ESRF	**Experiment title: Magnetic Octupole order in $Ce_{0.7}La_{0.3}B_6$? A resonant x-ray scattering investigation at 900mK in applied field.**	**Experiment number**: HE-1711
Beamline: BM28	**Date of experiment**: From: 31/3/2004 to:6/4/2004	**Date of report**: 12/7/04
Shifts:	**Local contact(s)**: D. Mannix	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

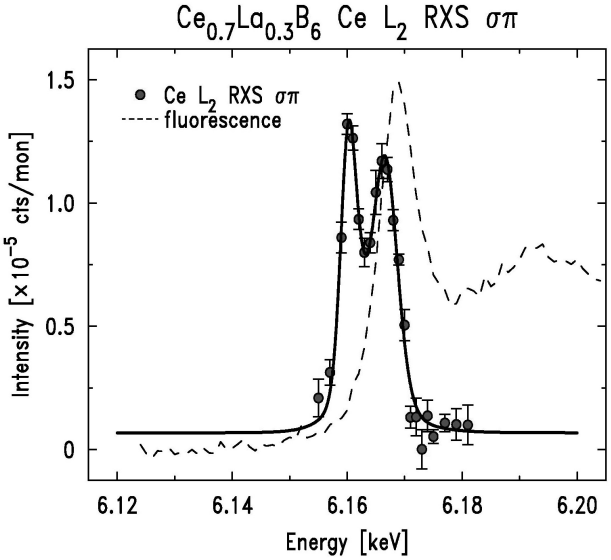
D. Mannix, XMaS UK CRG Beamline, ESRF, Grenoble, France.

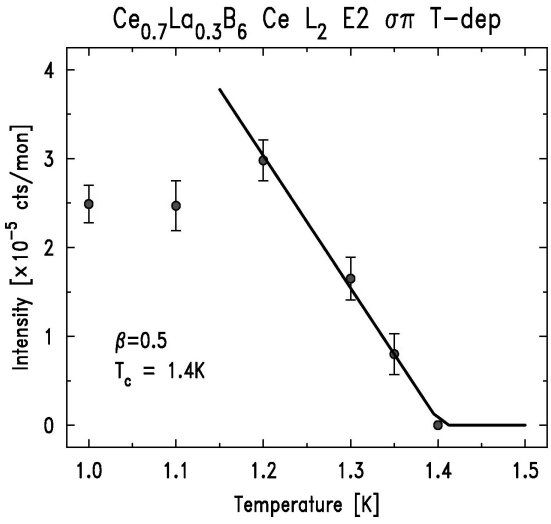
G. Carbone, CNRS-Grenoble, Grenoble, France

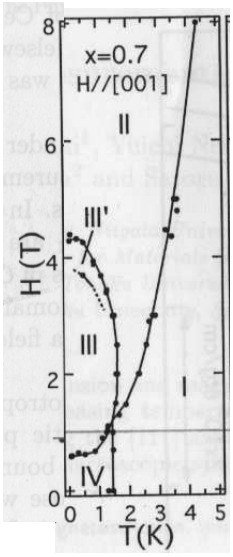
Report:

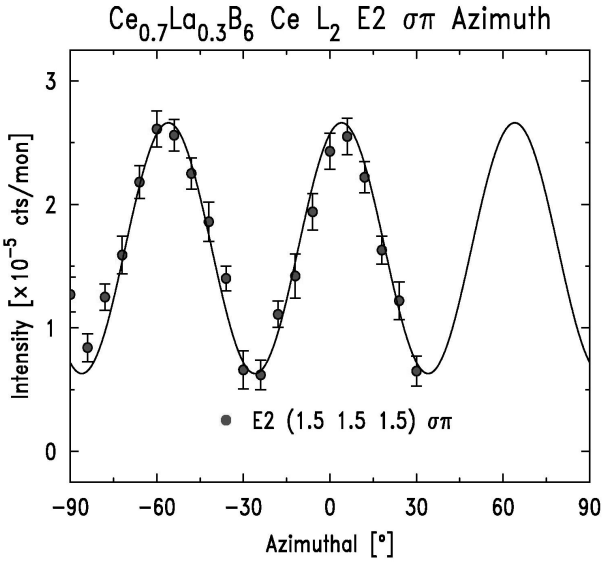
During experiment HE-1711 we have searched for possible signitures of magnetic octupole order in the new phase IV of $Ce_{0.7}La_{0.3}B_6$ by resonant x-ray scattering (RXS) using the ^{3}He displex at XMaS down to 900mK. We have been successful in obtaining diffraction information at the (½ ½ ½) Bragg position for the first time, by using RXS with the photons energy tuned to the Ce L_3 absorption edge (figure 1). No such superlattice peaks have been reported by neutron scatters, which suggests that they are not purely magnetic dipole in origin.

The RXS signal disappears at 1.4K (figure 2) in good agreement with the phase diagram deduced from magnetisation measurements [1] (figure 3). The azimuthal dependence of the RXS (figure 4) shows a six-fold symmetry. This azimuthal dependence is inconsistent with antiferromagnetic order (phase III) which would have a two-fold dependence and with antiferroquadrupole order (phase II) which gives a four-fold azimuthal dependence. Two possibilities exist as to the origin of the RXS giving this six-fold azimuthal dependence about the (111) direction: Either the RXS arises from a small crystallographic distortion, with the lowering of crysal symmetry from cubic to trigonal or the RXS arises from magnetic octupole order in phase IV. Only theory and further experiment will be able to determine which mechanism is the orgin of the RXS.









Figures 1-4 (above).

Figure 1 (top left). The RXS response at the Ce L_3 edge. Two peaks have been observed corresponding to E2 (quadrupole) transitions and E1 (dipole). No non-resonant scattering (away from edge) was observed).

Figure 2 (top right). The temperature depende of the RXS, the RXS disappears at 1.4K in agreement with the phase diagram (figure 3) crossing going from phase IV to the paramagnetic phase (phase I).

Figure 3 (botom left). The Ce(0.7)La(0.3) phase diagram. The new phase IV at low temperature and magnetic field. The antiferromagnetic phase III, antiferroquadrupole phase II and paramagnetic phase I.

Figure 4 (botttom right). The azimuthal dependence of the E2 RXS showing a six fold symmetry. The dependence is not consistent with antiferromagnetic order (phase III) or antiferroquadrupole order phase (II). The origin of the RXS can be either magnetic octupole order or from lowering of crystal symmetry.

References

[1] S. Nakamura et al. J. Phys. Soc. Japan. 71 112-114 (2002).