	Experiment title: Pressure dependence of the 4f and 3f magnetic moments in ErCo2	**Experiment number**: HE1470
Beamline:	**Date of experiment**: from: 02/02/2005 to: 08/02/2005	**Date of report**: 26/08/2005
Shifts: 18	**Local contact(s)**: **Dr Tom FENNELL**	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Dr J Taylor, ISIS Facility, RAL, Chilton, Oxfordshire, OX11 0QX, UK

Dr C Steer, Dept of Physics, Warwick University, Coventry, CV47AL, UK

Mr L. Blauw, Dept of Physics, Warwick University, Coventry, CV47AL, UK

Report:

The aim of experiment was to study the pressure dependence of the magnetic properties of Itinerant electron metamagnet $ErCo_2$, using spin-polarised Compton scattering. This method enables one to distinguish between the Er 4f and Co 3d moments. $ErCo_2$ is often thought of as a type of metamagnetic material. Metamagnetic materials exhibit magnetic phase transitions that are induced by the application of a magnetic field. Such effects occur in a number of *3d, 4f* and *5f* inter-metallics. As opposed to the *4d/3d* system YCo2 the *4f/3d* intermetallic systems (of which ErCo2 is an example), the magnetic properties are complicated by the presence of the magnetic moment carried by the *4f* electrons here, the Co sublattice can be magnetised by the molecular field arising from the *4f* exchange interaction, and metamagnetic phase transitions are observed at fields considerably smaller than in YCo_2. In zero field and zero pressure the large molecular field from the 4f subsystem is enough to induce order in the Co sublattice simultaneously at Tc=33K. However from previous pressure measurements Tc rapidly drops to <15K at 2.5 GPa and then remains fairly constant thereafter. (Fig. 1). The objectives of this experiment were to investigate the evolution of the 4f and 3d spin moments as a function of pressure and hence to determine the reason why the observed pressure dependence of Tc shows a non-monatomic decrease. It was expected that at some point the Co sublattice order is suppressed as a result of the effect of applied pressure on the band structure of the itinerant electron system.

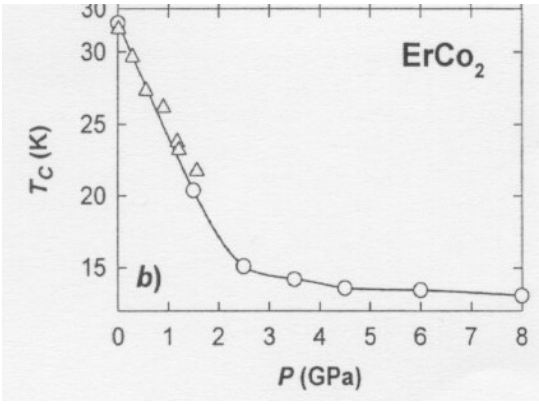

Figure 1. Pressure dependence of the Curie temperature in ErCo2,

We planned to make initially two measurements of the spin density, one at zero pressure and one above 3GPa. The beamline set up with an incident energy og ~90KeV using a horizontally focusing

monochromator. Sample environment was a standard He cryostat with Mylar windows. The first measurement performed was on a bulk sample of ErCo2 at 4K. Initially we encountered a problem associated with the digital electronics attached to the 13element Ge detector. In order to extract the spin dependent signal one makes a 'difference' measurement by flipping the direction of the magnetization vector of the sample. Unfortunately the digital electronics did not produce the required stability and thus upon subtraction of the +ve and –Ve dataset a spurious signal was obtained. (See figure 2) In order to check the system we performed a number of measurements with opposite incident beam polarizations. Theoretically this should result in one recovering spectra of opposite sign if the normalisation (to incident flux) is correct. Figure 2 and 3 shows the result of these measurements, it is clear that some component in the counting chain produces a signal that is not a function of the incident beam flux and there for cannot be normalised. This is evident in the spectra at 0pz where both the polarizations used produce a feature in the spectra that is strongly positive as indicated by the arrows. Unfortunately this is in the region of momentum space that corresponds to highly delocalized spins and although one may comment on the localized contribution to the momentum density (i.e. the 4f system) the 3d component is masked by this spurion.

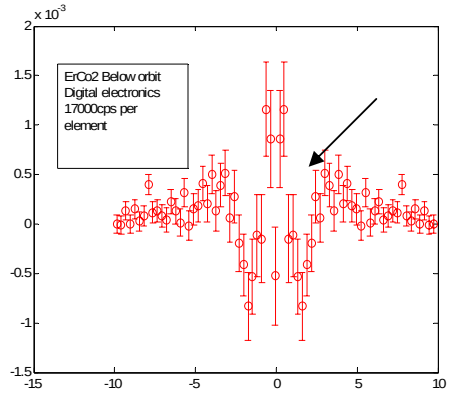

Fig 2 Magnetic Compton profile for -Pc

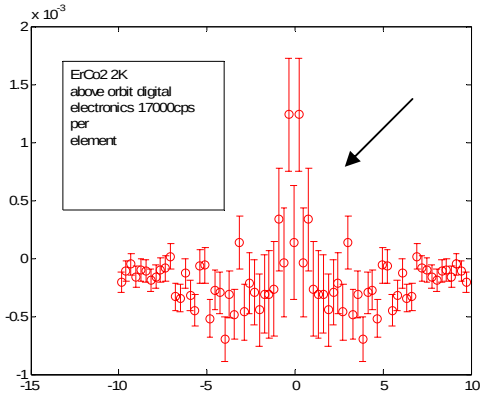

Fig 3 Magnetic Compton profile for +Pc

After changing the counting chain to an analogue system we re-measured the magnetic Compton profiles as a function of incident beam polarisation. Although we were limited to 10000cps per detector (thus partially negating the use of a horizontally focusing mono) we were able to obtain a reproducible signal (fig 4) The black line is a combination of relativistic Hartree Fock Compton profiles for 4f Er and 3d Co (convoluted with the experimental resolution of .45a.u. The aim of the experiment was to make two measurements one at 0 applied pressure and one at 3 GPa. However we encountered a major beam stability problem when attempting to measure a spectra from the sample (of dimension 300x100um) contained within the DAC pressure cell Unfortunately the ID15b monochromator did not produce a spatially stable beam, and thus the incident beam would 'wander' of the sample over a period of 2 hours. Which was not enough time to integrate a good statistic. A number of solutions were attempted i.e. to rescan the mono back onto the sample, however the very sensitive nature of the difference technique resulted in spectra that could not be normalised. Although this was a problem on this occasion, there is a feedback system available that should theoretically eliminate this issue and allow a measurement to be made.

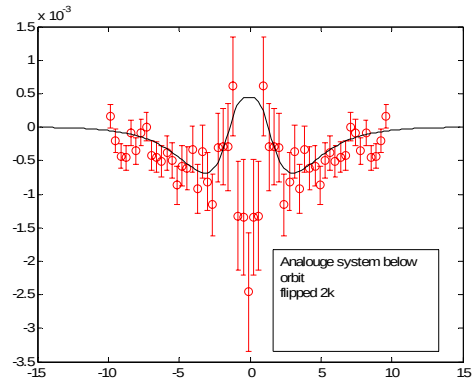

Fig 2 ErCo2 Magnetic Compton profile at 4K