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Magnetoelectric coupling at spin crossovers

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ABSTRACT

The term "magnetism" most commonly invokes ideas of ferromagnetism, or perhaps antiferromagnetism. However the zoo of magnetic functionalities is vast and ever increasing. In particular, materials constructed with organic ligands and magnetic ions offer different magnetic functionalities than harder materials due to their large and complex unit cells, and soft flexible lattices.
Spin crossovers are an unusual type of magnetic functionality in which the size of an atomic spin changes due to electronic orbital transitions, in response to an external stimuli such as temperature, magnetic field, pressure. At ambient pressures, spin crossovers involve are most commonly found in molecular materials at or below room temperature since they require the lattice to accommodate a large change in ionic radius. This large lattice effect is however also useful for coupling the magnetism to lattice properties. I will overview our efforts to create magnetoelectric coupling in spin crossovers. This effort is motivated by the desire to control spin states of molecules with electric voltages, or to control electric polarization states with spin crossovers. Eventual applications range from spin-based quantum information to magnetoelectric devices. I will also overview the high magnetic fields available at the National High Magnetic Field user facility, which are useful for triggering spin crossovers, and the field of Quantum Materials, that has adopted molecular magnets as a potential source of quantum functionalities, and in which I've taken on science management roles.