ESRF	**Experiment title:** Study of the pressure effect on the magnetic properties of $U(In_{1-x}Sn_x)_3$ using nuclear forward scattering	**Experiment number:** HE1034
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Report:

The experiment HE1034 was aimed at investigating the effect of external pressure on the stability of magnetism in systems with 5f-moments using Nuclear Forward Scattering (NFS). It was a continuation of proposal HE588. The system $U(In_{1-x}Sn_x)_3$ was chosen, which according to magnetic susceptibility and specific heat studies [1] shows antiferromagnetic (AF) order for $x \leq 0.5$, whereas no long range order is present for $x > 0.5$. Within this series, in the latest experiment we have completed the high pressure measurements on the compound with $x = 0.4$. Here we have determined the pressure dependence of the Néel temperature and studied in an external magnetic field the magnetic properties of the high pressure phase at 25 GPa. Furthermore we have studied the stability of magnetism in the compound with $x = 0.2$, for pressures up to 15 GPa.

The experiment has been carried out in 16-bunch mode. The high resolution monochromator delivered a flux of $\sim 2.5 \cdot 10^7$ photons/s in an energy bandwidth of ~ 0.7 meV (at a storage ring current of 90 mA). The beam was vertically collimated by a Be compound refractive lens, and horizontally focussed down to $\leq 250\,\mu$m using a bent Si crystal. The sample diameter in the DACs was 250 μm, and typical countrates were in the range 50-150 Hz. About 70 different spectra have been recorded, the measuring time per spectrum varied between 0.5 and 4 hours.

[1] L. W. Zhou et al., Phys. Rev. B 34 (1986), 483

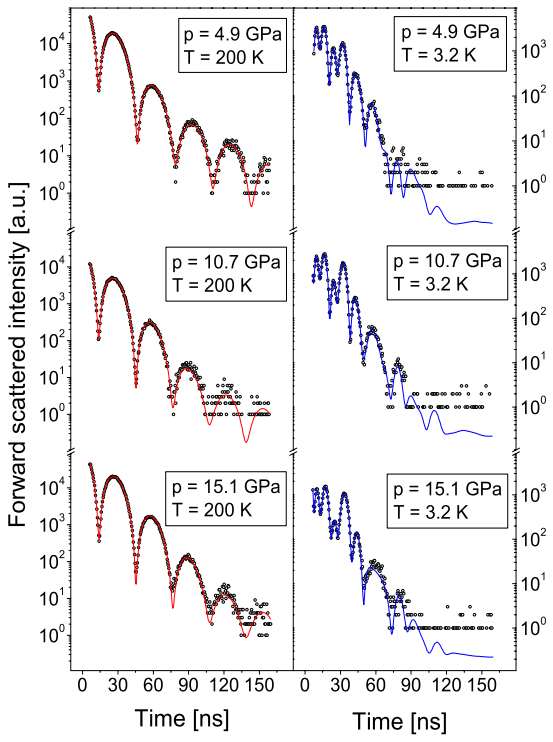

Fig. 1: NFS on $U(In_{0.8}Sn_{0.2})_3$

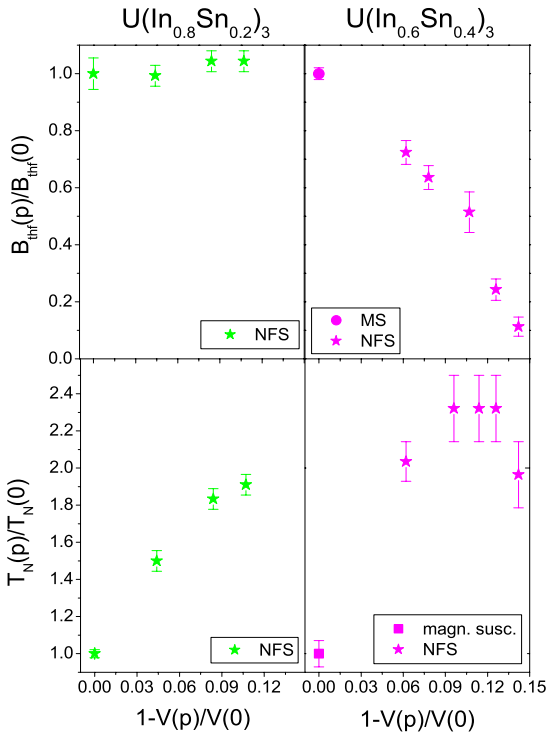

Fig. 2: Pressure dependence of $B_{\rm thf}$ and $T_{\rm N}$ at $T \leq 4\,{\rm K}$

Fig. 1 shows examples of spectra taken on $U(In_{0.8}Sn_{0.2})_3$ at 200 K (above $T_{\rm N}$) and at 3.2 K (below $T_{\rm N}$) and different pressures.

Fig. 2 shows the volume dependence of the transferred magnetic hyperfine field ($B_{\rm thf}$) and of the Néel temperature ($T_{\rm N}$) as determined from the measured spectra. Some conclusions can be drawn:

1. In the case of $U(In_{0.8}Sn_{0.2})_3$, $B_{\rm thf}$ remains almost unchanged when pressure is raised up to 15 GPa (corresponding to a contraction of $\sim 11\,\%$ of the unit cell volume) This suggests that the U magnetic moments are well localised in this system. This behaviour is confirmed by the pressure dependence of the Néel temperature: $T_{\rm N}$ increases from $\sim 90\,{\rm K}$ at ambient pressure to $\sim 172\,{\rm K}$ at 15 GPa.

2. In the case of $U(In_{0.6}Sn_{0.4})_3$, $B_{\rm thf}$ decreases monotonically as pressure is increased. At the highest pressure of 25 GPa (corresponding to a volume contraction of $\sim 14\,\%$), $B_{\rm thf}$ has a value that corresponds to only 10 % of the ambient pressure value. This suggests a reduction of the U 5f-moments due to the delocalisation induced by the external pressure. However, for volume contractions of less than 12 % $T_{\rm N}$ shows an initial increase with pressure, which is more typical for localised systems, where the magnetic moment is not strongly influenced by pressure. Only for volume contractions greater than $\sim 12\,\%$ the ordering temperature starts decreasing.

3. At the highest pressure of 25 GPa, where $B_{\rm thf}$ is almost suppressed, measurements in an external magnetic field of 6 T show the presence of a large induced magnetic hyperfine field. This indicates that strong dynamic spin correlations are present in the high pressure state of this compound.