Chiral Lanthanide-based Single-Molecule-Magnet

PhD founding in chemistry proposed to the University of Rennes 1 with an ERC contract

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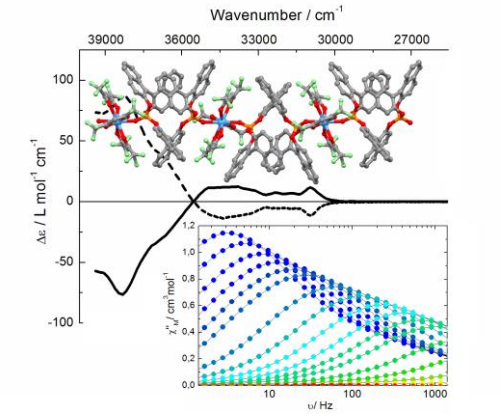
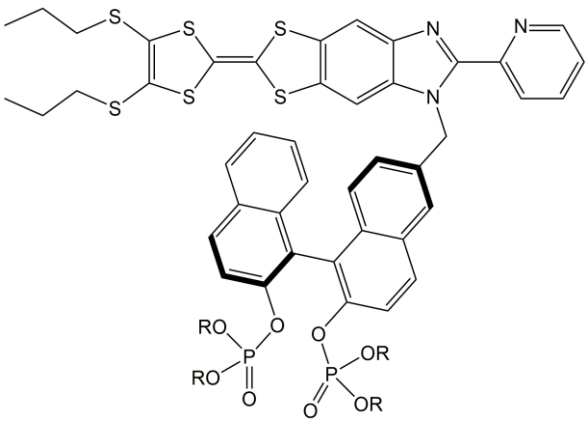
Description of the project: Nowadays there is an ever-increasing need to find more efficient ways to store digital information. Single-Molecule Magnets (SMMs) represent a promising alternative for high-density data storage since the information storage is at the molecular level. SMMs are metal complexes that individually exhibit the classical properties of a magnet below a critical temperature. Lanthanide complexes have attracted much attention during the last decade because they can be successively employed to produce Single Ion Magnets (SIMs) or SMMs. In SIM, the magnetic anisotropy of a single lanthanide ion is responsible of the hysteresis loop of the magnetic moment of one complex while SMM may involve several metallic centres. In addition, lanthanides possess specific luminescent properties with an emission ranging from the visible to the near infrared spectral range. Circularly polarized luminescence (CPL) measures the dissymmetry factor g_{em}, in other words the differential emission intensity of right-*vs* left-circularly polarized light, thereby providing information on the excited state properties of the chiral molecular systems. In general experimentally observed circular polarization of chiral organic chromophores is small (g_{em} <0.01), while chiral lanthanide complexes show much higher g_{em} values. In molecular magnetism the possibility to couple the magnetic properties with other characteristics is much more appealing, leading thus to molecular magnet showing an additional property and both may shed light on the origin of the other one.





The aim of this proposal is to investigate the synergy between **Single Molecule Magnets** (SMMs) and **Circularly Polarized Luminescence** (CPL). To do so chirality will be added to lanthanide-based luminescent SMMs to see if the magnetic-dipole f-f transition, responsible for the enhanced CPL response, interacts at low temperature with the internal magnetic field of the SMM, merging to new properties. The ligands of choice will be synthesized by functionalizing tetrathiafulvalene (TTF) derivatives with the chiral backbone of binaphtol (BINOL). The coordination reaction with 4f (and 3d) metal ions will be performed as well as the crystallization of the chiral coordination complexes.

Candidate profile:

A motivated student with a very good knowledge in **organic synthesis** is required. **Coordination chemistry** skills together with interest for a multidisciplinary project (chemistry, crystallography, magnetism and catalysis…) will be appreciated. The University offers French courses for foreigners and hosts an international Erasmus Mundus program. Students should obtain their PhD degree within the 3 years of the financial support (**starting date October-December 2017**). Rennes is a medium size French city less one hour and half away from Paris, offering a relaxing life style with many cultural and sport activities.

Selected recent publications of the group in the topics of BINOL and chiral Single Molecule Magnet:

1) C. Lalli *et al. Chem. Commun.* **2014**, *50*, 7495.
2) A. Dumoulin *et al. Chem. Commun.* **2015**, *51*, 5383.
3) J.-K. Ou-Yang *et al. Chem. Commun.* **2016**, *52*, 14474.
4) G. Fernandez-Garcia *et al. Magnetochemistry* **2017**, *3*, 2.
5) S. Speed *et al. Eur. J. Inorg. Chem.* **2017**, 2100.