ESRF	**Experiment title:** **High-pressure studies of magnetic Laves Phases by nuclear scattering of Synchrotron Radiation**	**Experiment number:** HC373
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Report:

1. We were using the first time a new diamond-anvil cell (DAC) made from nonmagnetic CuBe alloy and allowing for the application of external magnetic fields (at present up to 0.75 T from $Nd_2Fe_{14}B$ permanent magnets) perpendicular to the polarization (and to the direction) of the synchrotron radiation. This arrangement simplifies the measured beat spectra and provides a much easier analysis, as demonstrated in the recent high-pressure NFS study of the α/ε transition in iron metal [I]. The design of this cell (see Fig. 1) allows also for the detection of inelastically scattered radiation perpendicular to the incoming beam for future studies of phonon density-of-states [2,3]. In addition we were using our standard DACs, allowing at present for higher pressures, but not for the application of external fields.

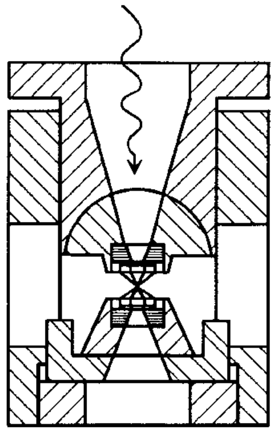

Fig. 1: New Diamand anvil cell, made from CuBe, with large opening angles.

2. We studied cubic Cl5-type YFe_2, $GdFe_2$, $HoFe_2$, $DyFe_2$ at room temperature with the NFS technique up to pressures of 50 GPa; about 25 high-pressure NFS spectra were taken in time intervals from 15 min to 60 min; as example we show in Fig. 2 the spectra of YFe_2 up to 43 GPa with and without an external field and in Fig.3, up to 53 GPa, the corresponding spectra of GdFez.

Due to the Gd magnetism and the Gd-Fe interactions (increasing with pressure), the Fe sublattice was not fully polarized in $GdFe_2$, but in the case of YFe_2. A small quadrupole interaction, present in all Cl5 systems, results in a small damping of the magnetic beat structures when studied in an external field.

3. As expected from the large orbital moments of Dy and Ho, the presently available external field of 0.75 T was not strong enough to polarize the spectra of $DyFe_2$ and $HoFe_2$ (both measured at ambient pressures in external fields and, without external fields, up to 10 GPa). In all cases we find a drop of the magnetic hyperfine field B_{eff} by about 10% for the first 10 GPa. The reduction of B_{eff} with pressure is directly reflected in the NFS spectra with external field, as shown in Fig. 2 for YFe_2. In $GdFe_2$, very similar to YFe_2 by structure and compressibility, the pressure-induced variation of B_{eff} is smaller. We obtained from first fits of the NFS spectra (Fig. 3) a reduction of B_{eff} from 22 T at ambient pressure to 14.5 T at 53 GPa. In addition, there are indications of a change in the magnetic behaviour around 20 GPa (possibly due to the Gd magnetism). The final evaluation of these and the other NFS data is in progress.

4. We further studied the magnetic ordering in C14-phase $TiFe_2$ at ambient pressure in the temperature range 20 K - 300 K; we also measured the local phonon density spectra [2-51 above and below the magnetic ordering temperature.

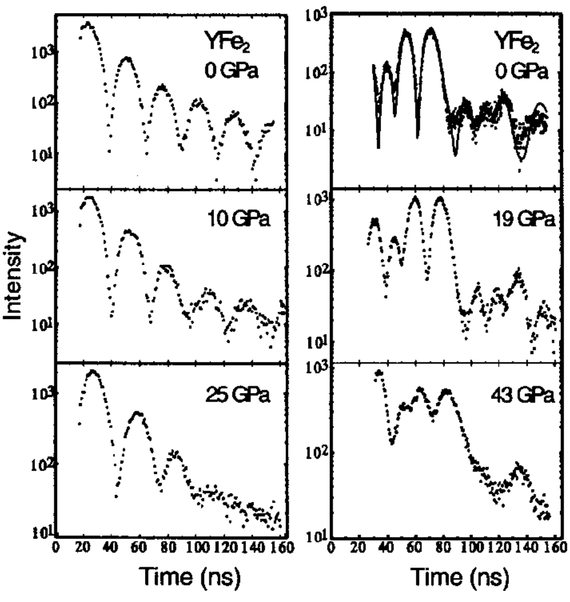

Fig. 2: NFS spectra of YFe_2 with (left) and without (right) external magnetic field.

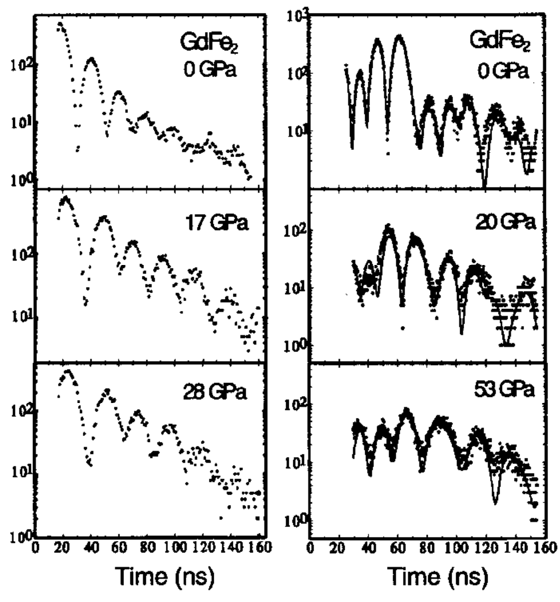

Fig. 3: NFS spectra of $GdFe_2$ with (left) and without (right) external magnetic field.

References:

[1] R. Rüffer et al., ESRF Newsletter, Nov. 1994, p. 12-14; ESRF Highlights 1994/95, p. 36-37. [2] M. Seto et al., Phys. Rev. Lett. 74 (1995) 3828. [3] W. Sturhahn et al., Phys. Rev. Lett. 74 (1995) 3832. [4] A.I. Chumakov et al., Europhys. Lett. 30 (2995) 427. [5] R. Rüffer, ESRF Report 1994/1995, p. 52-54.