

Neutron scattering experiments in a new multiferroic molecular magnet

Javier Campo¹, José Alberto Rodríguez-Velamazán², Oscar Fabelo², Ángel Millán¹, Laurent Chapon²

¹Materials Science Institute of Aragón, CSIC – University of Zaragoza, Zaragoza, Spain

²Institute Laue Langevin (ILL), Grenoble, France,
javier.campo@csic.es

The family of antiferromagnetic $A_2[\text{FeCl}_5(\text{H}_2\text{O})]$ compounds (A = alkali metal or ammonium ion) has awakened a renewed interest owing to the recent observation of multiferroicity in some of its members.[1], [2] We have recently investigated by means of single crystal and powder neutron diffraction the magnetic structure of $(\text{ND}_4)_2[\text{FeCl}_5(\text{D}_2\text{O})]$ (with properties completely equivalent to the hydrogenated form) in order to understand the underlying mechanism of multiferroicity in this compound. This material orders antiferromagnetically at $T_N = 7.25$ K and multiferroicity arises below ca. 6.9 K with the onset of ferroelectric order. We have observed at zero magnetic field a cycloidal magnetic structure propagating in the c-axis with $k = (0, 0, 0.23)$ and with the magnetic moments lying in the ac plane (Fig.1). This cycloid would be at the origin of the magneto-electric coupling via inverse Dzyaloshinsky–Moriya interaction [3]. Also the evolution of the magnetic structure with increasing the magnetic field has been determined by the use of neutron diffraction under applied magnetic field. It shows three different regions including a lock-in of the propagation vector for fields between 2.5 and 5 T.

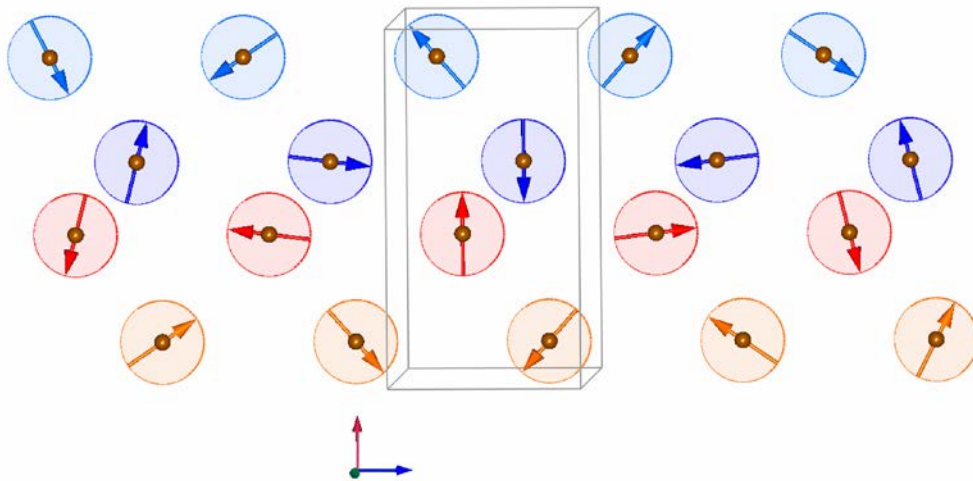


Figure 1: View along the ac plane of magnetic structures of $(\text{ND}_4)_2[\text{FeCl}_5(\text{D}_2\text{O})]$. For the sake of clarity only Fe atoms have been represented.

References

- [1] Ackermann M, Brüning D, Lorenz T, Becker P and Bohatý L 2013 *New J. Phys.* **15** 123001
- [2] Ackermann M, Lorenz T, Becker P and Bohatý L 2014 ArXiv :1408.3997v1
- [3] Rodríguez-Velamazán J.A., Fabelo O, Campo J, Millán A, Chapon L, Johnson R, *Scientific Reports* | 5:14475 | DOI: 10.1038/srep14475