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Knight shifts and novel transitions in $PrRu_4P_{12}$ and $CeOs_4Sb_{12}$ studied by μSR

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$PrRu_4P_{12}$ exhibits a metal-insulator (M-I) transition at T_{MI}=60 K [1]. On the other hand, $CeOs_4Sb_{12}$ was reported to be a Kondo insulator [2] exhibiting a phase transition below $\sim$ 1 K [3]. The origin of the phase transitions and the ground states of the two compounds are not clear yet. We conducted the first μSR experiments in $PrRu_4P_{12}$ in which the zero field (ZF) relaxation rate shows no anomaly across T_{MI} and then increases below $\sim$30 K, though no magnetic order appears down to 20 mK [4]. Recently, we have measured the μSR Knight shifts in both compounds and extended the ZF and LF measurements down to 20 mK in $CeOs_4Sb_{12}$.

In $PrRu_4P_{12}$, the Knight shift measurements suggest two frequencies above T_{MI} [upper panel of Fig. 1a)]. With decreasing temperature, f_1 shows almost no shift, while f_2 shows negative shifts and splits into two at least below $\sim$ 30 K [lower panel]. These results explains the increase of the internal field below $\sim$30 K considering the appearance of magnetically in equivalent Pr_1 (body center) and Pr_2 (cubic corner) sites as also suggested by the CEF level scheme [5].

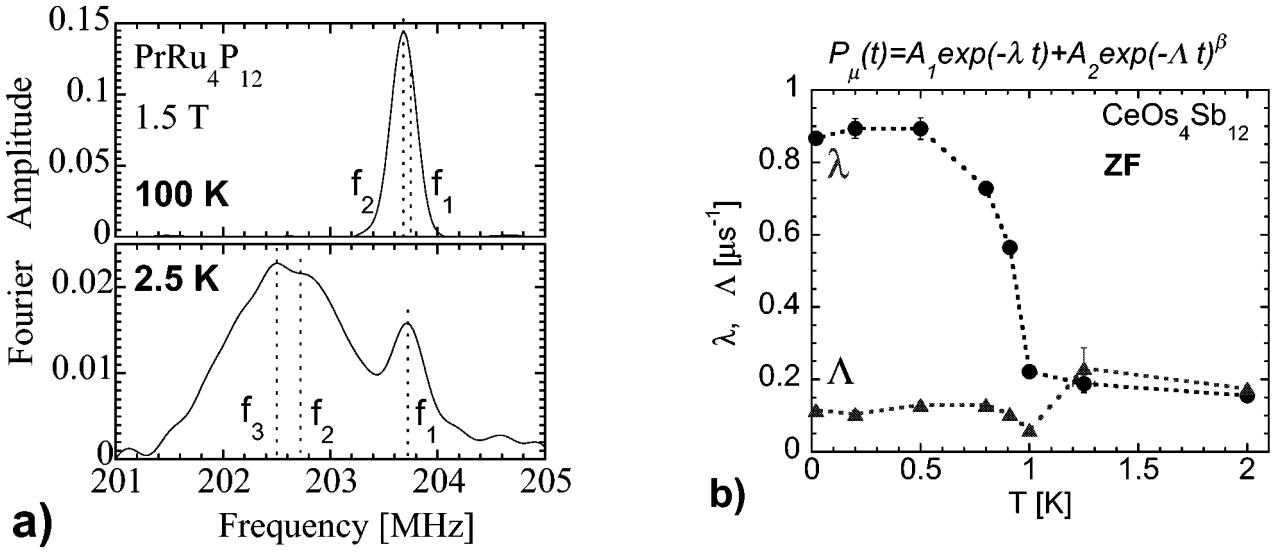

Figure 1: a) Fourier amplitude vs. frequency of the μSR Knight shift measurement at 1.5 T in $PrRu_4P_{12}$. b) The ZF relaxation rate (2-0.02 K) in $CeOs_4Sb_{12}$. The dotted lines are eye-guides.

Figure 1b) shows the temperature dependence of the ZF relaxation rate in $CeOs_4Sb_{12}$ down to 20 mK. The ZF asymmetry spectra were reproduced by the fit to a sum of the 'exponential' and 'power exponential' damping function $P_\mu(t) = A_1 exp(-\lambda t) + A_2 exp(-\Lambda t)^\beta$. The exponential relaxation rate λ clearly increases below $\sim$1 K, suggesting that the transition is intrinsic and it could be a spin density wave (SDW). The Knight shift measurements upto 6 T show multiple frequencies below 10 K in $CeOs_4Sb_{12}$, the detail of which will be discussed.

References: [1] Sekine et al., Phys. Rev. Lett. 79 (1997) 3218. [2] Bauer et al., J. Phys. Conden. Matter 13(2001)4495. [3] Namiki et al., Acta Physica Polonica B 34(2003)1161. [4] Saha et al., to be published in Physica B (proceedings of SCES 2004), 2005. [5] Iwasa et al., to be published in Physica B (proceedings of SCES 2004), 2005; submitted to Phys. Rev. lett.