



	<b>Experiment title:</b> Resonant inelastic x-ray scattering at the La L-edge in La-4d transition metal intermetallics	<b>Experiment number:</b> HE-1248
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## Report:

Resonant inelastic x-ray scattering (RIXS) may be used to highlight excitations that are partially or completely masked at an x-ray absorption edge by core-hole broadening. In the ground state, La and Ce compounds have respectively a  $4f^0$  and a mixed valent  $4f^0 - 4f^1$  configuration. Core-level excitation introduces strong Coulomb interaction between the core-hole and the  $f$  orbitals thus modifying the interactions between  $f$  states and conduction states [1,2]. The multi-electron problem that ensues is difficult to treat theoretically because, except in the favorable case of some ionic compounds, charge transfer must be included. This explains that theoretical models are still very much dependent on experimentally determined parameters.

In previous experiments performed at ESRF we were able to show [1,3] that  $4f^1$ - related states are present, though no pre-edge structure is apparent in the L-edge x-ray absorption spectra of La-3d transition metal (TM) intermetallics. An analysis using model densities of states and an "exact" description of each step of the RIXS process demonstrates unequivocally that the pre-edge structure is not related to a  $4f^0 \rightarrow 4f^1$  quadrupole transition in La-3d TM intermetallics but results from configuration interaction in the final state. Following on these experiments it has also been possible to model theoretically the interplay between  $4f$ - $4f$  interactions and  $4f$ -core-hole interactions [2].

Here experiments were performed La intermetallics containing a 4d TM (Rh or Pd). This work was motivated by our measurements on Ce-4d TM intermetallics which suggested the presence of more complex interactions than those observed in the 3d TM intermetallics. Two examples of the data obtained for the La-

Pd system are shown in Figure 1. These measurements confirm the presence of weak well screened states not observed in, for instance,  $\text{La}_2\text{Ni}_7$ . Work on a theoretical model able to help interpret the data is underway.

- 1 L. Journel, J.-M. Mariot, J.-P. Rueff, C. F. Hague, G. Krill, M. Nakazawa, A. Kotani, A. Rogalev, F. Wilhelm, J.-P. Kappler, and G. Schmerber, *Resonant inelastic x-ray scattering at the lanthanum  $L_3$  edge*, Phys. Rev. B **66**, 045106 (2002).
- 2 M. Nakazawa, K. Fukui, H. Ogasawa, A. Kotani, and C. F. Hague, *X-ray absorption and resonant x-ray emission spectra by electric quadrupole excitation in light rare-earth systems*, Phys. Rev. B (in press).
- 3 ESRF report HE970

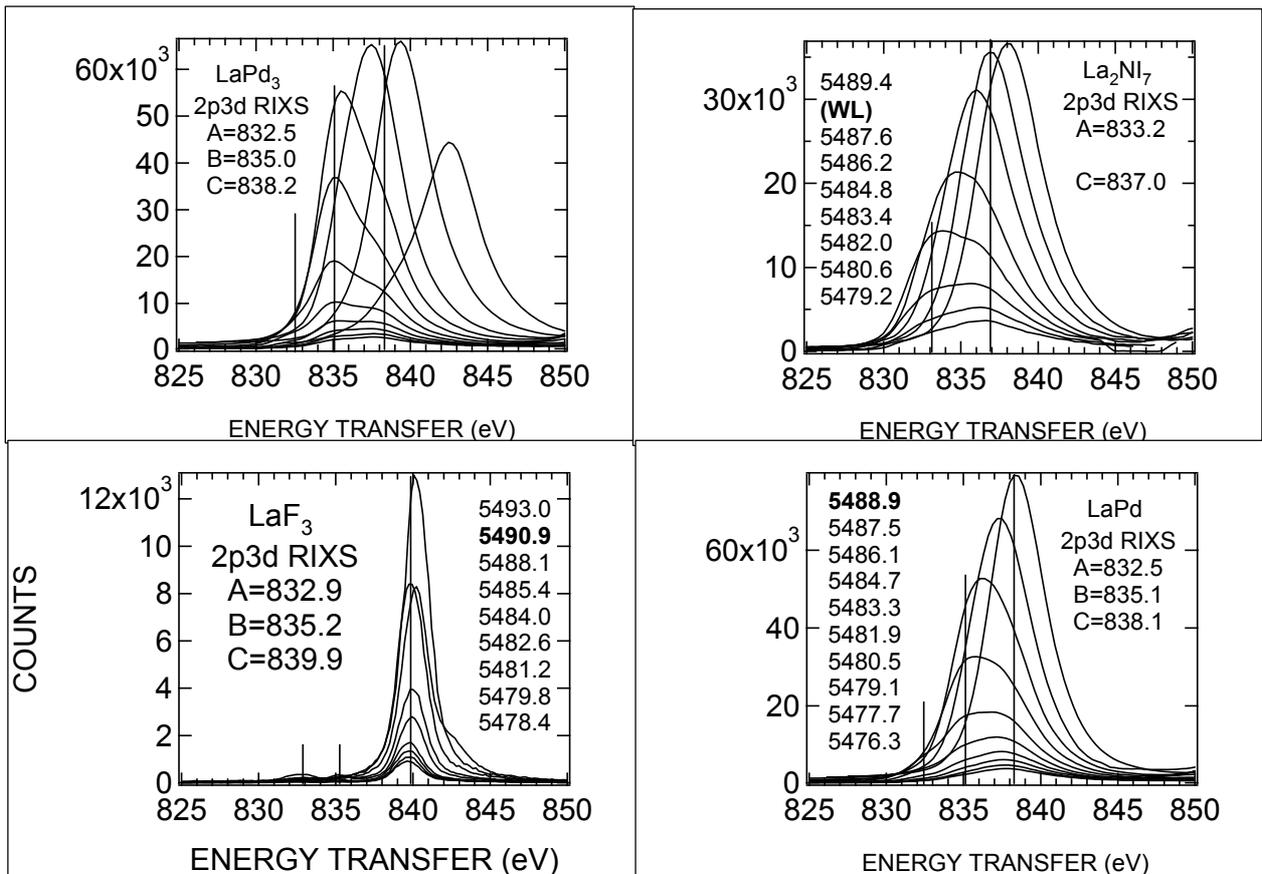


Fig. 1: La 2p3d RIXS data for two La-Pd intermetallics compared to  $\text{LaF}_3$  (where pre-edge structure is due to quadrupole transitions) and  $\text{La}_2\text{Ni}_7$  (where the pre-edge structure is dipolar in origin).