ESRF	**Experiment title:** Investigation of electronic anisotropies with high purity X-ray polarimetry	**Experiment number**: HC-4502
Beamline: ID26	**Date of experiment**: from: 22.6.2021 to: 28.6.2021	**Date of report**: 15.9.2021
Shifts: 18	**Local contact(s)**: Blanka Detlefs	*Received at ESRF:*

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Report:

In experiment HC-4502 we investigated electronic anisotropies of d- and f-orbitals at the Gd L_1 absorption edge (8376 eV) of $Gd_3Ga_5O_{12}$ with a highly sensitive polarimeter. The experimental setup was realized as originally proposed. We provided the X-ray polarizer and analyzer Si(333) channel-cut crystals as well as the goniometer setup of the polarimeter. The 18µm thin GGG sample crystal was mounted on the beamline Eulerian cradle. A diode and the ionization chambers, which were also provided by us, were operated with a current-frequency-converter.

The whole setup of the experiment was successfully implemented into the beamline system of ID26 and worked very well. We achieved a polarization purity of the polarimeter of $\sim 10^{-9}$ with X-ray polarizer and analyzer in crossed position around the Gd L_1-absorption edge. We were able to measure polarization-resolved spectra by scanning the energy with the Bragg angle of the monochromator and readjusting the Bragg angle of the polarizer and analyzer channel-cut crystal. The analyzer rocking curves were measured for each energy step to detect the $\sigma \rightarrow \pi$ scattered photons of the sample. Simultaneously, conventional absorption spectra were recorded by the ionization chambers in front of and behind the sample. The scanning routine could be automated with a macro. The experimental setup worked quite well and spectra of $\sigma \rightarrow \pi$ scattered photons of the sample were measured as planned for different sample orientations. A difficulty arose from the unit cell of GGG: there are many potential Bragg reflections, which lead to a change of the polarization state of the transmitted beam. These changes are in general much higher than polarization changes caused by resonances, which we want to address with spectropolarimetry. Nevertheless, we were able to align the sample in such a way, that these contributions could be minimized. The evaluation of the data is still ongoing.

In the second part of the beamtime we changed the sample to TGG (terbium gallium garnet). TGG is a Faraday rotator in the optical spectral range. The L_2 edge (8252 eV) of terbium is close to the edge of gadolinium, so no time-consuming change of the setup was necessary. By applying a magnetic field of ±0.7 T longitudinal to the beam path, we measured the edge structure with our high resolution polarimeter. We achieved a polarization purity of ~10^{-7} in the edge range and could see pronounced changes in the edge region between 8248eV and 8255eV with magnetic field applied. The publication of these results is in progress.

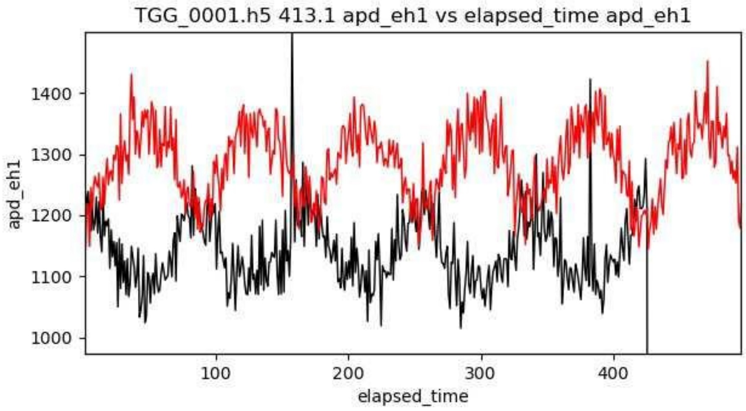

Figure 1: Faraday rotation in TGG. Timescan for a sinusoidal varying magnetic field (0…±0.7T) with polarimeter at an X-ray energy of E=8252eV.