Frustration Effects in *f*-electron Intermetallic Compounds

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The study of geometric frustration effects is currently one of the most dynamic and captivating topics in the field of quantum spin systems research. In particular, crystal structures possessing three-fold rotational symmetry have proven to be a fruitful ground for exploring novel ground states arising from frustration. Recently, our attention has been drawn to the cubic structure $YbCu_4T$, as shown in Fig. 1, which has exhibited intriguing electronic states.

In the context of frustration, $YbCu_4Ni$ has emerged as a compelling case, wherein magnetization, electrical resistivity, and specific heat measurements have suggested a fascinating competition between the Kondo effect and RKKY interactions [1]. The implication of numerically replicating the ground state with appropriate parameters holds significant promise for comprehending frustration effects in quantum spin systems.

A key aspect of *f*-electron compounds is their remarkable sensitivity to even small changes in external parameters due to the small energy scale of *f*-electrons. Consequently, an effective approach to unveil novel properties influenced by frustration effects in $YbCu_4T$ is to introduce non-magnetic transition metal substitutions and examine the resulting changes in the magnitude of each interaction. However, the determination of the precise crystal field level poses challenges, primarily due to the substantial Kondo effect. Thus, in this study, we propose a systematic approach to determine the crystal field level through inelastic neutron scattering experiments, utilizing samples prepared with various transition metals.

We successfully employed the CTI refrigerator to cool the samples down to 10 K, and after conducting experiments with four different Rajeshon shields, we identified the optimal condition with the least background noise. Building upon these optimized conditions, we performed inelastic scattering measurements on both $YbCu_4Ni$ and $YbCu_4Au$. Notably, we observed inelastic scattering signals for $YbCu_4Au$, while $YbCu_4Ni$ did not exhibit any detectable signals, possibly due to signal broadening caused by the strong Kondo interaction. To gain deeper insights into this aspect, further experiments are planned with another triaxial spectrometer.

The outcomes of this research hold the potential to unravel the fascinating interplay of frustration effects in quantum spin systems and pave the way for exploring novel ground states and electronic properties in $YbCu_4T$ compounds.

[1] J. G. Sereni et al., Phys. Rev. B, 98, 094420 (2018).

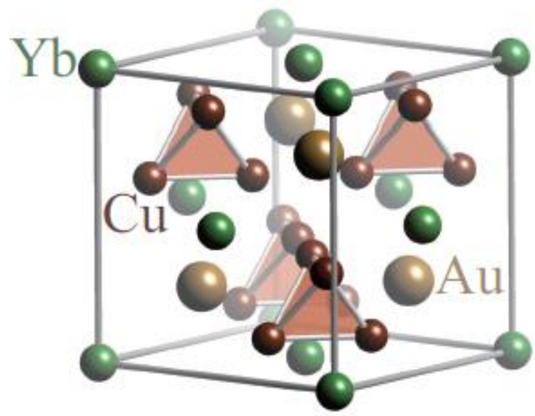

Fig. 1. Crystal structure of $YbCu_4Au$.