DARESBURY LABORATORY IN THE 1980s – BRISTOL UNIVERSITY X-RAY GROUP

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Abstract: In 1980's, the SRS Daresbury laboratory was the site of the first dedicated synchrotron source. Bristol University H.H.Wills Physics laboratory X-ray group with A.R.Lang as a leader was the place where splendid experimental ideas for the use of synchrotron source were born. From many there obtained experimental results only two were selected for this paper since they represent non-standard experimental approach which could be of interest even in the days when personal computing and new electronic equipment can allow us now for superb experimental advances. Diffuse scattering form static lattice disorder rand X-ray double refraction experiment are real highlights of the all experiments performed at Daresbury source in 1985.

SRS Daresbury Laboratory, mid-way between Liverpool and Manchester, is the site of the first (in 1980 the only one world wide) dedicated UK's synchrotron radiation source. Established mainly for the academic research, it also serves the needs of other scientific institutions as well as industry. Today, UK and foreign scientific community have to their disposal a second laboratory, the DIAMOND synchrotron source newly build and opened for the users in 2007 at Harwell campus...

Going back to year 1984, I was given a unique opportunity to work in UK with the Bristol University X-ray group. The group was headed by Prof. Andrew Lang, the collaboration with whom was a great experience for me. The "Lang topographic camera" is a world wide well known piece of equipment every X-ray lab was equipped with in those days. He was designer inventor of the method and our guru in the subject. We have met at Crystallography Congress in Hamburg in August 1984 and after quick discussion between Andrew, Yves Epelboin and myself I was given unique chance to join the Bristol group. Considering that I was following the footsteps of Norio Kato, Satio Takagi, André Authier and many other "names" in the X-ray world who have visited Andrew Lang's Lab, not forgetting the Lang's PhD students like Mike Hart one may imagine how I was delighted.

Shortly after my arrival at Bristol University in January 1985 I had to quickly learn about diffuse X-ray scattering in depth since our first visit to Daresbury SRS laboratory was planned for beginning of February 1985 and that was the subject of my first synchrotron experiment with A.R. Lang and collaborators. Diffuse X-ray reflections are commonly studied by monochromatic incident beam of X-rays and can either deal with "normal" thermal vibrations, or as in our, case permit to study static disorder of the crystal lattice. Our specimen was a natural diamond of spectroscopic type 1a [1] which contained so called "voidites" – submicroscopic defects we can envisage as voidlike (empty) volumes bound by {111} crystallographic planes, the presence of which give rise to specific star-like scattering pattern (Fig. 1). That was quickly published in *Philosophical Magazine* and in *Daresbury Newsletter* [2, 3].

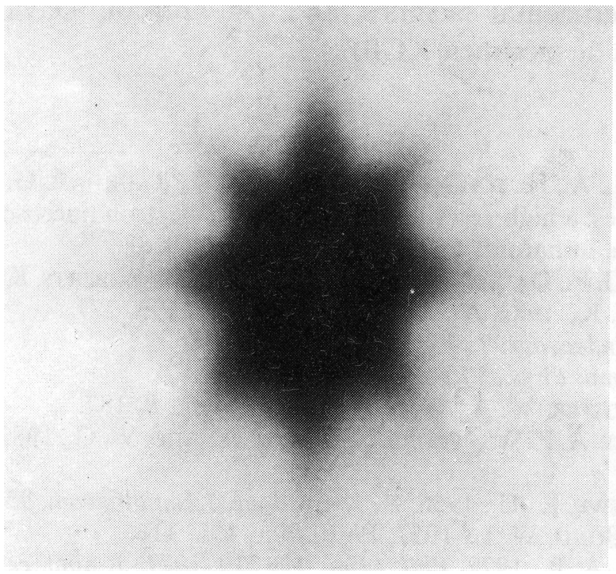

Figure 1. Diffuse scattering pattern observed from (111) growth sector of diamond. 400 reflection in symmetrical transmission.

That particular work as well as almost all other during my first three years long visit to Bristol University was done at station 7.6 at the end of so called topography line which in those days was probably the longest one (80 m) at any available synchrotron source (Fig. 2).

Figure 2. Topography line with 7.6 station hutch at the end (yellow box further away). The one in the foreground was station 7.2.

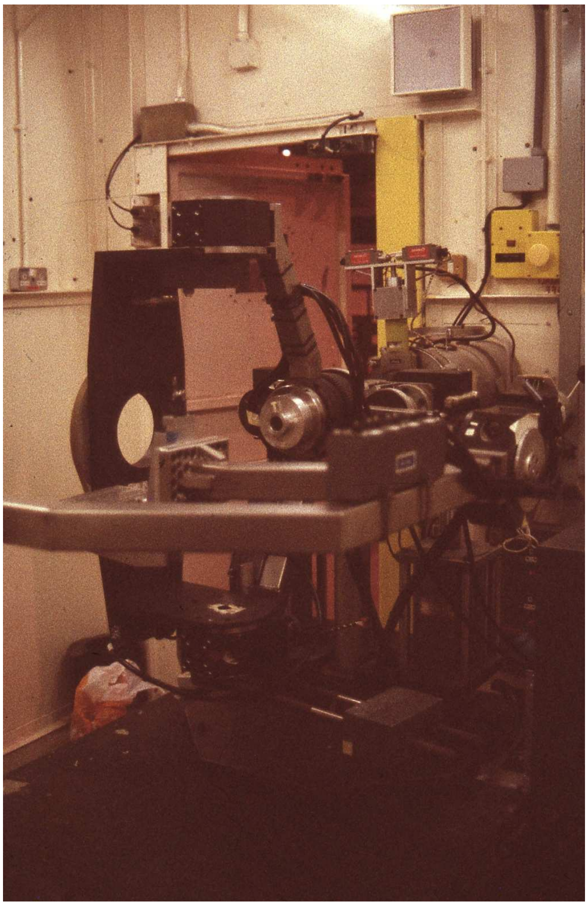

Figure 3. White beam topography camera, no longer in SRS. It was replaced by double crystal camera later and extensively used by our group.

The 7.6 hutch housed in those days a topographic camera (Fig. 3) which was later replaced by a dedicated double crystal camera.

Today, the station 7.6, reconstructed already for several times serves as x-ray optics test bench although it still houses the DC camera. Another highlight of my stay in Bristol and in Daresbury, where we spent, at the local laboratory hostel, many beam-hours as well as beam-days, was another excellent idea by Andrew Lang, namely the observation of double refraction of X-rays. Andrew was always full of splendid ideas for experiments as well as for constructing his own apparatuses to recompense the lack of specific equipment at Daresbury. Our locker close to 7.6 station was already full of Andrew inventions and we have constructed more equipment later as well. Special type of cameras, film holders, arms of every kind together with first motorised and computer driven film plate mover for taking multiple topographs on one plate. We should remember that those were very early days of PC computing and we did have, from Tony Makepeace, the so-called BBC type computer with BASIC language system only, not even IBM like PC. The topography camera in 7.6 hutch was driven by simple software from Texas Instruments programmable calculator. That was really great fun since I was given the function of main computer operator (including the Texas Instruments). It was simply because I was preparing for our X-ray group in Bristol all simulations packages for x-ray experiments like stacking fault contrast study, Borrman–Lehmann fringes, rocking curves calculations and whatever of smaller calibre was necessary [4,5].

The refractive index, n, of X-rays can be simply written as n=1-δ where δ is in the range of 10^{-5} to 10^{-6} and depends on electron density of the material, wavelength and $r_0=e^2/mc^2$ – the classical electron radius. That is when we are far from any Bragg reflection. But when we have the crystal Bragg diffracting, the matter is different since one of the branches of dispersion surface can lead to the situation when refractive index can be greater then unity (Fig. 4). That was very elegantly shown by Andrew Lang designed experiment, with the help of synchrotron source since large intensity was a must [6].

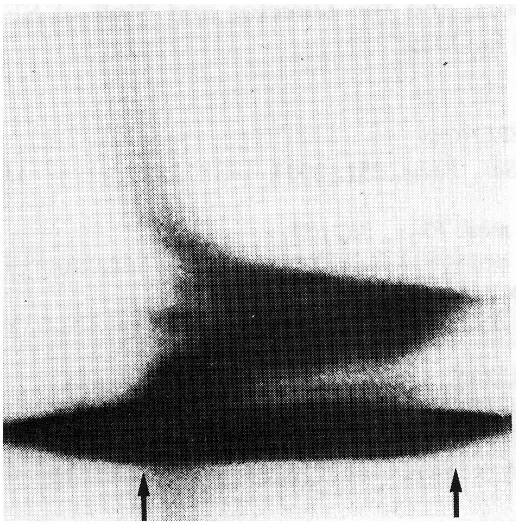

Figure 4. Refraction pattern of X-rays. We have used 111 Bragg reflection to produce a beam of Bragg diffracted X-rays directed towards the upper crystal surface to be later refracted and recorded on the photographic plate. Faint shadow close to the left hand arrow is the x-ray beam refracted with n value greater than unity. That phenomenon was reported for the very first time by our group.

Many other beam-hours and days we spend at SRS Daresbury ring but that first year 1985 was really a milestone. I would like to thank all colleagues and friends from Bristol Physics Department and Royal Holloway College University of London for their help and advice which was invaluable, thanks to Andrew Lang, Tony Makepeace and Moreton Moore (Fig. 5).

Figure 5. Inside the sample preparation and dark room area for 7.6 station. A.R. Lang in the front, and M. Moore and the author in the background.

SRS Daresbury laboratory will close for users and will be shutdown in September of this year (2008) maybe it was time to write about those early days.

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