Contribution ID: **9** Type: **not specified**

Inelastic neutron scattering from molecular nanomagnets

Molecular nanomagnets (MNM) are organometallic compounds with a magnetic core surrounded by an organic ligand sheath. The effect is to magnetically isolate the molecules into individual zero dimensional magnetic units. Isolated from the others, they can retains their magnetisation up to significant temperature[1]. In this case they are also termed as single molecule magnets (SMM).
Applications are ranging from ultra-dense magnetic storage up to the construction of elementary bricks for quantum information processing as scalable molecular electron spin devices.
Contrarily to bulk magnetism showing a quasi-continuum of collective and dispersive excitations, the MNM have local properties, each molecule possessing a finite number of energy levels that can be calculated from effective Hamiltonian diagonalisation provided the system is small enough.
Inelastic neutron scattering is probing the spin-spin correlations at the microscopic level. Experiments in a range of energies and energy resolutions allow the determination of the parameters in the effective Hamiltonians opening the route to the knowledge of the physical properties exhibited by these materials.
We shall overview here several results obtained from inelastic neutron scattering on various MNM, most on powder samples but also, with a recent refinement of the technique, from single crystals experiments[2,3].

[1] e.g., Gatteschi D., Sessoli R., Villain J. Molecular nanomagnets, Oxford University Press (2006).
[2] M. L. Baker et al., Nature Physics volume 8, pages 906–911 (2012).
[3] E. Garlatti et al., Nat. Commun. 8, 14543 doi: 10.1038/ncomms14543 (2017).

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