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 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:** Diffractive – refractive x-ray optics in Laue case	**Experiment number**: MI 848
Beamline: BM05	**Date of experiment**: from: 13.12.2006 to: 16.12.2006	**Date of report**: 21.2.2007
Shifts: 9	**Local contact(s): MSc. Paola Coan**	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Peter Oberta* Institute of Physics, Academy of Sciences of the Czech Republic
Jaromir Hrdý* Institute of Physics, Academy of Sciences of the Czech Republic
Petr Mikulík* Institute of Condensed Matter Physics, Brno, Czech Republic
Luca Peverini* ESRF
Paola Coan* ESRF

Report:

The experiment was devoted to study properties of a double surface-shaped Laue-diffracting monochromator. The possibility of sagittal focusing of SR by an asymmetric Laue crystal with profiled surface was experimentally demonstrated in our last experiment MI – 751. This time we used two identical samples of Si single crystals with two parallel holes of the diameter of 8 mm (Fig. 1) in a dispersive arrangement. The axes of the holes formed an angle of 7.95° with (111) diffracting planes. The minimum thickness of this Laue crystal was 0.5 mm.The 15.35 keV SR was diffracted in the space between the holes. The impinging and diffracted beam formed the angle of 0.55° with the local surface. The diffracted beam entered the second crystal under the same angle and was diffracted as well. The dispersive setting was used in the goal of canceling both the vertical and horizontal spread of the focus observed in the previous experiment. We observed a diffraction with a focusing effect (convergent beam) after the first crystal (Fig. 2) and after the second crystal (Fig. 3) separately. After arranging the two crystals in a dispersive setting, we observed a diffraction, but with a quite different shape and possition as predicted (Fig. 4). It turns out that it is not easy to observe a straight result of a focusing effect after the two-crystal arrangement due to its very delicate and sensitive settings. The displacement of the diffraction, which was found a little bit of the center, could be due to the different heights of both crystals with respect to the beam. Without any focusing effect, we would observe a horizontal (sagittal) divergence of the diffracted beam, which was not the case. The experiment confirmed the predicated convergence of the beam. Furthermore, additional interesting diffracting effects, like interference pattern (Fig. 5) and scattering (Fig. 6) were observed, whose origins are not clear and they are being intensively studied. We try to work out suitable models which could explain the origin of the observed diffracting effects and particularly the interference fringes. In order to get the maximum focusing effect we chose the wavelength such that the angle between the beam and the crystal surface was very small, 0.55^0. Grazing incident scattering is very sensitive to (sub)surface inhomogenities, which in our case could be present even if the mechano-chemical polishing was applied. Probably due to the scatering from the surface which we did not expect the diffracting spot is not sharp enough to calculate the focusing distance. On the other hand, the nature of the observed interference pattern and the scattering phenomena should be studied in

detail. For this reason **the experiment should be repeated** with somewhat shorter wavelenght and better definition of the impinging beam. It will be very useful to compare this experiment with the measurement on 0.5 mm thick **flat** Laue crystal with the same asymmetry. Such a flat crystal may be better polished which should allow to separate the focusing image from effects caused by the scattering from the insufficiently flat surface. This may help to explain the nature of the interference pattern.

Fig. 1

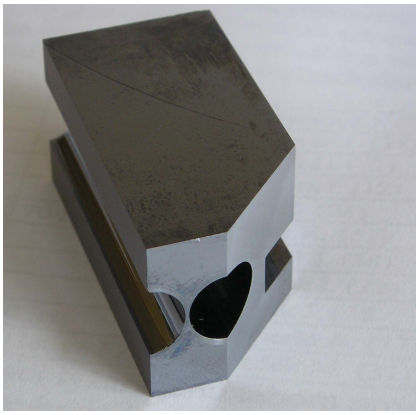

Fig. 2

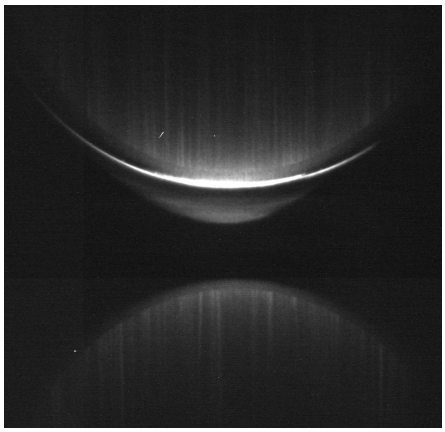

Fig. 3

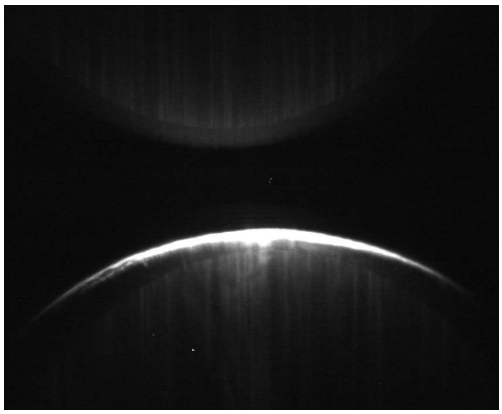

Fig. 4

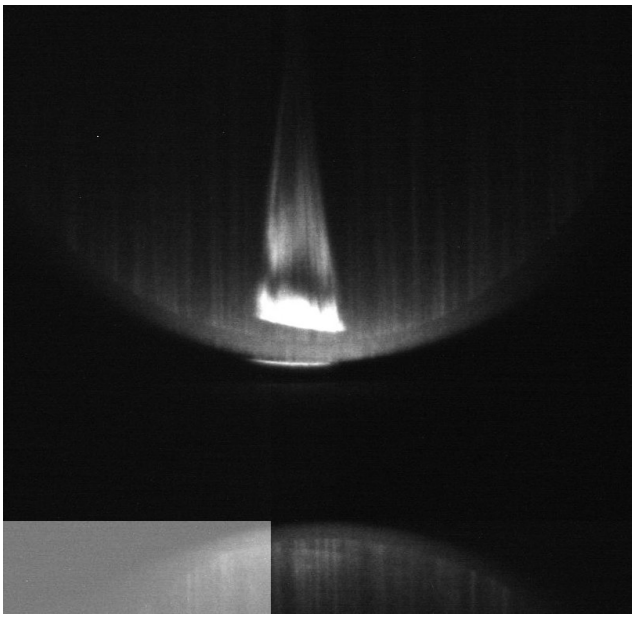

Fig. 5

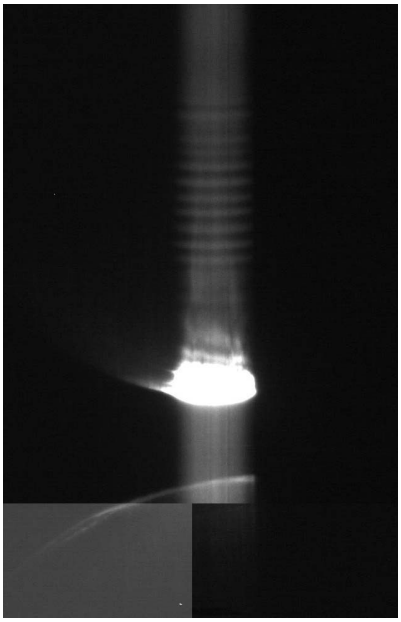

Fig. 6