PAUL SCHERRER INSTITUT

Invitation

LMU-Seminar

Title: **Stabilization of a spin liquid ground state in frustrated iridates**
Speaker: **Dr. Jean-Christophe Orain**
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Time: **Monday, March 26th 2018, 14:00**

Place: **OSGA/EG06**

Abstract:

The search for quantum spin liquid (QSL) states, such as the resonating valence bond state formed by the macroscopic resonance between the various spin singlet coverings of the lattice, is a major challenge in both experimental and theoretical condensed matter research [1]. The key feature to stabilize such a ground state in two dimensions is magnetic frustration. It is, however, not sufficient in the simple triangular case [2]. To destabilize further the ordered ground state one has to implement a deviation from this model such as a lower coordination number in the kagome model [3], or the introduction of spin-orbit coupling (SOC) [4].

I present here our µSR study on some compounds of the $Ba_3MIr_2O_9$ family which offers a tremendous playground to study the influence of this latter. The magnetism in these materials is based on iridium dimers which form a bidimensional triangular lattice [5]. Further, by changing the non-magnetic ion M one can tune the effective value of the dimers spin J. In this presentation I will focus on the $J = 1/2$ compounds (M=Y, Sc, In) which present all the characteristics to stabilize a QSL ground state.

We performed zero field measurements in order to probe the nature of the ground state in the different compounds. For the Y and Sc ones we found a homogeneous static magnetic ground state, with transitions at 4.5 K and 10 K respectively, and we reveal the presence of defects in the magnetic lattice. This behavior was expected for the Y compound from the susceptibility, heat capacity and NMR measurements but not for the Sc one where no transition had been observed [6]. Therefore, µSR is, in the case of those materials, the best tool to probe the static or dynamical behavior of the magnetism.

On the contrary, for the In compound, we found no sign of frozen magnetism down to 20 mK despite interactions of about 6.5 K, which could be the sign of a QSL ground state. Moreover, our transverse field measurements point out a local susceptibility for the muon similar to the squid and NMR experiments, enlightening the absence of defects. In addition, our NMR and heat capacity

measurements are in favor of a gapless QSL ground state [7]. Understanding the mechanisms which drive the ordering of the magnetism could help to have a better insight on how to stabilize a QSL ground state.

To address this issue, one can think of four different explanations. First, some order by disorder mechanism could be driving the transition since defects are present in the magnetic lattice of the Sc and Y compounds and not in the In one. Second, SOC could play an important role as was pointed out by a first principle calculation study [4]. Third, the lattice parameter could also change the magnetic model that has to be taken into account. Last, as the magnetic interaction is of the supersuperexchange type, the valence orbital of the metallic ion M could have a part to play. I will discuss some theoretical and experimental studies that could be performed to strengthen our understanding of the mechanism driving the transition.

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[4] S. K. Panda et al, Phys. Rev. B 92, 180403(R) (2015)
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[6] T. Dey et al, Phys. Rev. B 89, 205101 (2014)
[7] T. Dey et al, Phys. Rev. B 96, 174411 (2017); J. C. Orain et al, in preparation