ESRF	**Experiment title:** **Magnetic Compton profile of us**	**Experiment number:** **HE57**
Beamline: lD15A	**Date of Experiment:** from: 11th October 96 to: 20th October 96	**Date of Report:** february 97
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Report:

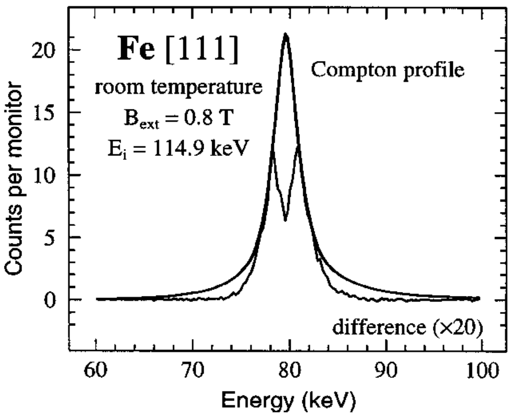
Recently a number of X-ray magnetic Compton scattering (XMCS) experiments have shown that this technique gives the opportunity to measure the spin magnetic moment of each electron shell for each species of a ferromagnet [1,2,3,4]. These experimental findings have been supported by theoretical investigations of the nature of the inelastic photon-electron magnetic interaction [5,6,7]. These works show that XMCS is one of the few experimental methods which can help in separating the bulk magnetization of a compound in its different components: spin and orbital moments from localized and delocalized electrons. Recently Sakurai et al. have reported XMCS measurements performed at KEK on the ferromagnet UTe for which the value of the spin moment of the $5f, 6d$ and conduction electrons is determined [8].

For the first XMCS study of an uranium compound carried out at the ESRF we have chosen to investigate the well-known ferromagnetic metal US. This compound crystallizes in the cubic NaCl structure, orders ferromagneticaly at 177 K with its bulk magnetization parallel to the [Ill] direction. The magnetic moment per uranium atom as determined by magnetization measurements is $\mu_{\rm Bulk} =$ 1.55 μ_B. According to polarized neutron scattering (PNS) measurements the orbital and spin magnetic moments of the uranium $5f$ electrons are μ_L^{5f} = 3.0 μ_B and μ_S^{5f} = -1.31 μ_B, respectively. μ_L^{5f} and μ_S^{5f} are antiparallel to each other and μ_L^{5f} is parallel to the applied magnetic field. Therefore the magnetic moment carried by the $6d$ and conduction electrons is $\mu^{(s,p,d)} \approx$ -0.15 μ_B and is antiparallel to μ_L^{5f}. From recent X-ray magnetic circular dichroism (XMCD) measurements [9] it has been found that μ_L^{5f} = 3.6 μ_B, i.e., 20% larger than the value extracted from PNS. More interesting, a detailed analysis of these XMCD data yields a $5f$ electron count n_{5f} = 2.5 [10], *e.g.*, US is a mixed valent compound. This latter result relies strongly on the values of μ_L^{5f} and μ_S^{5f}. The present XMCS study has been performed with the purpose to measure independently the spin moments in US and thereafter obtain a reliable decomposition of the bulk magnetization in its different components.

The measurements have been performed at the end-station of beamline ID15A where best conditions for Compton scattering experiments can be achieved. The X-ray source is an asymmetric 7-pole wiggler with a critical energy of 45 keV providing circular polarized photons above and below the orbit plane. The energy spectra have been recorded for alternating external magnetic field B_{ext} (0.8 T) with an energy dispersive Ge-solid-state detector. We used a standard backscattering geometry. The sample is a single crystal of thickness t = 2 mm and covering a surface of $\sim 6 \times 4$ mm^2. For minimizing the magnetic torque acting on the sample during the turning of the permanent magnet, the data have been recorded in the ferromagnetic state at 160 K. Two auxiliary measurements have been carried out: one on US at 295 K to check that ther was really no magnetic effect at that temperature and one on Fe for calibration purpose.

The experiment has been performed with photons of energy just below the K-edge of uranium (115.6 keV) at E_1 = 114.9 keV. At this energy, which is about twice the energy used earlier [8], the absorption in the sample is decreased and the resolution improved to 0.5 a.u. (0.75 a.u. in the earlier experiment) thus giving the possibility to see more details. In addition the magnetic contribution increases as it scales with the incident photon energy. The magnetic effects are seen near the Compton peak, which is located at $\sim$ 80 keV, below the Raman resonances.

In the figure we present the Compton profile and the difference for the two states of polarization measured for Fe and US. As already found for UTe [8], the sign of the magnetic signal is opposite for Fe and US. This is expected since the uranium spin moment is opposite to the total uranium magnetic moment. A detailed analysis is underway.



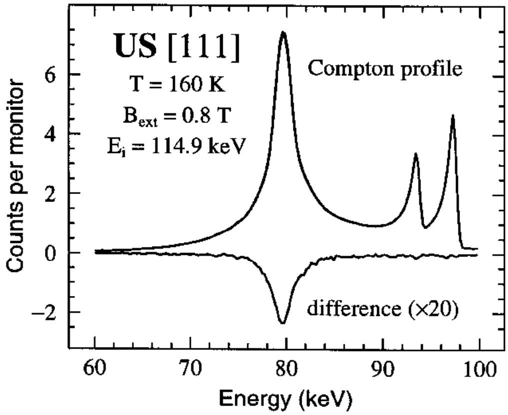


Figure : *(left hand side) Compton profile of Fe (the external field and the scattering vector are parallel to the [111] crystalline direction) measured in transmission geometry and difference between spectra recorded for two opposite field directions.*
(right hand side) Same caption but for US. The experiment has been performed in reflection geometry. Note the two Raman excitations present above 90 keV which do not exhibit any magnetic component.

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