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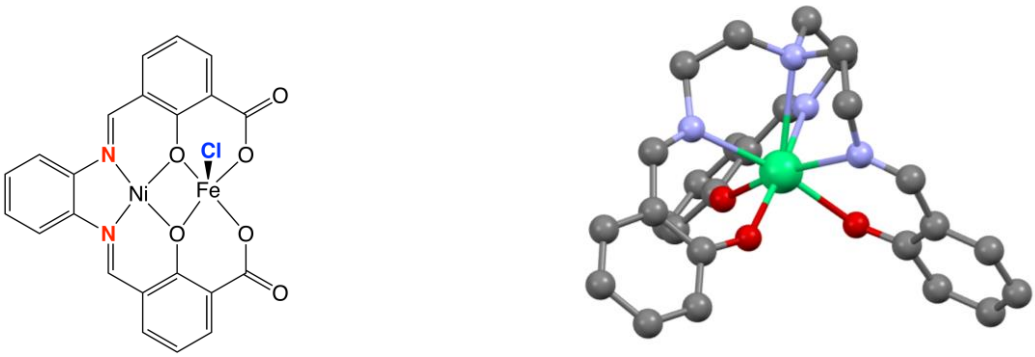
Dates of the internship: April-July 2024 (min 4 months)

Lanthanide and transition-metal containing complexes for quantum information

Key words: coordination chemistry, lanthanide, molecular magnetism, quantum bits (qubits), EPR

The internship aims at the preparation and the investigation of the magnetic properties of molecules that may play the role of quantum bits (qubits) for application in quantum information processing. For the electronic spin of the magnetic molecules to play the role of a quantum bit there are requirements on its electronic structure determined from the chemical nature of the surrounding atoms, the symmetry and the geometry of the metal ion coordination sphere, the value of the spin etc.
In this internship we will focus on two families of molecules, one containing Fe(III) (s = 5/2) and one containing Er(III) (J = 15/2) that are expected to have the main requirements to play the role of efficient qubits.
The internship consists in preparing the organic ligands (already described), then the complexes. The characterization of the complexes will be performed using different spectroscopic techniques, particularly Electron Paramagnetic Resonance (EPR) and magnetization measurements that will be carried out in the laboratory.
The next step consists in performing pulsed EPR studies in order to determine the coherence time of the qubit and assess whether the molecules can be considered as efficient qubits or not, which is required if genuine applications are targeted.
The subject requires strong knowledge in **inorganic chemistry** (synthesis, characterization of compounds), basic knowledge in magnetic materials would be a plus.
Techniques used: NMR, IR, UV-visible, SQUID magnetometry, EPR spectroscopy, data simulations



Targeted molecules containing either Fe(III) (left) or Er(III) (right) ions that should act as qubits