ESRF	**Experiment title:** High resolution magnetic Compton scattering in Nickel	**Experiment number:** HE-273
Beamline: ID15b	**Date of experiment:** from: 10.10.97 to: 21.10.97	**Date of report:** 10.2.98
Shifts: 30	**Local contact(s):** Abhay Shukla	*Received at ESRF:*

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Report:

The aim in this experiment was to obtain the first high resolution (Ap < 0.2a.u.) magnetic Compton profile from nickel (Ni), using the scanning spectrometer on ID15b. Previous measurements have been made on Ni using a solid state detector to analyse the spectra, but such studies are inherently limited to a best possible momentum resolution of -0.4 atomic units (a.u.) [1,2]. In contrast to Fe, there are many features predicted by band structure calculations which would be revealed at 0.2a.u., but which are smeared at 0.43a.u. Figure 1 shows the benefit gained fRom the acheived improvement in resolution. The thick dotted curve represents the effect of 0.43a.u. resolution as obtained in our previous successful measurement [l] on Ni, using a solid state detector on ID1 5a at the ESRF.

Although a high resolution study of Fe has been performed by this technique, the nickel moment is a factor of four smaller. The consequence of this is that in order to gain the same statistical accuracy, the total number of counts required is an order of magntidue larger. Unfortunately, despite having 30 shifts, it was not possible to collect sufficient data to form a partial MCP. A number of experimental problems were encounted. The main hitch was dealing with the large vertical acceptance angle of the analyser crystal. In principle, this permits a high count rate. Unfortunately, in this case the beam was collimated by the magnet

housing. This is not acceptable, for the magnet moves during the experiment, altering the degree of collimation, and destroying the validity of the data for this small magnetic signal. Slits were added to act as collimators, eliminating this problem, but simultaneously reducing the count rate.

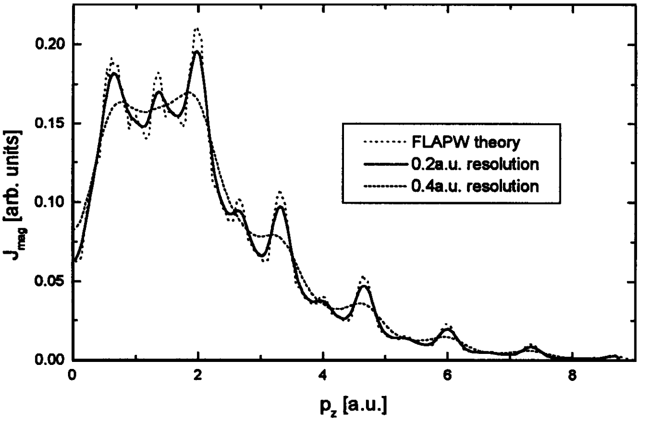

Figure 1. Band structure calculation of the MCP for Ni **[110]** (dotted line). The solid line represents the smeared profile at the resolution obtained in this experiment and the thick dotted line depicts the convoluted theory appropriate to using a Ge detector [**1**].

The experiment was thought to be possible on the basis of a previous successful measurement on single crystal Fe. Fe has a larger magnetic moment **($2.13\mu_B$,** instead of **$0.56\mu_B$),** increasing the experimental magnetic signal, and those data were not seriously jepardised by the magnet clipping the exit beam.

In conclusion, such a measurement is not presently feasible, but will be possible with the presently envisaged technical improvements on ID15b. Principally, this includes the planned replacement of the rotating magnet with an electromagnet having a larger vertical aperture for the scattered beam. Additionally the **flux** and incident beam energy will be increased, by using a new monochromator geometry. The improved flux and new magnet will increase the count rate by a factor of -5 [3], and the increased beam energy (from 58keV to 90keV) will enhance the magnetic effect, increasing the magnetic signal by 50%. Without these changes, the high resolution spectrometer cannot be reliably exploited for magnetic Compton scattering. However, once implemented, interesting high resolution experiments will clearly be feasible on ID15b. We intend to persue such experiments as soon as possible.

[l] M.A.G. Dixon *et al.* JPCM (1998).

[2] J.E. McCarthy et al J. Synchr. Rad. (1997).

[3] P. Suortti (1998) private communication.