DAY 1 (23 June): 14:10 – 14:50

Multi-polar orders in spin-1/2 frustrated magnets

Tsutomu Momoi (RIKEN)

We present a new scenario for the breakdown of ferromagnetic order in spin-1/2 frustrated magnets, which gives rise to "spin liquid" phases with hidden magnetic multi-polar orders. Dynamical effects lead to the formation of magnon bound states, which undergo Bose-Einstein condensation. This scenario is explored in some detail for Heisenberg models on the 2D square and triangular lattices, and also on the 1D chain.

On the square lattice, two-magnon bound states are most stable, giving rise to bond-centered spin nematic - i.e. quadrupolar - order but no long-range spin order in the ferromagnetic J_1–J_2 model. We present numerical evidence confirming the existence of a state with d-wave nematic correlations but no long-range spin order, lying between the saturated ferromagnetic and collinear antiferromagnetic phases [1]. In a model with ring exchange interactions on the triangular lattice, which is applicable to thin films of solid ^{3}He, three-magnon bound states are most stably formed. Condensation of these three magnon bound states leads to a gapless spin liquid with hidden octupolar order in applied magnetic field [2].

In the 1D Heisenberg chain with competing ferromagnetic nearest-neighbor and antiferromagnetic next-nearest neighbor interactions, the number of magnons forming the bound states increases consecutively with approaching the ferromagnetic phase boundary, which leads to a cascade of phase transitions. Bose condensation of the bound n magnons below the saturation field leads to novel Tomonaga-Luttinger liquids with multi-polar correlations [3].

[1] N. Shannon, T. Momoi, and P. Sindzingre, Phys. Rev. Lett. **96**, 027213 (2006).

[2] T. Momoi, P. Sindzingre, and N. Shannon, Phys. Rev. Lett. **97**, 257204 (2006).

[3] L. Kecke, T. Momoi, and A. Furusaki, Phys. Rev. B **76**, 060407(R) (2007); T. Hikihara, L. Kecke, T. Momoi, and A. Furusaki, preprint.