11.7-11   THICKNESS DEPENDENCE OF INTENSITY PROFILES
IN A NEUTRON-STEP-INTERFEROMETER.

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A new type of triple-Laue-case (LLL) interferometer
with lamellas of different thickness (step-IFM) has
been tested with the neutron-interferometer set-up at
the ILL in Grenoble. Thermal neutrons of about 1.9 Å
wavelength and Si-220 reflection were used. For an in-
cident spherical wave the spatial intensity profiles
as function of the geometric dimensions of a IFM have
been developed theoretically by W. Bauspiess, U. Bonse,
W. Graeff, J. Appl. Cryst. (1976) $\underline{9}$, 68. Contrary to
the X-Ray case with strong Borrmann effect, for neu-
trons with extremely weak absorption both types of wa-
ve fieldes (type 1 with antinodes and type 2 with no-
des on the crystal sites of the nuclei) have to be
considered in the analysis. Spatial intensity concen-
tration in the centre of the outgoing beams and good
contrast properties are found if $t_M = 2t_S = 2t_A$, where
t_M, t_S, t_A are thicknesses of mirror, beam splitter and
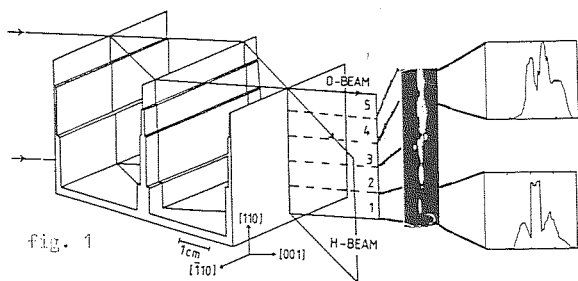
fig. 1

analyser, respectively. In our case (fig. 1) three re-
gions (2,4,5) of the step-IFM with $t_M = t_S = t_A$ and two re-
gions (1,3) with $t_M = 2t_S = 2t_A$ have been investigated (in
regions 5,4,2: $t_M = 4.1\Delta_o$, $12.9\Delta_o$, $27.2\Delta_o$ and in 3,1:
$t_M = 27.2\Delta_o$, $54.1\Delta_o$, respectively. Δ_o: extinction dis-
tance ≈ 65µm).
The interferometer was illuminated by a narrow beam.
The divergence was sufficient to excite the whole Borr-
mann fan, so that the beam leaving the step-IFM covered
a region of width $2T \tan \Theta_B$ ($T = t_S + t_M + t_A$). The spatial
intensity profiles in the O-beam were photographed by
the ^{157}Gd conversion method. From the optical density
the neutron intensity reaching the film was evaluated.
Thus a comparison with theoretical profiles is possib-
le.
The profiles show oscillatory structure in the O-beam
which can be considered as a superposition of Pendel-
lösung-oscillations of crystal plates with different
thickness. Visible in the experiment are so far only
the averaged intensities due to wavelength distribu-
tion and slit width. When compared with the experimen-
tal results the profiles agree reasonably with the cal-
culated ones shown in fig. 1. Deviations are due to va-
riations of focussing within a single region caused by
geometrical aberrations which at present have not all
been included in the calculations.
Clearly visible are the focussing properties of region
1 and 3 and the difference in the spatial intensity
profiles of region 4 and 3 both in the experimental
and in the theoretical profile.

Further results will be shown and discussed.

11.7-12   CREATION OF NEW WAVE-FIELDS - A THEORETICAL
TREATMENT. By F.N. Chukhovskii, Institute of Crystallo-
graphy, Academy of Sciences of the USSR, Moscow, USSR.
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The so-called creation of new wave-fields (or inter-
branch scattering) is a phenomenological explanation,
operating in reciprocal space, of how the crystal wave
is modified while propagating in highly distorted re-
gions. It cannot be accounted for theoretically unless
the Green function corresponding to the solution of
Takagi's equations (Takagi, J. Phys. Soc. Japan (1969)
$\underline{26}$, 1239) be itself expanded in reciprocal space. In
the case of crystals with a uniform strain gradient nor-
mal to the entrance surface, this can be achieved by
means of a Laplace transform. The h-Green function
(Chukhovskii, Petrashen, Acta Cryst. (1977) $\underline{A33}$,311)
then appears as a "non-planar wave-packet", i.e. a super-
position of amplitudes $P_h(p)$ representing the non-
planar wave that an incident plane wave of deviation
parameter p will induce at a depth z in the distor-
ted crystal. Apart from a multiplicative factor, $P_h(p)$
is in the form :

$$P_h(p) \mp \{D_\nu(-iY_o) \underline{D}_{-\nu-1}(-Y) - D_{-\nu-1}(-Y_o) D_\nu(-iY)\}$$

where D_ν is the parabolic cylinder function of order ν.

$$\nu = i/4B \; ; \; Y_o = i\nu^{1/2}p \text{ and } Y = Y_o + 4\nu^{1/2}B \frac{\pi}{\Lambda} z$$

Λ : Pendellösung   length.
B : measures the strain gradient $(B \propto \dfrac{\delta^2 (\vec{h}.\vec{u})}{\delta s_o \; \delta s_h})$

The asymptotic limit of $P_h(p)$ for B >> 1 is made of
4 terms which are all different combinations of the
phase factors $e^{\pm \frac{Y^2}{4}}$ and $e^{\pm \frac{Y_o^2}{4}}$. Two of them can be
identified, through their phase, as the "normal" wave-
fields of the Eikonal theory with tie-points staying
on the same branch of the dispersion surface
while the two others are shown to cor-
respond to a "jump" of the respective tie-points from
one branch of the dispersion surface to the other.

These are the newly created wave-fields. It should be
noted that they originate in the region where the cur-
vature of the normal trajectory is the largest, their
amplitudes are both proportionnal to $e^{-\pi|\nu|}$ while the
the two normal wave-fields differ by a factor
$(1-e^{-2\pi|\nu|})^{1/2}$ from what they could be if the Eikonal
theory were valid. These results are in good agreement
with previous predictions (F.Balibar, Y.Epelboin,
C.Malgrange, Acta Cryst. (1975) A $\underline{31}$, 836).