Beamline 14 and the Opportunities for Fibre Diffraction

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Beamline 14 is the new beamline currently in the final stages of commissioning on the Synchrotron Radiation Source (SRS) at Daresbury Laboratory. The beamline has two stations, principally for protein crystallography. However one, Station 14.1, will be able to accommodate the fibre diffraction work that is currently taking place on Station 7.2.

The multipole wiggler (MPW) used to provide radiation for beamline 14 has 9 poles, with a nominal field strength of 2.0T, and 2 side poles. The maximum length of straight section available in the second generation SRS governs the MPW length of 1m. The operating magnet gap of 20mm was determined by studying the effect of a restricted aperture on the lifetime of the electron beam in the SRS.

Calculations were done to establish suitable positions on the radiation fan for the two stations. The peak flux from the MPW is at the centre of the fan; between the centre of the fan and 6.5mrad the flux drops by an order of magnitude, highlighting the importance of positioning the stations as close to the centre of the fan as possible. If one station were to be positioned at the centre of the fan and the second offset then the second station would have significantly less flux than the first. However by offsetting the central station slightly from the centre of the fan, allowing the second station to be more central, the gain in flux for the second station more than compensates for the slight loss of flux in first station. Therefore, Station 14.2, the more intense station takes beam from +3mrad to –1mrad and Station 14.1 from –1.5mrad to –4.5mrad. It is possible for the two stations to be separated by only 0.5mrad by having the beam for Station 14.2 crossing over the top of the beam for Station 14.1. This allows the dead space on the outside of the radiation fan to be used for all the cooling and bending mechanisms. The outline of Beamline 14 shown in Figure 1 illustrates this.

In order to ensure swift beamline construction a simple optical design for both stations was chosen. Thus Stations 14.1 and 14.2 both have vertical focusing provided by a 1.2m silicon cylindrical mirror coated in rhodium. The horizontal focusing and monochromation is provided by a single bounce, 300mm long, Si 111 monochromator. Both optical elements are water-cooled. In addition the effect of the single bounce monochromator, to deflect the beam out sideways, allows the two stations to be fitted into the limited space available for the

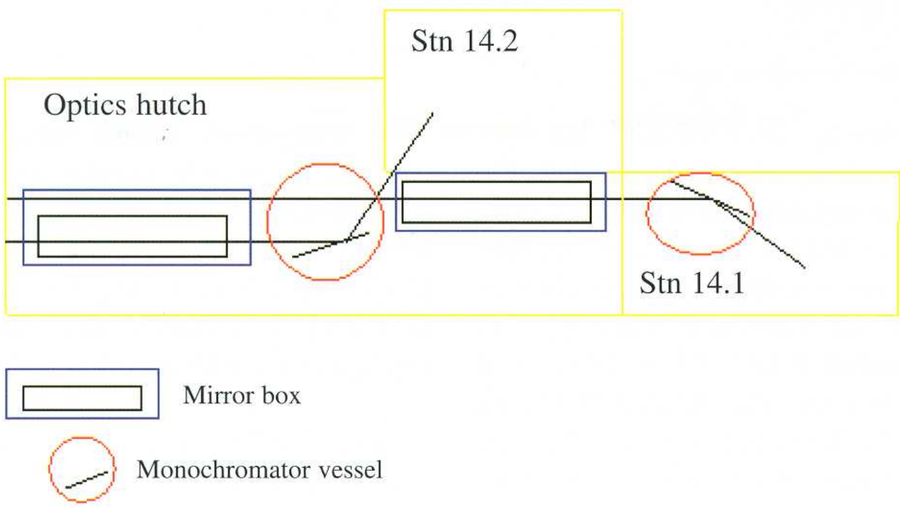

Figure 1: Schematic layout of BL14

beamline.

The optical configuration chosen tends to lead to operation at a single wavelength. However a system has been developed where two monochromator crystals optimized for 2 different wavelengths are mounted in the vessel in a double-decker arrangement. This allows the wavelength to be changed simply by translating between the two monochromators. The two wavelengths of operation for Station 14.1 are 1.2Å and 1.5Å. Table 1 gives an impression of the relative flux expected on Station 14.1 compared to the existing fibre diffraction station, Station 7.2.

Station	Relative Intensity
7.2/9.5	1
9.6	10
14.1	10-20
14.2	20-40
BM14 (ESRF)	20

Table 1: The Relative Intensity of Beamline 14 Stations

It is planned that initially the existing fibre diffraction equipment from Station 7.2 will be transferred to Station 14.1. The rotation camera on Station 14.1 was designed and manufactured at the EMBL in Hamburg, an earlier model is currently in use on Station 7.2. Initial commissioning of the station will be done using a MAR 30cm image plate detector. Ultimately an ADSC Quantum 4 CCD detector will be mounted on the station. This is a 180mm x 180mm 2 x 2 array of CCDs with a full-frame slow readout time of 9s. This drops to 3s if the fast readout option is used.

Plans are underway to develop a new fibre camera specifically for Station 14.1. Currently users' opinions are being sought on various design features such as sample alignment, helium beam path both before and after the sample, and the ability to move the sample in different planes. An outline design of the camera will be available by the end of March. This will then be refined before being manufactured to be available at the end of July. Anyone wishing to provide input into the design of the camera should get in touch with Rob Kehoe at Daresbury Laboratory (tel. 01925 603626, email r.c.kehoe@dl.ac.uk). Relevant web pages can be found via the Protein Crystallography web pages at http://www.dl.ac.uk/SRS/PX/index.html. The new Station Manager for Station 14.1 is Mike MacDonald (tel. 01925 603627, email m.a.macdonald@dl.ac.uk). The Station Deputy is Rob Kehoe (tel. 01925 603626, email r.c.kehoe@dl.ac.uk).

POLO Detector: 5 CCD SAXS/WAXS Area Detector for Synchrotron Radiation

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A novel area detector for SAXS/WAXS has been developed for use with synchrotron radiation. The detector is in fact two separate entities: one CCD for SAXS and 4 CCDs for WAXS. The detector has been designed to allow the simultaneous collection of time–resolved small and wide-angle scattering. The detector is based around 5 EEV 05-30 CCDs with resolution of 175μm each. The WAXS CCDs are angled at 22.5% to the X-ray beam, in a 2x2 mosaic with a hole at the centre of the array to allow the small angle signal to be transmitted to the SAXS detector at the rear of the instrument, see Figure 1. This arrangement allows the WAXS detectors to completely cover an angular range of 5° to 45° with a resolution of 0.05°. Using the diagonals of the mosaic, data up to angles 61° can be collected. Both WAXS and SAXS detectors are simultaneously collected at 30MB/s data rate, allowing time resolution down to approx 6 frames per second.

Each pixel value is digitised using low and high gain. The high gain channel has an adjustable offset allowing improved signal to noise characteristics for the selected range. This is particularly useful for