ESRF	Dichroism in soft X-Ray Raman Scattering from 3d-Transition Metal Systems	Experiment number: HE 30
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The main idea was the study the dichroism in the process $(2p^6 3s^2 3d^8) \rightarrow (2p^5 3s^2 3d^9) \rightarrow (2p^6 3s^1 3d^9)$ by using the transverse geometry in the scattering. In this case one can have a dichroism also when the incident helical photon beam is perpendicular to the magnetization of the sample. The absorption dichroism is zero but a scattering dichroism exists because of the symmetry breaking due to the detection of the photon at an angle. This photon scattering effect in the transverse geometry is connected to that shown in resonant photoemission by B.T. Thole, H.A. Dürr, and G. van der Laan, Phys. Rev. Lett. 74, 2371 (1995). This is an effect connected with the quadrupolar space distribution of the excited state which can be expressed as a combination of different moments and can give an alternate path to the exploration of the ground state of magnetic systems (G. van der Laan, and T B. Thole, J. of Phys. : Condens. Matter 7,9947 (1995).). From an experimental point of view these scattering experiments have the advantage of not requiring corrections to the raw data due to the absorption dichroism effect and of having very low selfabsorption. Thus they can be used also in concentrated systems without difficulties in the data handling.

The aim of the experiment was to demonstrate the feasibility of this approach and to obtain the first measurements to be compared with the theory done for magnetic Ni^{2+} by M.A. van Veenendaal. These goals have been reached as shown by the Raman spectra excited with opposite incident helicities in the transverse geometry at the Ni L_3 threshold in Ni ferrite (fig 1). The experimental results of fig 1A are in excellent agreement with the calculations reported in Fig 1B where the effect of the lifetime broadening and of the instrumental bandpasses has been included.

We have seen the effect also in Cobalt metal with L_3 excitation as shown in Fig 2. In Co metal we have tested also another important concept on L_2 excitation with transverse geometry. In this case the dichroism must be strongly reduced since it is not possible to build a quadrupole with a $2p_{1/2}$ hole and only the departure from the spherical symmetry due to the crystal field introduces a small effect. This interpretation is supported by the results of Fig.3 showing that the L_2 dichroism is zero within the errors. On the other hand a small dichroism is seen in the L_3 scattered component mostly originated by Coster Kronig conversion of L_2 holes. This last result could be useful in possible future work on Coster Kronig conversion.

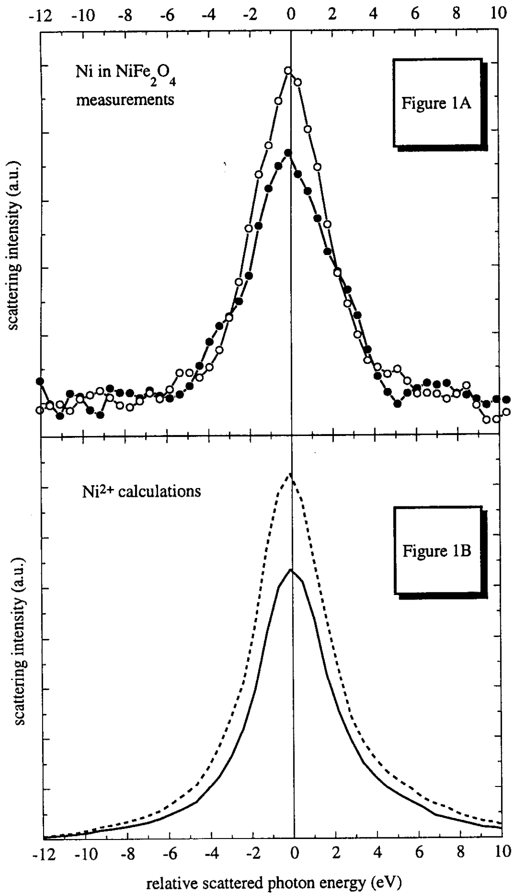
Figure 1A
Ni in NiFe2O4
measurements
Figure 1B
Ni2+ calculations
scattering intensity (a.u.)
-12 -10 -8 -6 -4 -2 0 2 4 6 8 10
relative scattered photon energy (eV)

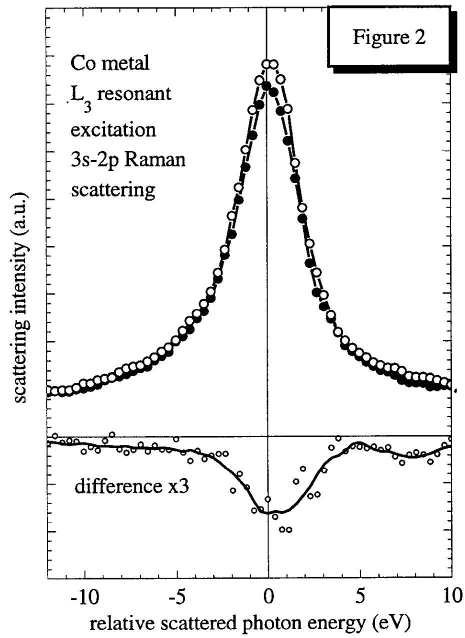
Figure 2
Co metal
L3 resonant
excitation
3s-2p Raman
scattering
difference x3
scattering intensity (a.u.)
-10 -5 0 5 10
relative scattered photon energy (eV)

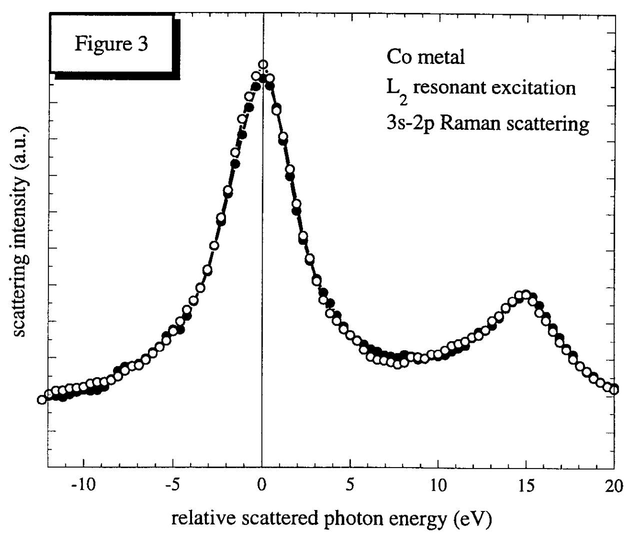
Figure 3
Co metal
L2 resonant excitation
3s-2p Raman scattering
scattering intensity (a.u.)
-10 -5 0 5 10 15 20
relative scattered photon energy (eV)