ESRF	Experiment title: Magnetic and non-magnetic RIXS at the $L_{2,3}$ and $M_{4,5}$ absorption edges of Ce in highly correlated systems Report #2	Experiment number: HE-218
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These resonant inelastic x-ray scattering (RIXS) experiments performed at the Ce L_3 edge [$2p^6 \rightarrow 2p^5(4f5d)^{+1}$ followed by $2p^5(4f5d)^{+1} \rightarrow 3d^9(4f5d)^{+1}$] aim at an improved understanding of the interaction between the $4f$ electron and the conduction states in a variety of Ce alloys and multilayers with varying magnetic properties. Distinguishing between well localized or delocalized states is one of the properties of such experiments provided a large data set is measured as a function of both incoming photon energy and scattered photon energy. The resolution is limited by the 3d core-hole lifetime (and not the $2p$ lifetime) which justifies the use of high experimental resolution. The x-ray spectrometers now available at ESRF for analyzing the scattered x-rays are not suited to this particular experiment because they are designed for higher energies. Our instrument uses a cylindrically bent quartz 2023 crystal working under UHV. It requires a focused primary beam for best resolving power. On ID12A a line focus ≈ 20 μm in the vertical plane is available. Under these conditions we measured the analyzer resolution to be 0.5 eV at 5 keV.

We chose two alloys, $CePd_3$ and CeCuSi, and two multilayers Ce./Fe and CeH_2/Fe as representative of systems with a-like or y-like properties. $CePd_3$ and Ce/Fe are a-like and have two peaks of comparable amplitude in the L_3 absorption spectrum. This may be explained in terms of a well screened $2p$ hole (there is a localized 4f electron and a $5d$ conduction electron in the final state) and a less well screened $2p$ hole configuration resulting from $4f$ -5d interaction.

Our measurements concentrated on the analysis of the RMS both close to the L_3 *edge* and in regions where structure is observed in the absorption spectrum.

Our preliminary conclusions are :.

i) In the pre-edge region quadrupole transitions are indeed present ($3d^9 4f^2 5d^0$ final state) as reported for other rare earths. However the shape and relative intensities of this structure is significantly different according to whether the sample is a-like or y-like.

ii) Beyond the first absorption peak, the shape of the $3d \rightarrow 2p$ inelastic scattering varies markedly according to the type of sample examined indicating varying degrees of localization and multiplet structure.

Fig. *1 RIXS data for a* CeH_2/Fe *multilayer.*
For clarity, only a partial data set is shown. Incident photon energy starts at 5710 eV; the white line is situated at 5728.2 eV. Here Ce is γ*-like.*