Minicolloque n° 18 ☒ **Oral** ☐ **Poster**

Magneto-electric properties of spin ices

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The pyrochlore lattice featuring corner sharing tetrahedra has been a playground for magnetic frustration effects. An example of exotic phases that may emerge is the so called spin ices – as referred to water ice with its O-H bonds – where, on each tetrahedron, two spins point inward and the other two point outward. This is a highly degenerate state (there exists many ways to organized the spins on all the tetrahedra) and can be viewed as a liquid of magnetic spins with peculiar short range correlations. Out of this equilibrium state, an excitation may be produced when one spin in one tetrahedron is reversed, creating a "magnetic monopole". Quite recently, it has been suggested that this magnetic monopole may carry an electric dipole [1] opening the route towards new magneto-electric effects and multiferroicity in spin ices and related phases. Up to now, very few experimental evidences exist [2]. Here, we present extensive results obtained on two different compounds : the classical spin ice $Ho_2Ti_2O_7$ and the quantum spin ice $Tb_2Ti_2O_7$. We show that, at temperatures as high as 100K, pyro electric currents are measured, associated with flowing electric charges arising from thermally activated defects. These effects are not sensitive to magnetic field. On the contrary, weaker magnet electric effects are observed below typically 20 K, that are noticeably different in the Ho and Tb compounds. These results will be discussed in the framework of magnetic monopoles and their possible electric moment.

[1] D.I. Khomskii, Nature Communication 3, 904 (2012)
[2] D. Liu *et al.*, Journal of Applied Physics 113, 17D901 (2013)

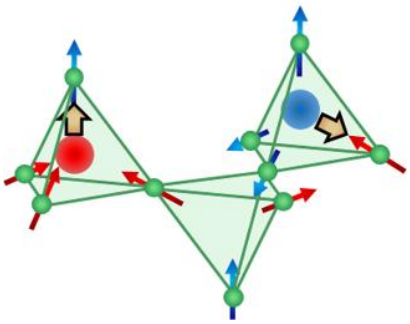

Figure 1 : Electric dipoles on magnetic monopoles in spin ice, predicted in Reference [1].