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Report:

The five known uranium heavy fermion superconductors (HFS) and their solid solutions are fascinating compounds [l]. A prominent puzzle is the homogeneous coexistence in most of these compounds of superconductivity and antiferromagnetic ordering believed to arise from the same set of $5f$ electrons. The Nkel temperature is about an order of magnitude larger than the superconductivity temperature. Although an impressive number of experimental techniques have been used to study the HFS, the electronic ground state of the uranium atoms is still debated. Useful characteristics of the ground state are its orbital and spin magnetic moments. Whereas polarized neutron scattering experiments have measured the $5f$ magnetic moment of uranium in UPd_2Al_3 [2], there is no published equivalent study for URu_2Si_2. For UPd_2Al_3 it has been found that the $5f$ uranium magnetic moment μ_{5f} measured under a field 5 T at 36 K is substantial : $\mu_{5f} = 0.16\ \mu_B$. The ratio of the orbital to the spin moment is $\approx$ -2. A rough estimate of the uranium magnetic moment generated at 50 K by a field of 5 T on URu_2Si_2 gives $\mu_{5f} = 0.08\ \mu_B$. The contribution of the orbital and spin moments is unknown.

With the advent of the X-ray dichroism techniques and the recently discovered sum rules, it is now possible to characterize the ground state of atoms embeded in a matrix. In particular, the X-ray Magnetic Circular Dichroism (XMCD) technique allows to measure the orbital and eventually the spin moment of the $5f$ orbital. Recently these measurements have been successfully done on $USb_{0.5}Te_{0.5}$ [3] and UFe_2 [4]. In agreement with the results of polarized neutron scattering experiments, the orbital and spin moments in UFe_2 were found antiparallel and of about the same magnitude.

We have performed XMCD measurements on single crystals of UPd_2Al_3 and URu_2Si_2. Since these compounds are antiferromagnets at low temperature, the measurements at the $M_{IV,V}$ edges were done in the paramagnetic state at a temperature and field direction for which the magnetic susceptibility is maximum. We used a magnetic field of 5 T. Note that it is the first time that XMCD measurements are performed in the paramagnetic state of uranium compounds.

In Fig. 1 we present the fluorescence spectra and the dichroic asymmetry for the two uranium edges in UPd_2Al_3. In Fig. 2 the same quantities are presented for URu_2Si_2.

In order to extract the value of the orbital moment from the fluorescence spectra, the X-ray absorption spectra at the $M_{IV,V}$ edges are needed [3,4]. They are going to be recorded at LURE.

This report shows that XMCD measurements can be performed in the paramagnetic phase of antiferromagnets. The compounds do not have to exhibit large magnetic moments. This work opens up new possibilities for XMCD.

[l] R.H. Heffner, and M.R. Norman, Comm. Condens. Matter Phys. 17, 361 (1996).

[2] L. Paolasini et al, J. Phys.: Condens. Matter 5, 8905 (1993).

[3] P. Dalmas de Réotier, J.P. Sanchez, A. Yaouanc, M. Finazzi, Ph. Sainctavit, G. Krill, J.P. Kappler, J. Goedkoop, J. Goulon, C. Goulon-Ginet, A. Rogalev and 0. Vogt, J Phys.: Condens. Matter 9,3291 (1997).

[4] M. Finazzi, Ph. Sainctavit, A.-M. Dias, J.P. Kappler, G. Krill, J.P. Sanchez, P. Dalmas de Réotier, A. Yaouanc, A. Rogalev and J. Goulon, Phys. Rev. B55, 3010 (1997).

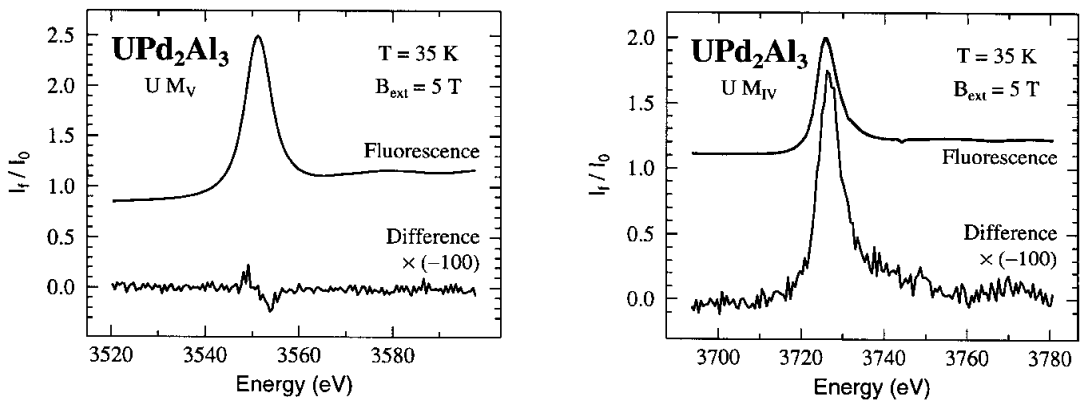
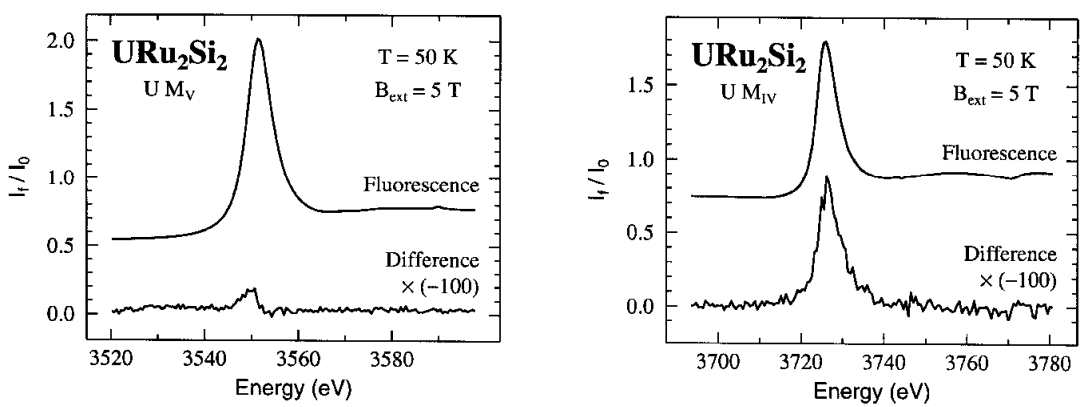


Figure 1 : *Fluorescence spectra and dichroic asymmetry spectrum ΔI ($\Delta I = I_+ - I_-$) measured at the $M_{IV,V}$ edges of uranium in UPd_2Al_3. The intensity of the field was 5 T and the temperature 35 K. The index + (−) specifies that the field is parallel (antiparallel) to the X-ray helicity.*



Figures 2 : *Same caption as for Fig. 2 but for URu_2Si_2. The data were recorded at 50 K.*