Magnetic field controlled frustration in a system of coupled spin chains

Martin Klanjšek[1], Mladen Horvatić[2], Claude Berthier[2]

[1]*Jožef Stefan Institute, Ljubljana, Slovenia*
[2]*LNCMI, CNRS, Grenoble, France*

In a certain range of applied magnetic fields, the ground state of an antiferromagnetic spin-$1/2$ chain is critical. Known as a Luttinger liquid, this state exhibits gapless excitations at a few points in the reciprocal space, where the dynamical spin susceptibility diverges on lowering temperature. Consequently, when weakly coupled, the spin chains magnetically order at low enough temperature. In simple coupling geometries, the chain mean-field theory (CMFT) proved to successfully capture the nature of such magnetic ordering, in particular, the transition temperature and the zero-temperature order parameter [1]. Geometric frustration of interchain couplings brings novelty and increases the number of possible ordered states, already when treated within CMFT. Using nuclear magnetic resonance, we demonstrate that $BaCo_2V_2O_8$ [2] provides an excellent experimental example of a system of weakly coupled spin chains with interplay of quantum criticality and geometric frustration. A unique combination of both allows to tune the effective strenght of interchain couplings by an applied magnetic field over a wide range. Consequently, the system can be brought over a novel zero-temperature phase transition separating two ground states with different phase arrangement of ordered spin density waves in the chains.

[1] M. Klanjšek *et al.*, Phys. Rev. Lett. **101**, 137207 (2008).

[2] P. Lejay, E. Canevet, S. K. Srivastava, B. Grenier, M. Klanjšek, and C. Berthier, J. Cryst. Growth **317**, 128 (2011).