Proceedings of the Eighth Meeting of the International Collaboration on Advanced Neutron Sources (ICANS-VIII)
8-12 July 1985, Rutherford Appleton Laboratory Report RAL-85-110

LOQ - The Small Angle Diffractometer at the SNS

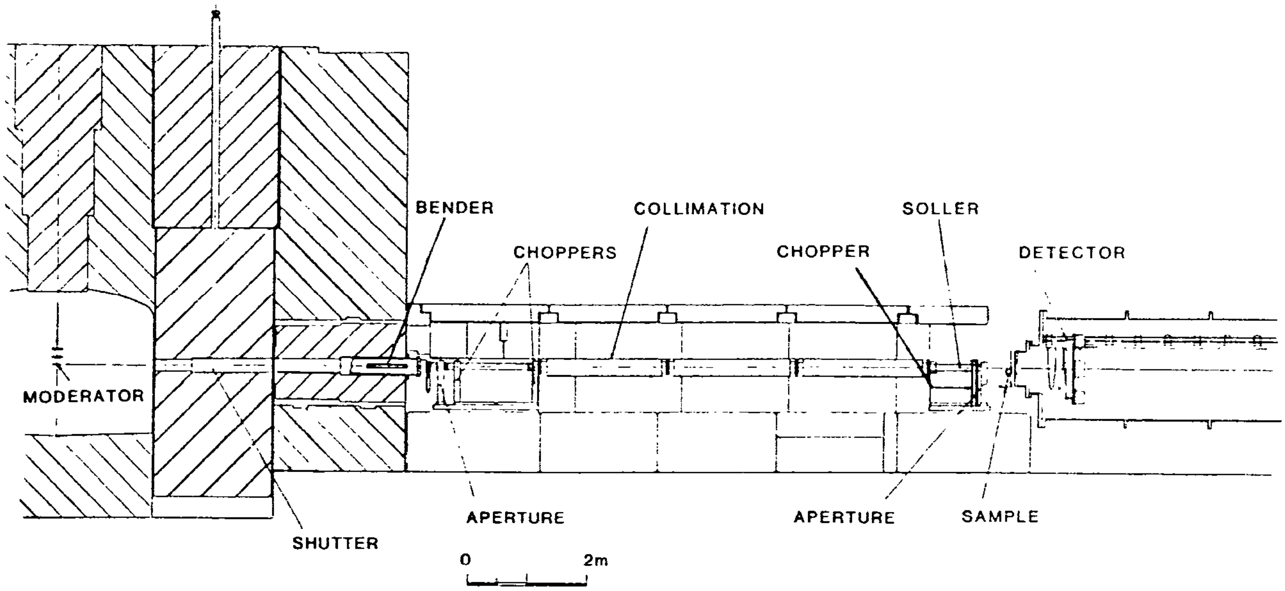
R K Heenan
Rutherford Appleton Laboratory
Chilton, Didcot
Oxon OX11 0QX

A pulsed spallation source such as the SNS is not generally considered ideal for small angle scattering since it is not optimised to produce long wavelength neutrons. In fact the LOQ machine at the SNS (Figure 1) will be very competitive with reactor based instruments such as D11 at the ILL. The wide range of scattering vector Q accessible in a single measurement (Figure 2) on the SNS means that many experiments could be performed more quickly than on D11.

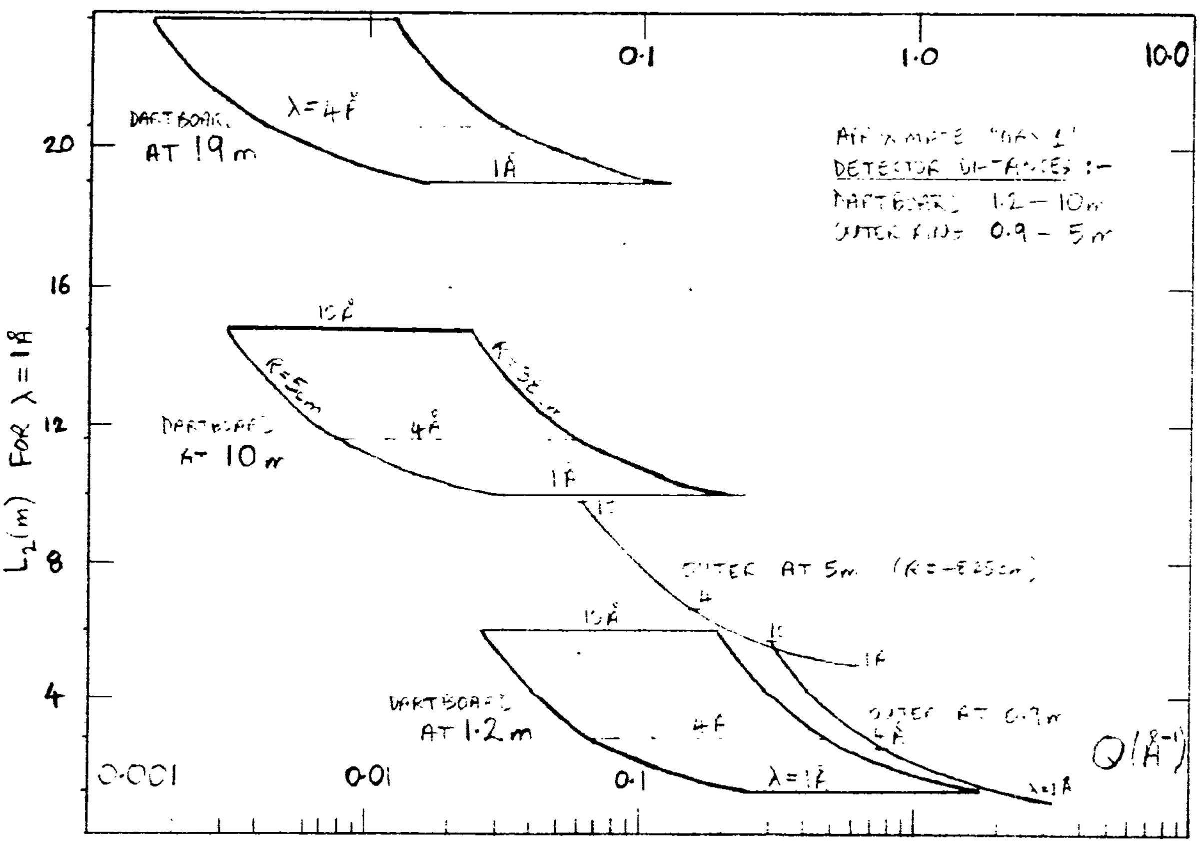
LOQ looks at a liquid hydrogen moderator, the sample is situated at 16m and there will eventually be 5 "telescopic" detector banks moving independently inside an evacuated tank (20m long, 1.8m internal diameter). Longer wavelength neutrons are selected by a super mirror bender thereby reducing neutron backgrounds at the detector and allowing thinner chopper blades and collimating apertures. A set of three mechanical disc choppers attempt to eliminate frame overlap and define the range of wavelengths used. The pulse rejection chopper could not in practise be placed close enough to the moderator so in some cases a small overlap of long wavelength neutrons occurs at certain detector positions. It is planned to eliminate these with nickel coated silicon crystal mirrors.

Beam diameters at the sample range from 2mm to 25mm. Some guesses have been made for time averaged intensity at the sample assuming full SNS output, allowing for all window transmissions and detector efficiency etc (Figure 3). Taking 1 in 4 pulses (12.5Hz) and selecting 4-10Å neutrons gives a wide Q range and about 3×10^5 neutrons/cm^2/sec. Using 1 in 2 pulses and 2-6Å neutrons reduces Q range and worsens resolution but increases intensity to over 10^6 neutrons/cm^2/sec. These figures compare well to D11 if it is set up with similar collimation. (In the long term a dedicated SNS cold source could do much better as longer moderation times could be tolerated without worsening resolution. Other instruments needing the hydrogen moderator prevent this at present.)

1) LOQ General Arrangement



2) LOQ Ranges of Q as a function of detector positions and wavelengths used.



Circularly symmetric detector banks, diameter 1m, are of glass scintillator elements with fibre optic encoding to many fewer photomultiplier tubes. Constructional details are presented in a separate paper. A central scintillator detector array should allow measurement of transmission coefficients as a function of wavelength simultaneously with the diffraction measurements.

Data reduction is quite complex, with various routes possible dependent on the nature of the experiment and quality of data. The discussion given in the paper by P A Seeger et al is relevant here. A modified version of their Monte-Carlo program has also been used to simulate LOQ data. A VAX 11-730 computer is attached to the experimental apparatus for initial display and analysis of data, it runs independently of data collection.

The LOQ apparatus can be tailored to give the best compromise of intensity and resolution for a particular experiment by careful choice of beam size, detector positions, and wavelength range selected. At the time of writing the beam line is still under construction and preparations are being made for a test of the first 1/9 detector segment (560 elements connected to 16 photo-tubes) in the recently delivered 10m section of the vacuum tank.

3) LOQ Estimated intensities at sample.