ESRF	**Experiment title:** X-ray resonant Raman scattering study at the $L_{2,3}$ edges of R ions in the $R_2Fe_{14}B$ permanent magnet systems (R=rare earth)	**Experiment number:** HE-115
Beamline: ID16	**Date of experiment:** from: 20/l/97 to: 27/l/97	**Date of report:** 01/03/97
Shifts: 20	**Local contact(s):** **Dr. M.** Krisch	*Received at ESRF:* 2 7 AOUT 199?

Names and affiliations of applicants (* indicates experimentalists):

Bartolomé, F.*; Chaboy Nalda, J.; Garcia Vinuesa, L.M.

ICMA-CSIC, Facu1to.d de Ciencias Universidad de Zaragoza, Pedro Cerbuna 12, 50009 SPAIN

Tonnerre, J.M.*; Sève, L.*; Barbara, A.; Raoux, D.*

Laboratoire de Cristallographie, CNRS., BP 166 38042 Grenoble Cedex 09 FRANCE

Report:

The interpretation of XMCD and XRMS experiments on very different rare earth systems strongly suggests the presence of a magnetic quadrupolar contribution (E2 *2p* to *4f* excitation) placed some eV below the energy of the **L3** edge of the R ion. However, the full understanding of the observed XMCD and XRMS signals requires a quantitative knowledge of the intensity of this E2 channel compared to the dominant dipolar one (El, *2p* to *5d* excitation). We proposed (September 1996) to systematically measure the XRRS spectra at the $L_{2,3}$ edges of the rare earth ion on $R_2Fe_{14}B$ (R = Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb) in order to obtain the needed information for a correct interpretation of XMCD and XMRS data in terms of El and E2 excitation channels and derive a correlation between the intensity of the negative pre-edge feature of the XMCD spectra and the intensity of the E2 excitation channel. The proposal was allocated with 20 shifts.

We have measured a "complete set" of X-ray Resonant Raman Scattering of 7 samples (R = Sm, Gd, Tb, Dy, Ho, Er, Tm) at the vicinities of the **L3** absorption edge. These "set" includes for each sample: several X-ray inelastic scattering scans at incident energies *below*, *at* and *above* the L3 edge and also several constant energy transfer scans performed by simultaneously scanning the incident and the scattered energy (in general, a constant energy transfer scan was performed at the energy transfer values at which a feature was appearing on the IXS scans).

The $L\alpha_{1,2}$ or $L\beta_{2,15}$ deexcitation channels with Si(333), Si(444), Si(531) and Si(440) analyzers were used for the measurements on different samples. We want to stress that it was possible to record a complete data set in 24 h due both to the performance of the beamline and the invaluable eficacity of the bemline personal.

Figs. 1 to 4 show some of the curves taken in two samples in order to give a flavour of the obtained results. Fig 1 show some of the IXS scans taken on $Sm_2Fe_{14}B$, at incident energies near the appearance

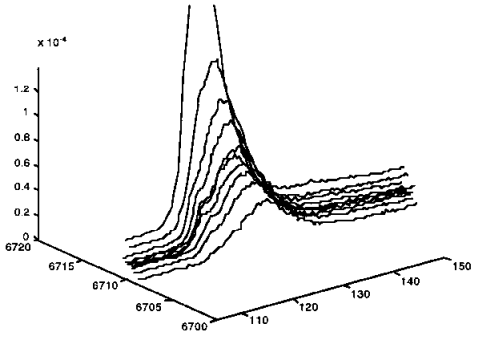

Fig. 1: Sm IXS scans at differen incident E_i.

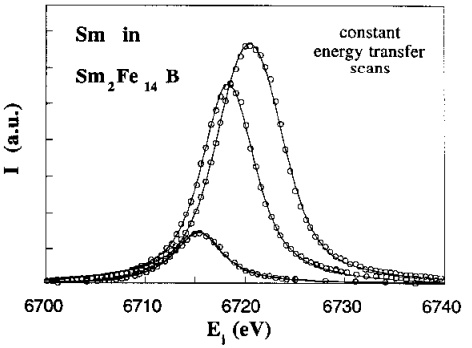

Fig. 2: Sm contant final state scans

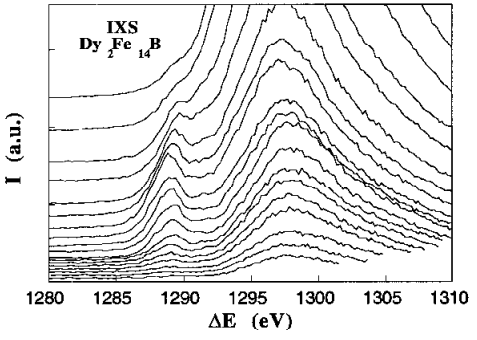

Fig. 3 Dy XIS scans around E_i(E2)

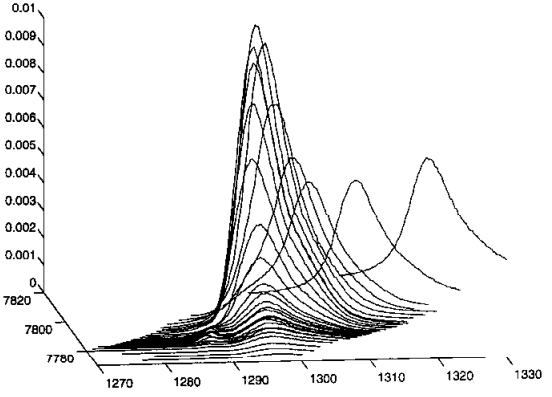

Fig. 4 Dy XIS scans (whole set)

of the quadrupolar feature of Sm. which is seen as a shoulder appearing and disappearing on the low energy side of the main (dipolar) feature. In fact, three different excitations are visible in that range, which can be experimentally separated by performing three constant energy transfer scans at different ΔE's, which are shown in Fig.2. The ensamble of IXS and cte ΔE scans in Sm allow us to give an interpretation to the fine structure of the Sm L_3 XMCD signal on $Sm_2Fe_{14}B$, and in general in light rare earth ions, which was one of the goals of the experiment.

Fig 3. show in a 2D plot of the Dy sample, as an example of the heavy rare-earth ions. The IXS scans show clearly the quadrupolar feature some eV below the edge, as it was found in each measured sample. Fig.4 show the whole set of XIS curves in Dy sample, of which some are shown in Fig. 3. It is possible to observe the quadrupolar and dipolar channels as well as the excitations to the continuum for energies higher than the edge. This is also a typical set, as taken for each sample.

We hope that will be possible to use XRRS measurements in a well characterized series of compounds in order to stablish the influence of the R substitution and its the electronic structure on the experimental XMCD and XMRS spectra.

In order to complete the study (performing some measurements at L2 edges as well as magnetic XRRS experiments) we plan to ask for a continuation of this experiment during next run.