Neutron scattering experiments with high magnetic fields in organic magnets

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Purely organic magnets with π-electron spins have essentially negligibly small spin-orbit couplings and are attractive materials because they are archetypical Heisenberg spin systems in which the quantum fluctuations play an important role. The spin size and the connectivity of the network is the key factor of the novel magnetic states arising from quantum fluctuation. Among the representative stable organic radical skeleton, nitroxide (-N-O·) radical has the advantage of making antiferromagnetic spin networks. The positive and negative partial charges on the N and O atoms, respectively, easily gives the intermolecular contact between the NO groups on which the singly occupied molecular orbital (SOMO), that is the molecular orbital with the unpaired electron, is distributed. The intermolecular overlap between SOMO's always yields the antiferromagnetic interactions [1, 2]. The stacking of planar π-conjugated molecules gives one-dimensional (1D) network. When two or more NO groups are substituted on a molecule, double spin chain with different spin size is formed [2, 3]. After the extensive study on the 1D Heisenberg antiferromagnet, there is growing attention to the effect of the quantum fluctuations in two- or three-dimensional (2D or 3D) Heisenberg antiferromagnets, but the experimental realisation is still rare.

Considering the nitroxide radical as magnetic entity we were able to growth and macroscopically study several compounds with different dimensionalities with different magnetic behaviours (frustrated spin ladder, 3D honeycomb with AF LRO or 3D Kagomé layers, etc...). In this presentation several examples will be shown in order to highlight the crucial role of the high magnetic fields to understand the basic physics of these interesting materials. In some cases, neutron scattering experiments with applied magnetic fields have been proposed to complement this knowledge.

Many times, in organic magnets the first step to understand the magnetic behaviour is the study of the overlapping between the magnetic molecular orbitals which is directly related with the experimental spin density determination, and this is often done by using polarised neutrons with applied magnetic fields, what will be also presented.

References

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