| ESRF | **Experiment title:** Development of $^{119}$Sn nuclear resonant scattering and first application to highly correlated electron systems | **Experiment number:** HE588 |
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| **Beamline:** ID18 | **Date of experiment:** from: 2/7/99 to: 8/7/99 | **Date of report:** 13/9/99 |
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Report:

Experiment HE588 was aimed at investigating the effect of external pressure on the stability of magnetism in systems with 5f-moments using Nuclear Forward Scattering (NFS). 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 we have studied the two cases $x = 0.4$ and $x = 0.6$ at ambient pressure, and we have then applied pressures up to 25 GPa (using a Diamond Anvil Cell) to the sample with lower Sn content.

The experiment has been carried out in 16-bunch mode. A new high resolution monochromator has been designed explicitly for NFS high pressure experiments, delivering a flux of $\sim 4.5 \cdot 10^8$ photons/s in an energy bandwidth of $\sim 10$ 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 150 - 300 $\mu$m, and typical countrates were in the range 20 - 50 Hz. 36 different spectra have been recorded, the measuring time per spectrum varied between 1 and 4 hours.

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

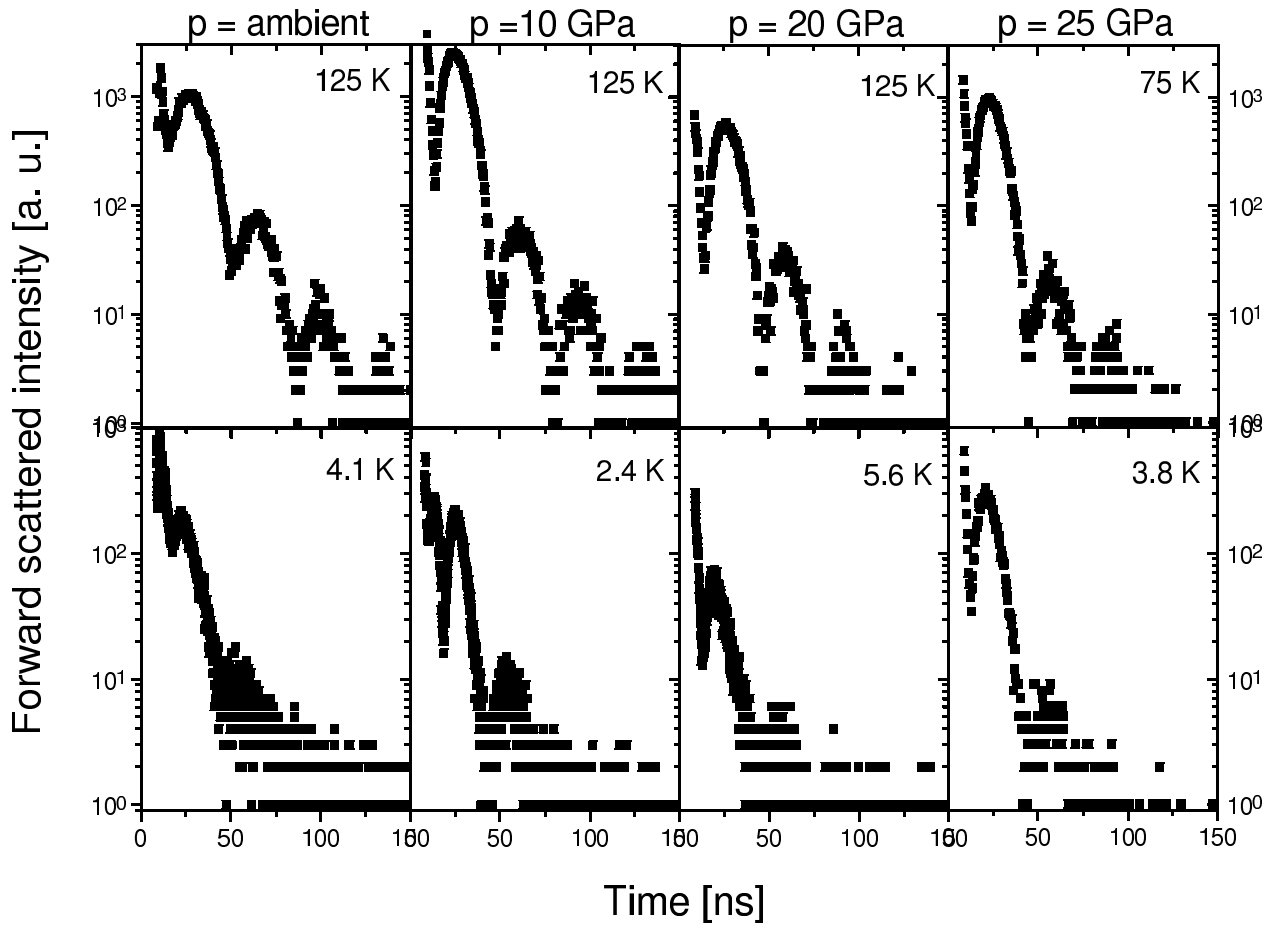


Fig. 1: NFS on $U(In_{0.6}Sn_{0.4})_3$

Fig. 1 shows part of the spectra taken on $U(In_{0.6}Sn_{0.4})_3$ at different pressures and temperatures above and below the magnetic ordering temperature ($T_N = 28$ K at ambient pressure). Although the final data analysis is still in progress, some conclusions can already be drawn:

1. The spectra taken at all pressures above the Neel temperature can be fitted assuming the presence of a quadrupole splitting that increases with pressure. This is in agreement with previous Mössbauer measurements at ambient pressure and is due to the non-cubic symmetry of the Sn sites in the unit cell.

2. The spectra below $T_N$ show the presence of a transferred hyperfine magnetic field ($B_{thf}$) at the Sn nuclei, due to the polarization of the conduction electrons by the U ordered magnetic moments. Even if no absolute values for $B_{thf}$ can by now be given, from a first rough analysis of the measured spectra one clearly observes a decrease of $B_{thf}$ (and therefore of the U magnetic moment) with increasing pressure, due to a gradual increase in the 5f-spd hybridization.

3. At the highest pressure (25 GPa), even at the lowest temperature reached ($T = 3.6$ K) no magnetic order can be observed, the measured spectrum is fitted with a simple quadrupole splitting. This is the first observation of a pressure induced non magnetic state in a 5f-moment system.