The Neutron Optics Test Station NOTS

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The Neutron Optics Test Station NOTS is designed for precise, comprehensive studies of any contemporary wide-bandwidth neutron optical devices and components to be used by the experimental facilities of the Spallation Neutron Source SNS.

General Consideration 1

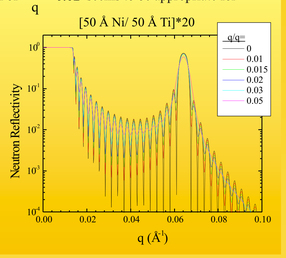
Wide-bandwidth neutron optical devices/components to be studied at NOTS include

- Supermirrors
- Neutron guide segments
- (Remanent) polarizers
- Polarization analyzers
- Beam benders
- Band pass filters
- Focusing devices
- Focusing monochromators
- Multilayer monochromators
- Fiber lenses
- Toroidal mirrors
- Spin-flipper

=> **NOTS has to be a time-of-flight instrument!**

Resolution Requirements 2

Generally, a resolution of $\frac{q}{q}$ 0.02 seems to be appropriate for most applications.



Example: Ni/Ti multilayer for R&D on supermirrors

Resolution, cont'd 3

$$\frac{q}{q}^2 = \quad^2 \quad^2$$

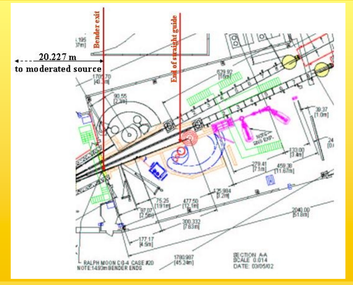
$$= \quad^2 \frac{L_{TOF}}{L_{TOF}}^2 \frac{t_{TOF}}{t_{TOF}}^2$$

$$= \quad^2 \frac{L_{TOF}}{L_{TOF}}^2 \frac{t_{Chopper}}{t_{TOF}}^2 \frac{t_{Detector}}{t_{TOF}}^2 \frac{t_{Det.elec.}}{t_{TOF}}^2$$

:	Standard deviation of the parameter
:	Angular divergence of the neutron beam
L:	Uncertainty of travel distance due to different flight paths
L_{TOF}:	Travel distance between chopper "window" and detector
t_{TOF}:	Time-of-flight (TOF)
t_{TOF}:	TOF uncertainty
$t_{Chopper}$:	TOF uncertainty due to chopper pulse width
$t_{Detector}$:	TOF uncertainty due to neutron detection process
$t_{Det.elec.}$:	TOF uncertainty due of detector electronic

For 2% q-resolution, the total length of NOTS needs to be on the order of > 10 m.
A double-disk chopper system provides t/t_{TOF} = constant.

HFIR Guide Hall 4



HFIR Beamline CG-4 5

- Source
width: 0.0852 m; height: 0.0852 m
flux density: 5.286 10^{14} n/m²/s

--- Distance between source and collimator: a = 2.832 m ---

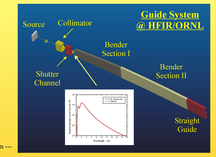
- Collimator (length: 0.730 m)
entrance width: 0.0494 m; exit width: 0.0410 m
entrance height: 0.1076 m; exit height: 0.1100 m

--- Distance between collimator and shutter channel: b = 0.468 m ---

- Shutter Channel (length: 0.641 m)
entrance width: 0.0356 m; exit width: 0.0282 m
entrance height: 0.1115 m; exit height: 0.1136 m

--- Distance between shutter channel and bender section I: c = 0.626 m ---

- Bender Section I (length: 6 m)
entrance width: 0.010m; exit width: 0.019 m
entrance height: 0.1156 m; exit width: 0.150 m
4 channels with 0.0005 m thick dividers
36 elements, 0.16667 m long with 0.0889 adjacent angle
coating: m = 2.5

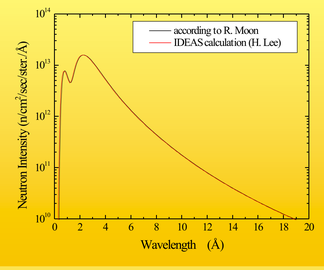


- Bender Section II (length: 9 m)
width: 0.019m
height: 0.150 m
4 channels with 0.0005 m thick dividers
54 elements, 0.16667 m long with 0.0889 adjacent angle
coating: m = 2.5

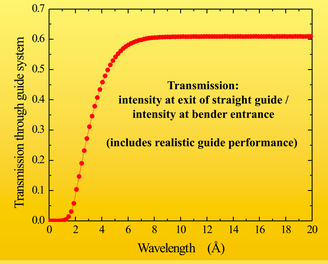
total deflection of bender sections I + II (i.e., over 15 m): 8 r = 107.43 m

- Straight Guide (length: 2.5 m + 9.405 m = 11.905 m)
width: 0.019 m; height: 0.150 m
coating: m = 2

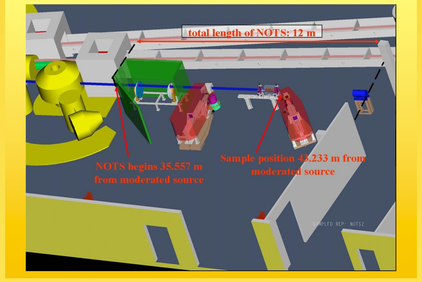
HFIR Source brightness 6



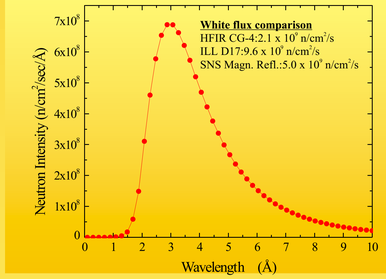
CG-4 Guide System 7



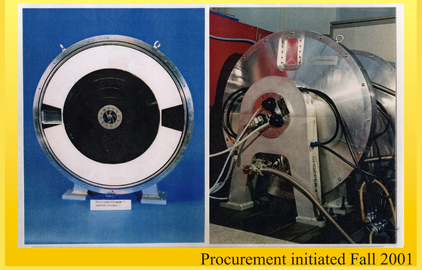
NOTS at HFIR 8



CG-4 Spectrum at NOTS 9

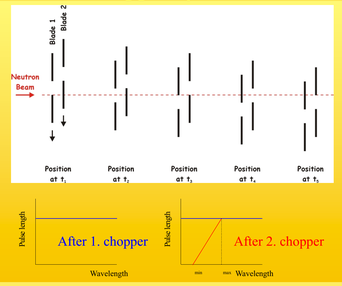


ASTRIUM 60 Hz Choppers 10

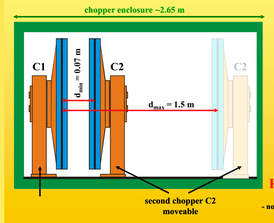


Procurement initiated Fall 2001

Double-disk chopper system 11



NOTS Chopper System 12

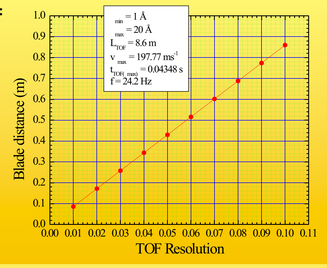


Variable chopper distance & variable chopper blade opening allow Trading of Resolution vs. Intensity

- not to scale -

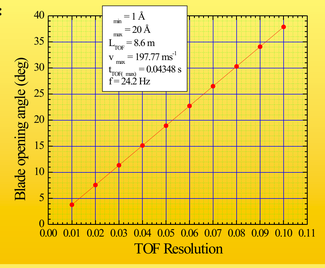
Chopper vs. TOF 13

Example:

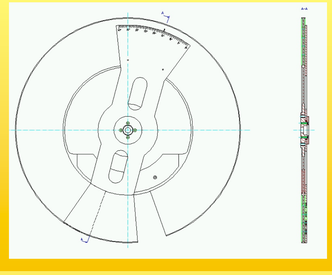


Chopper vs. TOF, cont'd 14

Example:

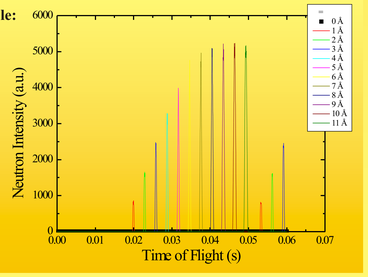


Adjustable Blade Aperture 15



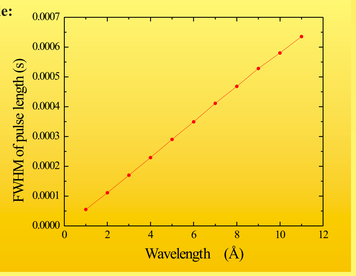
Pulse Lengths at Detector 16

Example:

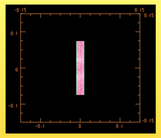


Pulse Lengths at Detector, cont'd 17

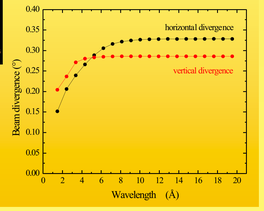
Example:



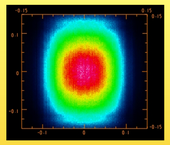
Beam Divergences 18



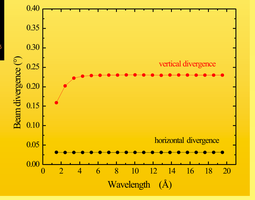
at end of straight guide
= 11.1 m before NOTS sample position



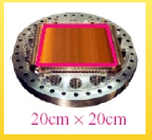
Beam Divergences, cont'd 19



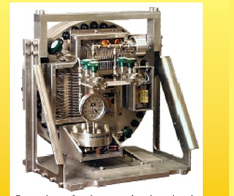
at NOTS sample position
= 11.1 m after end of straight guide



Brookhaven Neutron Detector 20



High precision neutron detector



Rear view of a detector showing signal feedthroughs and preamplifiers, as well as the gas purification system.

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