XMaS the UK-CRG	**Experiment title:** Time Dependence of Spin Ordering in Holmium	**Experiment number:** 28-01-37
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Report:

Thermal hysteresis in the region of the ferromagnetic phase transition in holmium indicates a non-equilibrium state. In order to investigate the origins of this phenomena a study was carried out of the time dependence of spin ordering. Initial measurements of the collapse of the q=1/6 phase on heating suggested that the wavevector was changing as a function of time and a phenomenological model was put forward which suggested an energy barrier comparable to the inter-planer exchange energy and a critical temperature which corresponded to an anomaly in the specific heat. Measurements carried out in this run, however, revealed a strong variation in switching time scales with the manner in which the sample was mounted onto the cryostat cold finger and the way in which the temperature sensor was attached. It now seems possible that the collapse of the 1/6 phase on heating is not strongly time dependent, although recent neutron measurements show strongly time dependent increases in intensity, over periods of several hours, at temperatures just below the temperature at which the 1/6 phase collapses [1]. Interestingly, in the same temperature range, x-ray intensities decrease. Before any further x-ray measurements can be performed it will be necessary to solve the temperature control problems. One solution might be to ion-

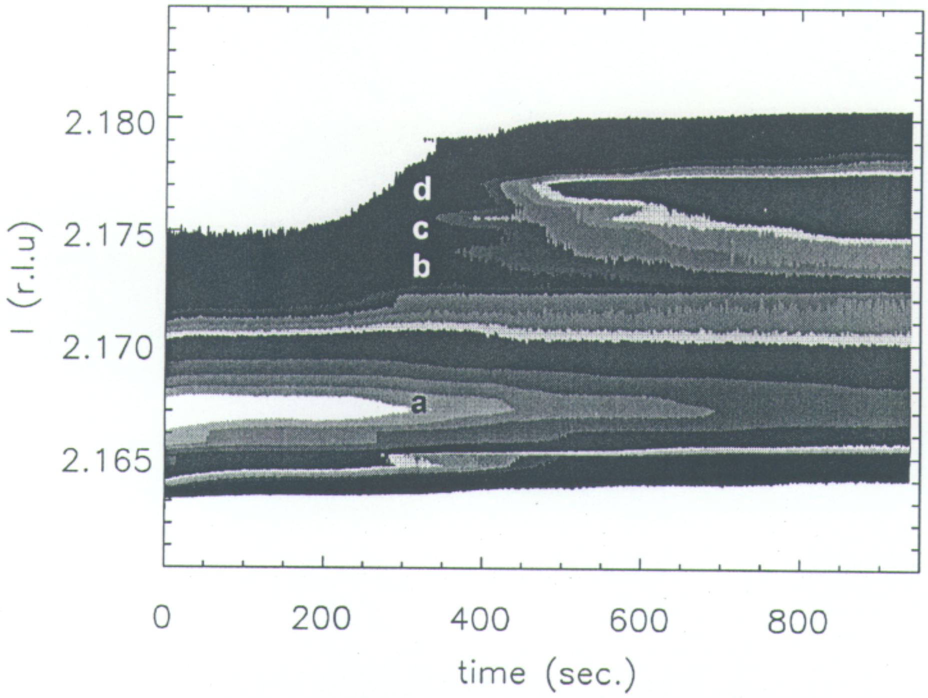

Fig. 1 Contour plot of the decay of the 1/6 phase (**a**) and subsequent metastable phases (**b**,**c** and **d**).

beam mill a hole in the sample and place the temperature sensor inside the sample. Test could then be performed using an identical cryostat to the one used in this experiment in order to minimise the time taken to thermalise the sample.

Despite this drawback, extremely high resolution data were obtained as illustrated in Fig 1. Here, the temperature was cycled from 10 K to 19.3 K with the diffractometer aligned to wavevectors around the 1/6 position. Thus, with each cycle, the apparent time dependence was measured at a different wavevector. The peak marked **a** which appears to decay with time (in fact, it probably decays with a slowly increasing temperature drift) is the 1/6 peak. The ridges masked **b**,**c** and **d** correspond to the 11/63, 10/57 and 3/17 lock in phases respectively. As the thermal evolution of the sample is the same at each wavevector, re-grouping of the data along lines of constant t has allowed time-independent measurement of momentum transfer around the q=1/6 position.