Experiment title: Investigation of 2-Component Line-shapes in Holmium with use of Grazing Incidence In-plane Magnetic Scattering		Experiment number: 28-02-44
Beamline: BM 28	**Date of experiment:** from: 8/9/99 to: 13/9/99	**Date of report:** 13/4/00
Shifts: 18	**Local contact(s):**	*Received at XMaS:*

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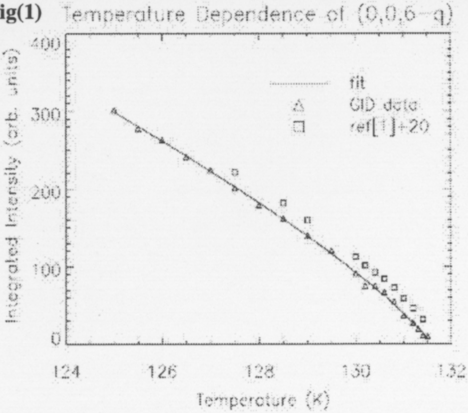
References.

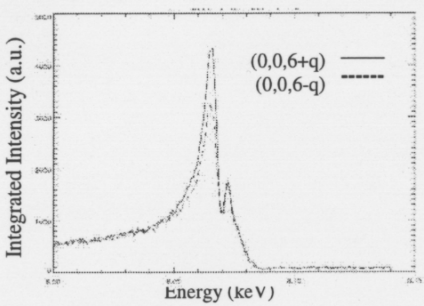
[1] T. R. Thurston et al, Phys. Rev. B 49, 15730 (1994)
[2] D. Gibbs et al, Phys. Rev. B 43, 5663 (1991)
[3] J. P. Hill et al, Acta Cryst A52, 236 (1996)

Report: The sample was initially aligned on the specular reflectivity, before moveing to the (006) charge reflection scattering in the horizontal plane whilst maintaining grazing incidence in the vertical plane. However, it soon became clear that the sample surface was not of sufficient quality to provide a good specular reflection. Critical scattering data were collected from the (0,0,6-q) magnetic satellite. Fig(1) shows this data plotted together with a fitted line with $\beta = 0.4$ and $T_N = 131.6$. The data of Ref[1] has been reproduced and is over plotted and offset by 20 for comparison (where fits gave $\beta = 0.37$ and $T_N = 131.14$). Count rates were low and in addition there is some doubt as to whether the observed scattering truly originated in the sample surface or was scattering from some edge, terrace or corner of the sample. Before any conclusions can be drawn regarding surface magnetic scattering we must first demonstrate unequivocally the two-dimensional nature of the scattering by measuring the surface truncation rods at anti-Bragg points. This should be possible with use of a larger, flatter sample, which we are currently investigating the possibility of obtaining.

Fig(1)



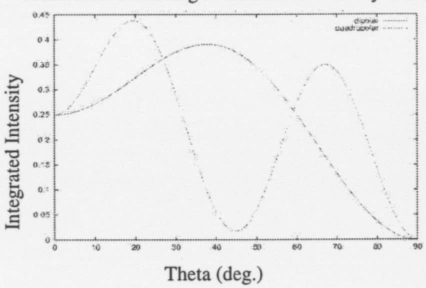
Fig(2) XRES Quadrupole and Dipole Signals at (0,0,6 ± q)



Energy scans were performed during alignment in order to maximize the signal to the peak of the XRES spectra at the ho L_{III} edge. Two such spectra, for the (0,0,6 ± q) reflections, are plotted in Fig(2). It is notable that the line-shapes bear little resemblance to the vertical scattering XRES spectra for ho (see for example Ref[2]). We have calculated the angular dependences of the π - π and π - σ components of the horizontal scattering XRES cross-sections, for both the dipolar and quadrupolar resonances, using the formulations of Ref[3]. The σ - σ and σ - π vertical scattering cross-sections for the quadrupolar resonance and the σ - π cross-section for the vertical scattering dipolar resonance have also been recalculated. For means of comparison, the angular dependences of the theoretical total dipolar and quadrupolar intensities are plotted in Fig(3a & b) for horizontal and vertical scattering geometries respectively (with $F_{E1}^{(1)} = F_{E2}^{(1)} = F_{E2}^{(3)} = 1$ for both plots, see Ref(3)).

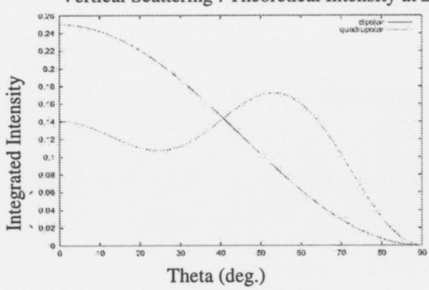
Fig(3a)

Horizontal Scattering : Theoretical Intensity at ± q



Fig(3b)

Vertical Scattering : Theoretical Intensity at ± q



At the ho L_{III} edge, the (0,0,6-q) reflection occurs at $\theta = 52.6°$ and the (0,0,6+q) at $\theta = 57.2°$. From examination of Fig(3a) it is clear that angular dependences of both the quadrupole and dipole components of the total scattering are in general agreement with the data. The extremely well resolved line-shape of the data is partly due to the small vertical slit settings required in order to avoid over illuminating the sample (s2vg = 0.1 mm) which results in ΔE (= 1.0 eV), being dominated by the natural width of the monochromator reflections. However, we have simulated the XRES cross-section using a model similar to that of Ref[2] and it is clear that the form of the line-shape can only result from the coherent interference of quadrupole and dipole resonances together with non-resonant contributions. We have subsequently carried out energy scans on this sample in the conventional c axis in the scattering plane (ie non-grazing incidence) geometry and can confirm the observed line-shape is due to the horizontal geometry and not unique to grazing incidence scattering.