Spin Liquid Ground State in $Y_3Cu_9(OH)_{19}Cl_8$: A μSR Study

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Recent theoretical work supported by DFT calculations stressed the possibility to merge strong correlations, metallicity and Dirac fermions with electron doping in the emblematic Herbertsmithite compound $ZnCu_3(OH)_6Cl_2$ [1, 2]. Indeed, for any electronic structure model that respects the hexagonal symmetry on the kagome lattice, protected Dirac points are located at the Fermi level for a filling $n = 4/3$. We explored the possibility to meet this challenge by replacing Zn^{2+} ($n = 1$) with trivalent Y^{3+}. The syntheses of $YCu_3(OH)_6Cl_3$ (non-hydrothermal conditions) and of its sister compound $Y_3Cu_9(OH)_{19}Cl_8$ (hydrothermal conditions) were successfully completed in the past two years [3, 4] but the charge of kagome layers is still balanced by boundings between Y^{3+} and the additional anions. The Kapellasite-type structures of these two cuprates are closely related, with no antisite disorder. While $YCu_3(OH)_6Cl_3$ presents perfect kagome planes with partial disorder in the two Y sites, the full occupancy in $Y_3Cu_9(OH)_{19}Cl_8$ makes the kagome lattice slightly distorted inducing two Cu sites (Fig. 1). This small release of frustration may be responsible for the weak singularities in thermodynamic measurements around 2K, when no sign of freezing is found in $YCu_3(OH)_6Cl_3$ down to 400mK. Nonetheless, our μSR experiments discard the development of bulk long range order of frozen magnetism in $Y_3Cu_9(OH)_{19}Cl_8$ down to 40mK, a first requirement for a spin liquid ground state.

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[2] D. Guterding *et al.*, Scientific Reports 6, 25988 (2016)
[3] W. Sun *et al.*, J. Mater. Chem. C 4, 8772 (2016)
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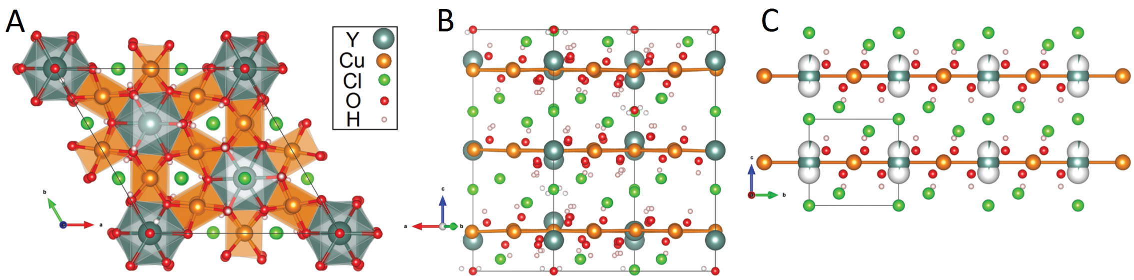

Figure 1: The structures of $Y_3Cu_9(OH)_{19}Cl_8$ (A, B) and $YCu_3(OH)_6Cl_3$ (C). Adapted from [4].