ESRF

	Experiment title: Spin-aligned dynamical structure factor $S(\vec{q},\omega)$ of ferromagnetic Fe(Si) single crystal	**Experiment number:** HE-461
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Report:

We have performed measurements of the dynamical structure factor $S(\vec{q},\omega)$ of ferromagnetic single crystal Fe(Si). We focused our attention on the interference term between the charge scattering amplitude and the magnetic scattering amplitude. This contribution can be separated from the pure charge scattering contribution by building differences between spectra for opposite helicity of the incident x-ray beam or for different directions of the magnetization of the sample.

Unfortunately the experiment could not be performed at the planned incident energy of 7 keV as the intensity turned out to be too low to achieve the necessary statistical accuracy. Therefore we had to change to 13 keV where the absorption of the sample was comparable to that just below the Fe K-edge. Although the higher incident energy led to an increase of the expected effect due to a prefactor E/mc^2, this increase was more than compensated by the loss of circular polarisation down to $P_3 = 0.53$, where P_3 denotes the 3rd Stokes parameter, and the worse resolution of 3 eV.

The measurements were performed in an energy range from 12.95 - 13.04 keV for a scattering angle of 24° corresponding to a momentum transfer of $q = 1.45$ a.u. After each spectrum we changed the orientation of the magnetic field by turning the permanent magnet by 180° and/or reversed the helicity of the incident x-ray beam by changing the phase of the helical undulator to end up with four types of spectra, where those belonging to different helicity *and* field orientation should be identical.

Surprisingly it turned out that spectra for different helicities show large differences (Fig 1a) while those for fixed helicity but different field orientation differ only within the limits of the statistical errors (Fig 1b). This effect was attributed to a sensitivity of the vdl monitor detector to the polarization of the incident beam. The respective device is detecting the radiation, scattered under 90° with respect to the orbital plane, from a Kapton foil positioned in the primary beam behind the monochromator. Therefore a change of the σ-part of the polarization leads to a change of the normalization signal. Considering this systematic effect we added up the spectra for opposite helicity and magnetization ending up with two sum spectra which should only differ by the magnetic effect. Admittedly the difference shown in Fig. 2 exhibits no significant structure. The reason for this can be attributed to a partially cancellation of the individual contributions of the spin-part and the quenched orbital-part of the magnetization.

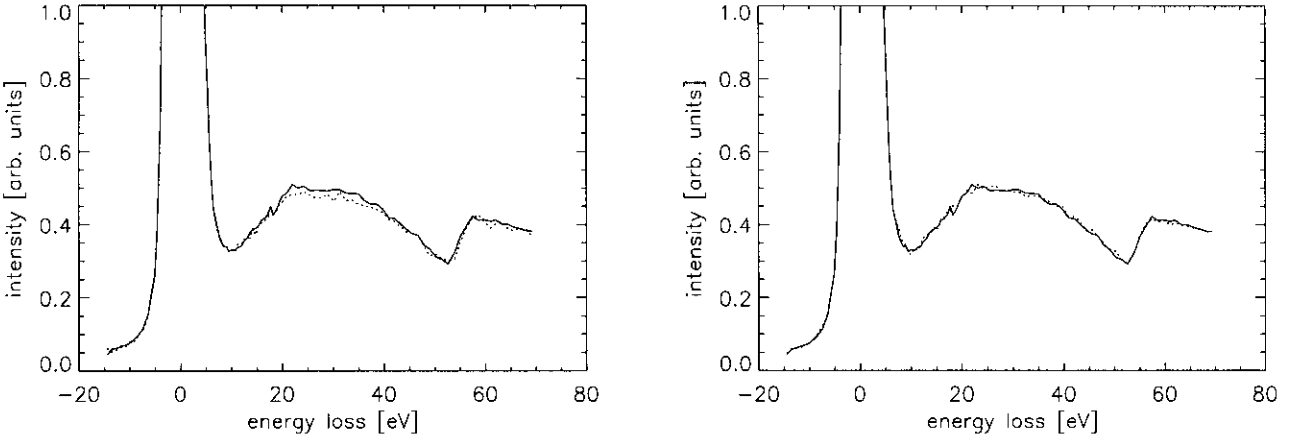

Fig. 1: (a) The left side shows two spectra which should be equal since they are equivalent due to opposite magnetization and helicity. (b) The right side shows two spectra for equal magnetization but opposite helicity. They should differ by the contribution of the interference part (cf. text).

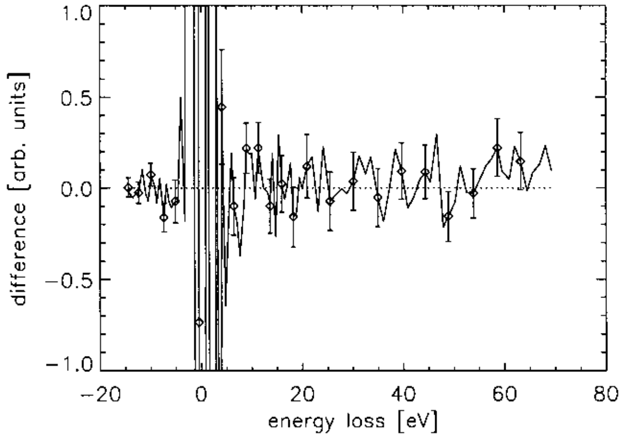

Fig. 2: Difference of the sums of all equivalent spectra.