ESRF	**Experiment title:** Phase contrast imaging with the coherent microbeam from an x-ray wave guide	**Experiment number:** MI160
Beamline: ID13	**Date of experiment:** from: 14/2/97 to: 18/2/97	**Date of report:** 14/3/97
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Report

In previous experiments at ID13 (MI50, MI75 and M199) a thin film waveguide was used to produce a submicrometer beam. It was shown that two beams with vertical dimension of 130 nm come out from the waveguide end, separated by the double of the inner reflection angle. The coherence of these beams was demonstrated. For the first order of resonance the two beams are not resolved and only one beam with a total divergence of lmrad comes out.

The aim of this experiment was to realize phase contrast experiments using the submicrometer beam from the waveguide, in order to improve the spatial resolution. In fact it has been demonstrated in several experiments, in particular at ESRF, that light materials can be imaged through phase contrast even with hard x-rays, and that the resolution is usually limited by the resolution of the detector, 1 micron with HR film and 1.5 micron with a CCD based detector.

In this experiment a new waveguide has been used and a gain in efficiency of one order of magnitude has been measured, compared with the previous waveguide (see also exp. rep. SC293). A gain of 3 is obtained with respect to a slit of 130 nm which anyhow can not be produced in reality.

With this waveguide we succesfully realized a phase contrast experiment with an unprecedent lateral resolution using the beam of the first order of resonance of the waveguide. The small size of the beam and its divergence in the vertical direction allowed to obtain images magnified in the vertical direction 300 times or even more, without loosing the coherence of the beam. In the simple set-up, the distances waveguide-object and object-detector allow to control both defocusing distance and magnification.

We obtained phase contrast images both from a nylon fiber and from a gold grating. With this, in particular, we could establish that the resolution was better than (data analysis is still in progress) 0.2 micron without using a high resolution detector. Scanning of the sample through the beam allowed to reconstruct the complete image of the object.