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Beamline:	**Date of Experiment:**	**Date of Report:**
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Shifts:	**Local contact(s):**	*Received at ESRF:*
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Names and affiliations of applicants (Indicates experimentalists):

MAGNETIC CIRCULAR DICHROISM IN Fe L_3 FLUORESCENCE

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Report:

Strange *et al.* [1] predicted that soft x-ray emission (SXE) spectra of ferromagnetic transition metals, excited close to threshold with circularly polarized photons, reveal the spin resolved partial density of valence band states. The experimental observation of dichroic effects in SXE spectra has been reported [2,3]. Only now, however, could the experimental requirements described in the original proposal [1] be achieved with beamline 26 [4] at ESRF. We used a photon beam with about 85% circular polarization and a bandwidth of 1.3 eV just above the Fe L_3 edge to measure the SXE using a grazing incidence Rowland spectrometer with a resolution of around 1 eV. The emission from bulk Fe (a 400Å thick buried layer) was measured to examine the predictions of the original theory, and the method was applied to a multilayer structure consisting of two monolayer of Fe sandwiched between Au layers.

Diffuse reflection, high-energy satellites and self-absorption can give rise to artifacts in the spectra. Several experimental measures have to be taken to extract the relvant valence band information: (a) The high-energy satellites are suppressed by exciting close to threshold. (b) As we show in Fig 1 for bulk Fe, the diffuse reflection of the primary beam has appreciable intensity. Since the reflectivity is highly dichroic, high resolution in the SXE spectroscopy is important in order to separate reflection dichroism and fluorescence dichroism. We believe that diffuse reflection is the major source of dichroic effects earlier attributed to dichroic fluorescence. Due to the high resolution in the spectra the reflected intensity can be subtracted. Orienting the sample surface normal off the scattering plane further reduces the influence of reflection. (Fig. 1 bottom) (c) Self-absorption of the outgoing radiation is corrected using the two-step approximation for the absorption-emission process.

In Fig. 2 we present corrected data for bulk Fe, confirming that the shape and not only the intensity of the SXE spectrum associated with a valence electron filling the $2p_{3/2}$ hole is dependent on the polarization of the exciting radiation. The dichroic effect is about 3% in magnitude, much smaller than has been assumed earlier. The discrepancy is mainly due to the correction for diffuse reflection. By comparing the experimental results to predictions based on band structure calculations we demonstrate the importance of including the energy dependence of the matrix element effects. The SXE spectrum is narrower than the calculated x-ray intensity (which in turn is narrower than the broadened d-DOS) and lacks the low-energy shoulder at -3.5 eV. Matrix element effects are seen to influence both the apparent d-bandwidth as well as the dichroism magnitude.

The results for the system with reduced dimensionality are currently being analyzed.

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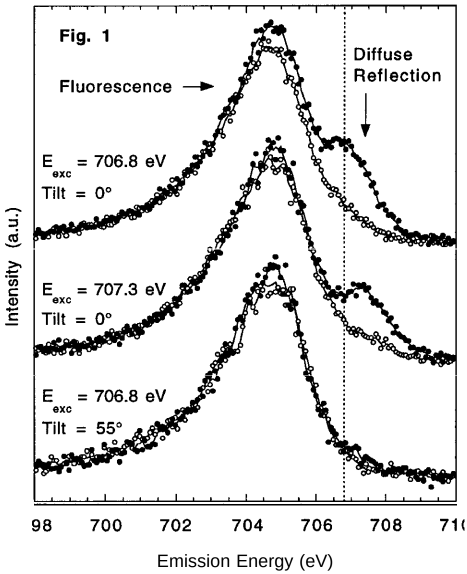

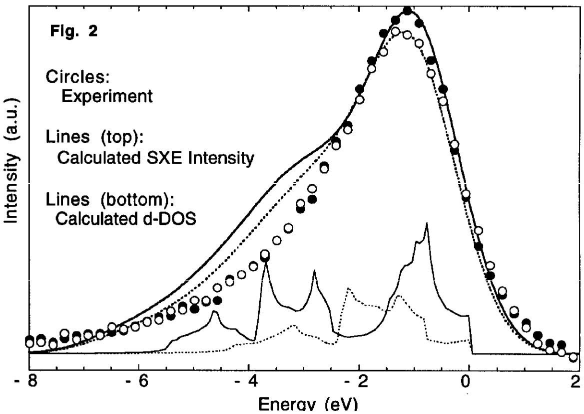

Figs.: Closed and open circles (solid and broken lines) refer to inverted magnetization (spin direction). Fig. 1: Raw data for different excitation energies / geometry. Fig.2: Corrected data and theoretical predictions.

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