ESRF	**Experiment title:** Existence of *3d-4f* hybridisation in rare-earth transition-metal compounds	**Experiment number:** HE 357
Beamline: ID12B	**Date of experiment:** from: 5 June 1998 to: 9 June 1998	**Date of report:** 31-8-1998
Shifts: 12	**Local contact(s):** J.B. Goedkoop	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

J.B. Goedkoop*, J. Vogel*, M. Finazzi*, 0. Tjernberg*, G. Ghiringhelli", **N.B.** Brookes*, ESRF

R.-M. Gal&a*, Lab. L. Néel, BP 166X, 38042 Grenoble Cedex 9

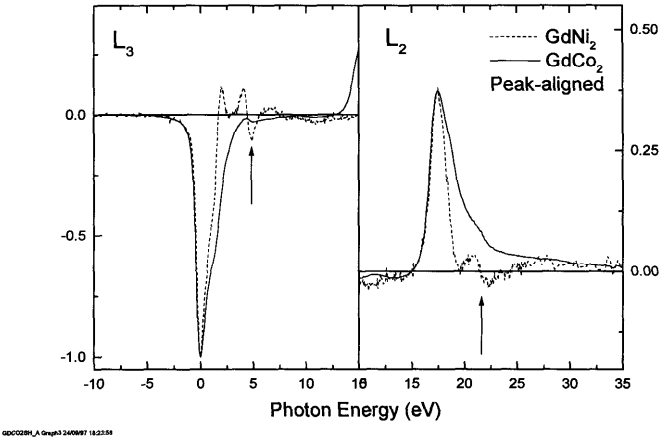
Report:

A. ***4f*** **satellites**

This work formed the extension of our earlier experiments on Gd,Ni, inter-metallic compounds (see report 'Unusual features in the XMCD spectra of Ni,Gd,, compounds', In house research, July 1997). In that work we observed strong satellite structure in the Ni L_{23} XAS and XMCD spectra that we tentatively identify as $3d^{n-1}4f^{N+1}$ and $3d^{n+1}4f^{N-1}$ charge transfer states. This identification explains their appearance at 5 and 9 eV above the edge threshold, which are the electron affinity (EA) and ionisation potential (IP) of the Gd *4f* shell [l].

In the experiments on R_xCo_y compounds described here, we verified this model in two ways:
By varying the rare earth R in the RCo_2 system we were able to show that the satellite structure is primarily dependent on the R element. It is found strongest and best separated from the edge for R=Gd. This is in agreement with the BIS and XPS data from Lang *et al.* [l] that show that for Gd the IP and EA are biggest and the *4f* multiplets narrowest of all the rare earth series. These factors optimise the visibility of the satellites in the XMCD spectra.
Secondly, the Gd_xCo_y series (x:y=2:5, 1:5, 1:2,4:3) showed satellites at the same energies that again increase become more pronounced with increasing Ni dilution.

For the quantification of the strength of the *4f* charge transfer states in the ground state we require theoretical investigations with the Anderson impurity model, for which we have approached A. Tanaka, University of Hiroshima.



B. Sum rule results.

The integrated XMCD curves provide the quantities used in the sum rules for the 'spin' and orbital moment. However, the satellite structure results in highly unusual integral curves, and therefore these systems form excellent test cases for the sum rule applicability. A collaboration with Prof. H. Ebert, University of Münich, is under way aiming at comparison of our results with fully relativistic band structure calculations of all these compounds.

Preliminary accounts of this research have been presented in oral contributions at the SR50 and XAFS X conferences, and will be so at the MMM43, Nov. 98. This shows the interest from both the spectroscopy and magnetic communities for this work. Several publications are under preparation.

J.K. La ng Y. Baer, P.A. Cox, J. Phys. F11 121-38 (1981)