**E**UROPEAN **S**YNCHROTRON **R**ADIATION **F**ACILITY

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# Experiment Report Form

**The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF**.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

*http://193.49.43.2:8080/smis/servlet/UserUtils?start*

***Reports supporting requests for additional beam time***

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

***Reports on experiments relating to long term projects***

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

***Published papers***

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

## Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

## Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

| | | |
|---|---|---|
| | **Experiment title:** XMCD measurements of $PuFe_2$ and PuSb compounds | **Experiment number**: |
| **Beamline**: ID12 | **Date of experiment**: from: 02/03/10 to: 08/03/10 | **Date of report**: 30/09/10 |
| **Shifts:** 18 | **Local contact(s)**: Fabrice Wilhelm | *Received at ESRF:* |


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## Report:

Continuing our experiments on transuranium materials we have measured XAS and XMCD spectra from plutonium-based ferromagnetic compounds $PuFe_2$ and PuSb.

Figure 1 shows the self-absorption corrected data, adjusted for the rate of polarisation at both the $M_4$ and $M_5$ edges. The measurements were taken at 10 K in an applied magnetic field of 6 T.

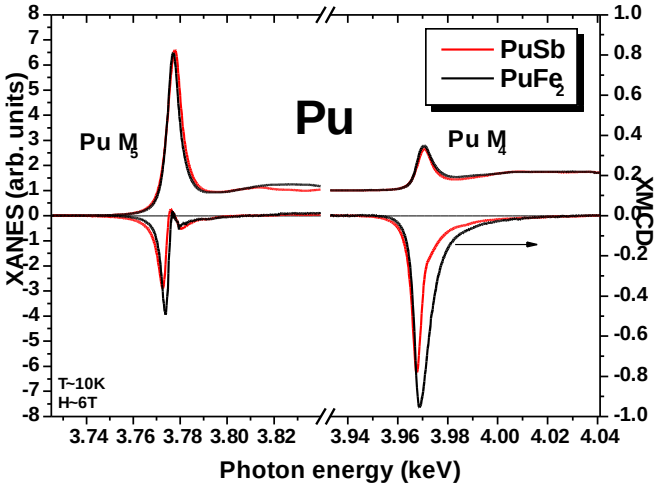


Figure 1 – Pu M4,5 edge XANES and XMCD spectra for PuFe2 (black solid line) and PuSb (red solid line) ferromagnets.

Clearly, there is an unusual feature of the results for PuSb. A look at the figure shows that that the signal at $M_4$ at 3.97 keV is *particularly narrow*. In almost all XMCD studies of actinides the FWHM of the $M_4$ signal is

In both materials the experiments show that the samples could be saturated, unlike the earlier (HE-2561, May 08) experiment on $NpX_2$ in which we believe surface roughness leads to strong anisotropy.

The spin and orbital moments are aligned anti-parallel in the Pu materials and there is a large orbital moment. Both are expected.

Using the sum rules and the observed magnetic saturation we deduce:

| Compd. | $\mu_{sat}$ ($\mu_B$) | $\langle T_Z \rangle$ | XMCD ($\mu_L/\mu_S$) | neutron ($\mu_L/\mu_S$) |
|---|---|---|---|---|
| $PuFe_2$ | 0.39 | +0.07 | –1.24 | –1.20 |
| PuSb | 0.75 | +0.08 | –2.21 | –1.35 |

~ 10 eV; in PuSb it is 5 eV. The orbital moment found in PuSb is +1.37 $\mu_B$, more than a factor of two smaller than predicted by theory and observed by neutron diffraction.

We believe these problems arise from exchange splitting of the 3*d* core states and calculations are under way to verify this intriguing possibility. Meanwhile the $PuFe_2$ results will be published with those of $NpX_2$ (HE-2561) when the problem of lack of saturation is solved with new samples.