XMaS the UK-CRG	**Experiment title:** Energy and Ionic Site Dependence of Magnetic X-ray Scattering from Antiferromagnetically Ordered Neodymium.	**Experiment number**: 28-01-29
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Shifts: 18	**Local contact(s)**: Anne Stunault	*Received at XMaS:*

Names and affiliations of applicants (* indicates experimentalists):

Prof. E.M. Forgan*
Mr. N. Burton*
Mr. P.G. Kealey*
School of Physics and Astronomy
University of Birmingham
Prof. W.G. Stirling
Mr. A. Herring*
Department of Physics
University of Liverpool

Report:

We have investigated the energy and **Q** dependence of x-ray resonant magnetic scattering (XRES) from a single crystal of Neodymium metal at low temperature.

Measurements were carried out at a temperature of approximately 10K, at which Neodymium has a sinusoidally modulated 2-**q** magnetic structure which is incommensurate with the crystal lattice. In a single domain sample this structure gives rise to four magnetic satellites around each charge peak. Scans of the diffracted intensity as a function of energy were made at each of the satellites around the (005), (007) and (009) reciprocal lattice points. These scans were made using polarisation analysis which will provide information about the relative contributions to the scattering process from dipole and quadrupole transitions [**1**].

At the L_{II} absorption edge (6.722 keV) the resonant response appears to be predominantly electric dipole, although the shoulder on the high energy side indicates a possible additional contribution [**Fig.1**].

The energy dependence of XRES near the L_{III} edge seems to be far more complicated [**Fig.3a**]. There are substantial contributions from both dipole and quadrupole transitions which appear to cancel exactly to zero at an interim energy indicating that the two

processes have opposite phase.

The higher energy peak is typically accompanied by a series of 'wiggles' which we believe to be magDAFS. As evidence for the dipolar nature of the higher energy peak, we present figure 3b which was taken in the σ-σ channel. The higher energy peak is not present, as would be expected from a dipole resonance. Conversely the lower energy peak is present in both channels indicating a quadrupolar response.

The relative dipole and quadrupole contributions also show a strong Q-dependence. We believe that detailed analysis will clarify the origin of this.

In addition to measurements by XRES, a small number of non-resonant scans were made (an example of which is to be seen in **Fig.2**). Polarisation analysis of non-resonant magnetic scattering can yield information about the **L** and **S** contributions to the atomic moment and these scans indicate the feasibility of such a study.

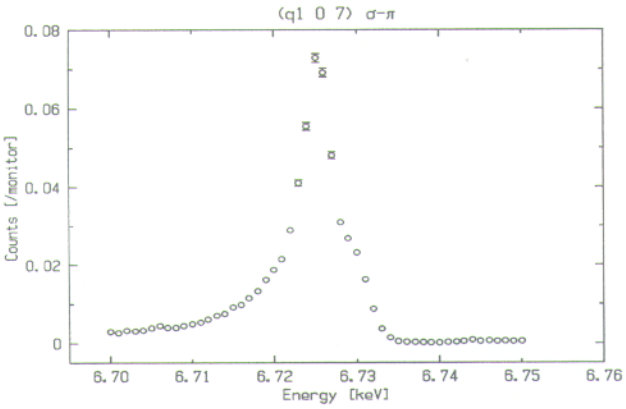

Figure 1.

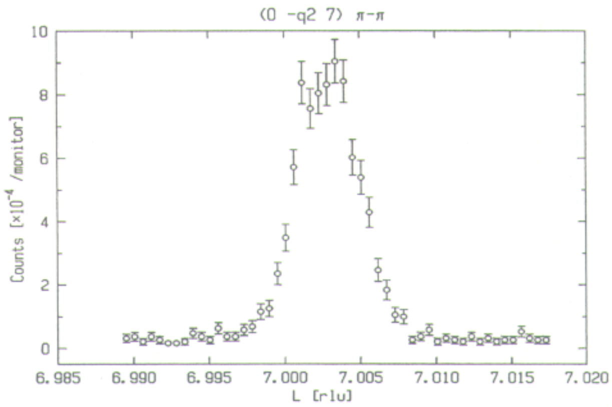

Figure 2.

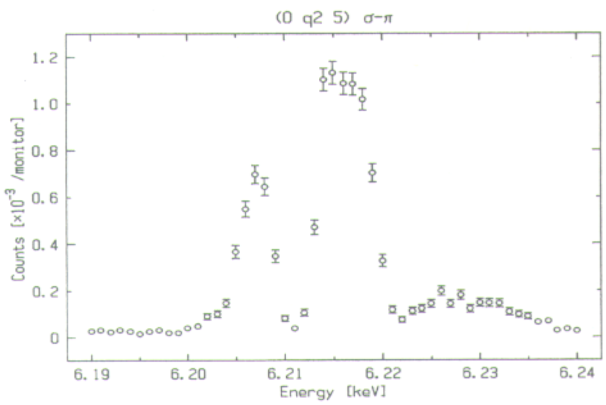

Figure 3a.

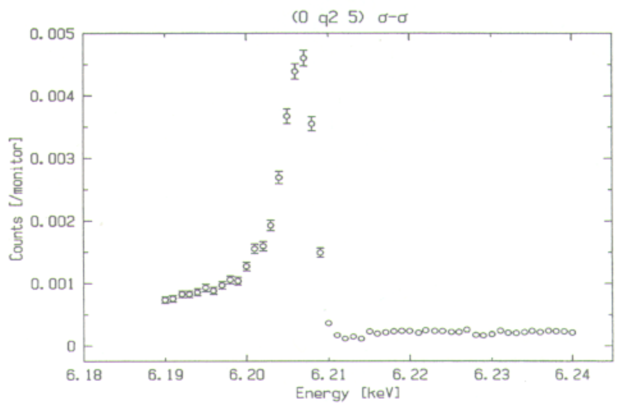

Figure 3b.

Figure 1: Predominantly dipole response at the L_{II} edge.
Figure 2: Non-resonant magnetic scattering at 6.14 keV.
Figure 3a: Mixture of quadrupole and dipole responses at the L_{III} edge.
Figure 3b: The higher energy peak is not present in the σ-σ channel.

References.

[1] J.P. Hill and D.F. McMorrow *Acta Cryst.* **A52 236 (1996)**