phys. Rev. Lett. **101** (2008) 207201.