

ESRF

	Experiment title: L edge magnetic scattering in Np compounds	Experiment number: HE-486
Beamline: ID20	Date of experiment: from: 10/12/98 to: 17/12/98	Date of report: 22/2/99
Shifts: 18	Local contact(s): C. Vettier	<i>Received at ESRF:</i>

Names and affiliations of applicants (* indicates experimentalists):

*D. Mannix (ESRF), *E. Lidström (ESRF), *R. Caciuffo (Univ. Ancona, Italy), *N. Bernhoeft (CENG) and *G.H. Lander (EITU, Karlsruhe, Germany).

Report:

Following our successful work on the M edges of NpO_2 (see exp. report on HE-302) we started this experiment at 8 keV and with a Ge analyser to search for extra peaks that would be associated with an internal lattice distortion, i.e. arising from a displacement of the oxygen atoms below T_N . In the previous experiment (HE-302) there had just been time for a rapid search for these effects, but without an analyser in place. Despite the much better signal to noise with an analyser, no extra peaks were found in the most likely positions in reciprocal space at the level of $\sim 10^{-8}$ of the charge peaks. This is some 3 orders of magnitude less than the extra peaks found in the case of an internal distortion in UO_2 [1]. Interestingly, we were able to see charge truncation rods from the surface of this rather perfect crystal.

We then turned our attention to the L edges of first NpO_2 and then NpP , since both crystals are in the same holder. The $L_{2,3}$ edges are at 21.58 and 17.59 keV, respectively, and the experiments are difficult. A LiF polarisation analyser used in $\sigma \rightarrow \pi$ is absolutely necessary to improve the signal to noise, but the one available is not the best of crystals. In the case of NpO_2 we did *not* find any evidence for intensity associated with either L edge. However, in the case of NpP (known to have a 3+, 3-) magnetic structure [2] at low-T we did find such scattering, at both edges. The spectra are shown in Fig. 1. The L_3 edge intensity has a double peaked structure. Notice that these spectra have been corrected for absorption, deduced from the fluorescence data. The intensity at the L_2 edge is much weaker than that at the L_3 and shows a single peak. Although the shape of the spectra are similar to that found for the light rare earths (we have comparable data to that in Fig. 1 for a Nd compound on ID20), there is an important difference. In the lanthanides the L_2 is greater than the L_3 intensity for the light rare earths, whereas this appears to be reversed in the actinides – see also the work on UPd_2Si_2 L edges [3]. Since the branching ratio (L_3/L_2) has been the subject of many papers (see, for example, Ref. [4]) this difference cannot easily be understood, since in both the lanthanides and actinides the principal magnetism is from f shells, and the matrix elements involve transitions from p to d shells. Further work is necessary to clarify this situation.

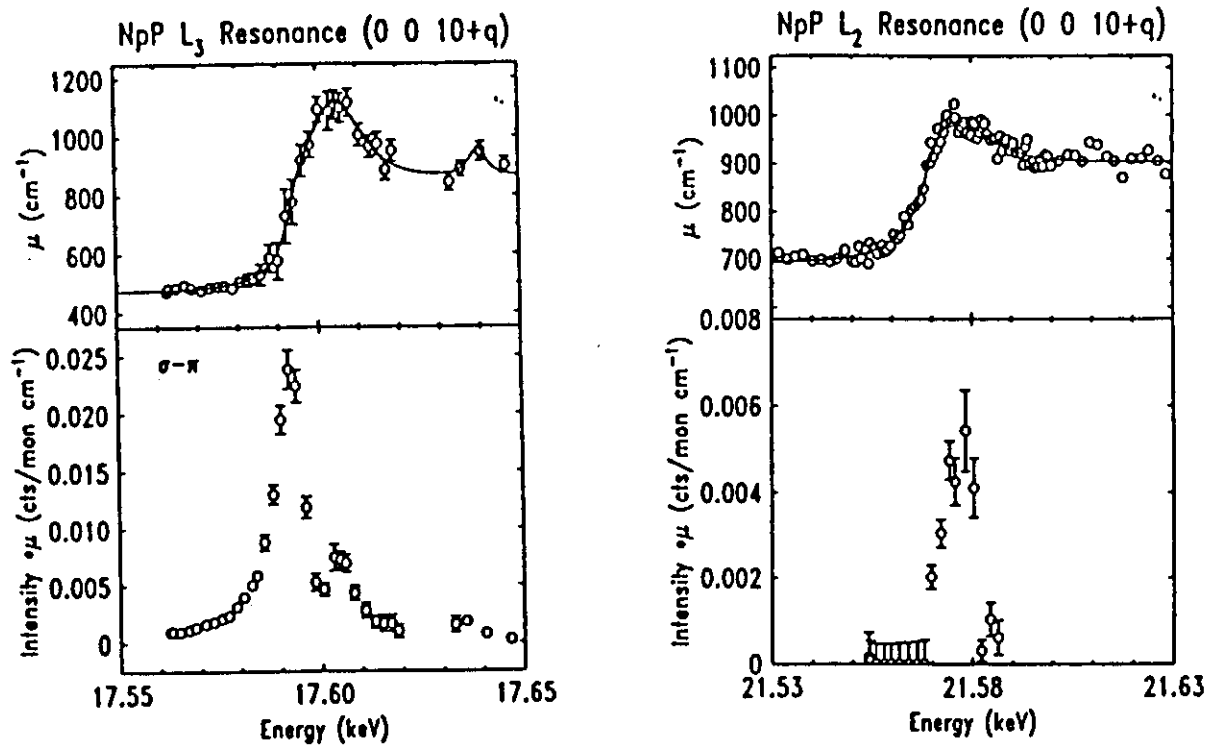


Figure 1

L edge spectra for NpP after correcting for the absorption by using the measured fluorescence, which is used to deduce the absorption coefficient as shown in the top panel. Note the two peaks at the L₃ position, and also that the signal is considerably stronger at the L₃.

References:

- [1] J. Faber and G. H. Lander, *Phys. Rev. B* **14**, 1151 (1976)
- [2] A. Aldred et al., *Phys. Rev. B* **9**, 3766 (1974)
- [3] D. Wermeille et al. *Phys. Rev. B* **58**, 9185-93 (1998)
- [4] M. van Veenendaal et al., *Phys. Rev. Letters*, **78**, 1162 (1997)