ESRF	**Experiment title:** Intra- and inter atomic contributions in rare earth magnetism	**Experiment number:** HE 18
Beamline: ID12A	**Date of experiment:** from: October 1996 to:	**Date of report:** 1/1/97
Shifts: 18	**Local contact(s):** A. Rogalev	*Received at ESRF:* 8 SEP. 1997

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ESRF

Report:

The interpretation of the L_{23} XMCD of rare earth materials is still a matter of debate. In a previous experiment on insulating rare earth compounds, *CH46,* we observed clear derivative like XMCD line shapes, which we could explain in terms of the intra-atomic *4f-5d* exchange interaction, treated in an atomic model, i.e. including the orbital part of the interaction"'. The role of the exchange interaction is to shift the spin-down spectrum by an amount X to higher energies. However, because this shift is much smaller than the line width *W*, this gives rise to derivative-like XMCD spectra.

In order to obtain a more complete picture of the behavior of insulators we extended our original data, which was limited to the $4f^7$ and $4f^8$ cases to the beginning and the lanthanide series. The results are plotted in figure 1 (dots) together with the derivative of the white line (thin solid curve). All spectra are peak normalized, and the zero energy is chosen as the energy of the maximum intensity of the white line. Due to the difficulty of measuring these paramagnetic systems, that show only very small signals especially at the L_3 edge the series is not complete. Nevertheless it is possible to isolate some pronounced trends from the data.

The L_2 edge shows dispersive features with -/+ sign throughout the series. Especially at the beginning and the end of the series the line shape is very close to the derivative of the white line. However, in the middle of the series the high-energy lobe tends to have less intensity in comparison with the derivative.

The L_3 edge on the other hand shows a **+/-** dispersion at the beginning of the series but in the heavier elements a negative peak grows up and moves to lower intensity. We interpret this structure as being the quadrupolar transitions. Indeed, with the presence of this quadrupole all resemblance with a derivative curve is lost. At the beginning of the series resemblance with the derivative is still present although again the high-energy lobe is smaller in the XMCD than in the derivative and the zero crossing of the XMCD lies a few eV higher than that of the derivative. Theoretical work is under way to interpret these results.

1. M. van Veenendaal, J.B. Goedkoop and B.T. Thole, Phys. Rev. Lett. 78 1162 (1997).
2. J.B. Goedkoop, A. Rogalev, M. Rogaleva, C. Neumann, J. Goulon, M. van VeenendaaI B.T. Thole, J. Phys. IV France ***7 C2-397 (1997)*** and ***ESRF Exp. Rep. CH46***