



	Experiment title: Magnetochiral effects in molecular magnetic chains with non collinear spin-structure	Experiment number: HC-972
Beamline: ID12	Date of experiment: from: 25/02/2014 to: 4/03/2014	Date of report: 1st September 2014
Shifts: 18	Local contact(s): A. Rogalev	<i>Received at ESRF:</i>
Names and affiliations of applicants (* indicates experimentalists): Roberta Sessoli, Marie-Emmanuelle Boulon* Laboratory University of Florence Laboratory of Molecular Magnetism Department of Chemistry & INSTM RU Via della Lastruccia 3 Sesto Fiorentino I - 50019 FIRENZE - Italy Kevin Bernot* , Lab.ISCR-CSM, UMR CNRS 6226, INSA de Rennes, 20 avenue des buttes de Coësmes, CS 70839, 35708 RENNES Cedex 7 France		

Report:

Single-molecule magnets (SMMs) exhibit a magnetic bistability due to the presence of an anisotropy barrier that, at low temperature, opposes the reversal of the molecular giant spin leading to a memory effect^[1]. Equally interesting are one-dimensional molecular materials exhibiting slow relaxation of the magnetization due to the anisotropic exchange interaction along the chain.^[2]

This experiment was continuation of a previous one (HE-3911) on the detection of the magnetochiral effect with hard X-ray on molecular magnetic helices. The observation of a strong magnetochiral effect in the Cobalt(II) derivative with a much weaker effect in the Manganese(II) is the first comparative investigation in this field, and is to be published very soon.^[3] This time, we investigated chiral magnetic chains with biaxial symmetry exhibiting spin-canted arrangement of the magnetic moments. The two compounds we wanted to investigate comprise either lanthanide(III) anisotropic ions or Jahn-Teller distorted manganese(III).

- *Magnetic dichroism of the $[Dy(hfac)_3NIT](C_6H_4OPh)$ single Chain Magnet*

The first investigated compound is the single chain magnet $[Dy(hfac)_3NIT](C_6H_4OPh)$ where *hfac* stands for hexafluoroacetylacetonate, NIT for 2-*R*-4,4,5,5-tetramethyl-4,5-dihydro-1Himidazolyl-1-oxil-3-oxide, and Ph for phenyl.^[4] This compound crystallizes in the space group $P2_12_12_1$ so that the building of the chain creates a chiral pattern. The crucial point is that one crystal contains only one of the two enantiomeric constructions, which allows us to go for magneto-chiral dichroism investigation, as demonstrated by our previous beam time on Co and Mn based chiral single chains magnets.

At low temperature ($\sim 2.15K$) the natural circular dichroism (XNCD), circular magnetic dichroism (XMCD) and magneto-chiral dichroism (XM χ D) were investigated at L1, L2 and L3 edges of the Dysprosium. We managed to observe a XNCD of 2% at L1 edge in the perpendicular orientation (**k** propagation vector perpendicular to the crystallographic **b** axis). Interestingly, in the parallel configuration, (i. e. when **k** and **b** are almost collinear) the XMCD signal at L3 decrease of about 3%.

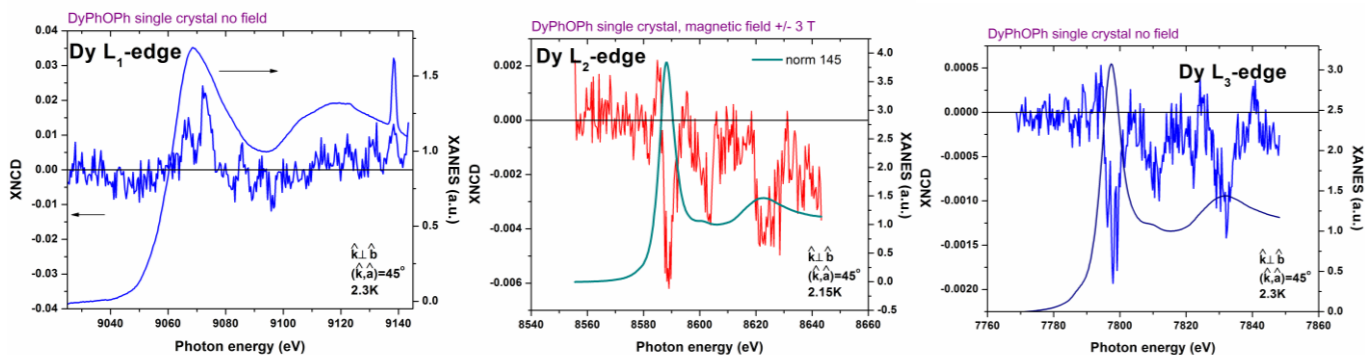


Figure 1: Natural dichroism at L1 (left) L2 (centre) and L3 edges (right) in the perpendicular configuration.

- The single chain magnet *Mn cyclamSO₄*

The second system we investigated is the *MnCyclamSO₄* (Cyclam = 1,4,8,11-Tetraazacyclotetradecane), contains Jahn-Teller distorted Mn(III) coordinated by the Cyclam macrocycle ligand and bridged by a simple sulphate anion.^[5] It is constituted by chains and crystallizes in the chiral $P2_12_12_1$ space group (see figure 2- left) and thus the crystal orientation was optimized in order to maximize natural circular dichroism signal before inserting the sample in the cryo-magnet (see figure 2 - centre). The measurement was carried out at a temperature $T = 2.1\text{K}$ with the \mathbf{k} vector perpendicular to the \mathbf{b} crystallographic axis at the energy of the manganese K-edge. The magnetic field has been swept between -3 and $+3$ Tesla.

The power have been set as low as possible in order to avoid radiation damage but conserving some signal. Unfortunately the data cannot be exploited because the crystals were damaged during the irradiation (see the picture on Figure 2 right), indeed, we cannot rely on *i*) chain orientation, *ii*) chain length, *iii*) chemical nature of the complex anymore.

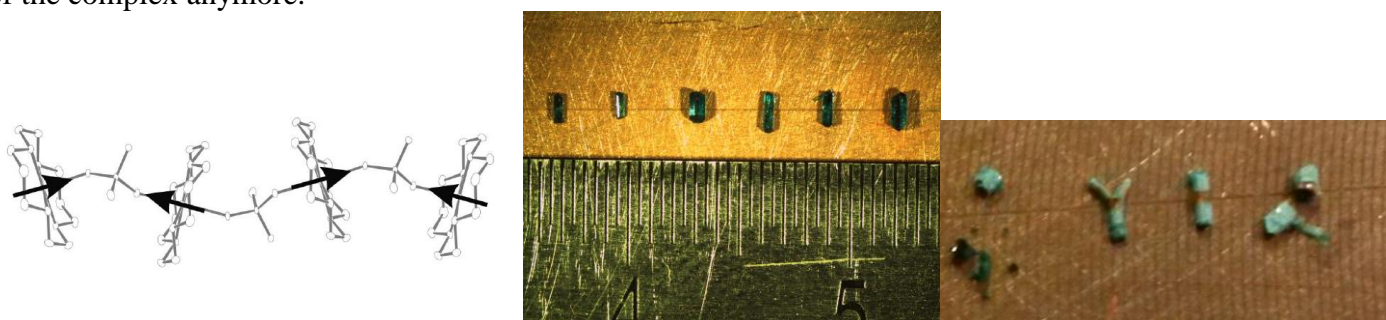


Figure 2 : left : representation of the chain structure. Center : picture of the crystal before the experiment. Picture of the crystals after the experiment.

Références

- [1] D. Gatteschi, R. Sessoli, J. Villain, *Molecular Nanomagnets*, Oxford University Press, Oxford, UK, **2006**.
- [2] A. Caneschi, D. Gatteschi, N. Lalioti, C. Sangregorio, R. Sessoli, G. Venturi, A. Vindigni, A. Rettori, M. G. Pini, M. A. Novak, *Angew. Chem. Int. Ed.* **2001**, *40*, 1760-1763.
- [4] R. Sessoli et al. Nature Phys. submitted for publication., G. Venturi, A. Vindigni, A. Rettori, M. G. Pini, M. A. Novak, *Angew. Chem. Int. Ed.* **2001**, *40*, 1760-1763.
- [2] K. Bernot, J. Luzon, a. Caneschi, D. Gatteschi, R. Sessoli, L. Bogani, a. Vindigni, a. Rettori, M. G. Pini, *Phys. Rev. B* **2009**, *79*, 134419.
- [3] S. Mossin, H. Weihe, H. O. Sorensen, N. Lima, R. Sessoli, *Dalton. Trans.* **2004**, 973.