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Origin of ferroelectricity and exotic magnetism in frustrated $LiCuVO_4$[1]

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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] M. Mourigal *et al.*, PRB **83**, 100409R (2011).
[2] M. Mourigal *et al.*, PRL **109**, 027203 (2012)

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