ESRF	**Experiment title:** Temperature dependent Fe 1s2p RIXS-LD on Fe_3O_4 thin film	**Experiment number**: HC-2266
Beamline: ID26	**Date of experiment**: from: 3/02/2016 to: 9/02/2016	**Date of report**:
Shifts:	**Local contact(s)**: Marco	*Received at ESRF:*

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1. Background Information

The wide variety of applications of Fe_3O_4 drive the need to develop a bulk sensitive, element and site selective probe of the electronic and magnetic structure of the Fe sites. 1s2p resonant inelastic X-ray scattering (RIXS) of Fe takes advantage of the high penetration depth and bulk sensitivity of hard X-rays combined with element selectivity. Although the energy resolution of the experiment is considerably lower than what can be achieved in the soft X-ray range, a detailed study of the angular dependence can reveal interactions smaller than the instrumental energy bandwidth (such as spin-orbit and exchange interactions as shown in experiments HC-2266). This is because the experiment makes use of the constraints imposed by the crystal symmetry and the scattering geometry. Based on our previous findings, we performed a detailed Fe 1s2p RIXS magnetic linear dichroism (MLD) measurement to elucidate the ground state (GS) and quantify the orbital moments of Fe in Fe_3O_4. This will serve as a corner stone in our understanding of the interplay of degrees of freedom in the archetype oxide.

2. Results

Our aim was to record the angular dependence of the Fe *1s2p* RIXS cross-section as a function of the external magnetic field rotation and polarization dependence. We identified four main dichroism features at the Fe K pre-edge of magnetite (see Figure 1).

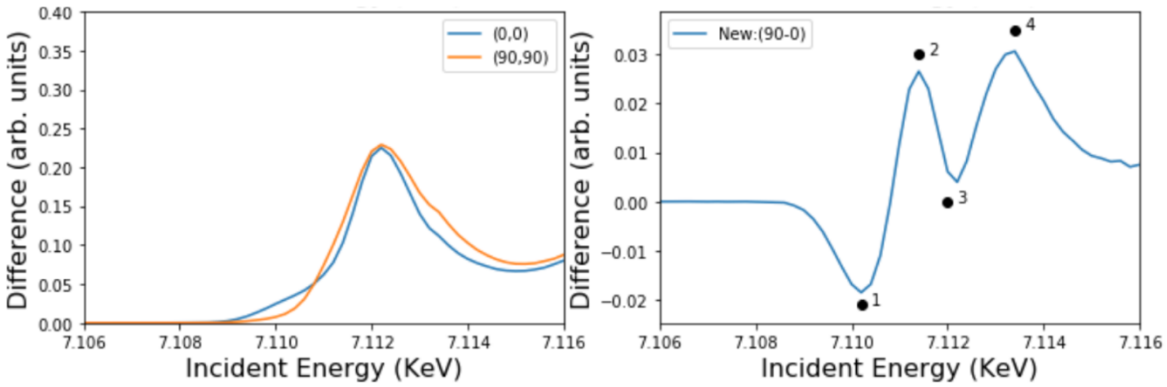

Figure 1: Fe K pre-edge of Fe_3O_4. Left: measurements at two rotation angles 0 and 90°. Right: Difference indicating the dichroism features.

At each feature, we recorded a detailed angular map of the RIXS intensity as can be seen in figure 2. The angular maps of the four features have different evolution indicating the difference in the excitations involved. By comparing our experimental angular dependence to ligand field multiplet calculaions, we will elucidate the ground state (GS) and quantify the orbital moments of Fe in Fe_3O_4

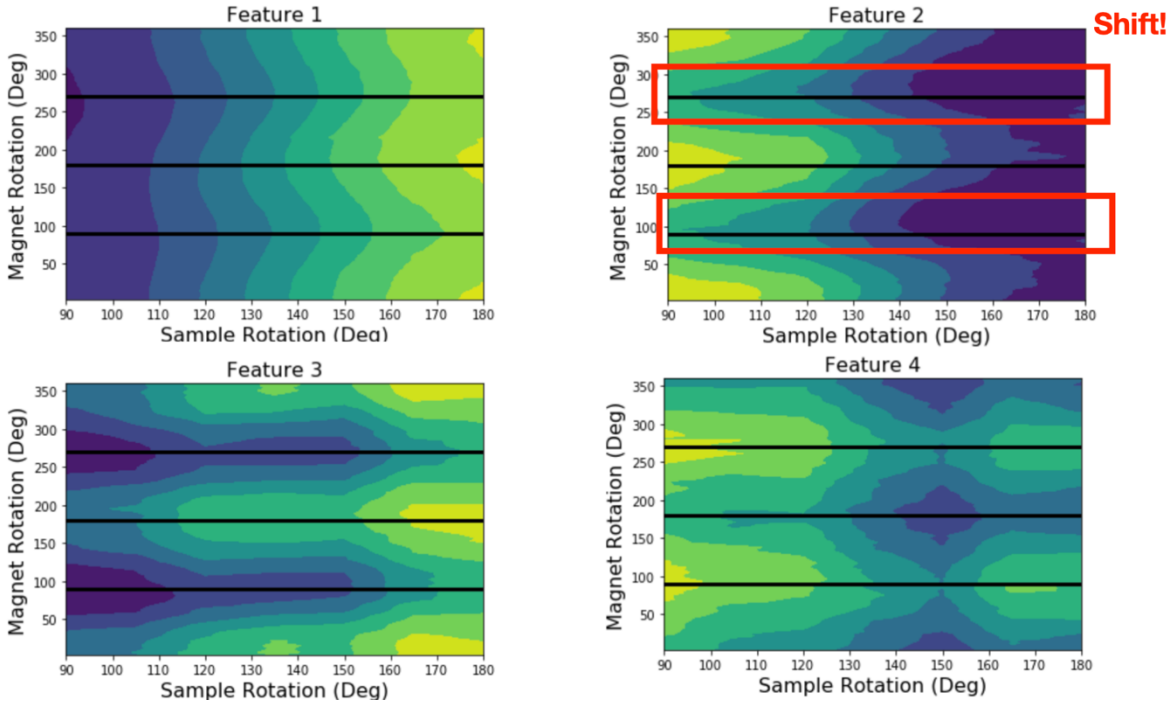

Figure 2: Angular dependence of the dichrism features at the pre-edge of Fe in Fe_3O_4.