a trade-off between structures that show the best packing (thermodynamic) and those that show the best interactions (kinetic). Systems in which both kinds of crystals can be isolated are typically polymorphic. A related concept is the reaction co-ordinate for crystallization that may contain metastable kinetic forms with possibly high values of Z', the number of molecules in the crystal asymmetric unit. In general, the collection of structures that are achievable by a given molecule define its structural landscape: polymorphs, pseudopolymorphs, co-crystals and even crystal structures formed by closely related chemical derivatives. Examination of the landscape provides an idea of possible crystallization pathways. The mechanism of crystallization is the ultimate goal of crystal engineering and this talk will review our current attempts at trying to understanding this complex issue.

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Frustration and spin lattice coupling in pyrochlores magnets and multiferroics

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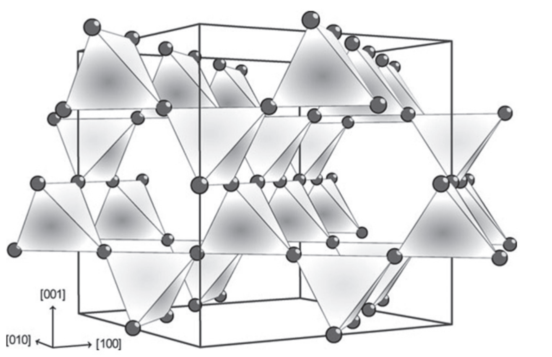
In some peculiar lattices, the frustration of the magnetic interactions induced by the geometry induces a large landscape of degenerated magnetic ground states. This effect is at play in spin ices and spin liquids, which show exotic short range magnetic orders [1,2]. Frustration is also a powerful source of unconventional long range magnetic orders, which can induce ferroelectricity [3]. In both cases, it appears as a subtle tool, allowing the selection of a given magnetic state by tuning the energy balance of interactions. Coupling such frustrated magnetism with the lattice offers an additional degree of freedom, opening the possibility of pressure induced magnetic states, hybrid excitations, or coupled (elastic-electric-magnetic) order parameters. Cubic pyrochlores magnets $R_2Ti_2O_7$ and hexagonal $RMnO_3$ multiferroïcs, where R^{3+} are rare earth ions, and the frustrated units are either tetrahedra or triangles, offer good examples of such effects.

Some examples will be reviewed in both cases, enlightening the power of neutron diffraction. Symmetry analysis, applied to neutron patterns measured under extreme thermodynamic conditions, is used to obtain a microscopic understanding of the tunable magnetic orders.

In pyrochlores, spin ice and spin liquid magnetic orders can be tuned by pressure [4], temperature and magnetic field [5]. The case of Terbium is especially interesting due to its specific crystal field. $Tb_2Ti_2O_7$ is known as spin liquid or quantum spin ice, whose origin has remained mysterious for many years. A lattice distortion, breaking the trigonal symmetry at the Tb site, may play a key role in stabilizing the spin liquid ground state. In hexagonal multiferroïcs, the magnetoelastic coupling releases the magnetic frustration. The key parameter is here the position of the Mn ions with respect to a critical threshold, which governs the symmetry of the magnetic interactions [6].



The pyrochlore lattice

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