NMR investigation of classical kagome magnets

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Kagome magnets are the archetype of frustration in two dimensions [1]. While significant efforts have been devoted to the study of the S=1/2 *quantum* kagome antiferromagnet, the ground state and the unconventional spin dynamics of *classical* kagome magnets are far from being completely understood, and the scarcity of relevant compounds prevents progress on the experimental side.

Here, we investigate the low temperature magnetic properties of the layered monodiphosphates family $Li_9\boldsymbol{M}_3(P_2O_7)_3(PO_4)_2$ with M=Fe^{3+} (S=5/2) and Cr^{3+} (S=3/2) [2]. The isostructural materials crystallize in the hexagonal space group P-3c1 with magnetic ions forming a lattice of regular corner sharing triangles in the crystallographic *ab*-plane (Fig. 1a & b). Thermodynamic measurements reveal an energy scale of ~10K for the exchange interactions, with frustration effect resulting in a lower temperature onset of a ferromagnetic order for $Li_9Cr_3P_8O_{29}$ at 2.3K and of an antiferromagnetic order at 1.2K for $Li_9Fe_3P_8O_{29}$ (Fig. 1c). We further carry out ^{31}P NMR local probe measurements on $Li_9Fe_3P_8O_{29}$ to get more insight into the static susceptibility and the spin dynamics. The NMR spin susceptibility reveals the development of anisotropic short-range correlations. The $1/T_1$ spin-lattice relaxation rate shows a critical divergence at 1.2K and evidence strong fluctuations in the correlated paramagnetic regime, presumably linked to the existence of predicted local zero energy modes.

[1] P. Mendels and F. Bert, Comptes Rendus Physique **17**, 455-470(2016).
[2] S. Poisson *et al*. J. Solid State Chem. **138**, 32 (1998).

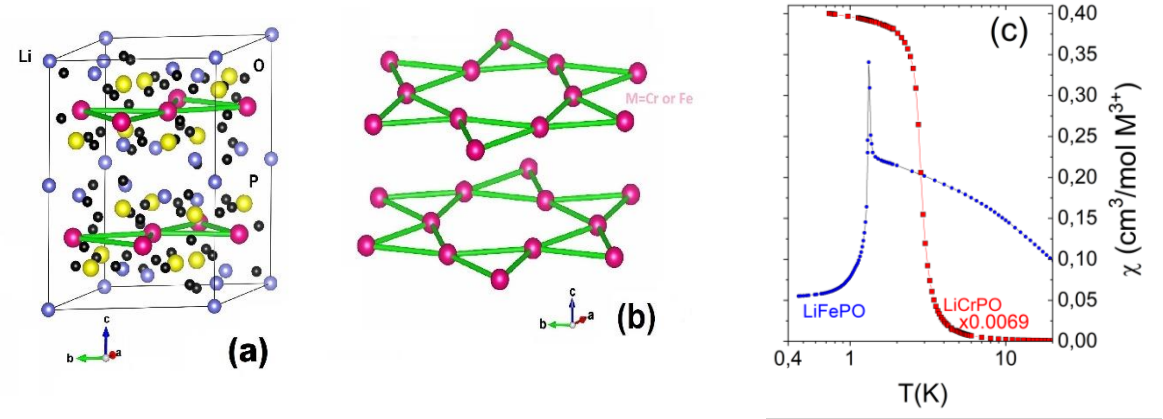

Figure 1 : (a) A depiction of a unit cell of $Li_9M_3P_8O_{29}$ (M=Cr, Fe). (b) M^{3+} ions form a network of corner sharing triangles in the crystallographic *ab*-plane. (c) Magnetic susceptibilities (dc) measured for the polycrystalline samples of $Li_9Fe_3P_8O_{29}$ (blue circles) and for $Li_9Cr_3P_8O_{29}$ (Red squares) with an applied field of H=100 Oe.