Origin of ferroelectricity and exotic magnetism in frustrated LiCuVO$_4$

MARTIN MOURIGAL, Johns Hopkins

The spin-1/2 Heisenberg chain with competing ferromagnetic nearest-neighbor ($J_1$) and antiferromagnetic next-nearest neighbor ($J_2$) interactions is probably one the simplest, yet richest model in frustrated magnetism. It is experimentally realized in a diversity of Mott insulators, in particular in copper-oxide materials built-up from edge-sharing CuO$_6$ octahedra. The quasi-1D compound LiCuVO$_4$ stands out for the diverse emergent magnetic and multiferroic phenomena it displays, its simple crystal structure and its availability as high-quality single crystals. I will review recent elastic neutron scattering works [1,2] on LiCuVO$_4$ which elucidate the nature of its ground-state as a function of applied electric field and magnetic field up to 14 T. Below 3.5 T [1], a model long-range ordered ferroelectric spin-cycloid is unveiled, its chirality fully controlled by an applied electric field, and the corresponding magnetoelectric coupling in excellent agreement with the predictions of a purely electronic mechanism based on spin currents. Above 8 T [2], a transition to a new quantum state is observed. This new phase resembles the longitudinal density-wave of magnon-pairs ($p=2$ SDW) predicted in the purely 1D case but is characterized by the intriguing absence of long-ranged dipolar correlations.


$^1$Work performed at the Institut Laue-Langevin in Grenoble and in collaboration with M. Enderle, B. Fäk, R. K. Kremer and J. Law.