ESRF	**Experiment title:** High Resolution Magnetic Compton Scattering from Fe.	**Experiment number:** HE-064
Beamline: ID15-BL25	**Date of experiment:** from: 27-Jul-96 to: 16-Aug-96	**Date of report:** 21-Feb-97
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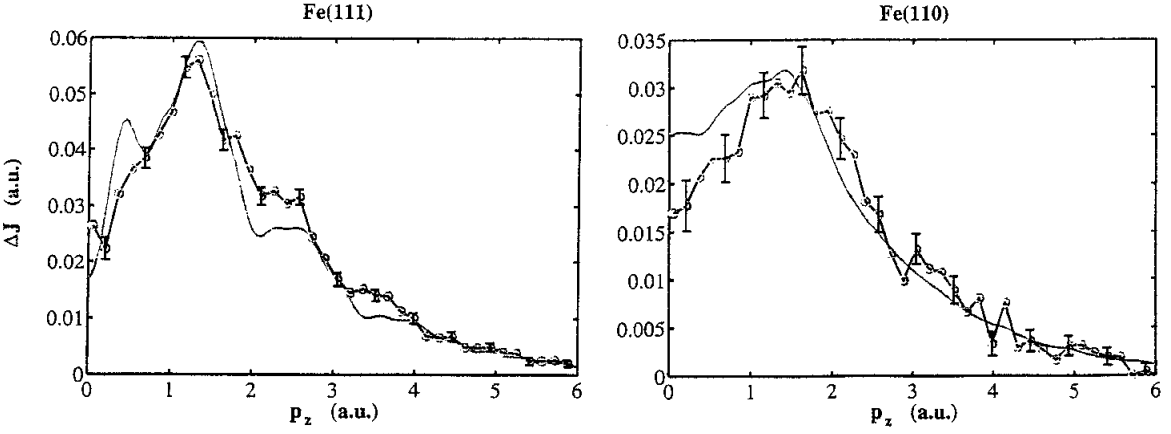
Report:

Magnetic Compton scattering made with synchrotron radiation has revealed many new results about the spin contribution in ferromagnets. Almost all determinations of magnetic Compton profiles have been made using a solid state Ge detector. The resolution of such measurements is typically 0.6-0.8a.u., limited by the use of such detectors. There are indications of fine features in the magnetic Compton profiles particularly at low electron momenta, but many of these are smoothed out due to low resolution. One example is Fe which has been extensively studied but which is still prone to discrepancies between experimental and theoretical profiles, again particularly at low electron momenta. During the beamtime given for this experiment, the magnetic Compton profiles of the [111] and [1 10] crystallographic directions of Fe were measured with 0.18a.u. resolution.

An incident beam of energy 57.56keV produced by a bent Si311 monochromator was incident on a single crystal sample of Fe. The sample was placed in the core of a mechanically-rotating permanent magnet with a field of 0.9T in a reflection geometry (chosen to minimise the resolution). The directions to be measured were aligned along the direction of the scattering vector **K** and the external magnetic field was aligned in turn collinear to both **K** and the crystal direction. Rotation of the permanent magnet allows the

field to be applied in the directions parallel and anti-parallel to the scattering vector to give the spin-up and spin-down Compton profiles. Circular polarised photons were extracted from the incident beam by using both primary slits and secondary slits to look only at the beam intensity arriving from +0.5mm to +4.5mm above the orbital plane, resulting in 80% circular polarisation. The horizontal focal width of the beam was 0.45mm. The magnetic field was reversed every hour and within this hour a scan of the Compton profile was made. The countrate at the Compton peak was ~1400cps at 100mA. A Si diode was used to monitor the incident beam intensity and a Ge detector placed at 90" to the incident beam monitored the Compton scattered intensity. The Fe[11 1] spin-up and spin-down profiles were measured over a total of 9 days = 27 shifts, and approximately $1.4x10^8$ counts were obtained under the Compton profiles of each. The average beam current during this time was about 100mA (combination of hybrid and 16-bunch modes). This left more time than expected in the original proposal and so the sample was simply rotated through 35" and the measurement repeated for the [110] direction. A total measuring time of 5 days = 15 shifts gave 9x107 counts under both the spin-up and spin-down profiles. The average beam current was again around 100mA. These statistics are very good.

The magnetic Compton profile was obtained by subtracting the spin-up and spin-down profiles. The figures below show the difference profiles for Fe[11 1] and Fe[1 IO] obtained in this experiment with 0.18a.u. resolution along with the theoretical profiles calculated using a FLAPW model. For the [111] direction the measurement made here reveals the presence of features around p_z=2.5a.u. and 4a.u. The main revelation of this measurement is the confirmation of a large discrepancy between theory and experiment at low momenta and particularly for the feature calculated to be at p_z=0.5a.u. by the theory. This feature is not present in the experimental data and implies that the theory includes an overestimation of the 4th and 5th band contributions to the profile in this region.



The Fe[1 10] profile has less features to compare with theory but again agreement was good above p_z=2a.u. but not so good at low momenta.