

THE PERFORMANCE OF THE IRIS AND HRPD GUIDES ON THE SNS

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ABSTRACT

Two of the eighteen beam ports on the SNS are furnished with neutron guide tubes. These guides supply neutron beams to the High Resolution Powder Diffractometer (HRPD) and the Quasielastic Spectrometer (IRIS). The performance of these guides was able to be evaluated during the initial operating period of the SNS.

COMMON FEATURES

Each guide comprises 1m glass sections closely abutted to approximate the required curved geometry. The 1m sections were mounted inside steel vacuum vessels with mounting and adjustment points accessible from the outside. Each 1m section is closely fitted with steel shield plates within the vacuum vessel to prevent fast neutrons streaming along the sides of the guide. The vacuum vessels are supported on concrete plinths at approximately 3m intervals. Both beams are completely shielded externally with 60 cm thickness of steel and 30 cm thickness of borated wax out to a distance of 30m approximately. The remaining length of HRPD to the diffractometer itself is shielded with 30 cm of concrete.

The alignment of the guide is carried out with respect to survey datums on the floor of the experimental hall. Datum lines which represent a tangent to the emergent neutron beam (the prime tangent) and a 45 cm translation of this line have been laid down for both beams. HRPD, because of the

shape of the concrete shielding, also has a 1° offset line to the prime tangent. Mirrors and metre scales perpendicular to the prime tangent are set up on the target shielding wall and at the end of the guides. HRPD has an intermediate set of scales midway along the guide. This arrangement enables any angular line to be defined.

Guide heights are adjusted by means of $1/5'$ arc second spirit levels and horizontal settings by a theodolite set along the prime tangent at the beam height and able to view the side of each guide element through glass ports along the guide vacuum vessel.

The surface quality of the vertical faces of each of the guide sections has been measured optically with a 0.1 arc second precision [0.5×10^{-6} radians] auto-collimating telescope. The best overall guide elements were selected for installation, each element being located with its flatter surface to the outside of the curve where more reflections take place. The RMS average value σ_R of the standard deviation σ of all vertical faces for the installed set of 87 HRPD guides was 35×10^{-6} radians compared with the specification of 60×10^{-6} radians. The resultant σ_R values for the outer and inner surfaces are 26×10^{-6} and 44×10^{-6} radians respectively. A frequency distribution for the HRPD guide elements is shown in Figure 1. The IRIS guides were selected in a similar manner.

THE IRIS GUIDE

Situated on beam N6, IRIS views a liquid hydrogen moderator at 22K. The moderated neutron spectrum peaks at 3\AA on an equal wavelength scale. The guide transmits neutrons to the spectrometer sample position at 31.4m. The design parameters of the guide are given in Table 1. The early section of the IRIS guide is fabricated from highly polished steel sections in order to minimise the effects of radiation damage at the guide entrance which is only 1.7m from the moderator. This small separation is necessary in order to ensure full illumination of the guide at $6-7\text{\AA}$.

The neutron spectrum at the entrance to the curved guide section at 6.4m as measured with a 1% scintillator monitor is shown in Figure 2a. This clearly shows the epithermal and thermal regions of the moderator spectrum. The intensity detected at this position includes a contribution from neutrons travelling at angles which would preclude them reflecting

from the subsequent guide sections. Accordingly when the neutron spectrum measured at the guide exit at 30.6m (Figure 2b) is normalised to the incident spectrum the resultant ratio (Figure 2c) is disproportionately low at short wavelengths. Despite this fact the throughput at longer wavelengths approaches 70%. The average number of reflections along the 24m curved section for 6Å neutrons is ~ 6.25.

HRPD GUIDE

Situated on S8, HRPD views a 10 x 10 x 2.5 mm liquid methane moderator at 90K. The details of the HRPD guide are given in Table 1. During the December test run of SNS, measurements were taken at both 9m and 92m using Davidson scintillator monitors [1] thus offering the possibility of determining guide transmission.

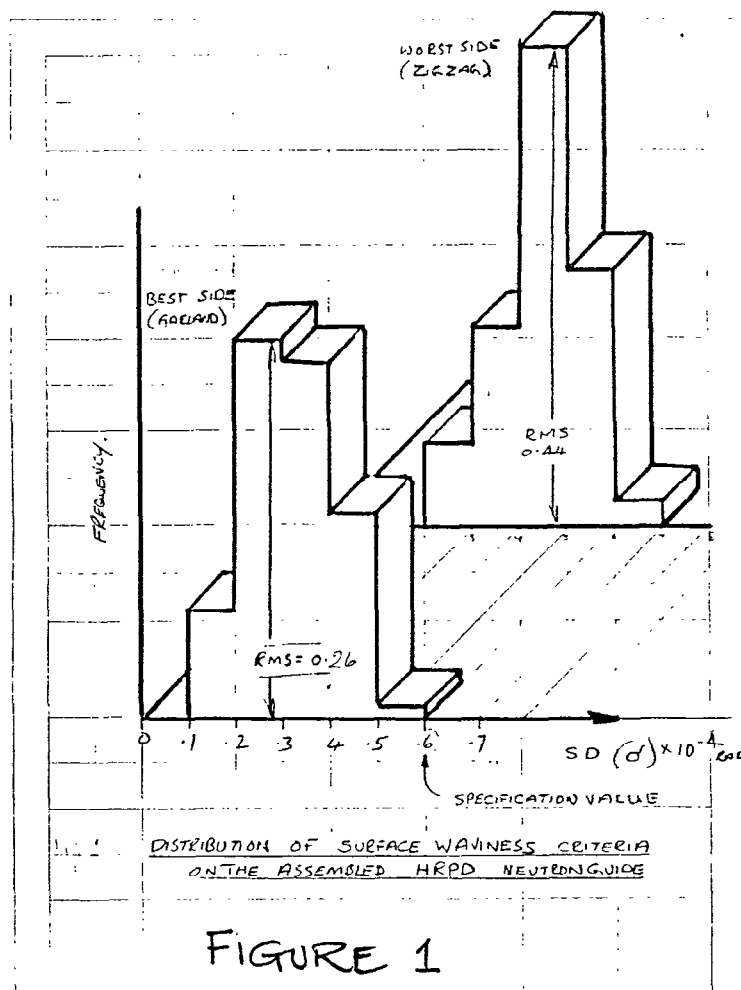
The two spectra are shown in Figures 3a and 3b. Taking a simple ratio between these measurements, and correcting for their different efficiencies provides an illustration of the transmission by the guide (Figure 3c). However, this is not a good measure of the guide's performance since many neutrons will be present at the 9m position that are non-transmittable, even by a perfect guide.

It shows that the expected characteristic wavelength has been realised and that the transmission exhibits a plateau at around 70%. The low-wavelength transmission is especially good, reaching down to 0.5Å. This indicates that the abutment errors are well within the specified tolerance of 0.001" s.d.

[1] P L Davidson 'Thermal Neutron Beamline Monitor' RAL-84-120 (1984)

Table 1 The geometrical design parameters of the IRIS and HRPD guides

	IRIS	HRPD
Moderator	Liq H ₂ 22K	Liq CH ₄ 105K
Moderator to Guide Entrance	1.7m	3.65m
Initial Straight Section	4.45m	2.28m
Curved Section	24m	55m
Final Straight Section	--	32m
Guide Aperture	65 mm x 43 mm	80 mm x 25 mm
Characteristic Wavelength λ^*	3.5 Å	0.98 Å
Cut-Off Wavelength	1.0 Å	0.5 Å



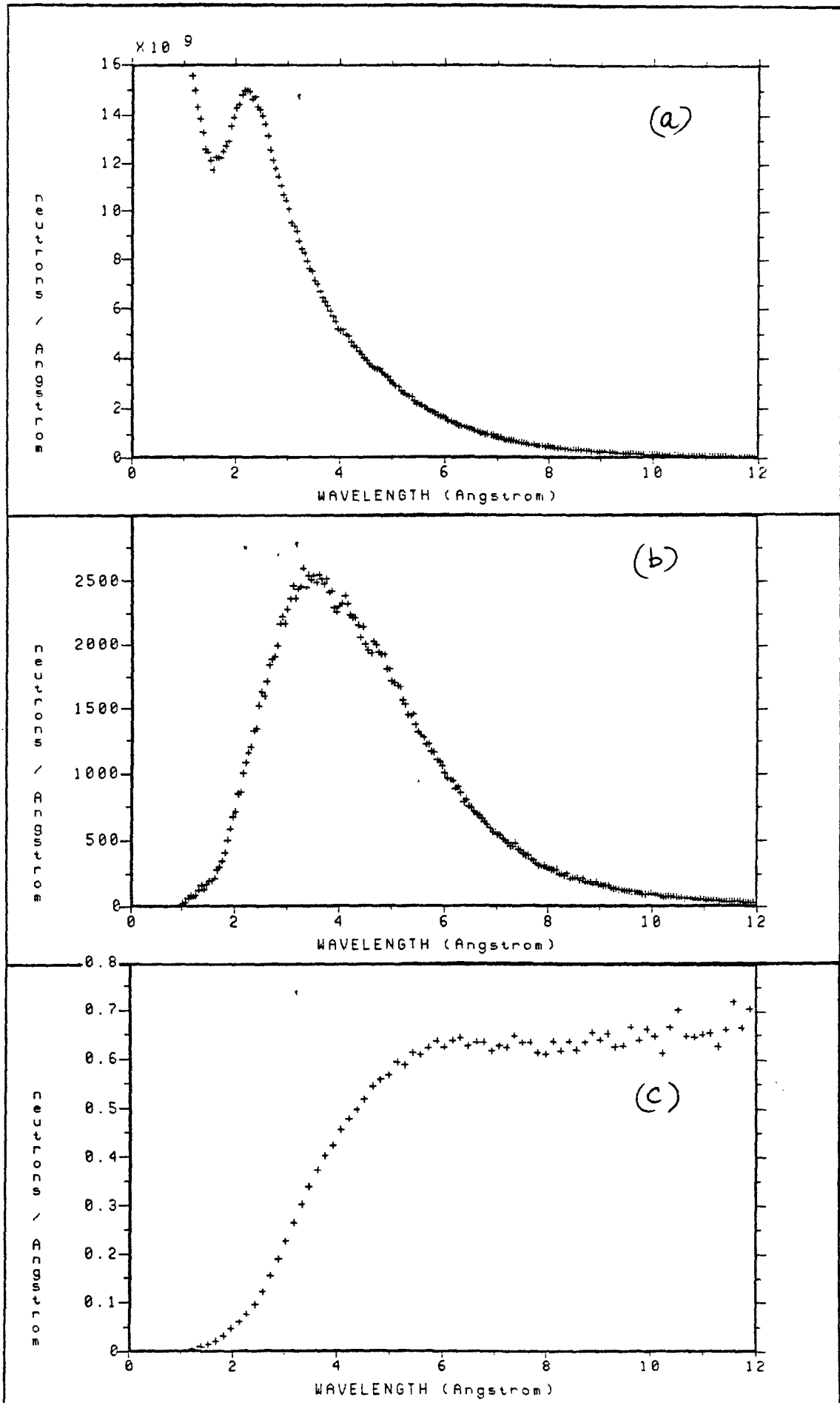


FIGURE 2 IRIS

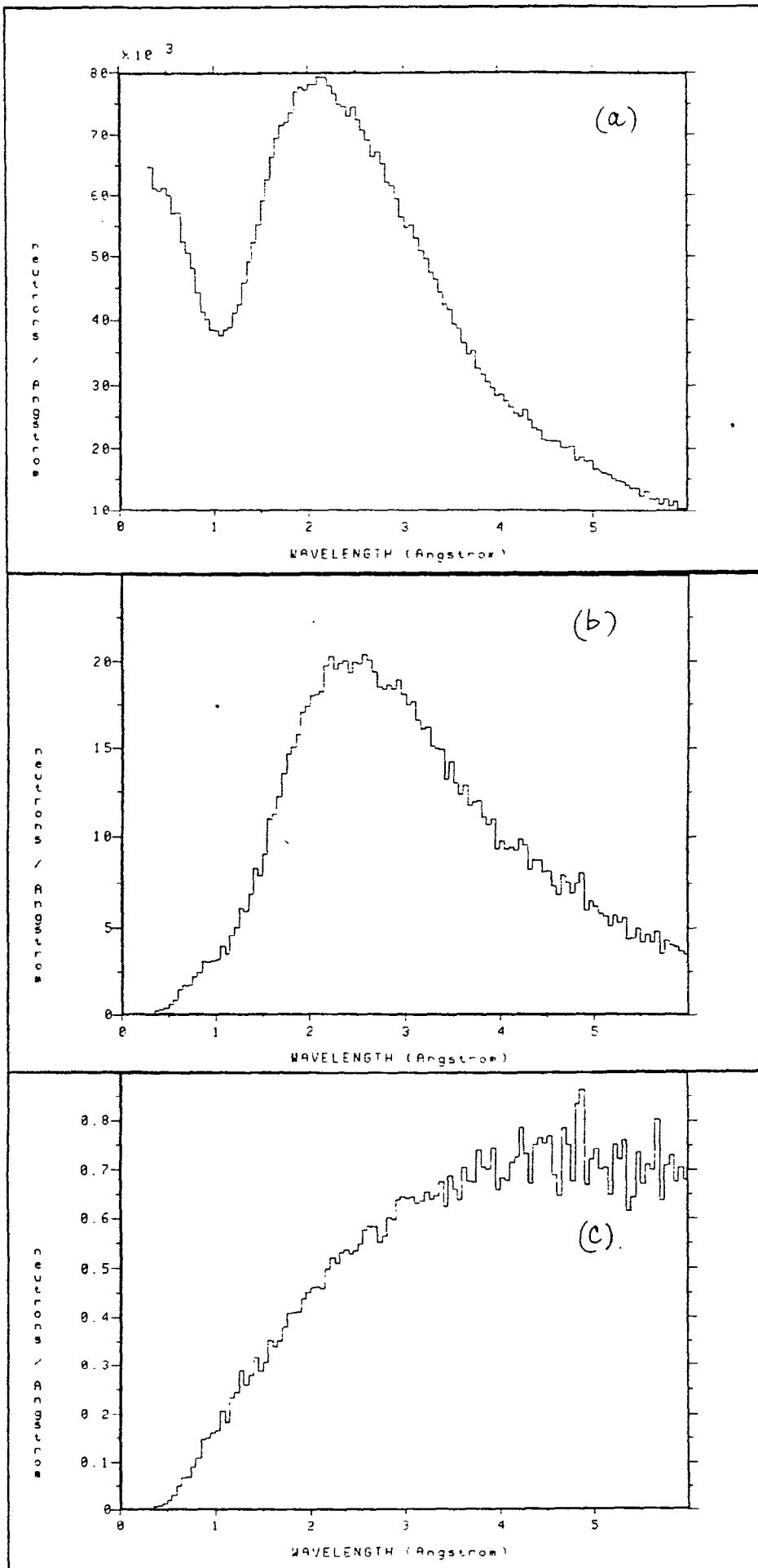


FIGURE 3 HRPD