ESRF	**Experiment title:** Sm valence and closure of the correlation gap in the Kondo Insulator SmB_6.	**Experiment number**:
Beamline:	**Date of experiment**: from: 23.01.2018 to: 30.01.2018	**Date of report**:
Shifts:	**Local contact(s)**: O. Mathon	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Cornelius Strohm* DESY Photon Science, Germany

DESY Photon Science, Notkestrasse 85, 22607 Hamburg, Germany

Fabienne Duc* CNRS LNCMI Toulouse, France

CNRS Laboratoire National des Champs Magnétiques Intenses, 143 avenue de Rangueil FR - 31400 TOULOUSE Cedex 04, france

Shingo Yamamoto* HZDR HLD Dresden, Germany

HZDR Dresden High magnetic Field Laboratory, Bautzner Landstrasse 400, 01328 Dresden, Germany

Report:

In the experiment we studied the Sm valence as a function of temperature and field at ambient and applied pressure. The demonstration of XAS up to 30 T for the sudy of the Sm-Valence state at the L_3-edge in a non-magnetic miniature high pressure cell is by itself a new technical development. Figure 1 shows a preparation and an absoprtion map of one of the samples inside the cell, Figure 2 shows some of the first results as a function of field and temperature.

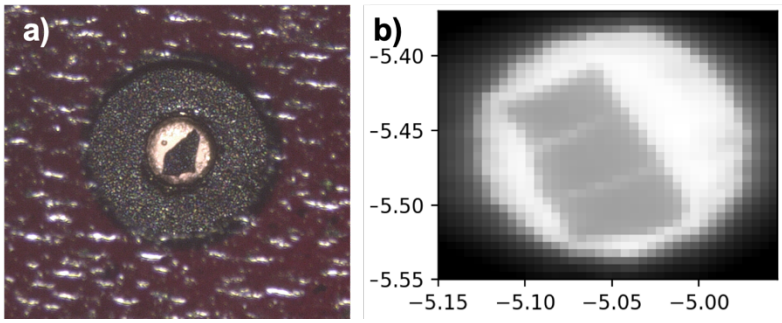

Figure 1: Non-magnetic miniature high-pressure cell. a) One of the preparations. Inner ring Ti6Al4V inner gasket, supported by Kapton ring to center windows and take hoop stress. This assembly minimizes eddy current heating. b) Absorption map of SmB_6 sample from a different preparation.

1) At zero field as a function of temperature we observed the reduction of the Sm valence in qualitative agreement with the literature at ambient pressure (Figure 2 b), and at 1.9 GPa.
2) As a function of field at low temperatures, we did not observe a significant variation of the valence state, neither at ambient pressure (Figure 2 c), nor under applied pressure of 1.9 GPa (decreasing to 0.9 GPa at the end of the experiment) (Figure 2 d).

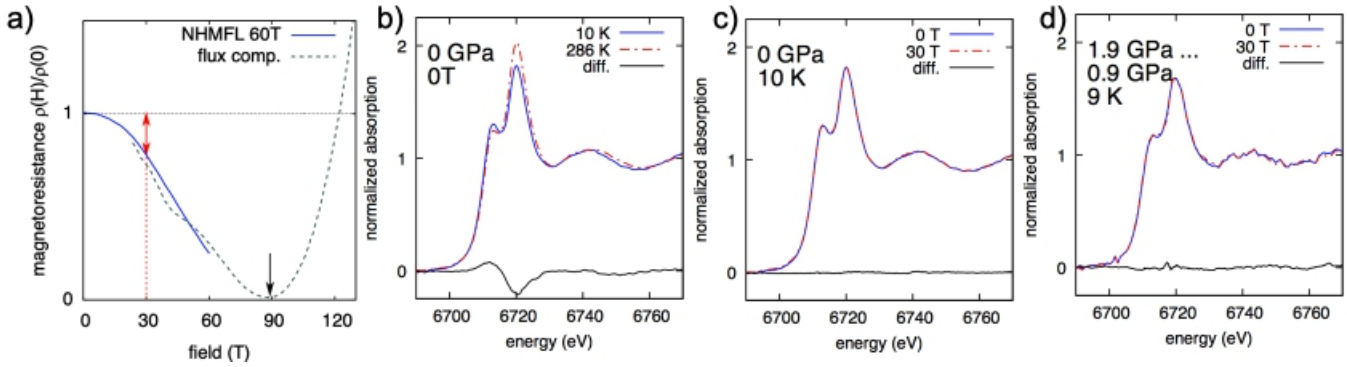

Figure 2: a) Magnetoresistance indicating the closure of the gap at about 89 T from J.C. Cooley et al. *J. of Soperconductivity* **12,** 171 (1999)**, b), c) and d) First XAS results obtained in HC3484: b) temperature dependence at ambient conditions. c) field dependence at ambient pressure. d) field dependence under pressure. No significant variation of the Sm valence was observed as a function of field up to 30 T and pressures up to 1.9 GPa as indicated by the difference spectra.**

Preliminary conclusions

- XAS data of excellent quality can be obtained in pulsed high magnetic fields up to 30T inside the miniature high pressure cell.
- Very small Valence changes can in principle be detected.
- We did not observe any sinificant evolution of the Sm valence up to 30T, neither at ambient pressure, nor at applied pressure, in the measuremets shown, even though a reduction of the gap may be expected from resistivity data in the literature. Furthermore, resistivity measurements already show a significant reduction in resistivity at ambient pressure within the field range of this experiment and long before the supposed gap closure around 89 T.
- The literature can be interpreted that applied pressure would allow one to reduce the correlation gap sufficiently, so that the field induced closure could be observed within the field range acessible in this expwriment.
- It would be important to confirm our observation a) with another field dependence closer to the gap-closure at 5.5 GPa, and b) to probe the magnetic state with XMCD, as the degree of localisation of the 4f electrons is key to understanding the nature of the correlation gap in SmB_6.
- An observation of the field induced closure of the gap through resititution of the ambient-P-T valence state would be the first microscopic observation of the field induced gap closure in SmB_6. On the other hand, confirmation of the observed trend would either point to a different nature of the field induced closure or magnetic state.
- One issue we faced was the stability of the complicated loading of the cells equipped with the special composite gasket and thin windows on both sides. We are working on inproving this. Another issue was that we did not have a pressure measurement at low Temperatures inside the cryostat. We therefore have taken steps to implement in-situ pressure measurements using a long focal distance pressure ruby luminescence setup developed at ESRF.