



Experiment title: X-ray dichroism investigation of the uranium heavy fermion superconductors

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Local contact(s):

A. Rogalev

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Names and affiliations of applicants (*indicates experimentalists):

- *P. Dalmas de Rkotier, CEA/Grenoble
- *A. Hiess, ILL, Grenoble
- *N. Kernavanois, CEA/Grenoble
- *J.-P. Sanchez, CEA/Grenoble
- *A. Yaouanc, CEA/Grenoble
- A.D. Huxley, CEA/Grenoble
- J.L. Smith, Los Alamos National Laboratory

Report:

The five known uranium heavy fermion superconductors are fascinating compounds [1]. Although an impressive number of experimental techniques have been used for their study, the electronic ground state of the uranium atoms is still debated: for example the uranium valency is unknown.

With the X-ray Magnetic Circular Dichroism (XMCD) technique and the sum rules, one can characterize the ground state of atoms embedded in a matrix, in particular uranium atoms in intermetallics [2,3]. In 1997 we managed to perform such measurements in the paramagnetic phase of the antiferromagnets URu_2Si_2 and UPd_2Al_3 [4]. In February 1998 we have recorded XMCD spectra on UPt_3 and UBe_{13} at a temperature and field direction chosen to induce the maximum bulk magnetization. In Figs. 1 and 2. we present our results. In Fig. 3 we show the fluorescence spectra and the dichroic asymmetry recorded last year for the uranium M_v edge in UPd_2Al_3 and URu_2Si_2 [4]. We note that the shape of the dichroic asymmetry at the uranium M_v edge depends strongly on the compound. We observe two lobes for UPt_3 , UBe_{13} and UPd_2Al_3 . One lobe is found for URu_2Si_2 , UFe_2 , UNi_2 , $USb_{0.5}Te_{0.5}$ and US . Referring to the theoretical work of van der Lann and Thole [5] we infer that the compounds of a given family have about the same uranium valency but the valency is different for the two families. A detailed analysis is underway.

References

- [1] R.H. Heffner and M.R. Norman, *Comm. Condens. Matter Phys.* **17**, 361 (1996).
- [2] P. Dalmas de Reotier *et al.*, *J Phys.: Condens. Matter* 9, 3291 (1997).
- [3] M. Finazzi *et al.*, *Phys. Rev.* **B55**, 3010 (1997).
- [4] A. Yaouanc *et al.*, ESRF report HE131.
- [5] G. van der Lann and B.T. Thole, *Phys. Rev.* B53, 14458 (1996).

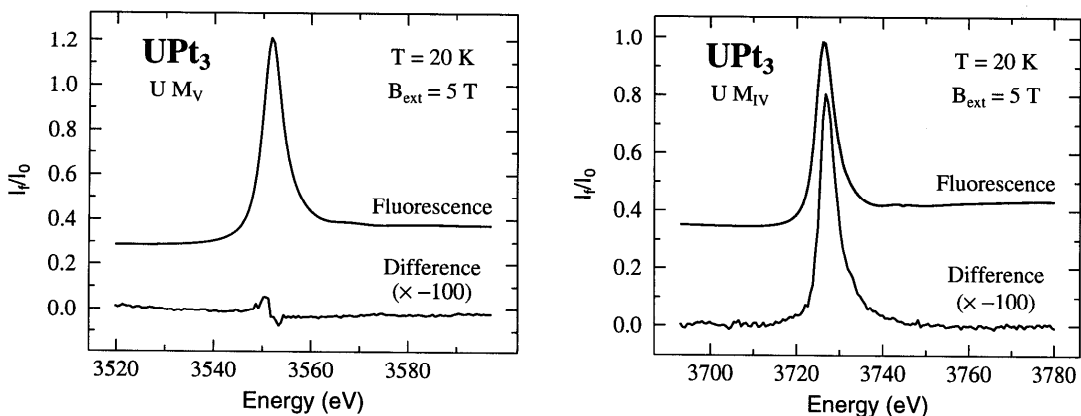


Figure 1 : Fluorescence spectra and dichroic asymmetry spectrum ΔI ($\Delta I = I_+ - I_-$) measured at the $M_{IV,V}$ edges of uranium in UPt_3 . The intensity of the field was 5 T and the temperature 20 K. The index + (-) specifies that the field is parallel (antiparallel) to the X-ray helicity.

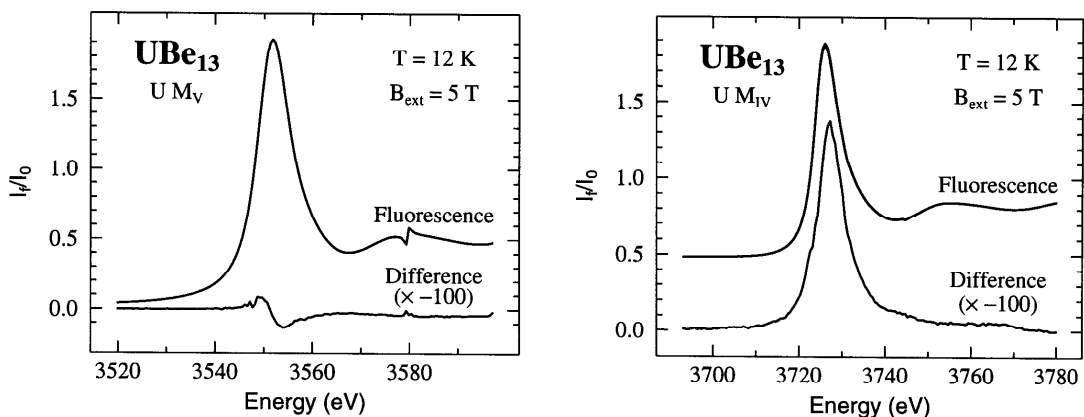


Figure 2 : Same caption as for Fig. 2 but for UBe_{13} . The data were recorded at 12 K.

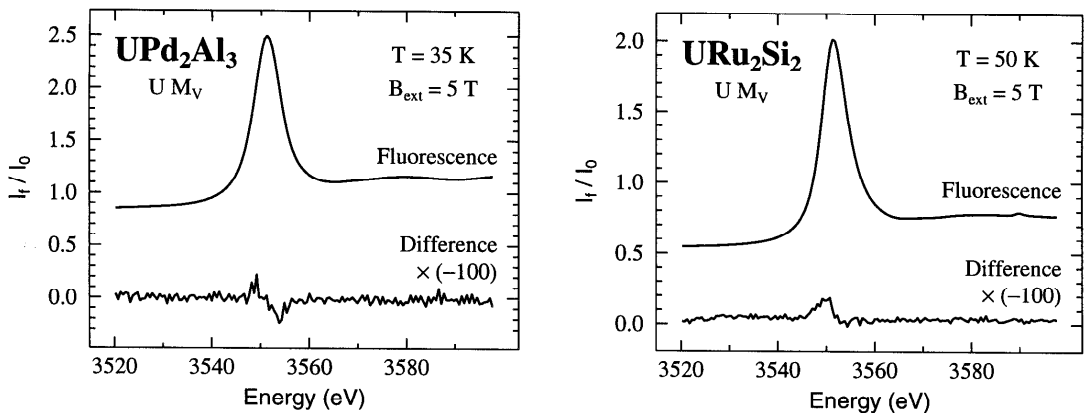


Figure 3 : Fluorescence and dichroic asymmetry spectra at the $M_{IV,V}$ edges of UPd_2Al_3 and URu_2Si_2 [4].