ESRF	**Experiment title:** **X-ray interferometry at high energies**	**Experiment number:** HC 475
Beamline: ID15A	**Date of experiment:** from: 21 Aug 96 to: 31 Aug 96	**Date of report:** **28** Feb 97
Shifts: **27**	**Local contact(s):** K. D. Liss	*Received at ESRF:* **4 MAR. 1997**

Names and affiliations of applicants (* indicates experimentalists):

U. Lienert*, D. Laundy*, K. D. Liss*, ESRF

M. Hart, NSLS, BNL, Upton, Long Island, New York 11973

Report:

The aim of the experiment was the precise determination of the real part of the atomic scattering factor at high energies. The results will be compared to recent calculations. Of particular interest is a relativistic correction term. Therefore high energies were employed to be able to use heavier samples and still be far above the K-edge to separate the relativistic term from the anomalous contribution.

The wavelength shifter at ID15 provides a unique high energies source. A scanning Laue interferometer was used to measure the phase shift for various elements. The interferometer was therefore installed in the direct beam. Particular experimental problems resulted from the narrow beam separation between the direct and twice reflected beam of only 2 mm. The beam separation limited the highest usable energy. Still, up to 15 mm long sample could be inserted into the 90 mm long interferometer. An energy dispersive Ge-detector was used for simultaneous measurement from the (2 2 0) fundamental up to fourth order (8 8 0), the fundamental being typically around 135 keV. Care must be taken to avoid cross-talk of

different orders by pile-up or partial energy deposition. The atomic scattering factor should be determined to a relative accuracy of 10^{-4} which requires that the sample thickness, phase shift and wave length are measured to same accuracy. The absolute wavelength calibration was problematic as the optical interferometer could not be used as absolute reference. Bond method was employed using an analyzer crystal mounted on a Huber rotation table. Up to fifth order was measured at various positions of the rotation table to average non-linearities of the gearbox and inch worm. The phase shift was obtained by comparison of fringe pattern with and without sample.

Fringe pattern were obtained up to fourth order around 540 keV. Si, CaF_2, Ge, Ag and Sn samples were measured to investigate the Z-dependence of the relativistic correction term. The detailed evaluation is under way.

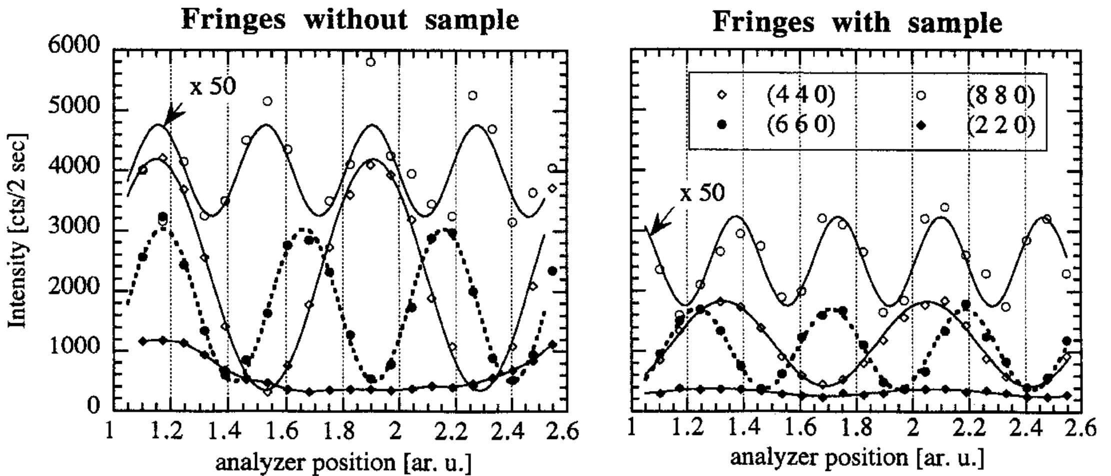

Fig. 1: Fringe pattern to obtain phase shifts by a 5 mm thick Ag sample. The scan without sample gives the reference phase. Note that the zero phases of all harmonics coincide. The fundamental (E = 135 keV) is biased by only partial energy deposition by the second order in the Ge-detector. The noise on the fourth order is likely due to pile-up. With inserted sample the phases, intensities and contrast of the different orders vary corresponding to their energy. The fundamental is absorbed by the sample but even the fourth order at 540 keV can be used for phase determination.