Magnetic frustration in iridium spinel compound $CuIr_2S_4$

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Geometrical frustration in electronic degrees of freedom has been one of the major topics in the field of condensed matter physics, for which inorganic compounds with the AB_2X_4 cubic spinel structure consisting of corner-shared network of transition metal ions (A and/or B) have served as fascinating stages. The thiospinel compound, $CuIr_2S_4$, is such a recent example, in which a charge order of mixed-valent Ir ions into isomorphic octamers of $Ir_8^{3+}S_{24}$ and $Ir_8^{4+}S_{24}$ is realized upon metal-insulator (MI) transition at $T_{MI} = 230$ K[1]. As per the currently accepted scenario regarding the t_{2g} manifold, the frustration is relieved by the formation of Ir^{4+} ($5d^5$, $S = 1/2$) dimers that accompany the spin-singlet ground state driven by orbital order and the associated spin-Peierls instability[2].

Here, we demonstrate via a muon spin rotation and NMR experiments that the electronic ground state of $CuIr_2S_4$ is not the presumed spin-singlet state but a novel paramagnetic state that exhibits a quasistatic spin glass-like magnetism below ∼100 K (see Fig.1)[3]. The present result indicates that the geometrical frustration remains partially unresolved even after Ir^{4+} dimarization, suggesting that strong spin-orbit interaction may be playing an important role in determining the ground state.

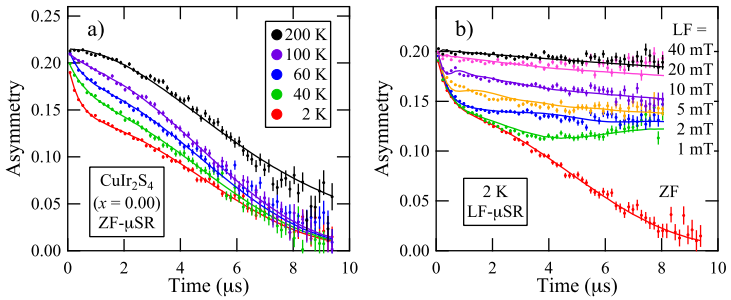

FIG. 1: a) μSR spectra in $CuIr_2S_4$ under zero external field, observed at several temperatures. b) μSR spectra at 2 K under a longitudinal field up to 40 mT.

[1] P. G. Radaeli *et al.*, Nature **416**, 155 (2002).
[2] D. I. Khomskii and T. Mizokawa, Phys. Rev. Lett. **94**, 156402 (2005).
[3] K.M. Kojima *et al.*, Phys. Rev. Lett., in press.

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