XMaS the UK-CRG	**Experiment title:** Magnetic ordering in single-crystal Ce/Nd superlattices	**Experiment number:** 28-01-098
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Report:

The growth of single-crystal Ce/Nd superlattices using molecular beam epitaxy allows the complex magnetic interactions between the different constituents of the superlattice to be studied. Synchrotron x-rays are required to study the structural superlattice harmonics in this system with small contrast between components. Furthermore, by tuning the energy of the x-rays to resonances it is possible to gain extra information on the structural properties of these superlattices, such as epitaxial strain, see Fig. 1.

A scan of x-ray energy at the Nd L_{II} edge with wave-vector transfer fixed at a magnetic reflection is shown in Fig. 2(a). Comparison with the fluorescence signal (Fig. 2(b)) shows that this is consistent with a transition to a broad *5d* band.

The high signal-to-background and narrow *Q*-resolution make x-ray magnetic resonant scattering (XMRS) ideal to investigate incommensurate magnetic ordering in thin-film samples. For a superlattice of composition $[Ce_{10}Nd_{30}]_{50}$ ordering of the Nd hexagonal moments is detected below T_N~18K with a sinusoidal modulation in the basal plane and an antiferromagnetic coupling between adjacent hexagonal planes. However, in contrast to bulk Nd, these sites remain in a transverse 2-*q* magnetic structure down to the base temperature *T*~1.7K, and the antiferromagnetic ordering on the cubic sites is suppressed. Figure 3 shows (a) ordering wave vector and (b) abrupt changes in the intensity below *T*~6K, and this is correlated with the onset of *c*-axis ferromagnetic ordering on the cubic sites determined in complementary neutron studies. The effect of the epitaxial strain in the Nd blocks is, therefore, related to the application of pressure to bulk samples.

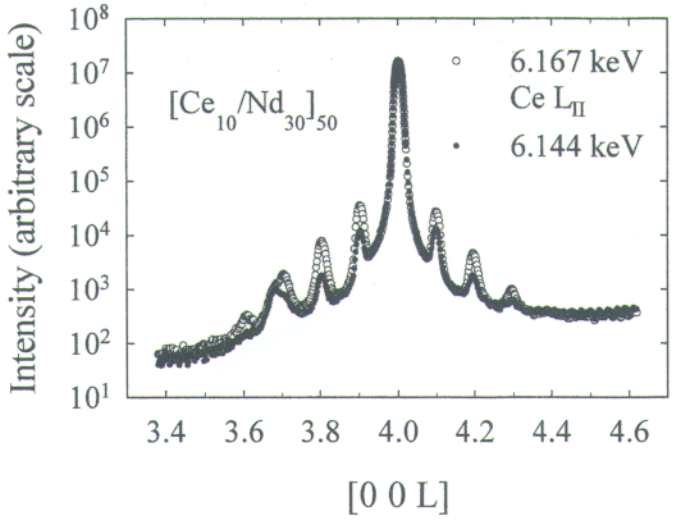

Fig. 1

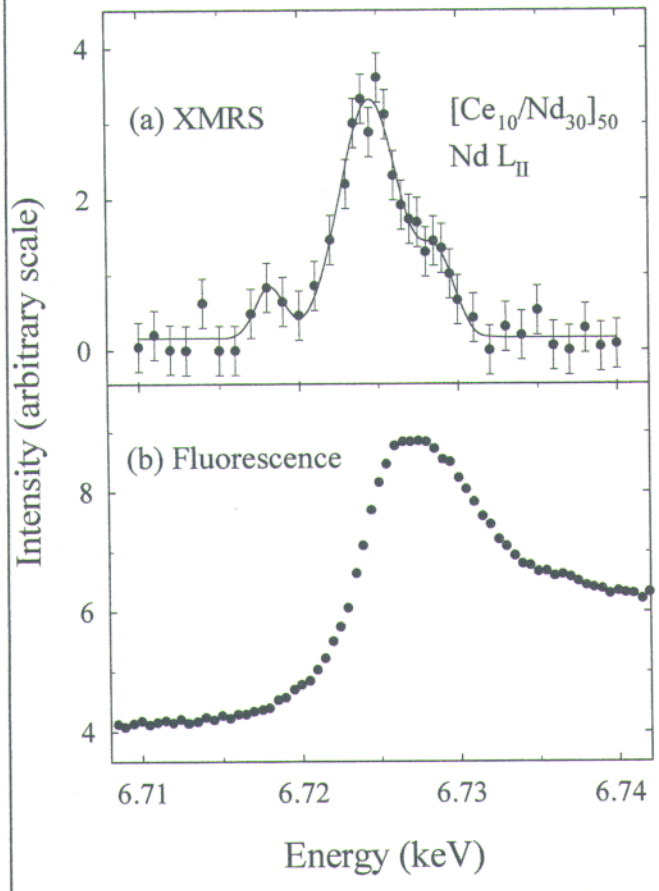

Fig. 2

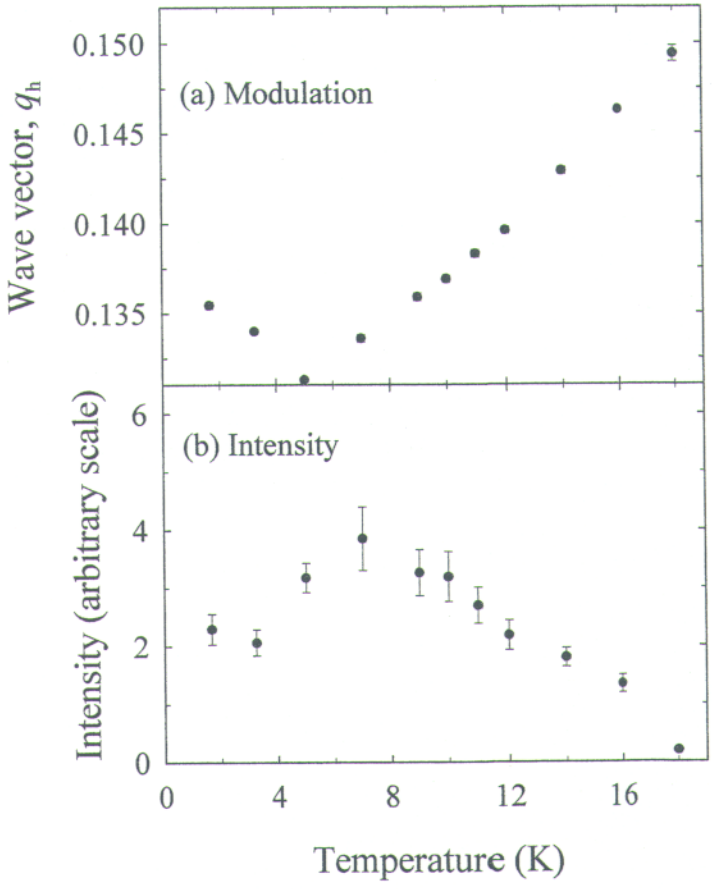

Fig. 3