

Full polarization analysis in LuFe_2O_4 on charge order superstructure reflections

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The aim of our experiment at beamline P09 on Petra3 was to verify if there is any anisotropic contribution in the polarization dependent scattering from charge order super structure reflections in LuFe_2O_4 single crystals. This anisotropy could indicate an order or glass like order (as reported in [1]) from the Fe orbitals. For this, we had some indications from previous soft x-ray experiment. We also performed a similar experiment at the ESRF on beamline ID20 at a temperature of 200K, where we found no indication for anisotropy connected to orbital order. In this experiment, we now want to test whether there is an anisotropic signal, and if so is it truly an orbital order contribution, or merely a manifestation of an anisotropic structural distortion. For this reason, we now measured the full polarization analysis below the 170K structural transition [2] at the Fe K edge. Our idea is, that this transition is may connected to the onset orbital order in LuFe_2O_4 .

After performing an energy scan on the ($\tau \tau$ 13.5) reflection around the Fe-K edge (see Fig.1 a) at 85K, we decided to perform the first full polarization analysis on the feature appearing on the Fe-K edge at 7111.1eV. This energy scan including its feature looks similar to previous results we achieved on this type of reflection on ID20 at the ESRF by using the same sample. We also performed polarization analysis on the ($\tau \tau$ 7.5) reflection leading to similar results and are thus not shown.

The result of the full polarization analysis (Fig.1 b) shows no clear indication for an anisotropic contribution to the polarization dependent scattering. The difference between the direct beam in grey (measured before) and the ($\tau \tau$ 13.5) reflection is explained by the higher 2θ value for this observation. This effect is reduced for the ($\tau \tau$ 7.5) reflection due to its smaller 2θ value. In conclusion, we have found no clear indication for anisotropic behaviour on charge order super structure reflections indication orbital order in the low temperature phase of LuFe_2O_4 . It may is possible that there is any weak orbital contribution below our signal, as there is a large isotropic scattering term present.

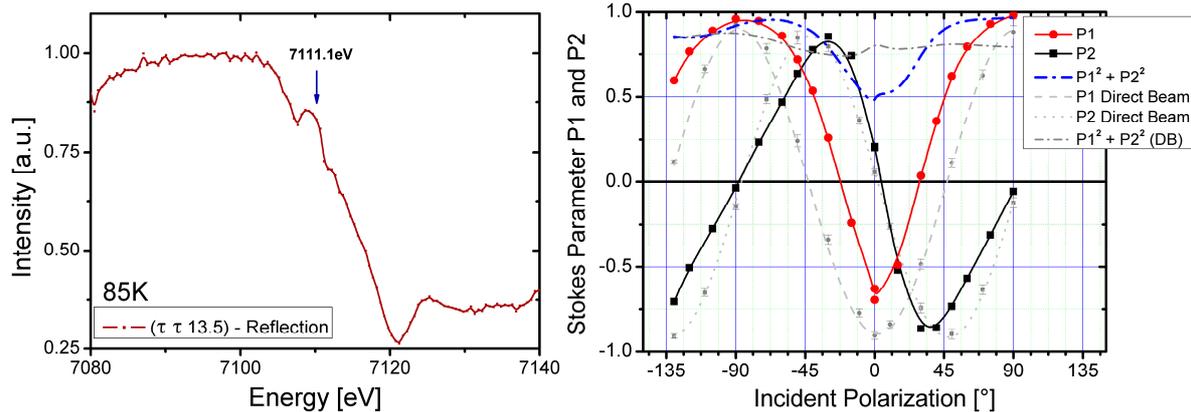


Figure 1: (a) Energy scan along the ($\tau \tau$ 13.5)-reflection taken at an temperature of 85K (b) Full linear polarization analysis on the ($\tau \tau$ 13.5) superstructure reflection, measured at an energy of 7111.1eV and an temperature of 85K.

Reference

- [1] A. M. Mulders *et al.*, Phys. Rev. Lett. **103** 077602 (2009).
- [2] X. S. Xu *et al.*, Phys. Rev. Lett. **101** 227602 (2008).