



Experiment title:
Search of structural changes or superstructure in the
Heavy-Fermion URu₂Si₂ .

**Experiment
number:**
HE-1414

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Local contact(s):
Dr. François Faust

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Names and affiliations of applicants (* indicates experimentalists):

F. Bourdarot* CEA-Grenoble DRFMC-SPSMS/MDN

J.P. Sanchez* CEA-Grenoble DRFMC-SPSMS/MDN

B. Fåk CEA-Grenoble DRFMC-SPSMS/MDN

Report:

URu₂Si₂ is one of the most fascinating uranium intermetallics, due to its unconventional properties. The compound presents magnetic anomalies at $T_N = 17.5$ K and below $T_c = 1.2$ K superconductivity is established, which coexists with magnetic order. The magnetic order is characterized by sharp features in bulk properties such as specific heat, linear and nonlinear susceptibilities, thermal expansion etc... Neutron scattering experiments show a tiny ordered uranium moment of $0.03 \mu_B/\text{U-atom}$ and the existence of a gap in the magnetic excitation spectrum. However, the size of the magnetic moment cannot account for the bulk properties, e.g. the entropy loss. A model assuming two order parameters predict an inflection point of the ordered moment. This behavior was found in recent neutron experiments under magnetic field up to 17 T at the Hahn Meitner Institut. However, this model could induce that the quadratic symmetry I4/mmm is not preserved below the ordering temperature $T_N = 17.5$ K. So far neither neutron diffraction nor x-ray diffraction experiments were able to detect structural anomalies close to T_N or in the ordered state. However, these experiments on single crystal considered only few positions in reciprocal space. Thermal expansion coefficients along the tetragonal axes show a jump at T_N (positive and negative) which looks like the jump of the specific heat. The thermal expansion anomalies at the phase transition are not particularly large ($5 \cdot 10^{-6} \text{ K}^{-1}$).

The aim of the experiment was to search for any small crystallographic distortion below T_N . The diffraction patterns were recorded between 25 K and 10 K on samples which were powdered and sealed under argon in small capillaries of 0.3 mm of diameter and at a wavelength of 0.2746 \AA (Fig.1a and b).

No structural anomaly or superstructure were found below T_N . The cell parameters extracted from the diffraction patterns at different temperatures are in agreement with the data of the thermal expansion. In conclusion, the transition below T_N does not show any structural anomaly or superstructure and only the antiferromagnetic order decreases the symmetry of the crystal at the transition.

Fig.1a: Diffraction pattern of URu₂Si₂ at 10K. Only one crystallographic structure is found.

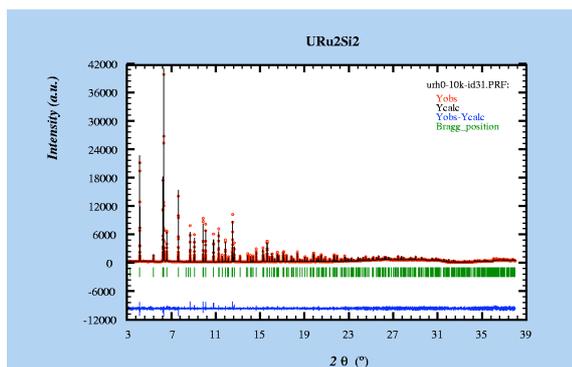


Fig.1b: Detail of the diffraction of URu₂Si₂ pattern at 10K. No distortion or superstructure is detected.

