ESRF	**Experiment title:** Determination of the spin-magnetization density in antiferromagnetic holmium	**Experiment number:** HE - 53
Beamline: IDlOA	**Date of experiment:** from: 06/08/96 to: 1 1/08. 1996	**Date of report:** 10.12.1996
Shifts: 12	**Local contact(s):** Christoph SUTTER	*Received at ESRF:* 2 7 FEV. 1997

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Report:

The aim of this experiment was the separation of the spin (S) and orbital (L) magnetization density in antiferromagnetic holmium. One way to address this problem is the determination of the non-resonant magnetic scattering cross-section, which depends linearly on the Fourier transforms of L and S [1].

The spiral magnetic structure of holmium gives rise to magnetic satellites of the type $(00n\pm\tau)$ (n=0,2,4,...). For incident σ-polarized photons (E=10.44 keV), we have measured the Q-dependence (n=0,2,4,6,8) of the σ- and π- components of the scattered intensity at T = 40 K (=>τ=0.202) of a holmium single crystal (mosaic width: 0.04" as determined at the (004) Bragg reflection). The (008) reflection of a graphite crystal was used to separate the σ-(I_σ) and π- polarized (I_π) intensity of the diffracted beam.

The degree of linear polarization P' of the diffracted which depends only on the orbital to spin magnetization ratio L/S is defined as:

$$P' = \frac{I_\sigma - I_\pi}{I_\sigma + I_\pi}$$

The integrated intensities I_π and I_σ were determined by rocking the sample at the different magnetic satellite positions and fitting the curves to a Lorentzian lineshape.

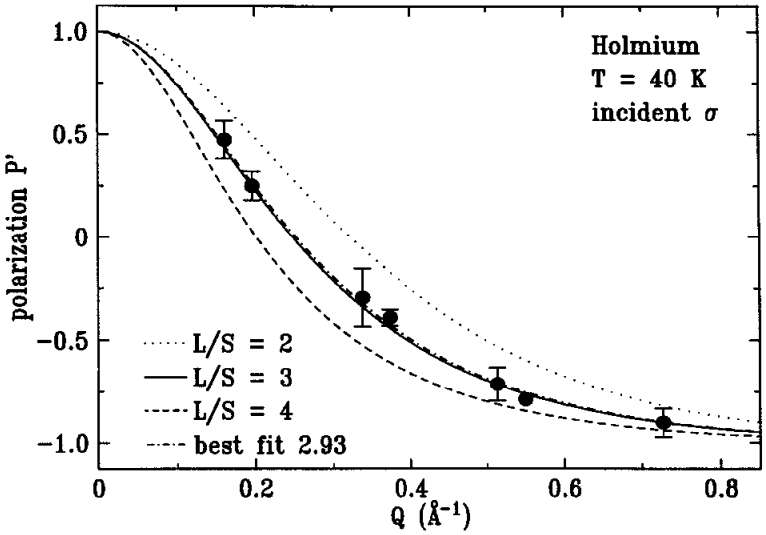

Figure: Degree of linear polarization (P') of the diffracted beam at the $(00n\pm\tau)$ (n=2,4,6,8) magnetic satellites. The dotted, full, dashed and dot-dashed lines are the calculated values for L/S = 2, 3, 4, and 2.93 respectively.

The Q-dependence of the degree of linear polarization P' of the diffracted beam is shown in the figure together with the theoretically expected curves for L/S = 2, 3, and 4. The satellite at the origine (00τ) could not be found due to the high background (about 1000 cps at this position) from the crystal truncation rod compared to the expected intensity for this satellite in the order of 1 cps. A similarly high background level was found in the Go-channel of the $(008\text{-}\tau)$ satellite which made the determination of P' impossible.

All other data points are well described by the curve for L/S = 3. The best fit to the data with the ratio L/S as the only fit parameter, yields L/S = 2.9kO.3. This value is in agreement with the expected value for the $^5I_8$ Hund's rule ground state of holmium.

In conclusion, the experiment showed that the L/S- ratio can be determined in a quantitative way. This is a major improovement to previous experiments performed at NSLS at Brookhaven [2] where only qualitative results could be obtained, mainly due to the lack of intensity and degree of linear polarization of the incident beam.

[l] M. Blume et al., Phys. Rev. B 37, 1779 (1988)
[2] D. Gibbs et al., Phys. Rev. B 43, 5663 (1991)