ESRF	**Experiment title:** RIXS at L_3-edge of Ce in $CeFe_2$ and $CeSi_x$	**Experiment number**: HE-527
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Report:

These experiments are part of an extensive study using resonant inelastic x-ray scattering (RIXS) experiments to gain a better understanding of interactions in mixed valent rare earths such as Ce. During this session we studied the Ce L_3-edge RIXS in $CeSi_x$ and also $CeFe_2$. All samples were well defined arc-melted bulk alloys. $CeSi_x$ is γ-Ce like, Ce Fe_2 is α-like. $CeSi_x$ has attracted particular interest in recent years because the interpretation of very high resolution photoemission spectroscopy (PES) experiments has proved to be controversial (see Garnier et al. Phys. Rev. Lett. **78**, 4127, 1997 and Arko and Joyce Phys. Rev. Lett. **81**, 1348, 1998). According to Baer and co-workers the Kondo resonance predicted by the Anderson impurity model is intercepted by E_F. So that the resonance shows-up as a small structure just below E_F in the PES data and as a marked peak above E_F in inverse PES (IPES). The indications are that, in $CeSi_x$, the Kondo temperature decreases as x decreases. This would explain the decrease in intensity of both the PES and IPES $4f^1$peak at E_F with decreasing x and corresponds to a decrease in the 4*f*-conduction band hybridization (reduced $4f^0$ contribution in the groung state).

Not only does the pre-absorption edge RIXS (Raman regime) show strong differences between the α-like and γ-like alloys as we would expect (see figure), but we also observe striking differences in the spectra for x=2 compared to x=1.7 in $CeSi_x$. Furthermore we also note differences in the spectra as a function of temperature (the experiments were performed at 300 K and 15 K).

Unfortunately some instabilities in the beam during our experimental period due to a storage ring feedback amplifier place the temperature effects very close to the experimental limits and so require confirmation. (The experiments could not be repeated on a sufficiently short time scale because of the cooling down-warming up cycle). The other changes observed are well within the experimental limits.

The main peak (886.1 eV energy transfer) corresponds to a dipole transition to the 5d6s conduction band. The excitation in the pre-edge region produces two resonances in $CeSi_x$ (880 eV and 882.5 eV) but one only may be distinguished in $CeFe_2$ (880 eV). The 880 eV structure is clearly reinforced relative to the 5d6s peak in $CeFe_2$ compared to $CeSi_x$ It is the result of 4*f*-conduction band hybridization leading to three final states. (We also observe a higher energy resonance in $CeFe_2$ at 895 eV. This is not shown in the figure). These may be labeled f^0, f^1, and f^2 according to the configuration that contributes most weight to each peak. We deduce from the relative intensities that the f^2-related peak at 880 eV in $CeFe_2$ contains a significant contribution from dipole terms.

The weight of the 880 eV and 882.5 eV features in $CeSi_{1.7}$ relative to that of the main f^1 peak is 30% smaller than in $CeSi_2$. Here again the explanation must be found in the degree of interaction between the possible final states. To a first approximation, we can normalize data for both concentrations to the f^1 peak. If hybridization could be neglected between the various final states, the f^2 peak would have to be attributed to a quadrupole transition to the intermediate state only. The weight of the f^2 peak would then increase slightly (higher $4f^1$ count in the ground state) in $CeSi_{1.7}$, not decrease by 30%.

We are presently working on a quantitative interpretation of the data.

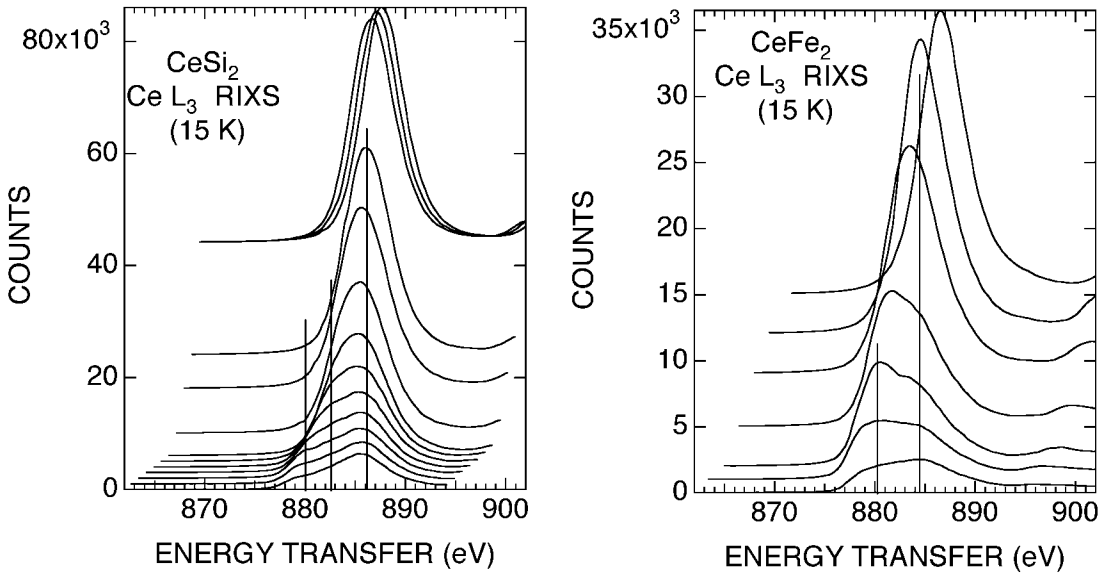

Figure 1. Ce L_3 RIXS for $CeSi_2$ (left panel) and Ce Fe_2 (right panel) taken at 15 K and plotted on an energy transfer scale.