XMaS the UK-CRG	**Experiment title:** The anomalous L-edge resonances in Nd/Pr superlattices	**Experiment number:** 28-01-64
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Shifts: 18	**Local contact(s):** Anne Stunault	*Received at XMaS:*

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Report:

By tuning the x-rays to resonant energies it is possible to study the magnetism of different components of a superlattice separately. This was achieved for the first time in a magnetic x-ray diffraction experiment using Nd/Pr superlattices. Energy scans with wave-vector transfer fixed at magnetic Bragg reflections revealed strong magnetic resonances at the Nd and Pr L_{II} edges, but with anomalous shoulders at higher energies. The aim of this experiment was to understand the line shapes of the L resonances.

The magnetism of a single-crystal DHCP $[Nd_{20}Pr_{20}]_{80}$ superlattice grown using molecular beam epitaxy was studied using XMaS. The x-ray energy was tuned to the Nd L_{II} and L_{III} resonances. Polarization analysis of the scattered beam was employed to eliminate the charge scattering background, and the sample was mounted in an ADP dysplex cryostat with a base temperature $T \sim 10$ K.

Energy scans were performed near the Nd L_{II} edge for a number of magnetic Bragg reflections at $T \sim 10$ K. The line shapes are found to overlay when the scans are normalized to the intensity of the main peak, see Fig. 1. This shows that the main peak and the shoulder at higher energy are due to the same type of transition. The integrated intensities of $\boldsymbol{Q}$ scans with energy fixed at $E = 6.723$ keV were obtained for many magnetic Bragg peaks. A preliminary analysis of these data indicates that the scattering arises from a dipolar transition from a $2p$ core level to the $5d$ band. The line shape of the Nd L_{II} resonance arises from the density of states in the $5d$ band, which is broader than the inverse core hole lifetime.

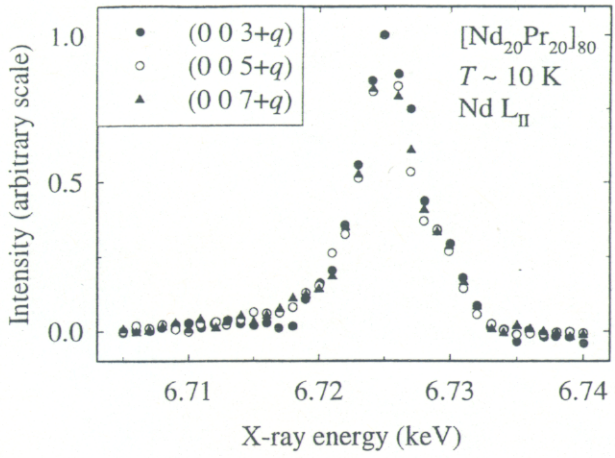

Fig. 1.

Preliminary measurements were performed at the weaker Nd L_{III} resonance. Figure 2 shows the energy line shape obtained with $\boldsymbol{Q}$ fixed at the magnetic Bragg reflection (0 0 3+q). The small feature below the absorption edge is attributed to a quadrupolar transition of a *2p* core electron to the *4f* level. $\boldsymbol{Q}$ scans at fixed energy confirm that this feature is peaked at the magnetic Bragg reflection. This scattering provides separate information on the localized ordering of the *4f* moments.

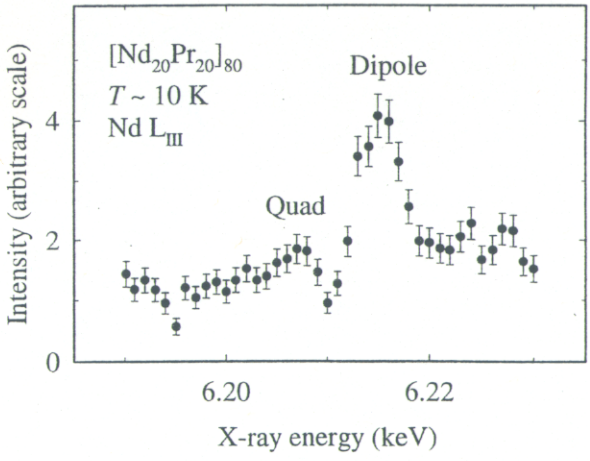

Fig. 2.