# XMaS Experimental Report

## BM28-01-980

**Date of Report:** 10/10/12

**Date of Experiment:** 26/09/12 to 02/10/12

**Title of Experiment:** Modulated magnetic states close to a ferromagnetic QCP


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**Summary**

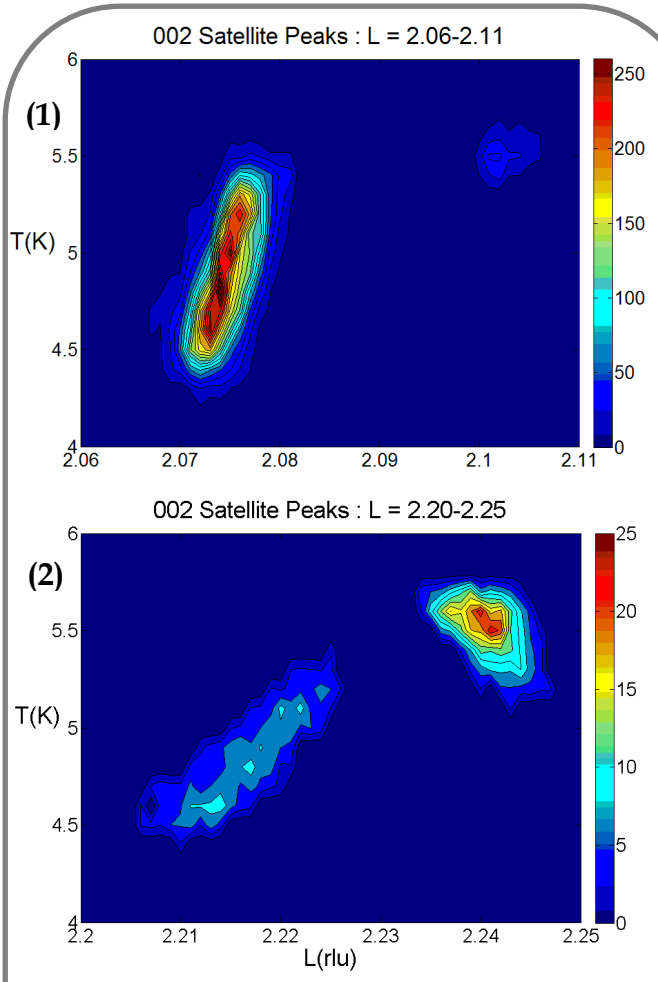
Vertical Scattering geometry
Joule Thompson Cryostat
σ-π polarisation
Azimuthal dependence
Vortex detector


The aim of the experiment was to resolve magnetic satellite peaks within a narrow temperature range of 4.7-5.7K in the intermetallic system PrPtAl. These satellites characterise two incommensurate phases sandwiched between the high temperature local moment paramagnetic state (T>5.7) and the canted ferromagnetic state (T<4.7K). The superior Q-resolution of XMaS relative to a neutron triple axis diffractometer and millikelvin temperature resolution down to 1.7K on a Joule Thompson cryostat allowed us to perform a precise study of Q vs T for all 4 satellites.

On the first day beam was aligned and four samples with the c-axis vertical were looked at. The best sample was chosen and then cooled to base temperature.

On the second day energy absorbance and fluorescence scans were taken at 5.0K at the 002 Bragg peak. This showed the $L_{II}$ edge to couple through dipole resonance at 6.440KeV. Looking first for the satellites off resonance we scanned along L on 002 observing nothing. On resonance the low Q satellite (L=2±0.07) satellite was observed but not the high Q satellite (L=2±0.22). Scans of the low Q satellite were taken as a function of temperature. Other Bragg positions were checked for the presence of the ±0.07 satellites at 004, 103, 001 and 003.

On the third day a LiF polarisation analyser crystal was mounted and the vortex detector moved into polarisation analysis position. Sample was realigned. In σ-π′ mode the satellites were remeasured at 5K. The tail of Bragg peak and other charge related background was suppressed and satellites at



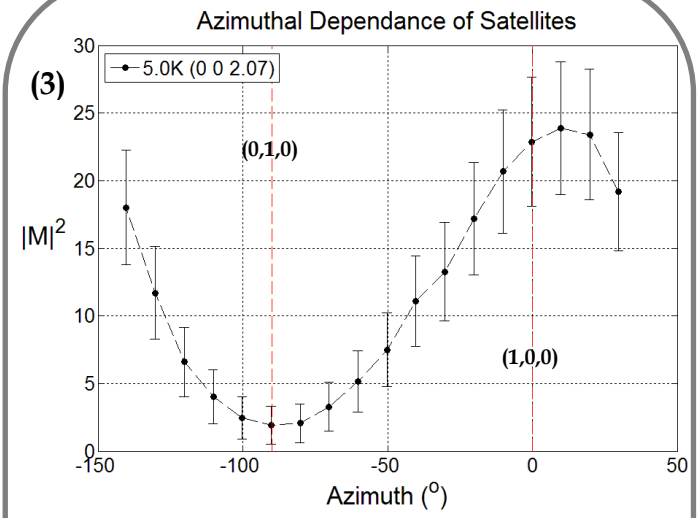

Figures (1) & (2) display elastic scattering about the 002 Bragg peak taken with XMaS in σ-π′ polarisation on the $L_{II}$ edge of Pr. Collectively the figures show the appearance of two satellite peaks at 5.7K at L = 2.103 & 2.241 rlu . At 5.2K these satellites vanish and are replaced by two new satellites centred at L = 2.074 & 2.217 rlu. The second pair of satellites are seen to have temperature dependant L components moving in from [2.077 – 2.072] & [2.224-2.208] between 5.2 and 4.5K.

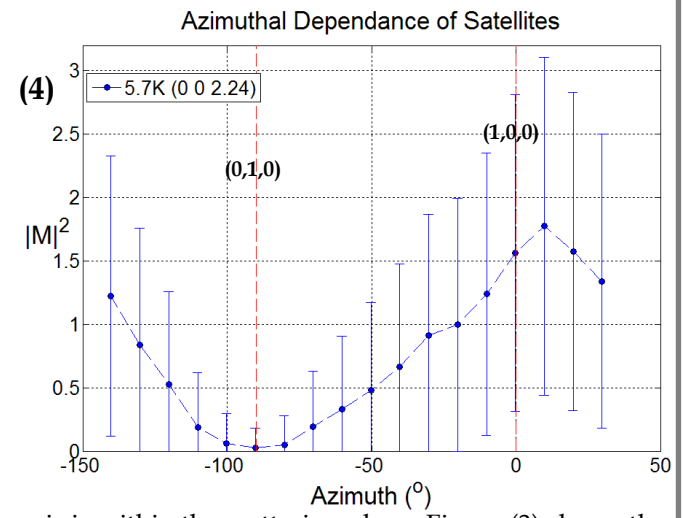
L=2±0.07 and L=2±0.22 were clearly observed. The H, K and L dependence of the satellites about 002 were then remeasured as a function of temperature. The results showed only an L component is present in the satellite propagation vectors. L dependence is displayed in figures (1) and (2).

On the fourth day azimuthal scans were taken in the two incommensurate phases (5.7K & 5.0K) on each satellite at the 002. Figures (3) & (4) display the results for two satellites one in each phase. It can be seen that the maximum intensity occurs when the a-axis resides in the vertical scattering plane while the intensity is at a minimum when the a-axis is normal to the plane.

Azimuthal scans were performed on satellites discovered at Bragg peaks : (0,-1,4), (1,0,4), (0,-1,4) and L vs T scans performed on the (1,-1,4) satellites with b-c in the scattering plane (i.e. azimuth at -90$^0$).

Experiment was successful and the analysis of the azimuthal dependence of the off-specular reflections is on-going.




axis is within the scattering plane. Figure (3) shows the azimuthal dependence at fixed Q=(0,0,2.07) at 5.0K and figure (4) shows fixed Q =(0,0,2.24) scans at 5.7K. The scan reveals a maximum in the scattering near the a-axis and a minimum when the b-axis rests in the scattering plane.