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ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the
Electronic Report Submission Application:

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** **High-pressure study of combined 3d-4f magnetism in RFe_2 Laves phases**	**Experiment number**: HS-1325
Beamline: ID22N, ID30	**Date of experiment**: from: 31.11.2000 to: 04.12.2000	**Date of report**: 26.02.2001
Shifts: 18, 12	**Local contact(s)**: Dr. Olaf Leupold, Brian Doyle, Mohamed Mezour	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

K. Rupprecht*, H. Giefers*, T. Friedmann*, G. Wortmann*, J. Zukrowski

A. Schiwek*, F. Porsch*

* Fachbereich Physik, Universität Paderborn, D-33095 Paderborn, Germany

** AGH Krakow

Report:

The goals of this combined experiments of magnetism in RFe_2 Laves phases at the beamlines ID22N and ID30 were:

- The use of a new versatile high-pressure diamond-anvil cell, made from especial Ti-alloy with small thermal expansion and heated by a temperature controlled mini-oven.
- The measurements of magnetic ordering temperature T_m by elastic nuclear forward scattering (NFS) of the 14.413 keV gamma rays of Fe-57 at high pressures in the temperature range 300 K to 800 K (20°C to 400°C).

The recording of the lattice parameters of the same samples in the same cells by angle-dispersive X-ray diffraction (ADXD) at ID30 and, exploratory, the determination of magnetic ordering temperatures by the observation of magnetoelastic anomalies around T_m.

The NFS experiments were performed at the beamline ID22N with the use of a Si(1,1,1) double crystal premonochromator and a high-resolution monochromator (HRM) consisting of two pairs of ("nested") Si(4,2,2,) and Si(9,7,5) crystals. Due to the focusing optics (compound refractive lens and bent crystal) similar to previous NIS phonon spectroscopy [Report HS-1175, HS-1488], the whole monochromatized beam could be foccused on the pressurized sample, allowing the measurement of NFS spectra at high p/T within 10 minutes.

Fig. 1 shows typical spectra of $ScFe_2$ at 16 GPa and of $LuFe_2$ at 26 GPa and various temperatures. From the disappearance of the magnetic NFS structures and occurrence of "pure" Bessel beats (due to thickness effects) [1] the disappearence of magnetic order between 543 K and 563 K for $ScFe_2$ and between 531 K and 549 K for $LuFe_2$ can be determined by visual inspection. In many additional NFS spectra we measured the magnetization curve (by the temperature dependent magnetic hyperfine fields) with the magnetic ordering temperature, the quadrupole interaction, and, by the use of an additional stainless steel reference absorber [2], the isomer shift. A detailed analysis of 43 spectra of $ScFe_2$ up to 18 GPa (here a

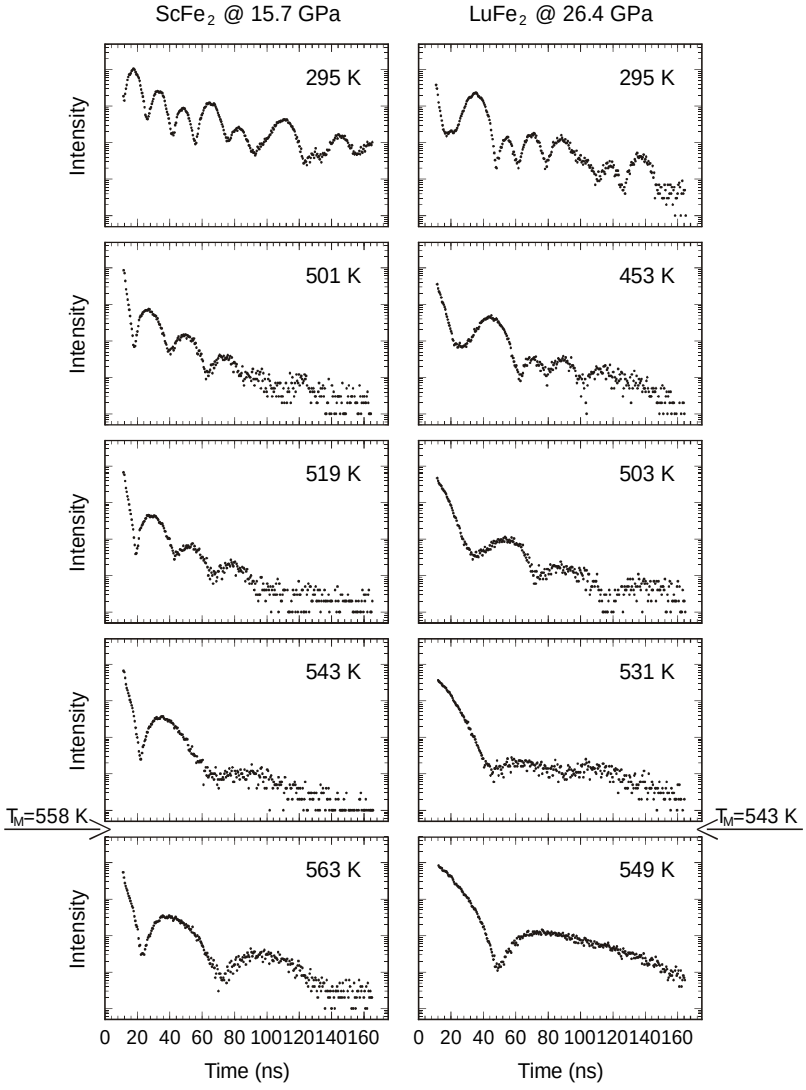

Fig. 1: Temperature dependent NFS Spectra of $ScFe_2$ at 16 GPa and $LuFe_2$ at 26 GPa. The arrows denote the magnetic ordering temperature.

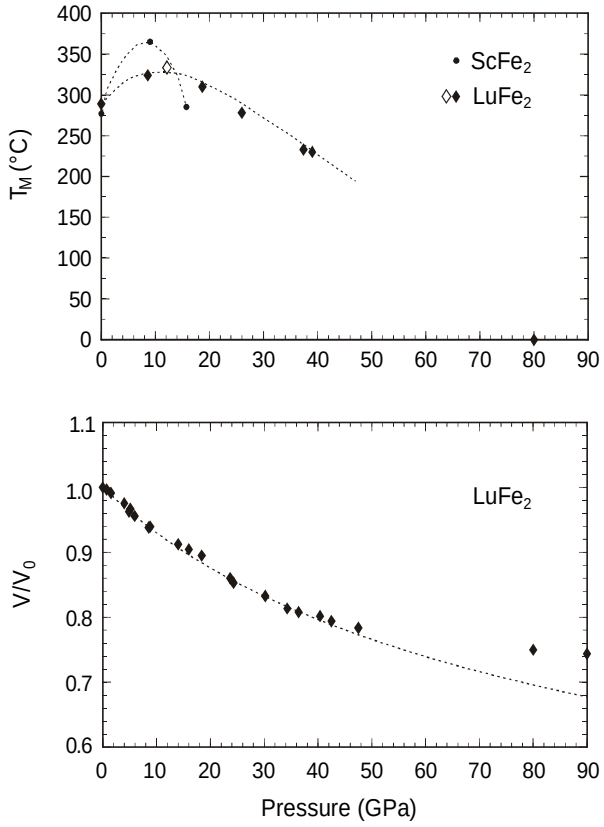

Fig. 2: top: magnetic ordering temperatures at various pressures.
bottom: pressure - volume dependence of $LuFe_2$

broken diamond limited the pressure range) and 70 NFS spectra of $LuFe_2$ up to 80 GPa and various temperatures is still in progress.

The lattice parameters for each pressure was determined by angle-dispersive X-ray diffraction (ADXD at ID30 before and after a temperature cycle with NFS measurements at ID22N) (Fig. 2). We observed a systematic (and expected) decrease of the applied pressure by about 10% after a temperature cycle. In an exploratory ADXD high-temperature run, we determined the magnetic ordering temperature in $LuFe_2$ at 12.3 GPa as 332°C from a sudden increase of the lattice parameter (open symbol in Fig. 2).

References

[1] R. Lübbers et al., Hyp. Interactions 120/121, 49 (1999).

[2] M. Pleines et al., Hyp. Interactions 120/121, 181 (1999)