ESRF	**Experiment title:** Study of structure of Ce-based intermetallic compounds with anomalous superconducting properties	**Experiment number**: HS-2163
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Shifts: 9	**Local contact(s)**: Andy Fitch	*Received at ESRF:*

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Report:

The aim of the proposed experiments was to address the problem of anomalous T_c dependence in $Ce_{1-x}La_xRu_2$ as a function of La concentration in order to explore the role lattice excitations on the anomalous superconducting behaviour in this Laves phase short coherence length superconductors. It worth recalling that the Laves phase $CeRu_2$ system is a good example where f electrons represent both localized and itinerant character, with coexistence of superconductivity (T_c~6.2 K) and magnetism. The T_c of chemically substituted $Ce_{1-x}La_xRu_2$ shows change from ~6.2 K (x=0) to ~0.3 K (x=0.5) and ~4.4 K for the $LaRu_2$ (i.e. x=1), with an anomalous behaviour (maximum of 6.7 K in the range of x~0.06-0.09 before the decrease with further increasing of the La). It is still to be understood whether the decrease of the Tc in $Ce_{1-x}La_xRu_2$ is due to increasing magnetic interaction or due to change in the local electronic density of states and/or local lattice distortions.

During the allocated beam-time we have measured high resolution x-ray diffraction on the $Ce_{1-x}La_xRu_2$, as a function of La concentration. We could perform the measurements on several samples with x=0.00, 0.03, 0.06, 0.09, 0.12, 0.15, 0.2, using the wavelength

λ=0.57970072 . All these samples were prepared using arc melting under argon atmosphere, followed by high temperature vacuum homogenization and were well characterized for their superconducting properties. The measurements were made at twelve different temperatures in the range between 80 K and 375 K for all samples.

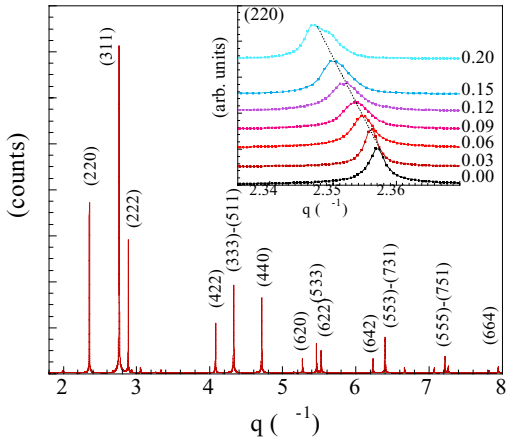

Fig.1 Representative diffraction pattern on x=0.3 sample (T=300 K); the inset shows the (220) reflection as function of La concentration.

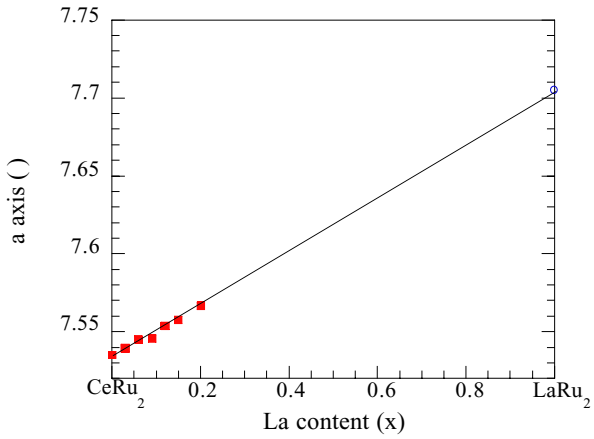

Fig. 2 The evolution of lattice parameter at T=300 K. The lattice parameter *a* shows a linear elongation with increasing La concentration.

Figure 1 shows a representative high resolution powder diffraction pattern measured on x=0.3 sample at room temperature. All the peaks can be indexed to CeRu2 type structure, confirming the high quality of the samples. The inset of the figure displays the evolution of the (220) reflection as function of La concentration, scanning the anomalous superconductivity regime. Thanks the high resolution we were able to determine the lattice parameters with very high precision. The x-ray data were analyzed using Rietveld refinement method (GSAS program). The evolution of lattice parameter *a* (300 K) shows a linear elongation with increasing the La concentration, as shown in figure 2. The detail analysis as a function of temperature and La concentration is in progress.

To further clarify the role of lattice fluctuation, and order/disorder of atoms, in the superconductivity of $Ce_{1-x}La_xRu_2$ the work has to be taken up with measurements of high resolution diffraction across the superconducting transition temperature.