Synchrotron radiation

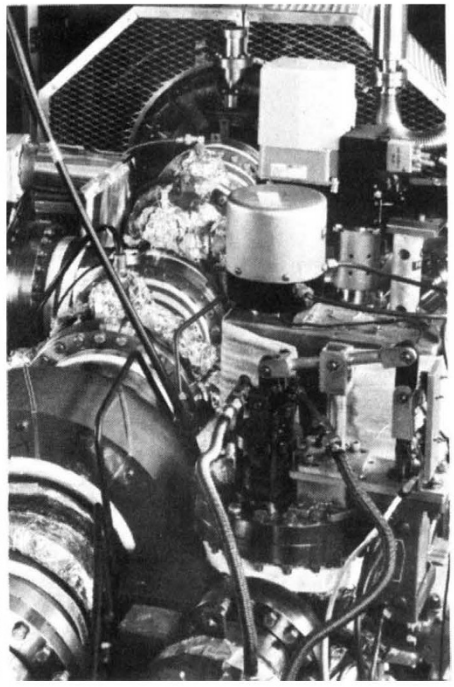
Bright news for Daresbury

THE British Synchrotron Radiation Source (SRS) at Daresbury, Lancashire — arguably the world's best X-ray machine, used for analysing the structure of molecules and materials — is to get brighter. It will thereby remain competitive with planned American and Japanese sources. The conversion will take some five months and will cost £850,000 (to be provided by the Science and Engineering Research Council). Work is scheduled to begin in the autumn of 1985.

Meanwhile Daresbury, flushed with the success of a new wiggler beamline which has already doubled brightness, is planning to run the SRS non-stop instead of with an eight-hour break each day. In the course of the past year Daresbury has managed to double, to 18, the number of experiments which can run simultaneously on SRS; even so, user demand is still not satisfied, according to the director Dr D.J. Thompson.

Technically, the objective of the SRS improvement is to get more light out of a smaller area — to make the source look to the experimenter like a brilliant point of light. The more brilliant and point-like the source, the more information can be gleaned from any experiment which requires high resolution in space and time. These tend to be the experiments at the "cutting edge" of synchrotron radiation science, says Dr John McTague, the director of Daresbury's American rival, the National Light Source (NLS) at Brookhaven, Long Island: experiments such as X-ray holography and X-ray microscopy. Simple microprobe analysis and Bragg scattering are also improved by more, finely-focused light. And since the source of light in a synchrotron source is a curving beam of electrons, the experimental objective means narrowing the beam cross-section and increasing the current: a piece of accelerator technology.

Since some synchrotron radiation experiments do not need high brightness, but merely good integrated flux, there has been a degree of controversy at Daresbury over whether the five-month delay and the technical risk of brightening the source is worth it. The technology of the improvement is not simple: NLS is having troubles in commissioning its own high brightness X-ray source. (A smaller ultraviolet machine is now working well, says McTague.) The NLS X-ray ring is designed to have a "figure-of-merit" (involving brightness and focus) 100 times better than Daresbury's present value although it is nowhere near design value yet. Daresbury's modification should bring it within a factor of 2–5 of the NLS design.



To improve the Synchrotron Radiation Source, Daresbury engineers must find space to fit an extra quadrupole magnet in this crowded area.

According to McTague, increasing effort is going into commissioning the X-ray ring. Teething troubles in commissioning new accelerators — synchrotron radiation sources are essentially electron accelerators — are common in high-energy physics, but the commissioning of a synchrotron light source is even more complex, McTague says. However, he believes, "there are no unique problems" and "the notion of high brightness is OK".

McTague expects sufficient beam for the first experimenters to be able to align their experiments "in late fall", and useful currents a few months after that.

Meanwhile Daresbury is taking a close interest in the NLS commissioning, and has its principal engineer there to make sure that the Daresbury plan does not need modification in the light of NLS experience.

Meanwhile other sources in Germany and Japan are now being commissioned: in Hamburg, a modification to the DORIS electron ring (DORIS II) should give it roughly equal "figure of merit" to the SRS (unmodified), although it has not yet reached target brightness; and the Japanese "photon factory", now coming on line, is aiming for merit figures which would match the modified SRS.

Plans for a European Synchrotron Radiation Source, 1,000 times brighter even than the NLS design, are also still being pursued.

Robert Walgate

Station log book

THE following entries were discovered in the log book kept at one of the experimental stations at the SRS. Dating from September 1982, they record the actual experiences of a user who prefers to remain anonymous.

Thursday, 16th
00.00 hrs. We have beam in single bunch. Spent all night aligning camera. Got tired — left at 7.10 when beam stopped.

12.00 — got beam again. Worked all afternoon. Achieved superb alignment at tea time — and started experiment but you won't believe this — THE BEAM stopped about 5.30 pm! Went for tea.

10.30 pm — Hooray. Beam again, but it's in the wrong place, waiting for bumps. Have been promised beam continuously until 10 am. Looking forward to getting results!! Got bumps at 11.00. Started experiment. 2 GeV 7.5mA.

Friday, 17th
3.00 am — everyone gone except us. Feet hurt like crazy, but ring still going, down to 4.4mA. Films look good — might actually get results this time. Ian in good spirits — amazing after only 2 hours sleep.

6.00 am — Still beam — will it never end. Despite what Ian says about sleep deprivation experiments, I don't think you can do without sleep. I feel awful.

7.00 am — 3.8mA in ring.

7.30 am — Went for breakfast, was starving. Came back 8.00 am — changed specimen but too knackered to work anymore — scared of knocking camera. Went to bed.

4.15 pm — Return, like giants refreshed. Lots of beam 2 GeV 217 mA, but it keeps going on and off.

7.00 pm — Paul Quinn drops by. Says he's given up. Whoopee, continuous beam from now on. Got great photographs. Except for the last one which was blank cause beam dumped.

Saturday, 18th
9.00 am — Back again! 2 GeV 270mA. Wow! Never get our exposures short enough. Crazy this synchrotron radiation — half the time you don't have enough beam and half the time too much.

11.07 am — Knew it was too good to last: beam gone. Gone for coffee.

12.00 — Went to control room. Found them hitting the machine and swearing. Suggested sacrificing two chickens and a goat. Gone for lunch.

1.30 pm — Back from lunch. Beam again. 2 GeV 217mA.

11.30 pm — Beam dumped. Feet now dead. Can't wait to change socks.

Sunday, 19th
Beam ran all day (more or less). 2 GeV 200mA. Took about 55 photographs. Can't keep this up much longer; thank God we've nearly run out of film.

Monday, 20th
9.00 am — Back again! Beam 2 GeV 220mA. Finished Laue experiment — ran out of film and specimens. Bliss! Might be able to get some sleep now. Feet still very bad.

Tuesday, 21st
2 GeV — 219mA. Good beam all day.

Wednesday, 22nd
2 GeV — 230mA. Good beam all day!

0028-0836/83/340676-02$01.00