EUROPEAN SYNCHROTRON RADIATION FACILITY

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Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** RXS study of superstructure reflections in CeSb at low T and high magnetic field applied	**Experiment number**: HE-2910
Beamline: ID 20	**Date of experiment**: from: 18/02/2009 to: 24/02/2009	**Date of report**: 30/11/2009
Shifts: 18	**Local contact(s)**: Valerio Scagnoli	*Received at ESRF:*

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The Ce monopnictide compounds CeX (X=P,As,Sb,Bi) possess a simple NaCl-type structure but exhibit unusual transport and magnetic properties, having been extensively studied with neutron and synchrotron scattering techniques [1]. Considered as heavy fermion systems, they show extremely low carrier densities, and the magnetic properties are determined by the single electron of the 4f orbital of Ce^{3+} ion.

The aim of this experiment has been to explore for the first time the rich H-T magnetic phase diagram of CeSb [2] by using RXS, exploiting both the polarization analysis and the element selectivity, in order to better understand the role of the orbital-magnetic interplay in this compound.

Non- resonant measurements were taken at 6.10 keV while magnetic resonant scattering (MRXS) data were taken at the Ce L_2 edge, which was expected to show a stronger signal than L_3 as previously reported [3]. During the experiment the energy dependence of the scattering intensity was measured as a function of the outgoing photon polarization, in- and out-of-plane (π–π' and π–σ' respectively), at different temperature (T) and values of the externally applied magnetic field (H), up to 7.5 Tesla.

Figure 1 shows **Q**-scans at Ce L_2 absorption edge in two different domains of the sample as a function of T, for H=0 and H=2.6 Tesla. Magnetic reflections observed are signatures of the different magnetic phases in the H-T diagram, a different magnetic propagation vector **q** characterizing each one. We must note that we have been able to identify 10 out of the 13 FP, AFP and AFF magnetic phases described in ref. [2]. Most of them had never been previously studied by RXS, in particular no one of those phases only appearing under the application of a magnetic field.

The most relevant features derived from our resonant measurements are: i) π–π' scattering is present for all magnetic reflections. Instead, intensity in the π–σ' channel is only clearly detected in FP and AFP phases, i.e. it appears to be absent in phases lacking from the presence of "para-planes"; ii) we have unambiguously observed AFP6 phase for the first time (q=7/13) antiferromagnetic reflection (1 0 0); iii) a non-resonant charge scattering component has been observed in (2 0 q) magnetic reflections in FP1, FP2 and FP3 phases. We note that for a given reflection, energy scans were very similar in all these three phases. The charge component was absent or its intensity highly reduced in also studied (4 0 q), (4 2 q) and (6 0 q) reflections, whose energy dependences were comparable. The existence of a charge modulation coupled to magnetic ordering had been already addressed in literature, despite its origin is not clear yet [3,4].

Regarding non-resonant scattering measurements, we focused on AFP5 phase, where signals corresponding to magnetic and charge modulation ordering were observed.

A deeper analysis of the data recorded during this beamtime is underway and we expect to publish results soon elsewhere.

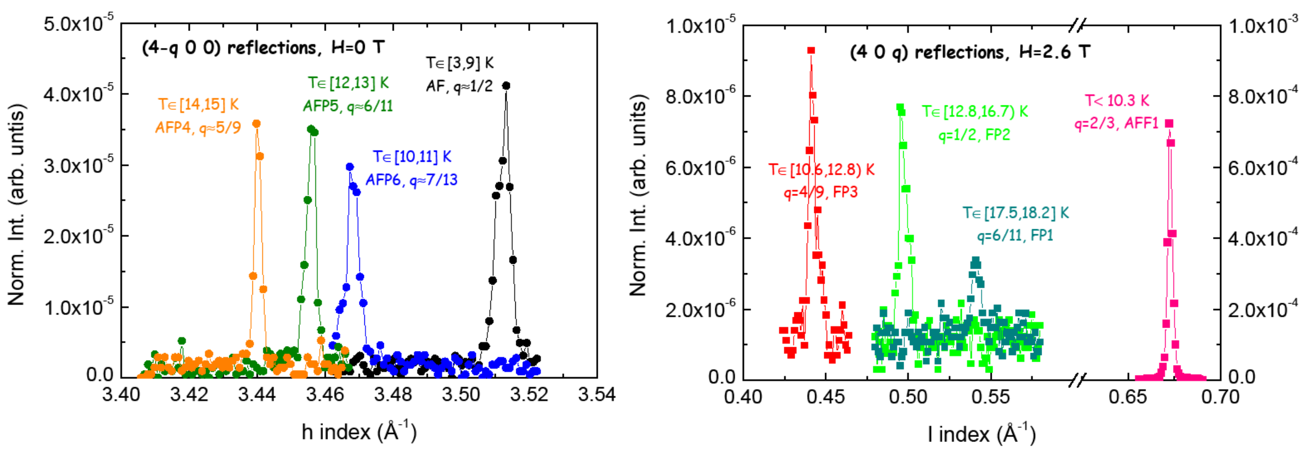

Figure 1. Q-scans parallel to a* (left) and c* (right) reciprocal space axes as a function of T and for two different values of H.

[1] J. Rossat-Mignot et al, J. Magn. & Magn. Mater. **52**, 111 (1985)

[2] J. Rossat-Mignot et al, J. Magn. & Magn. Mater. **31-34**, 398 (1983)

[3] A. Stunault et al, Physica B 345, **74** (2004)

[4] D. F. McMorrow et al, J. Phys: Cond. Matter **9**, 1133 (1997)