XMaS the UK-CRG	**Experiment title:** Resonant X-ray Magnetic Scattering from USb	**Experiment number:** 28-01-125
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Report:

We have recently been completing a series of measurements on an unusual diffraction effect that occurs near magnetic phase transitions. The central experimental observation is that when materials disorder there is an apparent "shift" in the ordered wave vector, defined as Dq. This is unrelated to the material becoming incommensurate. In the latter case there has to be a second, symmetry related, peak that is never observed. The effects are small, a few parts in 10^3, but easily within the resolution of modern diffractometers at synchrotron sources. Such measurements have been reported in the literature, but not understood [1, 2]. Recently, Bernhoeft has proposed an explanation of this effect in terms of a *dynamical phase* [3].

The present experiment on a single crystal of USb was to test this effect in a material with a much higher ordering temperature (~215 K) than any of the preceding materials, which all ordered at or below 30 K. The lattice and magnetostrictive effects are also known to be large in USb, so that a question we had was whether the effect would be robust enough to be observed in this material.

The experiment consists of tuning the photon energy to the U M_4 energy (3.728 keV) and measuring with the highest precision the position of the charge (002) and magnetic (003) reflections near T_N. Raw data for the magnetic (003) reflection is shown in Fig. 1. These data, and similar sets for the (002) charge reflection, may then be analysed for position, intensity, and width. Normalising to the reciprocal lattice vectors, we show the position of these two peaks in Fig. 2, together with insets giving the intensity and FWHM.

The Dq shift at T_N, i.e. the sudden drop of the apparent position of the magnetic peak, can clearly be seen (even in the raw data), even though Dq only attains a maximum value of 1.5 x 10^{-3} rlu. Further experiments on USb showed a resonance enhancement at the Sb L_3 edge at 4.13 keV, and a weaker effect at the Sb L_2 edge.

Figure 1:

Raw data for the (003) magnetic reflection (taken with a photon energy of 3.728 keV) as a function of temperature (data were taken for more temperatures than shown here). The shift away from the position (003) may be clearly seen.

Figure 2:

Normalised lattice position for the charge (002) [solid circles] and for the magnetic (003) [open circles]. The insets show the integrated intensity and FWHM of the (003) magnetic reflection.

Refs: [1] Watson et al.. PR B **53**, 686 (1996) [2] Hill et al., PR B **53**, 3487 (1996)
[3] N. Bernhoeft (to be published)