ESRF	**Experiment title:** **High-Pressure Studies of Magnetic Laves Phases by Nuclear Scattering of Synchrotron Radiation II**	**Experiment number:** HE-99
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Report: 1. The work presented here is a continuation of previous nuclear-forward scattering (NFS) studies of magnetic RFe_2 Laves phases under high pressure (HC 373, 15.- 19.2.96), where we studied $GdFe_2$ and YFe_2 up to 50 GPa at room temperature. We observed a strong decrease (25%) of the hyperfine fields, indicating a corresponding reduction of the Fe moments. For the present work we used the same experimental set-up as described in our report on HC 373, but improved the diamond-anvil cells for higher pressures and for the use at low temperatures.

2. Fig. la shows selected NFS spectra of ferromagnetic YFe_2 (Cl5 structure) taken at room temperature and various pressures. An external field of 0.75 T, applied perpendicular to the σ-polarization and to the $\vec{k}$ vector of the synchrotron radiation, fully polarizes the Fe moments, yielding a simplified beat pattern in the NFS spectra [1,2]. With increasing pressure, the decrease of the hyperfine fields B_{hf} results in slower beat frequencies in the NFS spectra, which are in addition modified by an increasing quadrupole interaction. At 105 GPa (100 GPa = 1 Mbar), the magnetic hyperfine field has vanished. The remaining beat pattern is now only due to the quadrupole interaction. From the plot of $B_{hf}(p)$ shown in Fig. la we conclude that the magnetic ordering temperature drops from 520 K at 0 GPa to about 300 K around 75 GPa.

3. $ScFe_2$ crystallizes in the hexagonal Cl4 structure, orders ferromagnetically at 520 K and has a large anisotropy field of 4.5 T [3]. The presently available external field of 0.75 T is not strong enough to polarize the sample. NFS-spectra taken without external field at T = 300 K and pressures up to 51 GPa are shown in Fig. lb, indicating again a strong decrease of the hyperfine field with increasing pressure. Preliminary calculations with the CONUSS program [4] yield for

the spectra at 26 GPa and higher pressures a transition to an antiferromagnetic state similar to the related $TiFe_2$ system [3]. The 51 GPa spectrum yields a small residual field of 0.8 T.

4. In order to get more information on the magnetic properties of our samples, we measured now for the first time high-pressure NFS-spectra at various temperatures using the closed-cycle He-cryostat at BL 11. Fig. lc shows the corresponding spectra for $ScFe_2$ at 51 GPa. From the $B_{hf}(T)$ dependence we extrapolate an (antiferromagnetic) ordering temperature of 310(10) K at 51 GPa.

5. We performed NFS studies on $Sc_{0.4}Ti_{0.6}Fe_2$ (Cl4 structure) at various pressures (0, 4, 8, 21, 37 GPa) and, in part, at various temperatures. These studies were motivated by a study of the $Sc_{1-x}Ti_xFe_2$ alloy series, where a transition from ferromagnetism to antiferromagnetism was observed as function of x and temperature. [3]. We observed the same behaviour, like in $ScFe_2$, as function of pressure and temperature. These data are presently evaluated.

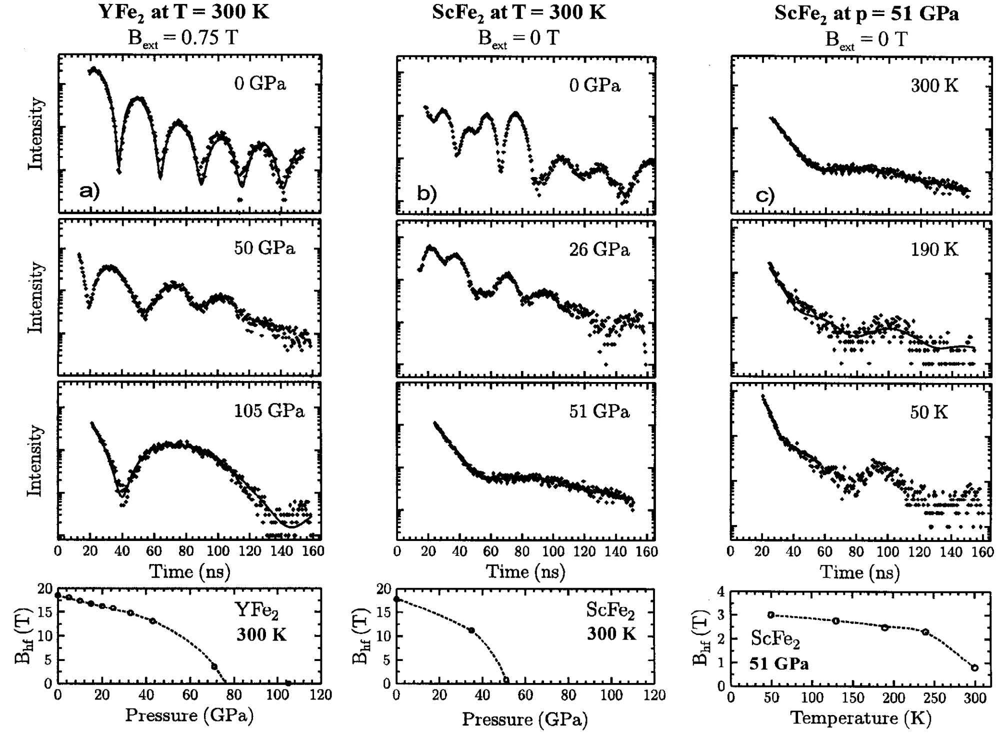

Fig. 1: NFS-spectra of (a) YFe_2 and (b,c) $ScFe_2$ at various pressures and/or temperatures. The corresponding averaged hyperfine fields B_{hf} (p) and B_{hf} (T) are shown at the bottom.

References: **[l]** R. Rüffer et al., ESRF Newsletter, Nov. 1994, p. 12- 14; ESRF Highlights 1994/95, p. 36-37. [2] G.V. Smirnov, Hyperfine Interactions 97/98 (1996) 551-588. [3] Y. Nishihara et al., J. Phys. Soc. Japan 55 (1986) 920. [4] W. Sturhahn and E. Gerdau, Phys. Rev. B 49 (1994) 9285.