EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

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 via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can 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:** Superluminal and subluminal propagation of narrowband x-ray pulses	**Experiment number**: HC-1899
Beamline: ID18	**Date of experiment**: from: 17 June 2015 to: 23 June 2015	**Date of report**: 01/03/16
Shifts: 18	**Local contact(s)**: R. Rüffer	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

R.Röhlsberger*, DESY Hamburg

J. Haber*, DESY
Kai Schlage*, DESY
Kilian Heeg, Max-Planck-Institute for Nuclear Physics
Jörg Evers, Max-Planck-Institute for Nuclear Physics

Report:

Since we did not receive beamtime in the 16-bunch mode as requested in the proposal, the experiment was not performed as planned. Without measuring the time delay of scattered radiation, information about the pulse propagation velocity was impossible to measure.

Instead, we decided to measure the dispersion of a nuclear cavity QED system displaying features of electromagnetically induced transparency. We measured the energy spectra of the reflectivity, for a series of angles of grazing incidence around the center of a cavity.

The measurements were taken with the synchrotron Mössbauer source (SMS) of ID18.
By and large, our experiment was successful. There were however some problems and setbacks. For several days, the SMS showed wildly unreliable behaviour. The energetic width of the beam changed regularly. Also, the angle of incidence of the beam coming from the SMS crystal onto the sample drifted and changed, which was highly inconvenient for reflectivity measurements. Furthermore, the measured spectra had a strong sinusoidal modulation which is very likely not due to the sample properties, but to some sort of problem with the SMS.
The beamline scientists determined that the problems were largely to blame on the particular crystal in the SMS and exchanged it for another one; this certainly solved the problem of the resolution, which was extremely reliable and good from that point on. The other problems were alleviated enough to continue the experiment, altough they have caused some problems

and uncertainties in the process of data analysis. Nevertheless, the data is by and large of good quality.
We also used the same sample to perform cavity QED transmission experiments. While taking temporal spectra was not possible as mentioned above, we were able to (a) determine the total transmission of the waveguide, and (b) take energy spectra of the transmitted radiation. It turns out that while the transmission is very low, the contrast in the Mössbauer spectra is very large, such that effects can be observed even with low countrates.

While we were not able to pursue this in a systematic way, these measurements will certainly be a great help in planning and optimizing future experiments.