ESRF	**Experiment title:** Element selective magnetometry in ferrimagnetic $HoFe_5Al_7$	**Experiment number**: HC-782
Beamline: ID24	**Date of experiment**: from: 24/07/2013 to: 31/07/2013	**Date of report**: 05/09/2014
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Report:

The unique experimental setup of ID24 is ideally suited for element selective magnetometry studies by XMCD in pulsed magnetic fields. The setup was utilized successfully to collect high quality data through the field-induced magnetic phase transition along the [110] axis of a tetragonal $HoFe_5Al_7$ single crystal.

Two single-crystalline platelet-like samples of thickness ~20 μm oriented along the [110] and [001] axes were prepared for the experiment. Data collection was performed at 12 and 75 K in transmission for opposite circular polarizations of the incident X-ray radiation. The obtained raw data in zero magnetic field are presented in Fig. 1. In the upper panels one can see the Fe K and Ho L_2 absorption edges. Below, the XMCD signal is shown for both edges below and above the compensation temperature, T_{comp} = 65 K. As the total magnetization is dominated by the Ho sublattice below T_{comp} and by the Fe sublattice above T_{comp}, the signal is inverted upon crossing the compensation point.

Next, measurements were taken in pulsed magnetic fields up to 30 T at the Fe K and Ho $L_{2,3}$ absorption edges in order to study the evolution of the Fe and Ho magnetic moments through the field-induced phase transition along the easy [110] axis. As an example, the data at 12 K are given in Fig. 2 for the Ho L_2 edge. One observes a pronounced XMCD effect that is inverted when the circular polarization of the incident X-ray beam is switched to the opposite. The observed XMCD signal is rather noisy, which originates from a relatively small size of the sample comparable with the lateral dimension of the incident beam. Nevertheless, it has little effect on data analysis as the XMCD amplitude vs. magnetic field

displays a pronounced anomaly in the vicinity of 10 T (Fig. 3) which is the field where the field-induced transition occurs. However, there should also be a signal from the 3d moment induced at the Ho $L_{2,3}$ edges and a signal from the 4f moment induced at the Fe K edge. In order to separate the signals arising from the Fe and Ho magnetic moments, principal component analysis will be performed.

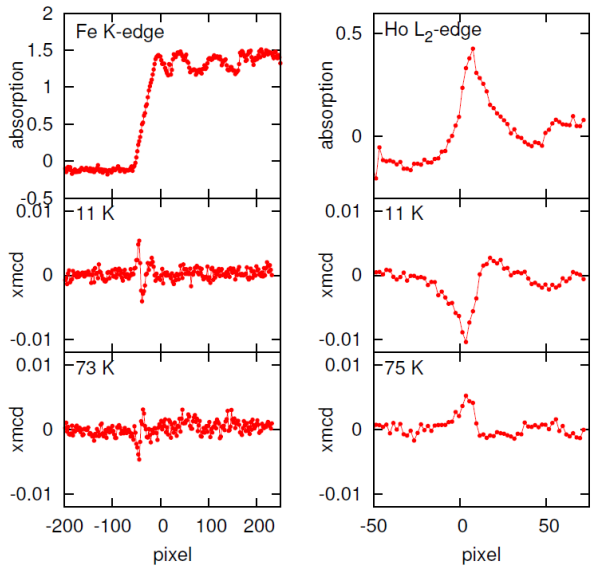

Fig. 1. (upper panels) Fe K and Ho L_2 absorption edges and (middle and lower panels) corresponding XMCD signals of $HoFe_5Al_7$ below and above T_{comp} = 65 K.

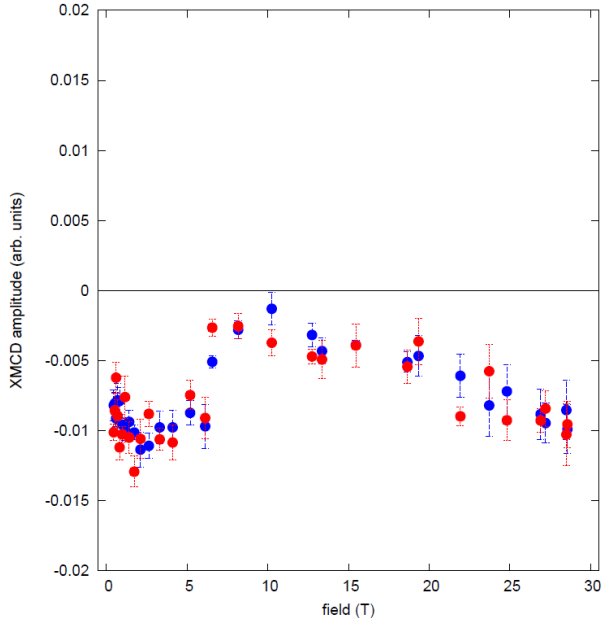

Fig. 3. XMCD signal as a function of magnetic field applied along the [110] axis of $HoFe_5Al_7$. The red and blue symbols correspond to opposite polarizations of the incident X-ray radiation (one of the datasets was multiplied by -1 for comparison).

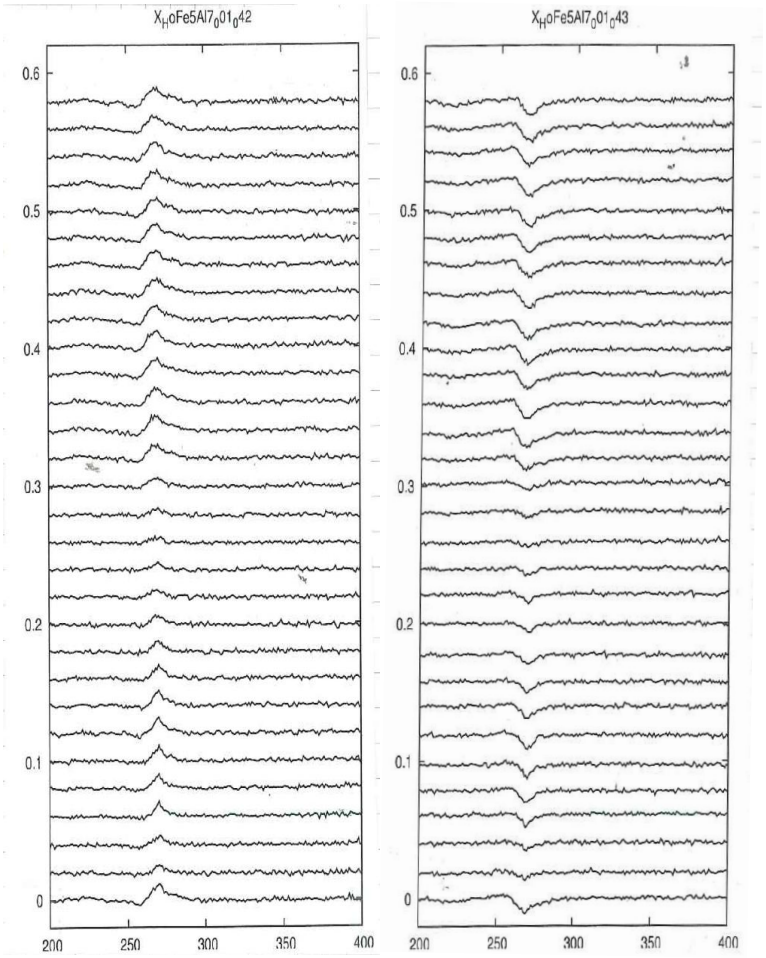

Fig. 2. XMCD signal at the Ho L_2 edge of $HoFe_5Al_7$ in magnetic fields up to 30 T for opposite polarizations of the incident X-ray radiation. The field was applied along the [110] axis at 12 K.