ESS Instrument Performance Sheets

Compiled by
the ESS Instrumentation Task Group

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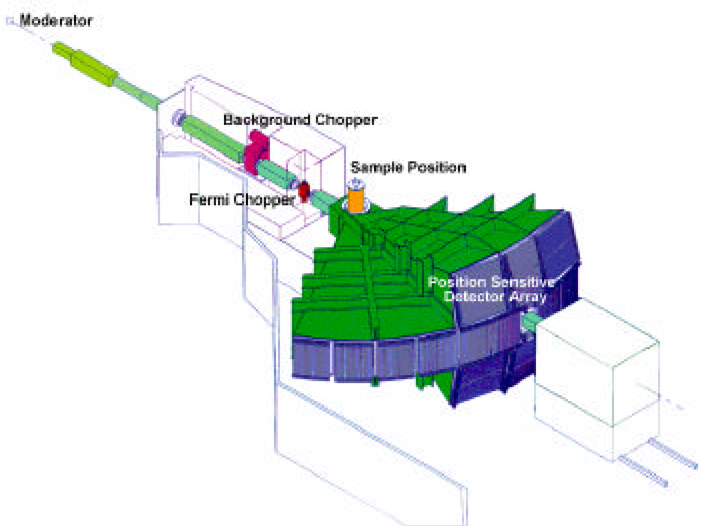
Content:

Instrument performance sheet: **High Energy Chopper Spectrometer**

Instrument description:
The instrument description is very similar to that of the MAPS spectrometer at ISIS. The beam is monochromated by a Fermi chopper, with T=0 chopper to reduce the prompt pulse. Detector coverage is as large as possible within space and cost constraints, using position sensitive detectors to provide a high degree of pixelation

Schematic set-up:
Viewing decoupled poisoned water moderator. Moderator to sample distance 13m; sample to detector distance 6m. Detector array: position sensitive He-3 tubes



Generic type. Chopper Spectrometer
Incident Energy Range: 25 meV - 2 eV
Energy Transfer Resolution 1%-3%
Moderator Type: Decoupled poisoned water
Target Station: 50Hz short pulse

Performance:
The instrument performance in terms of incident flux will be approximately 30 times that of MAPS at ISIS. Greater improvements in terms of data rate can be achieved by increasing the detector area. Access to higher resolutions will be possible by extending the sample-detector distanceand the primary flight path.
Nominal flux at 100 meV, 2% $\Delta\varepsilon/E$: 2 $\times 10^5$ n cm^{-2} s^{-1}

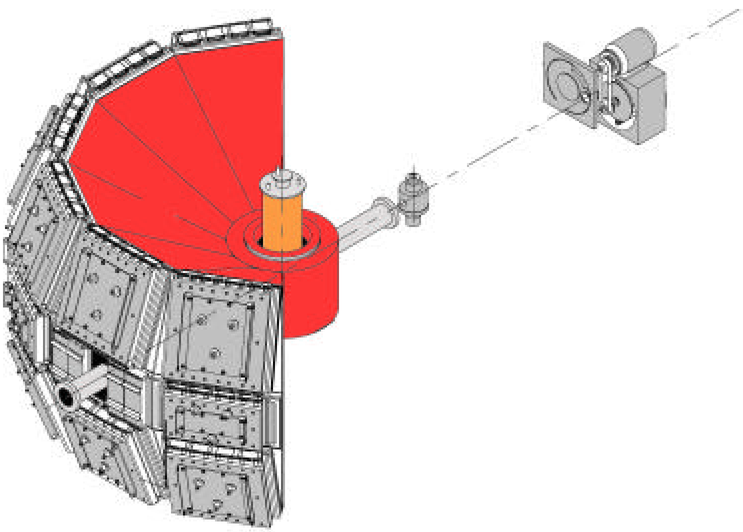
x ~ 30

Instrument performance sheet: **Thermal Energy Chopper Spectrometer**

Instrument description:
The instrument description is very similar to that of the MAPS spectrometer at ISIS. The beam is monochromated by a Fermi chopper, with T=0 chopper to reduce the prompt pulse. Detector coverage is as large as possible within space and cost constraints, using position sensitive detectors to provide a high degree of pixelation

Schematic set-up:
Viewing coupled water moderator. Moderator to sample distance ~20m; sample to detector distance 2.5m. Supermirror Guide. Detector array: position sensitive He-3 tubes. Solid angle of >πSr; 50000 detector pixels

Generic type. Chopper Spectrometer
Incident Energy Range: 10 meV – 140 eV
Energy Transfer Resolution 2%-10%
Moderator Type: Coupled water
Target Station: 50Hz short pulse



Performance:
A medium resolution high intensity chopper spectrometer. Performance in terms of intensity relative to HET at ISIS: x 240 (source 30x; moderator 2x; instrument 4x). Large angular coverage provides additional performance in terms of data rate.
Nominal flux at 50 meV, 2.5% $\Delta\varepsilon/E$: 9 $x10^5$ n cm^{-2} s^{-1}.

x ~ 240

Instrument performance sheet: **Variable resolution cold neutron chopper spectrometer**

Instrument description:
Time-of-flight spectrometer with detectors covering a large solid angle and a large angular range from about 2° to 140°. The secondary resolution is assured by a disc chopper in front of the sample, the primary resolution by the source pulse and/or a pulse shaping chopper up-stream. Chopper speed, choice of slit width and/or adjustable pulse tail cutting determines the resolution. Resolution ratio between best intensity and best resolution modes: 1:6. Best elastic resolution at 7Å incoming wavelength: 20 μeV

Schematic set-up:
Source to sample distance: ~ 40 - 80m, bridged by ballistic guide. This distance allows to have detectors on both sides with little interference of neighbouring beams. Repetition Rate Multiplications allows max 300Hz pulse rate on sample. Detector to sample distance: ~3m, detector area ~ $20m^2$.

Generic instrument type for comparision: IN5 (ILL), as in Dec. 2000
Choice of incoming wavelength: 2 Å < λ_{in} < 20 Å
Moderator type: cold coupled moderator

Q-w-range and resolution: varies with wavelength
Q: from 0.01 $Å^{-1}$ (at λ_{in}=20 Å) to 6 $Å^{-1}$ (at λ_{in}=20 Å)
ω: from 1 μeV (best elastic resolution at λ_{in}=20 Å) to 100 meV maximum energy change in up-scattering and 15 meV in down-scattering (at λ_{in}=2 Å)

Source gain:

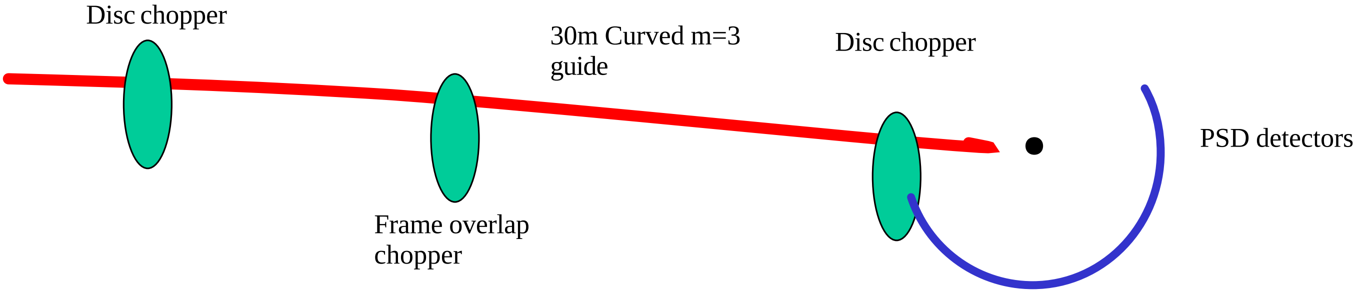
Target	50Hz	10Hz	16.6Hz
High resolution setting	**40**	**15**	**20**
High intensity setting	**7**	**3**	**15**

*Additional gain by modern/new design: ~**35-70*** **x ~ 800**

Instrument performance sheet: **Multi-Chopper Spectrometer**

Instrument description:
A direct geometry multi-chopper instrument. The multiple choppers give full control over the resolution and allows one to 'match' the resolution contributions from the moderator and chopper, thus giving maximum flux for a certain resolution. The instrument would be on a 30m curved supermirror guide.

Schematic set-up:



Generic type: IN5, NEAT, direct geometry multi-chopper
Wavelengths used: $1 < \lambda < 16$ Å
Moderator Type: cold coupled
Resolution: $\Delta\varepsilon/E_i$=1-6%
Q-ω-range: $.03 < Q < 13.0$ Å^{-1}
$1 < E_i < 100$ meV

Gain for LET at 4.86 meV for 2% resolution

Source Gain:

Target	50Hz	10Hz	16.6Hz
Moderator	Coupled Cold	Coupled Cold	Coupled Cold
Gain relative to IN5*	60	10	10
Gain relative to IN6	112	20	20

*IN5 upgrade. autumn 2001

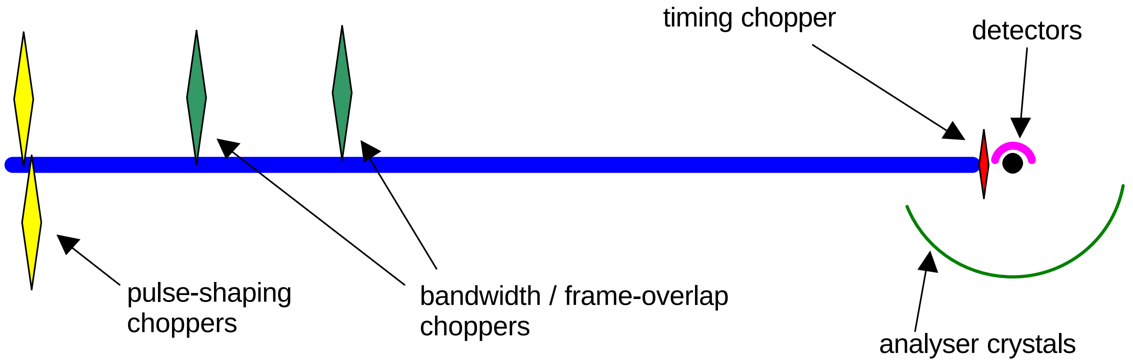
Further instrumental gains are possible: larger detector areas (PSDs) x 4; rep. rate multiplication x2-4. Additional advantages arising from the use of position sensitive detectors are not easily quantifiable but provide considerable additional experimental capability.

x ~ 1000

Instrument performance sheet: **0.8 meV Backscattering**

Instrument description:
An inverse-geometry instrument using Si 111 crystals arranged in direct backscattering to give an energy resolution of 0.8 μeV. A pulse-shaping chopper is used to provide a very sharp time structure. The instrument is 200m long and optimised for quasielastic measurements with a dynamic range of about 300 μeV.

Schematic set-up:



Generic type: IN16 direct backscattering Si 111
Wavelengths used: 4 → 7 Å
Moderator Type: cold coupled

Q-w-range: $0.3 < Q < 2.0$ Å^{-1}
$\hbar\omega$-range ~ 300 μeV
usually quasielastic, i.e. –150 → +150 μeV

Gain (relative to IN16)

g0 = flux gain at the elastic wavelength
d0 = gain in dynamic range

Source gain:

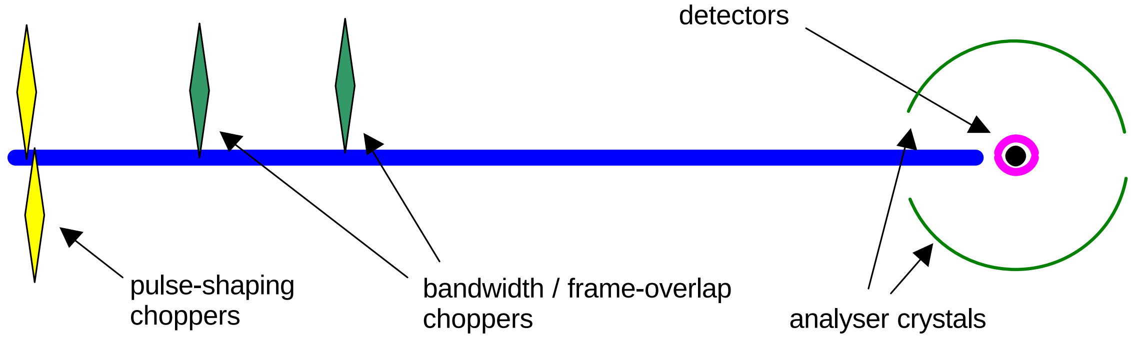
Target	50Hz	10Hz	16.6Hz
moderator	coupled cold	coupled cold	coupled cold
g0	**25**	**5**	**4**
d0	**10**	**12**	**30**

Additional gain due to modern/new design: ~2 **x = 50**

Instrument performance sheet: **1.5 μeV Backscattering**

Instrument description:
An inverse-geometry instrument using Si 111 crystals arranged in near-backscattering to give an energy resolution of 1.5 μeV. A pulse-shaping chopper is used to match primary and secondary resolution at inelastic energy transfers. The instrument is 200m long and optimised for inelastic measurements with a dynamic range of about 300 μeV.

Schematic set-up:



Generic type: IRIS/IN16 near-backscattering Si 111
Wavelengths used: $2 \rightarrow 7$ Å
Moderator Type: cold coupled

Q-w-range: $0.3 < Q < 2.0$ Å^{-1}
$\hbar\omega$-range ~ 300 μeV
if quasielastic: $-150 \rightarrow +150$ μeV

Gain (relative to IN16, which has a slightly better resolution of 0.9 μeV)
g0 = flux gain at the elastic wavelength
d0 = gain in dynamic range

Source gain:

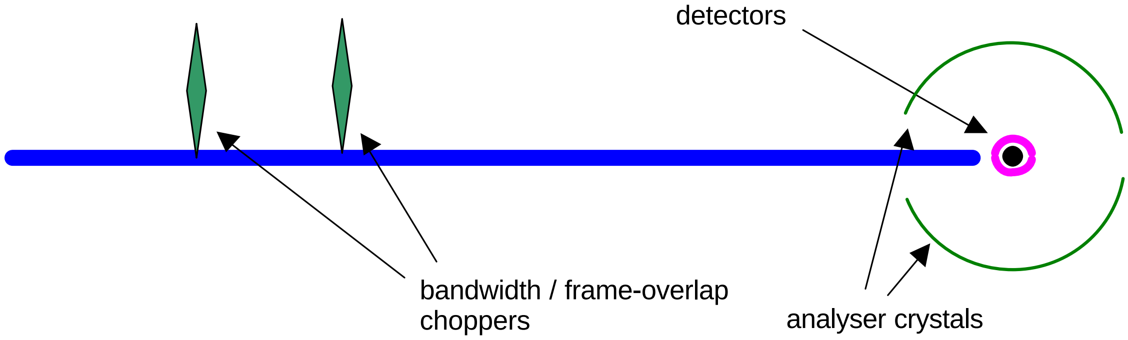
Target	50Hz	10Hz	16.6Hz
moderator	coupled cold	coupled cold	coupled cold
g0	**100**	**20**	**15**
d0	**10**	**12**	**30**

Additional gain due to modern/new design: ~3 **x = 300**

Instrument performance sheet: **17 meV Backscattering**

Instrument description:
An inverse-geometry instrument using PG 002 crystals arranged in near-backscattering to give an energy resolution of 17 μeV, similarly to IRIS at ISIS. The instrument is 22m long and optimised for inelastic measurements with a dynamic range of about 3 meV.

Schematic set-up:



Generic type: IRIS near-backscattering PG 002
Wavelengths used: 2 → 7 Å
Moderator Type: cold decoupled (50Hz) or coupled (10Hz)

Q-w-range: $0.3 < Q < 1.9$ Å^{-1}
$\hbar\omega$-range ~ 3 meV
if quasielastic: –1.5 → +1.5 meV

Gain (relative to IRIS)

g0 = flux gain at the elastic wavelength
d0 = gain in dynamic range

Source gain:

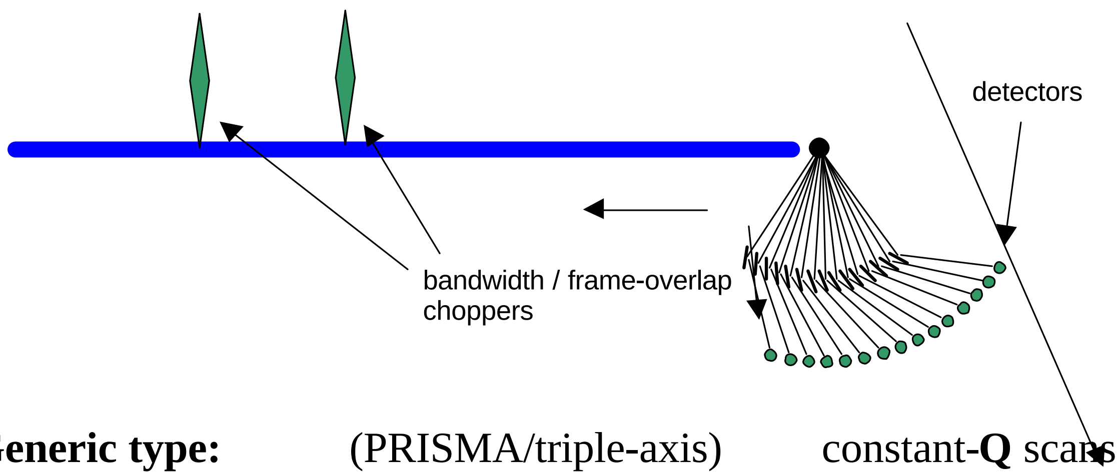
Target	50Hz	10Hz	16.6Hz
moderator	decoupled cold	coupled cold	coupled cold
g0	**150**	**100**	**150**
d0	**2**	**3**	**0.5**

Additional gain due to modern/new design: ~4 **x = 600**

Instrument performance sheet: **constant-Q Machine**

Instrument description:
An inverse-geometry instrument for measuring constant-**Q** scans in single crystals. A multianalyser array of PG002 crystals is used, consisting of at least 20 arms with at most 1° separation with individually adjustable take-off angles.

Schematic set-up:



Generic type: (PRISMA/triple-axis)
Wavelengths used: 1 → 6 Å
Moderator Type: decoupled hydrogen

Q-w-range: $0.2 < Q < 4$ Å^{-1}
$-30 < \hbar\omega < 80$ meV

Gain (relative to PRISMA)

g0 = flux gain

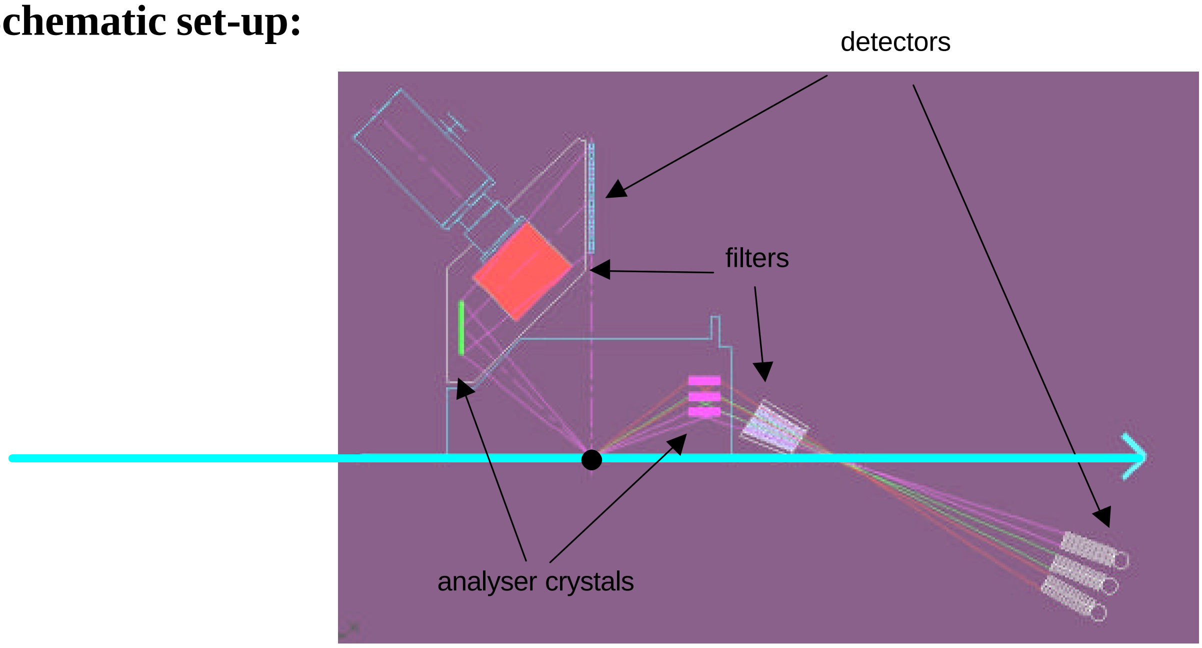
Target	50Hz	10Hz	16.6Hz
moderator	decoupled cold	coupled cold	coupled cold
g0	**100**	**50**	**30**

Additional gain due to modern/new design: ~5 **x = 500**

Instrument performance sheet: **Vibrational Spectroscopy Machine**

Instrument description:
An inverse-geometry instrument for measuring the vibrational density of states, particularly in hydrogenous systems. A multianalyser array of PG002 crystals is used at fixed k_f, covering as much solid angle as possible. Cooled Be filters remove higher-order contamination.

Schematic set-up:



Generic type: TOSCA Vibrational Spectroscopy
Wavelengths used: $0.2 \rightarrow 5$ Å
Moderator Type: decoupled hydrogen

Q-w-range: $0 < \hbar\omega < 1000$ meV

Source gain:

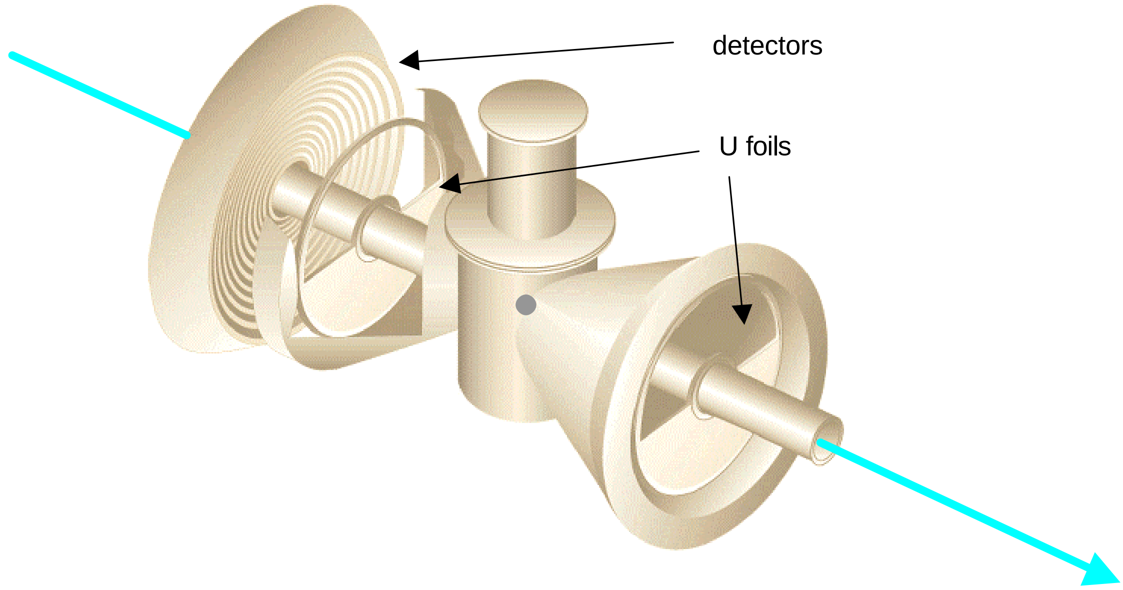
Target	50Hz	10Hz	16.6Hz
moderator	decoupled cold	decoupled cold	
flux gain relative to TOSCA	**50**	**20**	**0**

Additional gain due to modern/new design: ~2 **x = 100**

Instrument performance sheet: **Resonance High-Energy Spectrometer**

Instrument description:
An inverse-geometry instrument for measuring atomic momentum distributions by neutron Compton scattering. It uses the resonant neutron absorption of ^{238}U at 6.67 eV as energy analyser.

Schematic set-up:



Generic type: eVS Neutron Compton Scattering
Wavelengths used: 0.04 → 0.11 Å (5 to 64 eV)
Moderator Type: poisoned water or hydrogen

Q-w-range: $30 < Q < 200$ Å^{-1}
$1 < \hbar\omega < 30$ eV

Source gain:

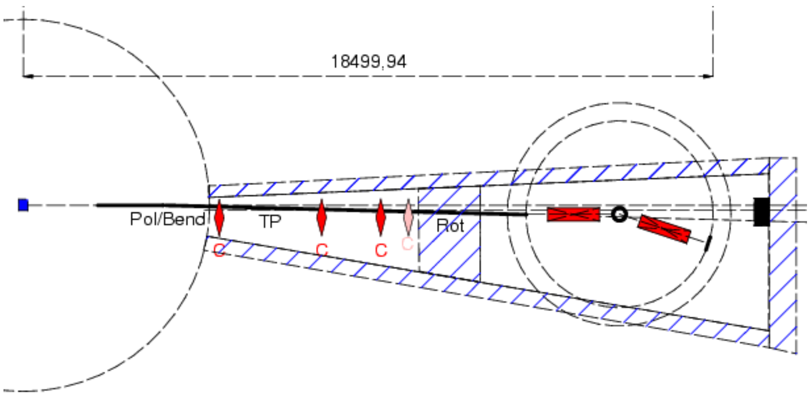
Target	50Hz	10Hz	16.6Hz
moderator	poisoned	poisoned	
flux gain relative to eVS	**30**	**6**	**0**

Additional gain due to modern/new design: ~10 **x = 300**

Instrument performance sheet: **High Resolution NSE**

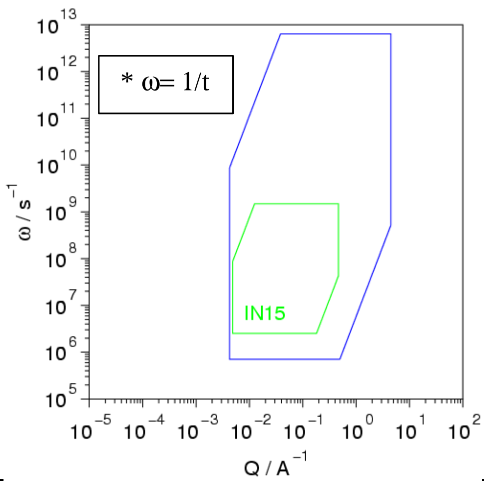
Instrument description:
Neutron Spin-echo instrument, the exact layout depends on the target station (repetition frequency); new design features to achieve long Fourier times; resolution depends on long wavelength NOT on short pulses.

Schematic setup:



Generic type: IN11 ; Fourier method -> S(Q,t)
Wavelengths used: 0.2 nm < λ < 2 nm
Moderator type: cold coupled hydrogen

Q-w -range:



Intensity gain (relative to reactor)

$$g0 = \ln(\lambda_{max} / \lambda_{min}) / (\text{rel.FWHM})$$

Target	50Hz	10Hz	16.6Hz
$g0*(\Phi_{ESS} / \Phi_{ILL})$	**2.7-7.4**	**2.8**	**14 !**

Additional gain due to modern/new design: ~10 **x = 140**

Instrument performance sheet: **Wide Angle NSE**

Instrument description

The spectrometer will be of SPAN (HMI) generic design. It will have an overall diameter of 8-9m and the set-up should allow for the maximum detection solid angle. Due to its large dimensions the spectrometer should be located at ~40m from the source, i.e. far from the crowded area around the shielding.

Generic type: SPAN

Wavelength range : 0.2 nm = λ = 2 nm

Energy range at λ = 0.2 nm : from 2 μeV up to 4 meV

λ = 1 nm : from 16 neV up to 32 μeV

λ = 2 nm : from 2 neV up to 4 μeV

Schematic set-up:

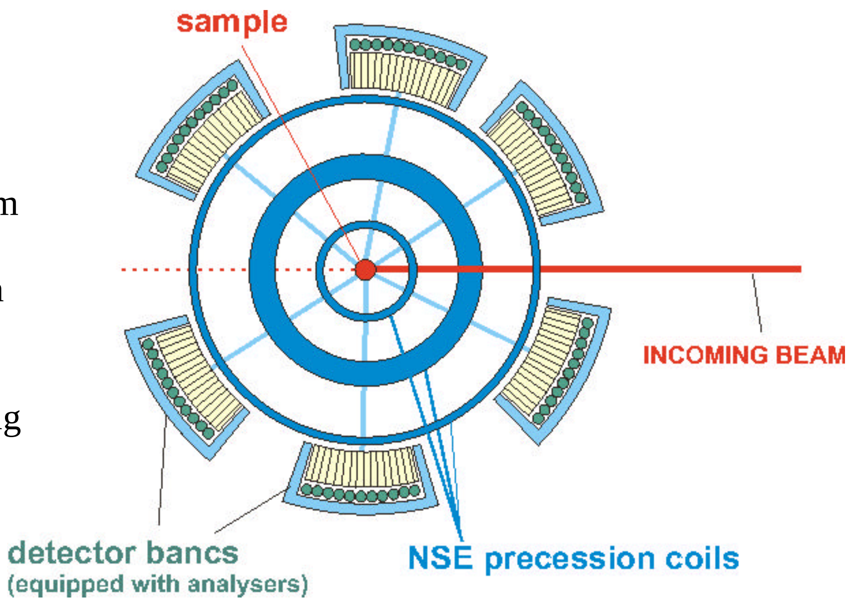
Spectrometer seen from the top

Angular range for NSE:
from -150 deg to 150 deg

Detector – moderator distance 40m

Distance sample – detectors 4.5m

Detecting system :
benches of single detectors moving around the sample



Source gain:

Target	50Hz	10Hz	16.6Hz
$g0*(\Phi_{ESS} / \Phi_{ILL})$	**4**	**2**	**9**

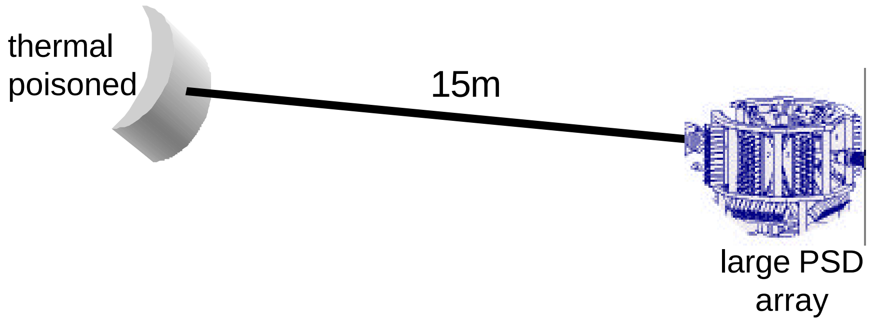
Additional gain due to modern/new design (ref. IN11C): ~35

x = 300

Instrument performance sheet: **Single Crystal Chemical Crystallography**

Instrument description:
"Standard" chemical crystallography and materials science, rapid structure determination for unit cells up to 30 Å cell edge, parametric studies e.g. function of T, small crystal samples. Hydrogen atom positions, atomic disorder, thermal parameters, charge and spin density studies etc. d-spacings to 0.35-0.4 Å d_{min}. Good Q-space resolution to allow peaks to be separated and integrated.

Schematic set-up:



Generic type. D9 (ILL); SXD (ISIS)
Wavelengths used: 0.5-5 Å
Moderator Type: thermal, poisoned, decoupled (option of 130K)

Q-w-range:

d_{min} ~ 0.35-0.4 Å
$\sin\theta/\lambda \leq 1.4$ Å^{-1}
($Q \leq 18$ Å^{-1})

Gains (relative to reactor/best spallation) - very dependent on sample / background / application etc). Not just flux.

Source gain:

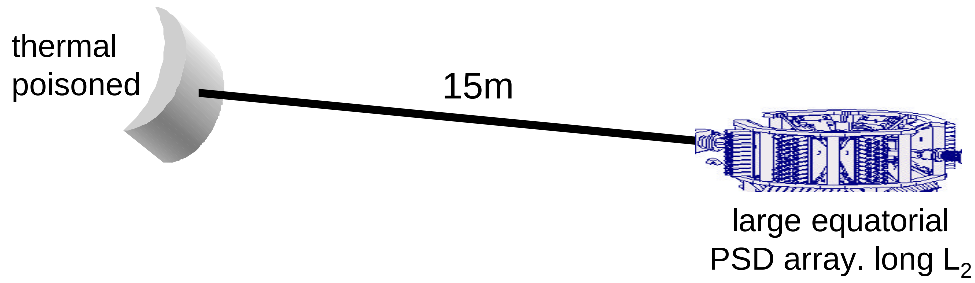
Target	50Hz	10Hz	16.6Hz
Gains	**optimal, »10**	**2nd choice**	**3rd choice**

No additional gain by modern design **x >>10**

Instrument performance sheet: **High Resolution Single Crystal Diffraction**

Instrument description:
High resolution (both short d-spacing and good ΔQ/Q) single crystal diffraction. Studies of anharmonicity, critical scattering, incommensurate structures, satellite reflections, magnetic structures, phase transitions. d_{min} of 0.2 Å. Very high Q-space resolution required to allow for features close to Bragg peaks to be resolved. High positional resolution area detectors important.

Schematic set-up:



Generic type: D9, D10 (ILL); SXD (ISIS), SCD (IPNS)
Wavelengths used: 0.25-2 Å
Moderator Type: thermal, poisoned, decoupled (dt~10µs)

Q-w-range:
d_{min} ~ 0.2 Å
$\sin\theta/\lambda \leq 2.5$ Å^{-1}
($Q \leq 31$ Å^{-1})

Gains (relative to reactor/best spallation) - very dependent on sample / background / application etc). Not just flux.

Source gain:

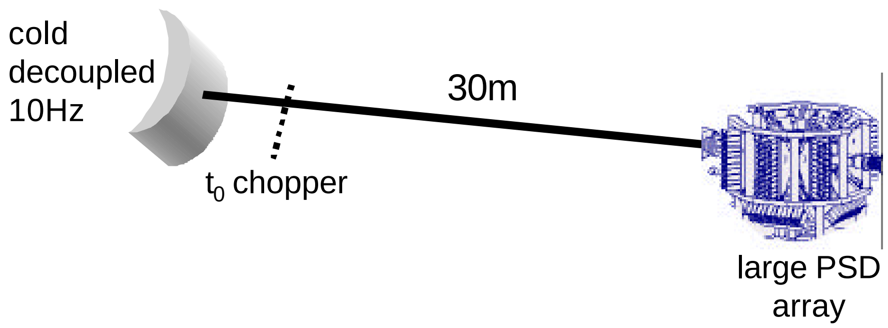
Target	50Hz	10Hz	16.6Hz
Gains	**optimal, »10**	**2nd choice**	**3rd choice**

No additional gain by modern design **x >>10**

Instrument performance sheet: **Single Crystal Diffuse Scattering**

Instrument description:
Diffuse scattering studies, particularly away from the Bragg peaks. Studies of (static and dynamically) disordered single crystals - fast-ion conductors, GMR/high T_C materials etc. Analysis techniques such as Reverse Monte Carlo, pair distribution function etc. Good intensity at high/low Q, continuous coverage of reciprocal space at good Q-space resolution. Fully resolved 3D volumes accessed.

Schematic set-up:



Generic type: SXD (ISIS), D10 (ILL)
Wavelengths used: 0.5-5 Å
Moderator Type: medium cold (130K) or cold, decoupled

Q-w-range:

d_{min} ~ 0.4 Å
$\sin\theta/\lambda \leq 1.2$ Å^{-1}
($Q \leq 15$ Å^{-1})

Gains (relative to reactor/best spallation) - very dependent on sample / background / application etc). Not just flux.

Source gain:

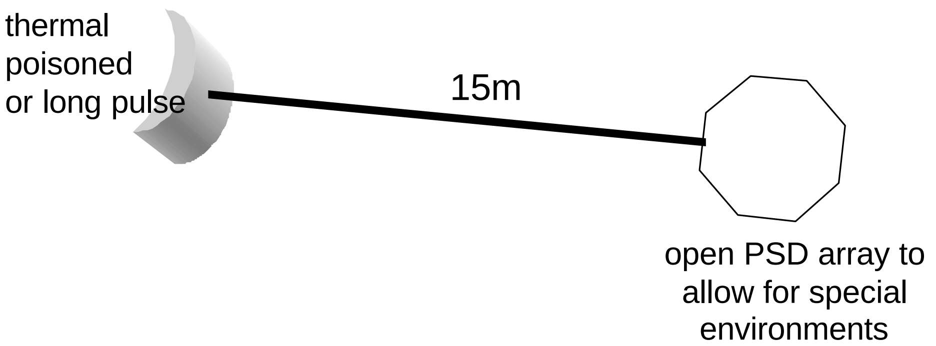
Target	50Hz	10Hz	16.6Hz
Gains	**optimal, »10**	**2nd choice**	**3rd choice**

No additional gain by modern design **x >>10**

Instrument performance sheet: **Single Reflection Single Crystal Studies**

Instrument description:
Rapid and/or accurate studies of individual peaks through e.g. a phase transition under the influence of changing external environment e.g. temperature, pressure, magnetic field. Important in physics area. Need for high point-by-point flux, good resolution to resolve e.g. splitting peaks, appearance of satellites. Complementary (simultaneous) structural measurements also necessary.

Schematic set-up:



Generic type: D10 (ILL), 6T2 (Saclay), TAS in elastic mode
Wavelengths used: 0.5-5 Å
Moderator Type: thermal, decoupled

Q-w-range:

d_{min} ~ 0.4 Å
$\sin\theta/\lambda \leq 1.2$ Å^{-1}
($Q \leq 15$ Å^{-1})

Gains (relative to reactor) - very dependent on sample / background / application etc). Not just flux.

Source gain:

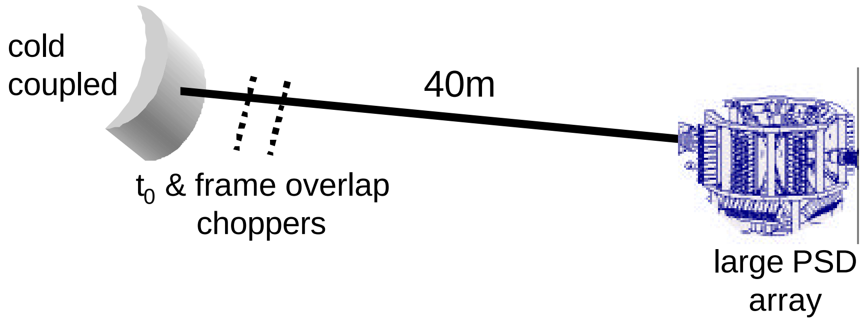
Target	50Hz	10Hz	16.6Hz
Gains	**0.3-3**	**3rd choice**	**0.3-3**

No additional gain by modern design **x = 0.3-3**

Instrument performance sheet: **High Resolution Protein Crystallography**

Instrument description:
Macromolecular (protein) crystallography, unit cells up to 150-200 Å, crystals of 1mm^3 or less. Determination of H/D positions in active sites, mobile protons, studies of H/D exchange, solvent structure around biological macromolecules. High d-space resolution - d_{min} of 1.2-2.4 Å depending on application and crystal diffraction quality. Good Q-space resolution for reliable peak integration.

Schematic set-up:



Generic type: LADI, D19 (ILL); PX-station (LANSCE)
Wavelengths used: 1.8-5 Å
Moderator Type: cold, coupled (but 3-5 x gain if 130K mod.)

Q-w-range:

d_{min} ~ 1.2-2.4 Å
$\sin\theta/\lambda \leq 0.4$ Å^{-1}
($Q \leq 5.0$ Å^{-1})

Gains (relative to reactor/best spallation) - very dependent on sample / background / application etc). Not just flux.

Source gain:

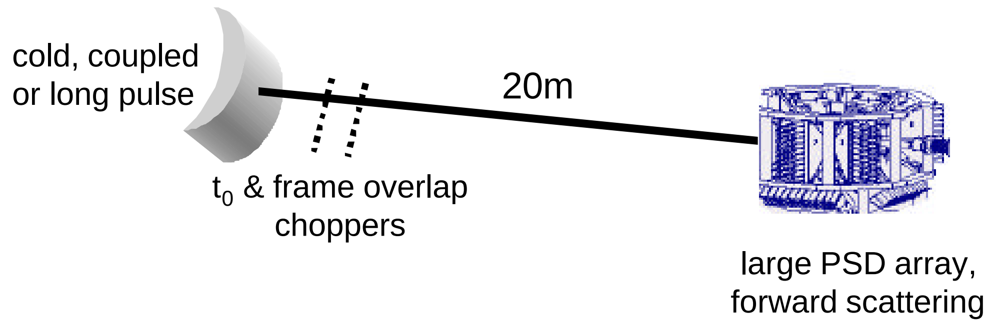
Target	50Hz	10Hz	16.6Hz
Gains	**optimal, >10**	**2nd choice**	**3rd choice**

No additional gain by modern design **x >10**

Instrument performance sheet: **Low Resolution Protein Crystallography**

Instrument description:
Low resolution biological crystallography, studies of partially ordered components of molecular complexes and assemblies, membranes, protein-nucleic acid interactions. Use of contrast variation/D labelling. Small single crystals ($<0.1mm^3$) or large unit cell (>300 Å) studied to low d-spacing resolution ($d_{min}$of 6-10 Å). An important area under exploited with current instrumentation.

Schematic set-up:



Generic type. DB21 (ILL)
Wavelengths used: 5-15 Å
Moderator Type: cold, coupled

Q-w-range:

d_{min} ~ 6-10 Å
$\sin\theta/\lambda \leq 0.08$ Å^{-1}
($Q \leq 1$ Å^{-1})

Gains (relative to reactor) - very dependent on sample / background / application etc). Not just flux.

Source gain:

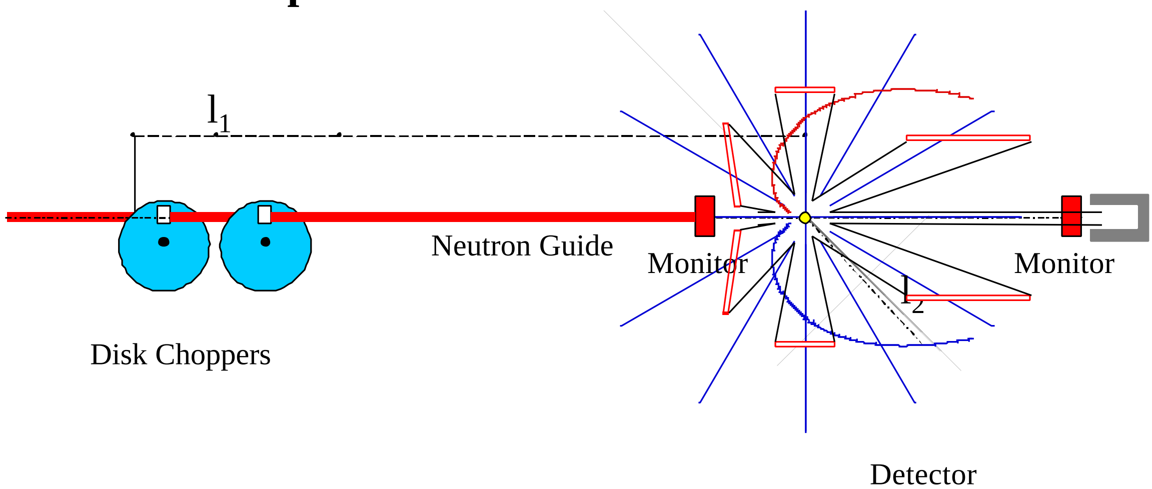
Target	50Hz	10Hz	16.66Hz
Gains	**3-5**	**3rd choice**	**3-5**

No additional gain by modern design **x = 3-5**

Instrument performance sheet: **High Resolution Powder Diffraction**

Instrument description:
High resolution powder diffractometer, with either a continuous detector or discrete banks. The primary flight-path is 200m. It can be operated in narrow- or wide-bandwidth mode. The resolution on an H_2 moderator (0.04%) will be similar to that of HRPD at ISIS in the 2m position, and can be improved on an advanced cold moderator.

Schematic set-up:



Generic type: High-resolution powder diffractometer
Wavelengths used: 0.7 Å $< \lambda < 10$ Å. $\Delta\lambda \sim 0.4$ Å@ 200m
Moderator Type: decoupled cold poisoned (H_2 or advanced)

Q-w-range:
$0.5 \leq Q \leq 12.0$

Intensity gain (relative to ISIS)
Additional gain (×2-4) can be achieved in back-scattering by using a supermirror guide.

Source gain:

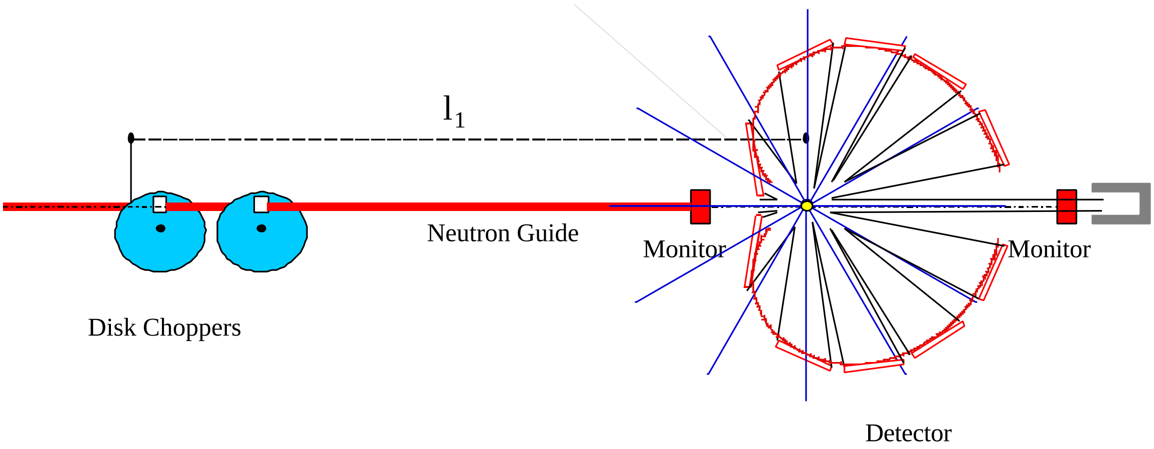
Target	50Hz	10Hz	16.6Hz
g0	**50**	**50**	**50**

Additional gain due to modern/new design: 2-4 **x = 100-200**

Instrument performance sheet: **High-Q Powder Diffraction**

Instrument description:
Medium-resolution powder diffractometer for fast crystallographic and PDF data collection to high Q. The primary flight-path is 40m. It can be operated in narrow- or wide-bandwidth mode, with either multi-bank or continuous detector. The resolution is ~0.2% on a poisoned H_2O moderator, 0.1% on an advanced cold moderator.

Schematic set-up:



Generic type: Medium-resolution powder diffractometer crystallographic applications
Wavelengths used: 3 Å < λ < 8 Å. Δλ ~ 2.1 Å@ 50m
Moderator Type: decoupled ambient poisoned H_2O/advanced cold

Q-w-range:
$0.2 \leq Q \leq 80$

Intensity gain (relative to ISIS)
Vertical focussing can be optimised for a ×2 gain.

Source gain:

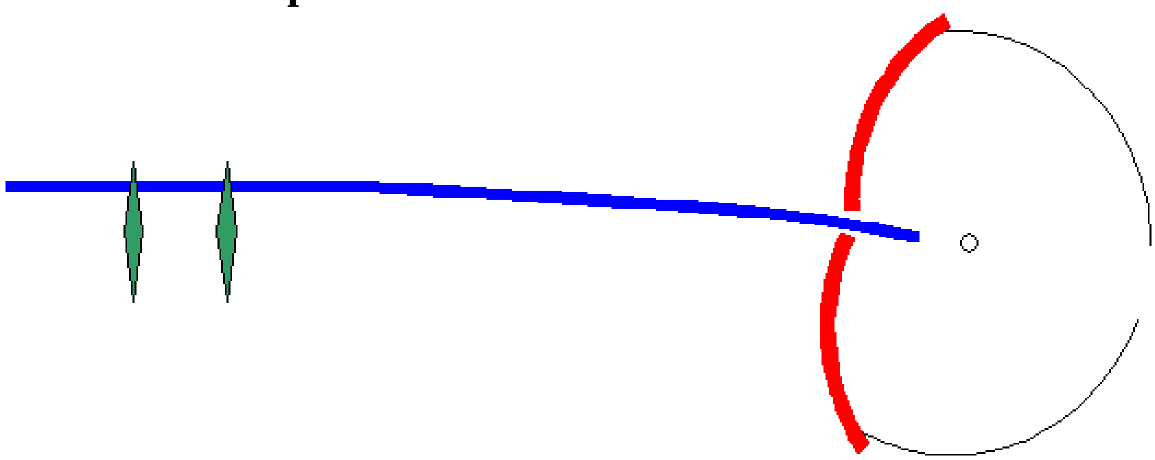
Target	50Hz	10Hz	16.6Hz
g0	**60**	**60**	**n.a.**

Additional gain due to modern/new design: ~2 **x = 120**

Instrument performance sheet: **Magnetic Powder Diffraction**

Instrument description:
Medium-resolution powder diffractometer for magnetic diffraction, with continuous detector in back-scattering. The primary flight-path is 80m. The resolution on an unpoisoned H_2 moderator is ~0.2%.

Schematic set-up:



Generic type: Medium-resolution powder diffractometer for magnetism
Wavelengths used: 1.2 Å $< \lambda < 30$ Å. $\Delta\lambda \sim 1$ Å@ 50m
Moderator Type: decoupled cold unpoisoned H_2

Q-w-range:
$0.2 \leq Q \leq 6.0$

Intensity gain (relative to ISIS)
Osiris guide is already optimized.
Extended detector design yields a ×2 gain.

Source gain:

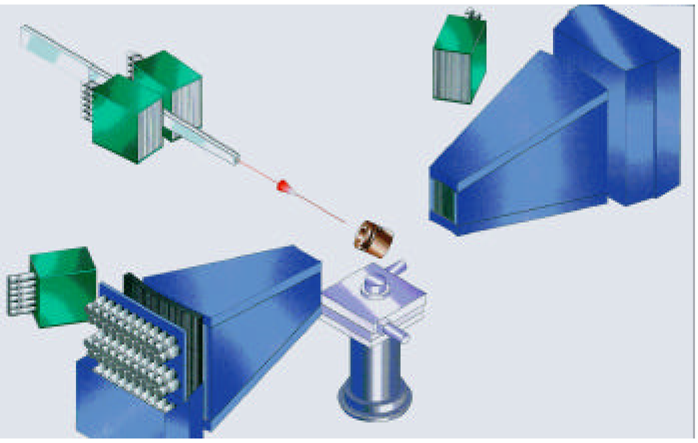
Target	50Hz	10Hz	16.6Hz
g0	**60**	**60**	**25-50***

Additional gain due to modern/new design: ~1 **x = 60**

Instrument performance sheet: **Engineering Diffractometer**

Instrument description:
Medium-high resolution powder diffractometer optimised for strain measurement, similar to ENGIN-X at ISIS. The primary flight path is ~50m, on a curved guide. The final section of the guide can be inter-changed with absorber to provide tuneable resolution in the 90° detector banks. Large 90° detector banks, also backscattering and transmission detectors. The sample area is large and open to the air, to allow large samples and sample environment equipment.

Schematic set up:



Moderator to sample distance 40-50m, supermirror guide, frame definition choppers.

Large sample environment space. Variable incident horizontal divergence. Variable incident and exiting collimation.

Generic type:
Medium resolution powder diffractometer

Wavelength.	0.7 Å < λ < 3 Å. λ range ~ 1.5 Å.
	0.2%< Δλ/λ < 0.7% in 90°.
Moderator type:	decoupled, poisoned H_2O or new cold one
Target station:	50Hz short pulse

Performance:
High resolution engineering diffractometer. Performance gains vs. ENGIN-X instrument presently under construction at ISIS x30 (source), further x2-3 for some types of experiments from instrument design.

x=90

Instrument performance sheet: **Reflectometers**

Instrument description:
Instrument which measures reflectivity curves down to reflectivities of the order 10^{-8} in the small angle range up to $q = 0.5$ Å^{-1}. For solids it is possible to measure atomic Bragg peaks at large q-values.
In order to optimize the instrument with respect to both resolution and intensity **two** instruments are needed, a high intensity reflectometer on the 16.6Hz LPSS and a high resolution reflectometer at the 50Hz SPSS.

Schematic set-up:

The exact set-up strongly depends on the source parameters, the wanted resolution and the samples which should be investigated: solid magnetic/non-magnetic samples or liquid samples. Polarized neutrons should be available.
Length of instrument at a LPSS: 40-80m
Length of instrument at a SPSS: 12m

Generic type: high resolution: SURF (ISIS)
high intensity: ADAM (ILL)
Wavelengths used: 0.2 nm < λ < 0.9 nm
Moderator Type: cold coupled moderator

Q-w-range:
0.01 Å^{-1} < q < 3 Å^{-1}

Source gain:

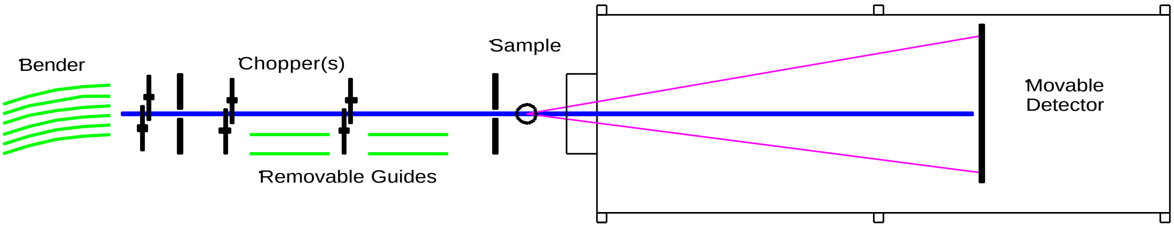
Target	50Hz	10Hz	16.6Hz
g0 (high resolution)	**120**	**25**	**90**
g0 (high intensity)	**10**	**2**	**15**

Additional gain due to modern/new design: ~2 **x = 30-200**

Instrument performance sheet: **SANS**

Instrument description:
Neutron Small Angle Instrument, the exact layout depends on the target station (repetition frequency).

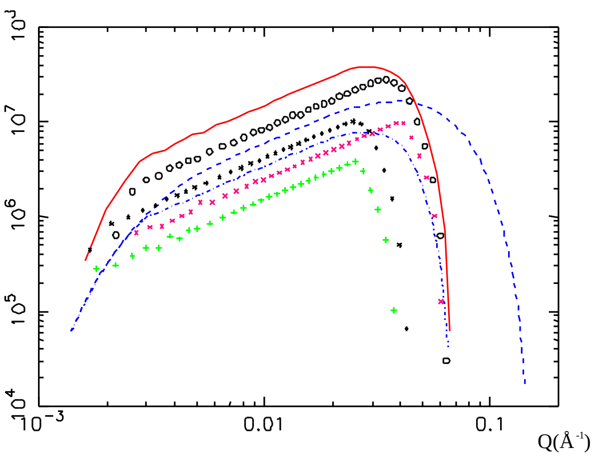
Schematic set-up:
Generic SANS instrument for ESS:



Generic type (c.f. D22 at ILL): total length ~ 40m; large area detector (> 1m x1m); curved guide and/or bender removes direct view of moderator, optional polariser.

Wavelengths used: 0.2 nm < λ < 2 nm
Moderator type: cold coupled hydrogen

(a)



SANS at 36m (6/15/15), collimation and sample to detector distance of 15m, 1cm^{-1} flat scatterer

line (-): l=4.4-9.2 Å; 5MW, 16.6Hz
circles: l=4.6-6.6 Å; 5MW, 50Hz
asterisk: l=6.8-8.8 Å; 5MW, 50Hz
dashes (-): l=2-11 Å; 1MW, 10Hz
dot-dash (-): l=4.4-11 Å; 1MW, 10Hz

xxx: l=5 Å; +++:l=8 Å, 10% FWHM; ~ ILL reactor

Source gain: Approximate improvements in count rate g_0, and Q resolution σ_0 (FWHM) over ILL, which are then coupled with an expanded simultaneous Q range:

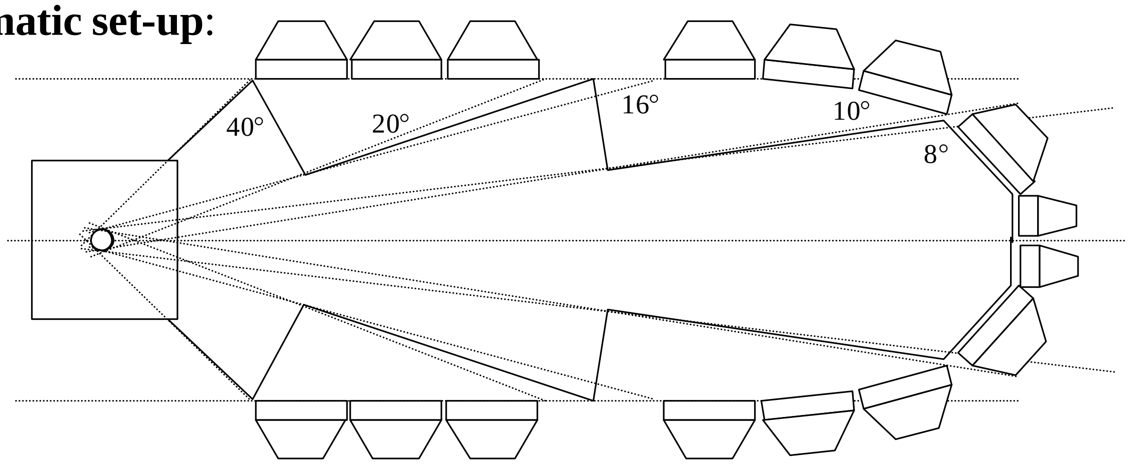
Target	50Hz	10Hz	16.6Hz
g_0*(Φ_{ESS} /Φ_{ILL})	**4-5**	**2-4**	**7-10**
σ_0*(σ_{ILL} /σ_{ESS})	**3.5**	**3.5**	**2**

No additional gain due to modern design **x = 10**

Instrument performance sheet: **Total Scattering Diffractometer**

Instrument description:
Total Scattering diffractometer for disordered materials and crystalline materials. Can be 11m incident flight path (50Hz target) or up to 25m incident flight path (10Hz Target). 50Hz option is preferred. Most detector solid angle is at low scattering angles, but **backscattering** detectors are needed for higher resolution at large Q. This instrument(s) should be kept separate from any crystallographic powder diffractometers because the flight path requirements are different.

Schematic set-up:



Generic type. SANDALS/GEM TOF diffractometer
Wavelengths used: 0.05 Å – 5.0 Å
Moderator Type: water (50Hz) – preferred
Q-range: $0.01\ Å^{-1} < Q < 60\ Å^{-1}$

Source gain (relative to ISIS)**:**
"C-number" is the peak count rate from 1cm^3 vanadium in units of cts/s/0.05 Å^{-1}/cm^{3}V
Current value at D4 (ILL) is 50-500, at SANDALS (ISIS) is ~600

We quote the ratio C-number(ESS)/C-number(SANDALS)

Target	50Hz	10Hz	16.6Hz
C-number ratio	**~20**	**4**	**-**

Additional gain due to modern/new design: ~1 **x = 20**