From Spin Ice to Kagome Ice in $Dy_2Ti_2O_7$

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Water is special in that it exists at usual temperatures and pressures in the three basic states. Maybe due to this, together with its ubiquity and importance, the first notions of the concept of phases and changes of state are usually given using water as an example. Very recently, the analogy between the phases of water and the many other forms of order existing in nature has been focused on the lower temperature range of the phase diagram, in what has now been called *Spin Ice*.

Spin Ices are crystalline solids ($Dy_2Ti_2O_7$ and $Ho_2Ti_2O_7$) whose magnetic degrees of freedom below ~ 1 K can be mapped into those describing the proton (dis)order in normal ice. The frustration present leads to a degeneracy of the fundamental state similar to that predicted by Pauling in 1935 to account for the residual entropy in water ice. Aside from being a realisation of a “magnetic ice”, the magnetic properties of Spin Ice compounds, conferred by their special structure and composition, makes these systems a unique arena to study the possible consequences of competing interactions.

One important difference with water is that in the magnetic case it is relatively easy to perturb and measure the relevant properties. A magnetic field of the order of 1 T is enough to completely raise the degeneracy of the fundamental state. A smaller field along the (111) crystalline direction can order one fourth of the spins in the lattice. The disorder of the remaining magnetic moments, arranged in a set of parallel Kagome planes perpendicular to the field, still holds a macroscopic entropy at T = 0 K. This constitutes the so called *Kagome Ice*.

In this talk we will firstly discuss more deeply some general equilibrium aspects of these systems. We will then see very recent experiments showing peculiarities on the actual magnetisation process below 600 mK, when the system is driven by an external magnetic field from the Spin Ice state into the Kagome Ice.