ESS Instrumentation Task Group - SANS **24th October 2000**

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Goals

To consider the general advantages and disadvantages of SANS on the ESS as compared to the best available elsewhere for the three ESS target stations presently under consideration: (i) 50Hz, 5MW, (ii) 10Hz, 1MW, (iii) 16Hz, 4.2MW, 2.5msec pulse.

A list of SANS instruments to be considered is outlined below, based on the report of a previous ESS working group that met in 1996 [1]. Further ideas will be welcomed, for example on the use of polarised neutrons.

In the "long pulse" option (iii) the target is supplied with protons directly from a linear accelerator without the pulses being time-compressed in a synchrotron. Due to limitations of the proton linear accelerator the pulse length of (iii) is unlikely to be less than 2msec. There would probably be a choice of either target (ii) or target (iii) with target (i). With target (ii) the power of target (i) would reduce to 4MW as 1 in 5 proton pulses would go to the 10Hz target.

For now consider that the time-averaged flux of a coupled hydrogen moderator on a 4MW pulsed source is about the same as the ILL second cold source (i.e. D22). Further information on ESS moderator characteristics is expected by late November 2000.

R.K.Heenan will perform some calculations and circulate an initial draft report for comment by February 2001. All ten task groups plan to meet on 16 February 2001 in England. A final report is needed for the ESS Science Advisory Committee on 7-8 March, which is expected to make a definitive decision on the target/moderator/repetition rate options to be included in an ESS proposal is expected.

Neutron instrumentation will then be discussed at a Workshop in Switzerland on 4-5 May 2001 (SAC, plus other invitees and the task group leaders).

SANS Instruments to be considered

1. Long L_2, up to 20m sample-detector (possibly up to 40m at 5Hz).

2. Medium L_2, up to 10m sample-detector, possibly with some high angle banks.
3. Focussing mirror, large sample, short beam line, to reach smaller Q than (1) or same Q with higher count rate.
4. Short L_2, wide angle, say 2m, with high angle banks, high flux, good Q resolution, probably using decoupled hydrogen moderator.
5. Double crystal diffractometer, using time-of-flight to separate diffraction orders.
6. Polarised neutron options - which of the above would be most effective with options to polarise the incident beam? Is a separate instrument justified? Is polarisation analysis of the scattered beam a realistic possibility?

Reference

[1] Report of ESS Working Group on Large Scale Structures Instrumentation, 29 April 1996, Chair J.Penfold, (members D.Schwahn, R.Texeira, K.Mortensen, R.May, R.Triolo & R.K.Heenan).

Background Information

The time of arrival T (msec) for neutron wavelength λ (Å) for a flight path of L (m) from the moderator is of course:

$$T = \frac{m}{h} L\,l = \frac{L\,l}{0.2528}\ , \qquad \text{or} \qquad l \approx \frac{4T}{L} \qquad (1)$$

The maximum wavelength which may generally be used, λ_{max} for a given length of beam line L is given by the time between pulses T_P. *Approximate* values are illustrated in Table 1.

Table 1(a) *approximate* frame overlap distances

Maximum length for single frame operation.	T_P	Lmax for λ = 10 Å	Lmax for λ = 15 Å
50 Hz short pulse, 5MW	20msec	8m	5.33m
10 Hz short pulse, 1MW	100msec	40m	26.67m
16 Hz long pulse, 4.2MW	62.5msec	25m	16.67m

Table 1(b) *approximate* frame overlap wavelengths

Maximum wavelength for single frame operation.	T_P	L=10m	15m	20m	40m
50 Hz short pulse, 5MW	20msec	8Å	5.3Å	4Å	2Å
10 Hz short pulse, 1MW	100msec	40Å	26.7Å	20Å	10Å
16 Hz long pulse, 4.2MW	62.5msec	25Å	16.7Å	12.5Å	6.25Å