ESRF	**Experiment title:** Circular magnetic dichroism on Uranium M edges in UX compounds (X = S, Sb, Te)	**Experiment number:** HC216
Beamline: BL6	**Date of Experiment:** from: 13 September 95 to: 21 September 95	**Date of Report:** January 96
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Report:

In recent years the study of uranium compounds has attracted much interest because of the variety of behaviors which can be found at low temperature. One of the key parameter which governs their physical properties is the degree of hybridization of the $5f$ electrons with the conduction band electrons. This parameter can be estimated from the orbital to spin moment ratio of the $5f$ orbital moment. Recent experiment al and theoretical works have shown that the Magnetic Circular X-ray Dichroism (MCXD) technique is a method to measure that ratio.

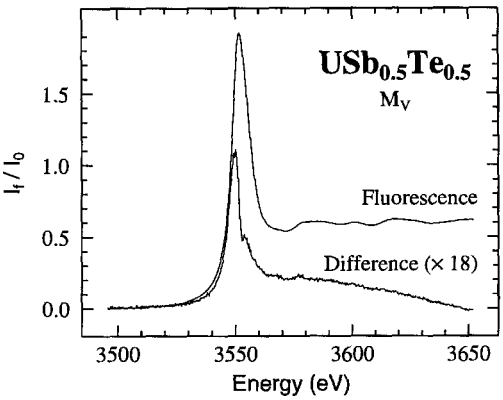
We report the first MCXD measurements performed on a uranium compound at the ESRF. One way to probe the *5f* electrons is to study the M_V and M_{IV} edges located at 3.5 keV and 3.7 keV. At these energies the measurements are difficult because the degree of circular polarization after the monochromator is not as large as at high or low energy. In fact the number of studies in this intermediate energy range is very small.

The measurements have been performed at BL6 on $USb_{0.5}Te_{0.5}$. This compound, which crystallizes in the simple cubic NaCl structure, orders ferromagneticaly at ~ 200 K with its uranium magnetic moment (of 2 μ_B at low temperature) parallel to the [111] direction. The spectra have been recorded in fluorescence mode with the primary and secondary X-ray beams subtending the illuminated crystal face at angles $\alpha = 80°$ and $\beta = 10°$, respectively. A magnetic field of 2 T was applied parallel to the incident beam. The sample temperature was 100 K. The relative direction of the field to the light helicity has been selected either by changing the direction of the field or the helicity after each energy scan. Within uncertainties the resulting dichroism spectra are the same.

In Fig. 1 we present the fluorescence spectrum 1, and the dichroic asymmetry for the two edges. The two dichroic signals are positive indicating a strong orbital magnetic moment. Their ratio is ~ 6 with the signal weaker at the M_V edge. Whereas the M_{IV} dichroic signal is quite symmetric, the M_V signal is highly asymmetric and presents structures. We note the extended X-ray fine structure (EXAFS) between the two edges. Relative to the only published MCXD work on an uranium compound (US)

[1], our data are of a much better statistical quality. The two set of data agree on the qualitative level. In Fig. 2 are shown the absorption spectrum γ_+ and the dichroic asymmetry deduced from the fluorescence spectra (Fig. 1) obtained after correction for the self-absorption effects using a formula given in Ref. [2] and published attenuation coefficient data [3]. We note that the absorption correction has substantially modified the spectrum. While the analysis will be pursued to extract information on the orbit al and spin magnetic moments, we point out that magnetic dichroism of $M_{IV,V}$ fluorescence light is possible [4]. This dichroism will complicate the analysis.

[I] S.P. Collins, D. Laundy, C.C. Tang and G. van der Laan, J. Phys.: Condens. Matter 7,9325 (1995).
[2] C.J. Sparks, in Synchrotrons Radiation Research, edited by H. Winick and S. Doniach (Plenum, New York, 1980), p. 459.
[3] E. Storm and H.I. Israel, Nuclear Data Tables A 7,565 (1970).
[4] L.-C. Duda, J. Stohr, D.C. Mancini, A. Nilsson, N. Wassdahl, J. Nordgren and M. G. Samant, Phys. Rev. B 50, 16758 (1994) and references therein.



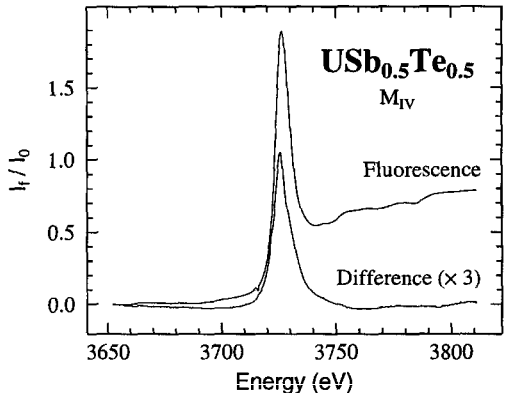


Figure la *(left* hand side): fluorescence spectrum I_+ and *the* dichroic asymmetry AI $(\Delta I = I_+ - I_-)$ measured *at the* M_V *edge* of uranium in $USb_{0.5}Te_{0.5}$. The intensity of the applied magnetic field was 2 *T* and *the temperature 100 K.* The index + (–) specifies that the applied *field* is parallel (antiparallel) *to the X-ray* helicity. Whereas *the* ordinate scale for the fluorescence spectrum is *arbitrary, this scale is meaningful for the dichroic spectrum.*

Figure lb *(right hand side): same caption as for Fig. la but for the* M_{IV} *edge.*

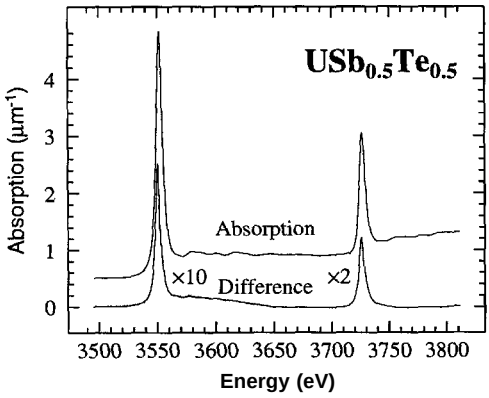


Figure 2: *absorption spectrum* γ_+ *and the dichroic asymmetry* $\Delta\gamma$ $(\Delta\gamma = \gamma_+ - \gamma_-)$ *measured at the* $M_{IV,V}$ *edges of uranium in* $USb_{0.5}Te_{0.5}$. *The intensity of the applied magnetic field was 2 T and the temperature 100 K. The index + (−) specifies that the applied field is parallel (antiparallel) to the X-ray helicity. The data have not been corrected for the energy dependence of the circular polarization rate of the monochromatic beam.*