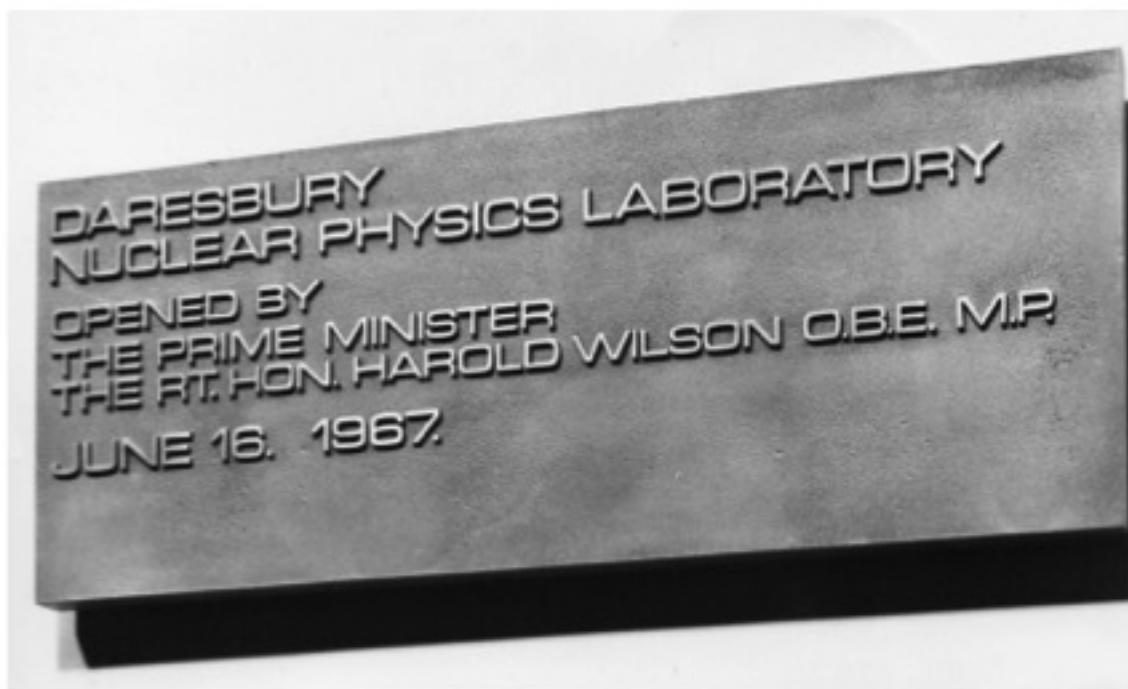


Presentation by Ian Munro in 2018 on the history of Synchrotron Radiation at Daresbury Laboratory

The Genesis of synchrotron radiation research at Daresbury in the UK

Ian Munro
Daresbury Laboratory
University of Manchester

Harold Wilson Opening



Daresbury



The Letter



Institute of Physics
Atomic & Molecular Physics Group,
THE PHYSICAL LABORATORIES,
THE UNIVERSITY,
MANCHESTER, M.
26 January, 1966.

Professor A. W. Morrison,
Department of Physics,
University of Liverpool,
L69 3BX.

Dear Professor Morrison,

I am writing on behalf of our Branch Committee, to ask you whether it would be possible for the Manchester Branch to hold their 1966 Summer visit at the Daresbury Accelerator Laboratories. Several of our Branch members have expressed interest in the accelerator and the work being carried out in the Laboratories.

We have normally held our visits in July, but, of course, we would come at any time convenient for the laboratory staff. It has been suggested that there might be scope to see if the visit were to be held on a day when the machine is shut down for maintenance. Would this be possible?

If you feel our visit will not cause much inconvenience, perhaps you could let us know what day, or days, would be suitable for the visit.

On a topic quite unconnected with the Institute of Physics— In the Molecular Physics Group here, we are hoping to extend our studies into the vacuum ultraviolet (from 2000 Å to ~100 Å) and have some enquiry available for equipment. Our problem is to obtain an intense continuous source of radiation for excitation in this region.

Dr. Kamarie (from our Department) told me of some work he had come across when in Hamburg, concerned with the properties of the emission from magnetically accelerated electrons in a synchrotron. It sounds as though such emission might provide an ideal source of excitation for our experiments.

I am still waiting for more details from Dr. Kamarie, and have at present little idea of the experimental problems involved in extracting such emitted radiation from a large accelerator.

However, I thought I would like to write to you now to let you know what we are thinking about, and to ask what you feel about making use of the Daresbury accelerator in this way, if the project should prove feasible. Has anybody else considered a project of this nature?

Yours sincerely,

J H M^{ScD}

J. H. MORRISON.

The Proposal

12th January, 1966.

Dear Dr. Mather,

We should be very pleased to see the Manchester Branch in Daresbury in July. If you like to suggest a few days we shall pick one out. We shall of course be very happy to offer you tea and buns.

On synchrotron radiation. There is no doubt that this is an extremely intense source in the region you mention. People have spoken for years about using it but nobody, so far as I know has done anything about it. ~~However~~ will certainly be able to tell you all about it but if you want to calculate yourself all the necessary theory is contained in a paper by Julian Schwinger in Phys. Rev. 75 1912 (1949).

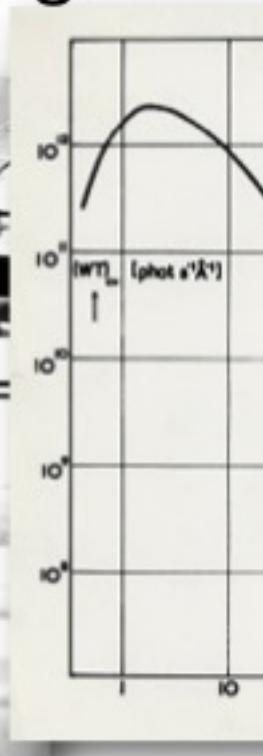
Attitude to such work at Daresbury is that if there is good physics in it I would be very enthusiastic.

Yours sincerely,

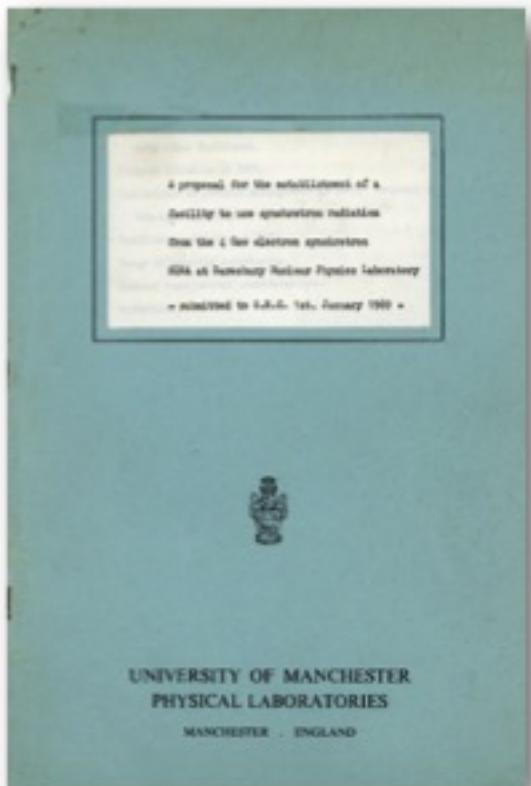
(A. H. MORRISON)

Dr. A. H. Morrison,
Atomic & Molecular Physics Group,
The Physical Laboratories,
The University,
MANCHESTER, 3J.

Data gathered for the funding



Grant Proposal



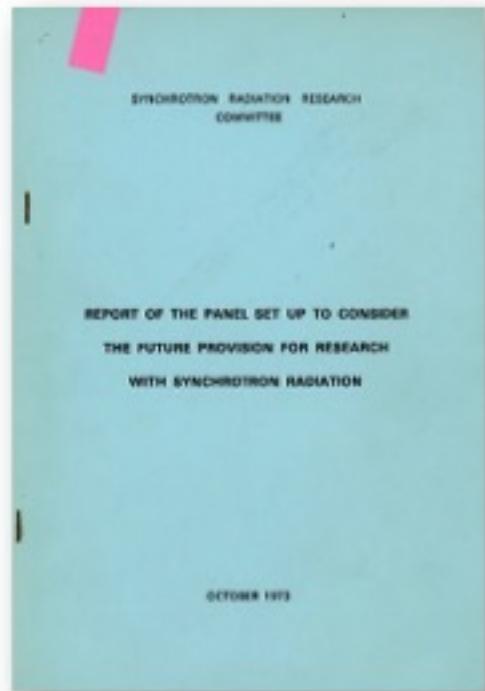
A proposal for the establishment of a
facility to use synchrotron radiation
from the 1 GeV electron synchrotron
NSR at Technology Research Nuclear Physics Laboratory
– submitted to I.R.E.C. Ltd., January 1969 –

UNIVERSITY OF MANCHESTER
PHYSICAL LABORATORIES
MANCHESTER . ENGLAND

Approval



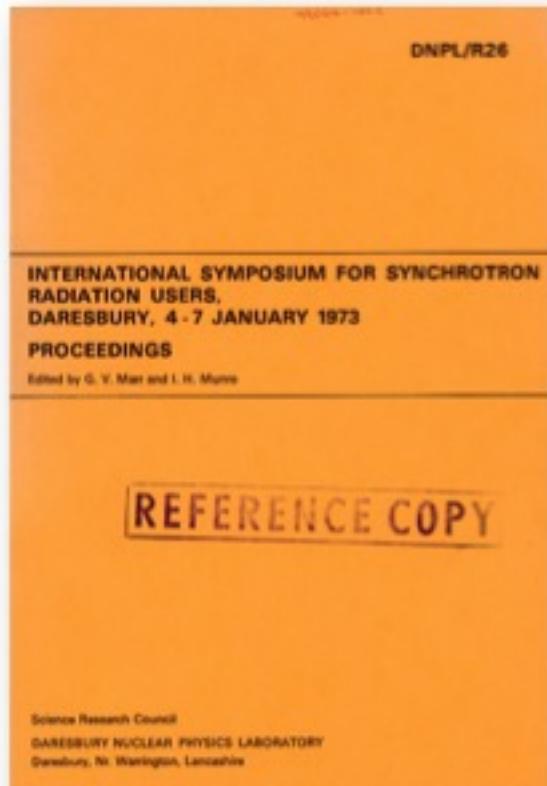
1973 - Collective study of Science programme



1973 – Chairman of SRC inspects



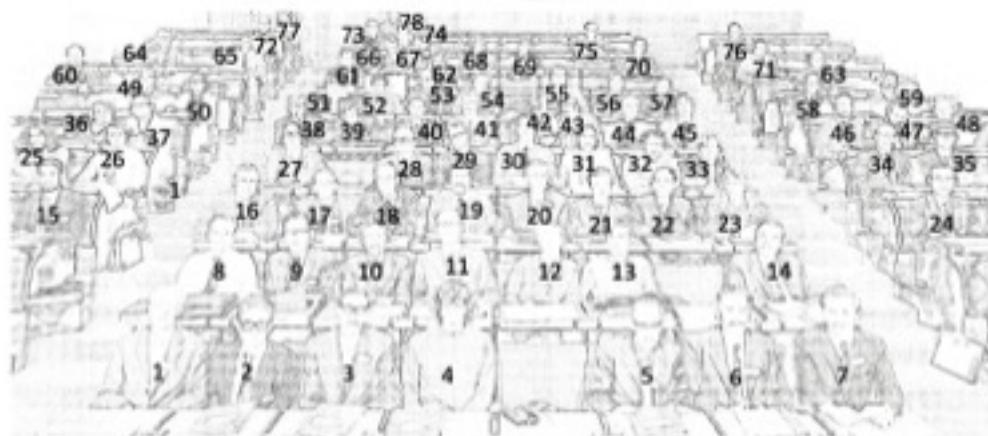
SRF Users International meeting



SRF Users International meeting

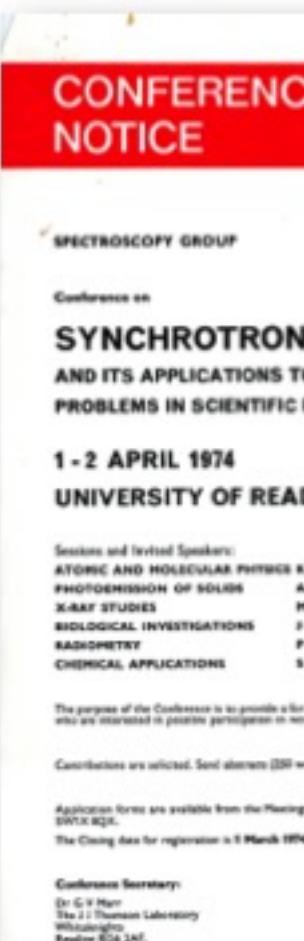


SRF Users Meeting – Guess Who

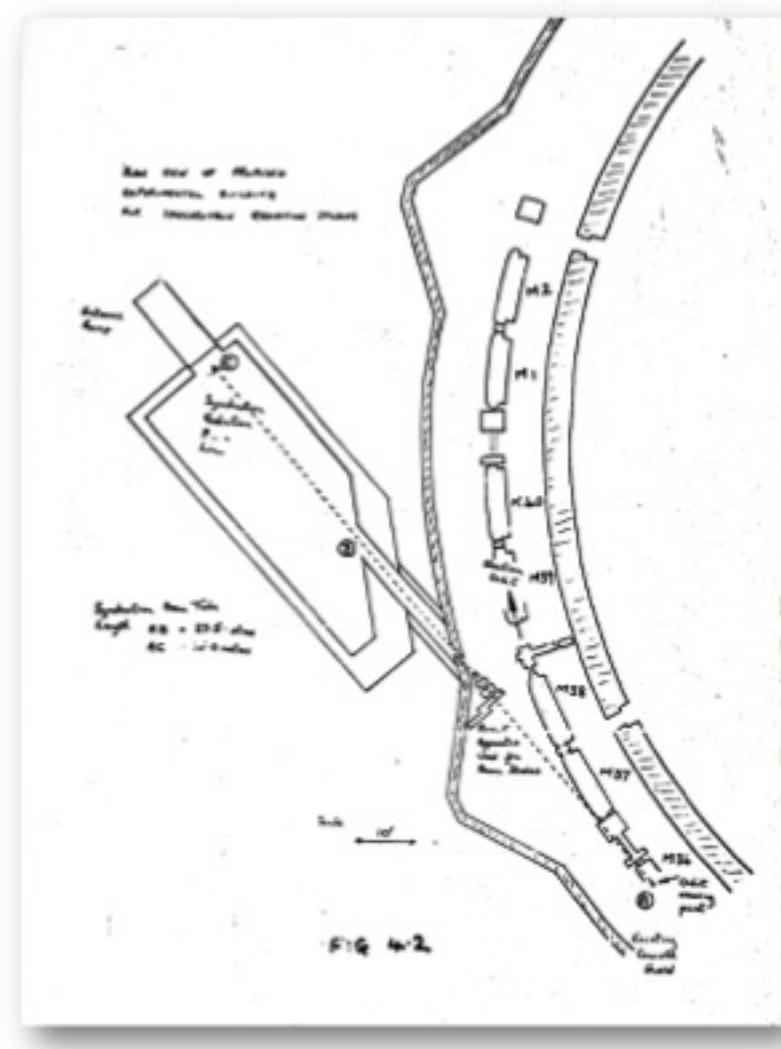


1. R. W. Dickburn	15. Michel Pouyet	29. Tony Potts	43. Joe Berkowitz	57. ?	71. ?
2. Rishak Steinberger	16. Christof Kuntz	30. Ruprecht Haensel	44. Reg Corson	58. John West	72. Len Naylor
3. ?	17. ?	31. Gwyn Williams	45. Peter McWhirter	59. Michael Lynch	73. Scott Hamilton
4. Nick Webb	18. ?	32. ?	46. Derek Fabian	60. Albert Frankis	74. ?
5. Bill Price	19. ?	33. Malcolm Howells	47. ?	61. ?	75. Peter Kay
6. Keith Coding	20. Phil Burke	34. ?	48. ?	62. ?	76. ?
7. Ian Munro	21. Bill Hayes	35. David Creek	49. Uwe Arndt	63. ?	77. Joen Bordas
8. Bob Speer	22. ?	36. R. Lopez-Delgado	50. Wiesi Fenugi	64. ?	78. Vic Soller
9. Fred Brown	23. Yvette Cauchois	37. ?	51. ?	65. Geoff Marr	
10. Michael Mansfield	24. Jim Samson	38. Anthony Bourdillon	52. ?	66. Doug Heddle	
11. ?	25. ?	39. John Beaumont	53. ?	67. ?	
12. J.-P. Cormeado	26. Mandisa Pentoos	40. T. Namroka	54. ?	68. Ray Houlgate	
13. Pierre Diaz	27. ?	41. ?	55. ?	69. Jim Lang	
14. Yves Farge	28. Ernst Koch	42. Paul-Marie Guyon	56. Dave Lynch	70. John Party	

1974 - The decision of the location of the SRS



SRF



1976 - Gap Years!

DRUM 1/77

21st May, 1977

SCIENCE RESEARCH COUNCIL
DARSBURY LABORATORY

SYNCHROTRON RADIATION USERS MEETING

Synchrotron radiation research during the "gap"

I.H. Munro

The synchrotron radiation facility committee have approved a considerable programme of research during the next few years (prior to the start-up of the SRS in late 1979). The programme involves the transfer of personnel and equipment to a number of synchrotron source facilities mainly in Europe but also to other facilities in the USA and the USSR.

It is the intention of the SRC that all apparatus and UK user group activities described below should be subsequently transferred to the new source as soon as possible after research activity commences at Daresbury. In some instances apparatus will be needed at D.L. in advance of the actual start-up date of the SRS.

OVERSEAS FACILITY LISTINGS

1. Bonn (Germany)	Prof. W.K.S. I (Imperial Coll.)
2. Bonn (synchrotron)	Dr. G.V. Raft (Leading)
3. Hamburg (DESY)	Dr. D.E. Tanner (Chairman)
4. Hamburg (DESY)	Dr. A.R. Glaz (Chairman)
5. Hamburg (DESY)	Dr. W. Heyen (Chairman)
6. Hamburg (PSI)	Dr. H. Cooper (Chairman)
7. Hamburg-EVSL (DESY)	Mr J.T. Read (Chairman)
8. Hamburg-EVSL (DESY)	Prof. J. Von Knebel Doeberi Dr. P. Schill (Chairman)

Can you spot the Garden shed?



An early SSRP experimental facility (left), mounted on the concrete roof of the building (right), a visitor for one year from the UK (center), a visitor for one year from the first light. On Munro's right, Sebastian Doniach (SSRP's t

The Only Paper published -1976

Downloaded from Acta Cryst. Part D 32 No. 2000 pp. 387-395 August 12, 1976

Small-angle scattering experiments on biological materials using synchrotron radiation

J. Bernal & L. H. Murray
Daresbury Laboratory, Daresbury, Warrington WA4 4AD, Cheshire, UK

A. M. Glauert
Wadsworth Center for the Study of Photo Transitions in Biomolecules, Channing Laboratory, Wadsworth Road, Chipping Barnet, London N19 5SE, UK

This paper describes an alternative approach to small-angle scattering experiments on biological specimens. The method makes use of the unique properties of synchrotron radiation and provides very fast data acquisition with great consistency. Preliminary experiments on rat tail tendon are described.

Unconventional macromolecules for which a meaningful approach is a subject of continuing interest and an efficient way of dealing with the problem is to study them in solution rather than in the solid state. The size of biological specimens is usually larger than those commonly encountered in conventional crystallography and may lie in a range of 1,000 Å or more. A conventional X-ray source is usually used to study such specimens. X-ray scattering from such large molecules is a small angle on the direction of the incident X-ray beam. As a consequence, the experiments can be long and difficult to perform. The results of such experiments are often patterns for the main beam, because of the rapid fall-off in intensity with distance from the source, photographs recording the intensity against long exposure times, but, in practice, a series of short exposures are required to obtain enough data to be made. If existing techniques are used, the experiments can be discontinued but at the expense of complexity in instrument design. Even so, the intensities are still needed.

If one could achieve very rapid data acquisition, there it would be possible to carry out low-angle X-ray diffraction experiments of biological materials during normal growth processes, the intensity of the scattered radiation being measured. Then it is possible to record the pattern rapidly and from high resolution using simple apparatus, thus making a tremendous improvement of this type of studies. So far, we make use of the synchrotron radiation.

Biosynthetic materials have four important characteristics: high intensity, low beam divergence, a high degree of linear polarization and, probably most important, an exceedingly short wavelength.

At present, work is in progress to study the application of this latter special attribute of X-ray diffraction methods. Preliminary work has already been carried out in the field of X-ray diffraction by biological materials in powder diffraction (J. B. and A. M. in preparation).

Synchrotron radiation

In the conference NESTA, of the Science Research Council's Daresbury Laboratory, lectures are concerned on to FRDS and some ultrahigh-gain applications which include in a

synthesis of the infrared in the hard X-ray regime (around 8.1 Å). The synthesis is 100% linearly polarized in the horizontal plane. The incident X-ray beam is well collimated, with the divergence constant in a range of half-angle between 0.1° and 1° . The wavelength is operating at 1 Å with an incoherent extension of 10 nm, operating at 100 nm with an incoherent extension of 1 Å. Within a band width of 0.1%, for the spectrum used in the experiments of J. M. Glauert, private communication. This high flux is particularly suitable for small-angle scattering experiments. X-ray sources of this type have already been constructed and used with synchrotron radiation at BESY (Daresbury), NESTA (Channing) and several elsewhere. These cameras are vertically focusing and have a resolution of 0.1 Å. The resolution is limited by the size of every detector as possible, but, at the same time, to prevent small, high contrast diffractive spots on a predominantly dark or overexposed plate.

It is proposed to use this technique as an approach to the measurement of X-ray diffraction patterns, which are before mentioned one of the unique characteristics of synchrotron radiation and which does not require any optical components. Furthermore, the use of very short wavelength is particularly appropriate to illustrate the method we have used for soft collagen because it contains a large fundamental lattice spacing (17.5 Å) with well defined, sharp reflections.

Extending energy-dispersive techniques

The approach to the measurement of X-ray scattering at small angles is comparatively very simple and is an extension of the range of use of ultrahigh-gain techniques with some minor technical complications. Many authors have

The Bragg reflection for X-ray diffraction is usually expressed by

$$\sin \theta = \frac{2\pi}{\lambda} d \sin \phi$$

From this it is clear that for a particular spacing, d , and a single X-ray wavelength, λ , the values $\phi = 0, 1/2, \dots, \pi/2$ appear to give no reflection. This is not true.

It follows, in general terms of white quasielastic radiation, that an unstrained sample, due to a particular spacing and for a limited scattering angle, there will be a number of discrete wavelengths, λ , which will satisfy equation (1).

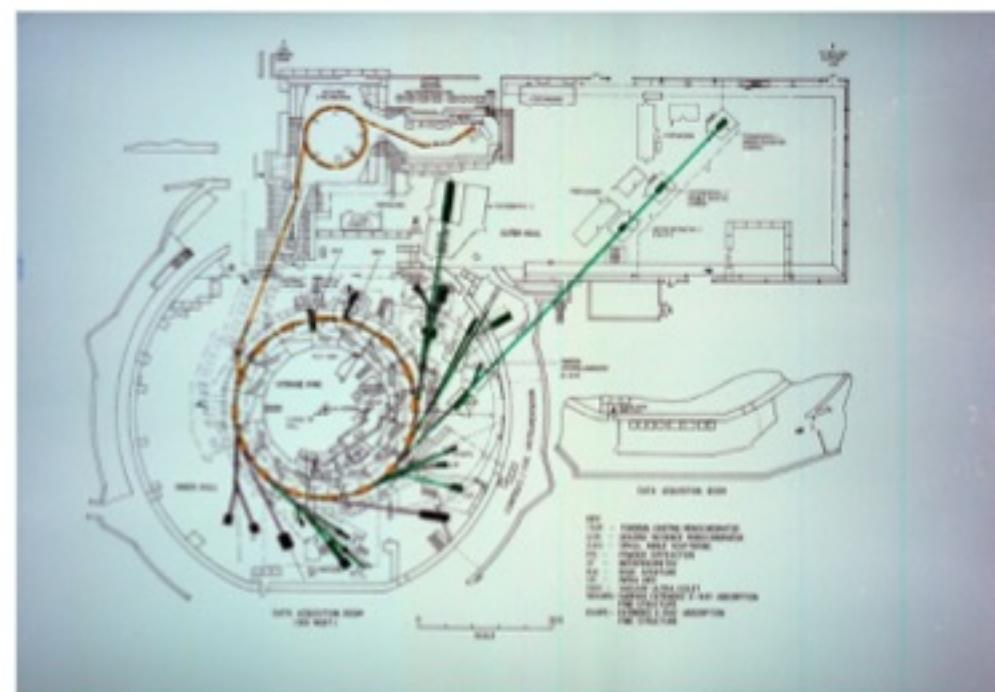
In other words, in place of a conventional Bragg scattering maximum, in which the sample is deformed with some strain, there is a series of discrete wavelengths, λ , for which the reflection is maximal, and moreover a photon energy spectrum giving all the wavelengths diffracted at a constant angle.

18 / 31

1977 – Staff



1980 - Layout of the Synchrotron -



1985 – The facility



1991 – SRS User Meeting

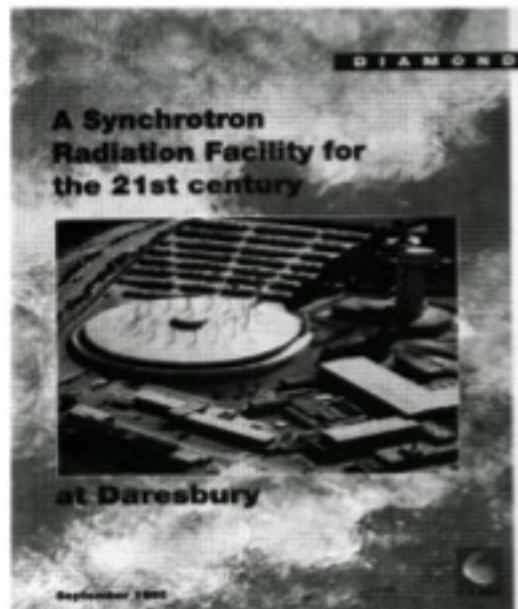


1996 – John Cadogan – Inspecting SRS



1996 – Bid for DIAMOND, lottery application

Going for Diamond
(Hard, Brilliant and Very Expensive)!



MC/C/2033 DIAMOND X-RAY

MILLENNIUM COMMISSION

"met our key criteria but judged
not to have as distinctive a public
impact as others"

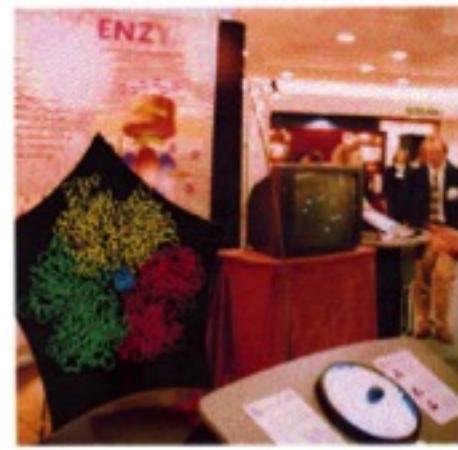
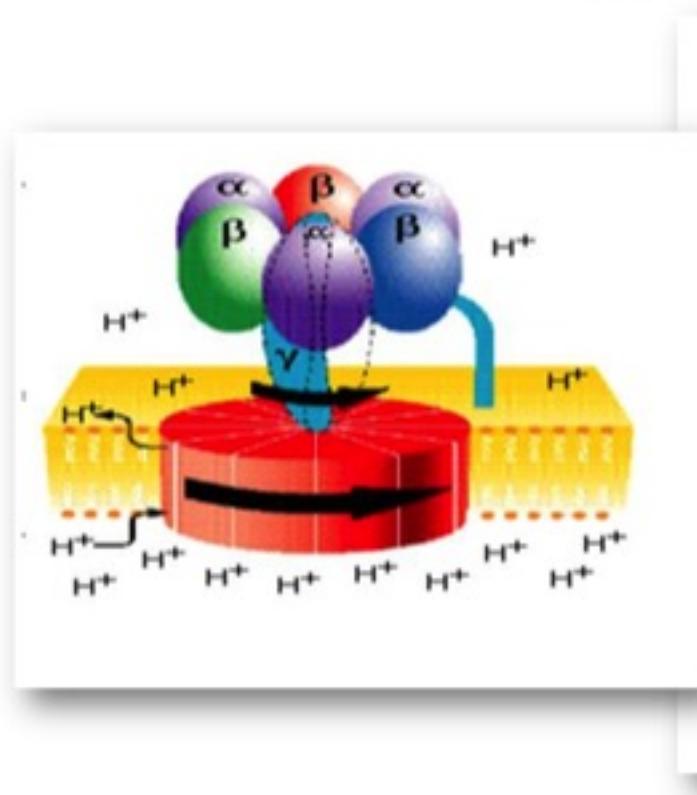
1011 applications for £4.3b

Very strong support from:
Halton
Warrington
Research Councils

1997- The Nobel Prize for F1 ATPase Structure Using the SRS



John Battle (Scientist
admires F₁-ATPase)



1998-2008 SRS operational... and achievements



Archaeometry - new horizons for Synchrotron Radiation



- Synchrotron Radiation is now playing an increasingly important role in the physical sciences
- Studies are establishing origins of ceramics, pigments and glazes and helping in the accurate ageing of artefacts
- Techniques used range from high resolution diffraction to X-ray absorption spectroscopy and microscopic imaging with infra-red spectroscopy



The light harvestes

Turning sunlight into energy

The light harvesting complex is the plant's solar cell

It turns sunlight into electrical energy to drive photosynthesis
~ 100% efficient!

- Structure solved at the SRS - from Rhodopsin
- Work modelling charge transfer in the protein
- The best synthetic solar cells are only about 10% efficient

2007 – Moving to 3rd Generation L Source



2008 – The SRS final countdown.

Gone! – The Closure of the SRS – 4 August 2008

After two million hours of science a British world first bids farewell

Cleaner fuel, safer aircraft and new medicines, not to mention a Nobel prize, great tasting chocolate and iPods - all of these things have been influenced or made possible by world leading scientific research carried out on the Synchrotron Radiation Source (SRS which is now closed) at the Science and Technology Facilities Council's (STFC) Daresbury Laboratory in Warrington, which closes today (4th August 2008) after 26 years of operation and two million hours of science.

- £500 M
- 5000 Publications
- 1200 Proteins
- 11000 Users
- 60 Sources Worldwide



Aerial view of
Daresbury
Laboratory
Credit: STFC
Daresbury
Laboratory

The SRS was a genuine world first, pioneering the way for the development of 60 similar machines around the world. Since 1980 it has played a key role in enabling and performing cutting edge research in many areas of UK and international science. The SRS produces beams of light so intense that they can reveal the structure of

atoms and molecules inside materials. It produces this light by generating beams of high energy

2008 - The Switch off ceremony



Spin offs Diamond / ESRF



Dipole Henge – the fossil remains SRS!!

