

Performance of the Reactor Beam Velocity Selector at the BT-7 Thermal Triple Axis Spectrometer

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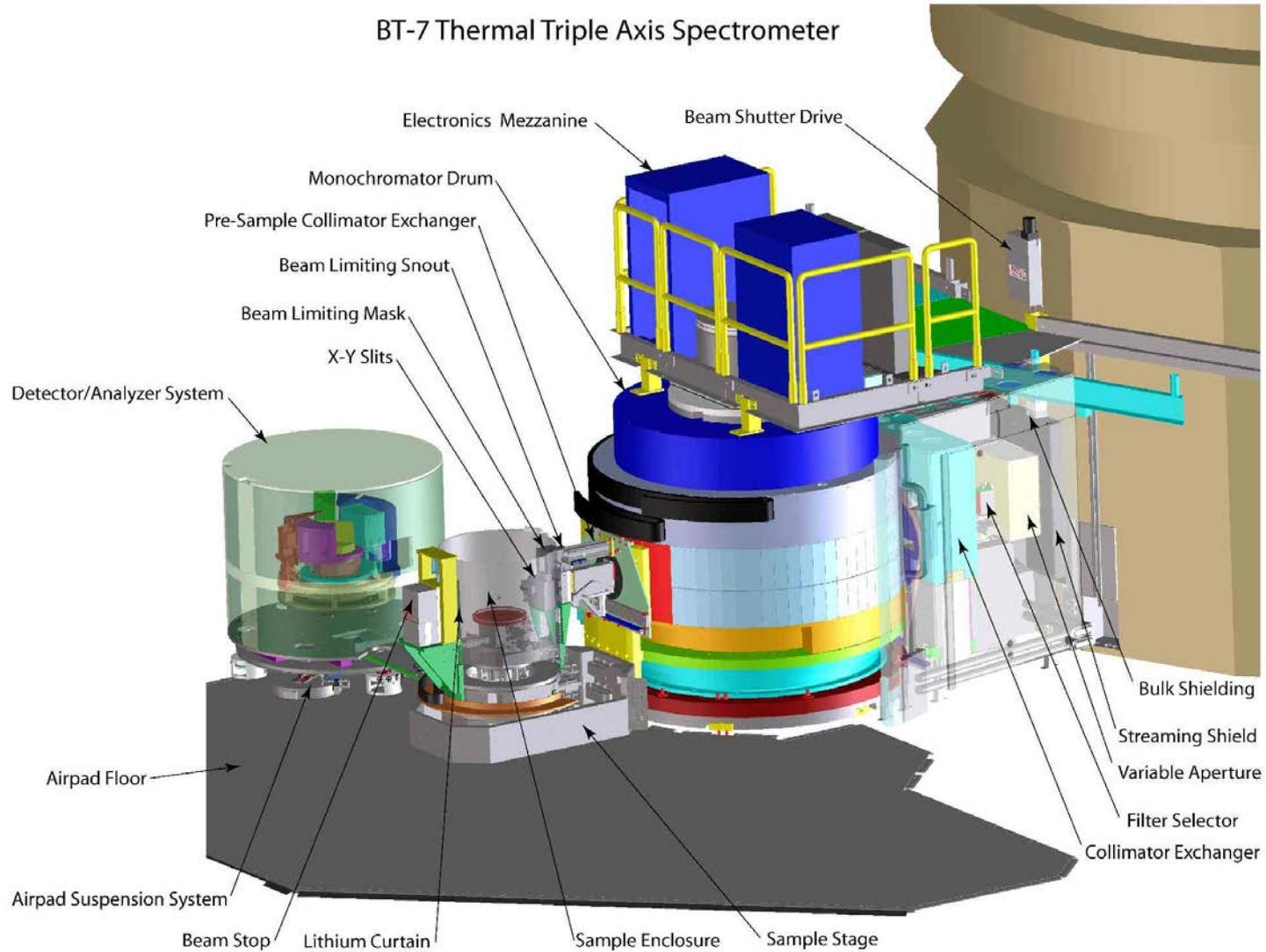
BT-7 Features

- Full use of large reactor beam (ID=16 cm)
- Choice of Double Focusing Monochromators
- Polarized Beam (optically pumped He³)
- Elevator, magnet axis for sample (15 Tesla)
- Computer Controlled Analyzer System
 - Conventional (with collimation)
 - Horizontal Focusing
 - Flat PG + PSD
 - Constant-E PSD scan
 - Diffraction with PSD
- Velocity Selector (~~being developed~~ Installed)

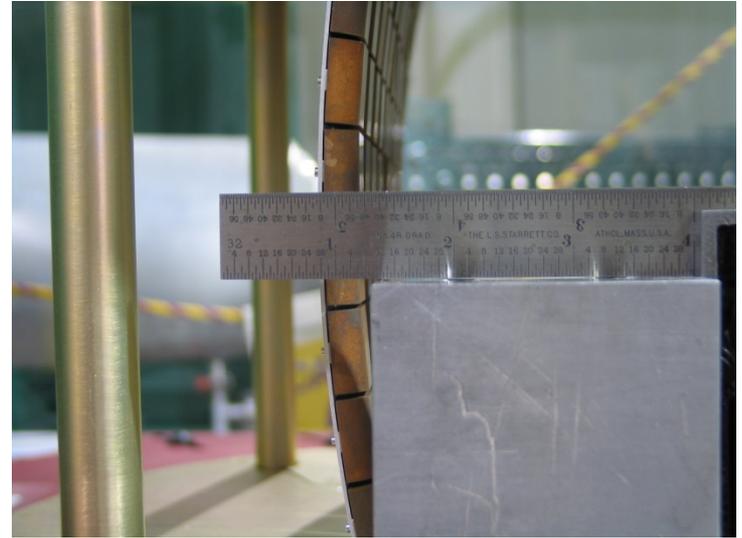
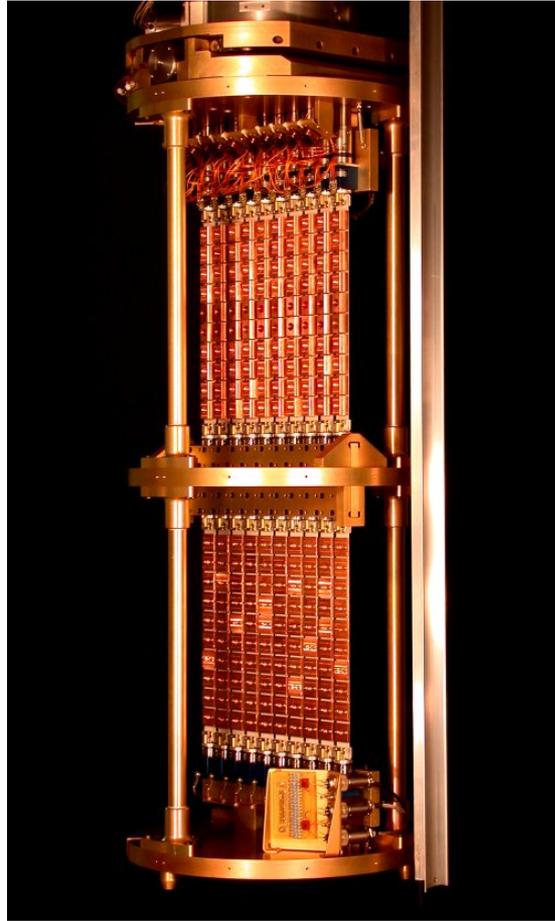
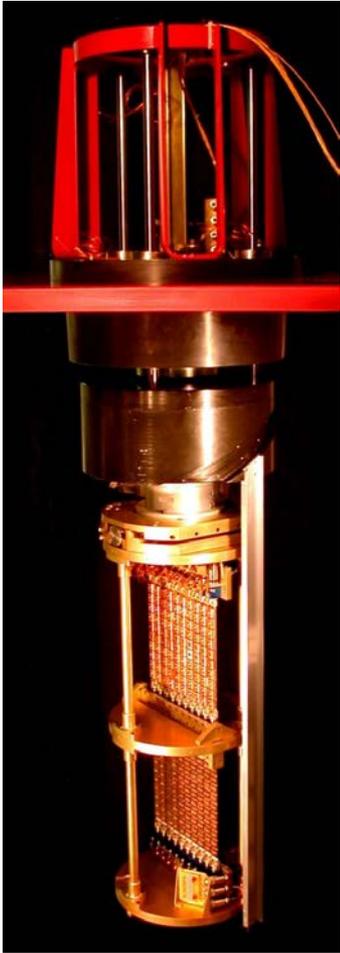
BT-7 Thermal TAS

Overview

BT-7 Thermal Triple Axis Spectrometer



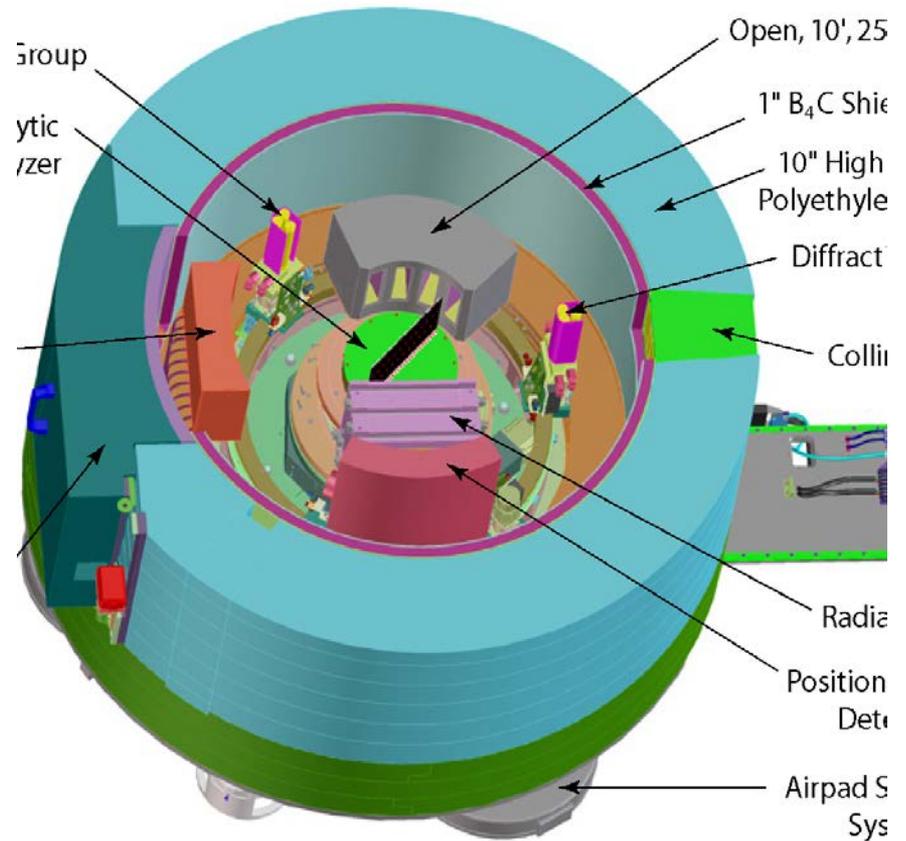
Double focusing monochromators



PG(002) $d = 3.354 \text{ \AA}$; PG(004), $d = 1.677 \text{ \AA}$
Cu(220) $d = 1.270 \text{ \AA}$

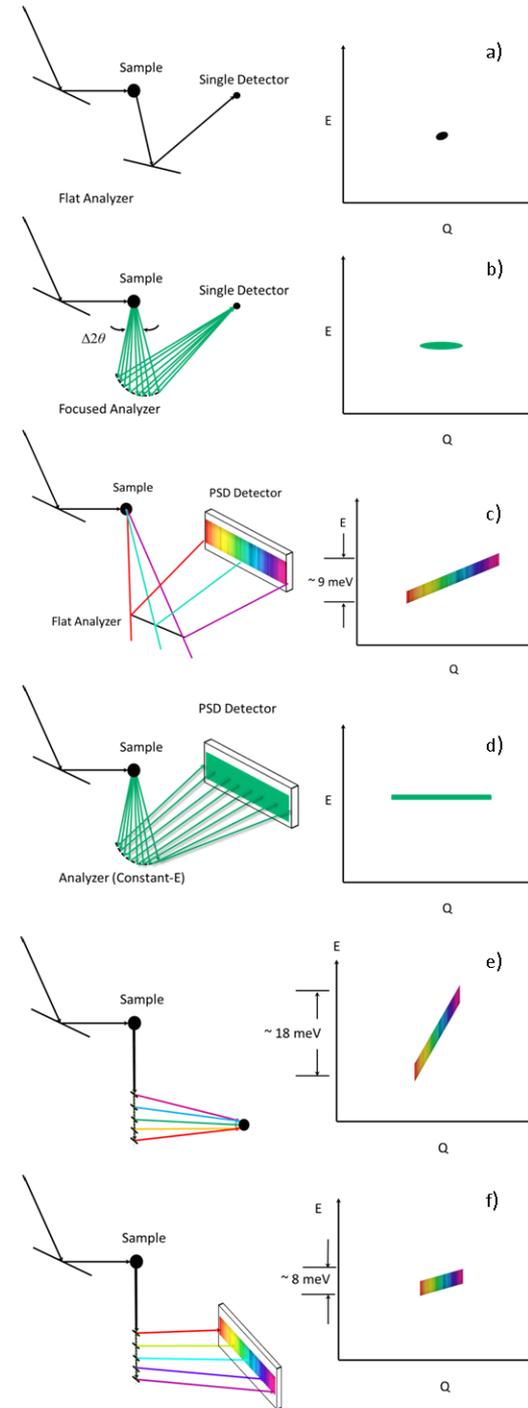
Analyzer Modes

- Diffraction detector (single detector)
- Diffraction mode (radial collimator + PSD)
 - (door detector; poor man's PSD)
- Flat PG analyzer + collimation + SD
- Flat PG analyzer + PSD (range of Q , E or range of diffuse scatt.)
- Horizontal focusing (radial collimator + single detector)
- Horizontal energy focusing + PSD



Inelastic Scattering

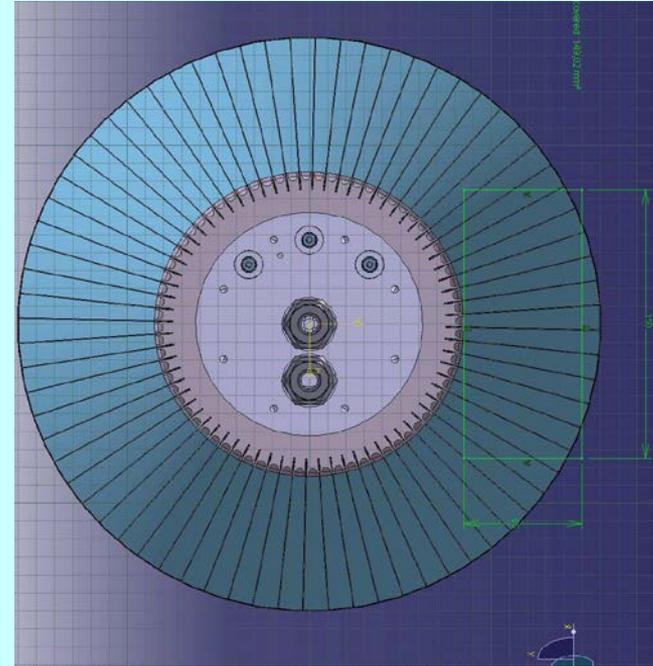
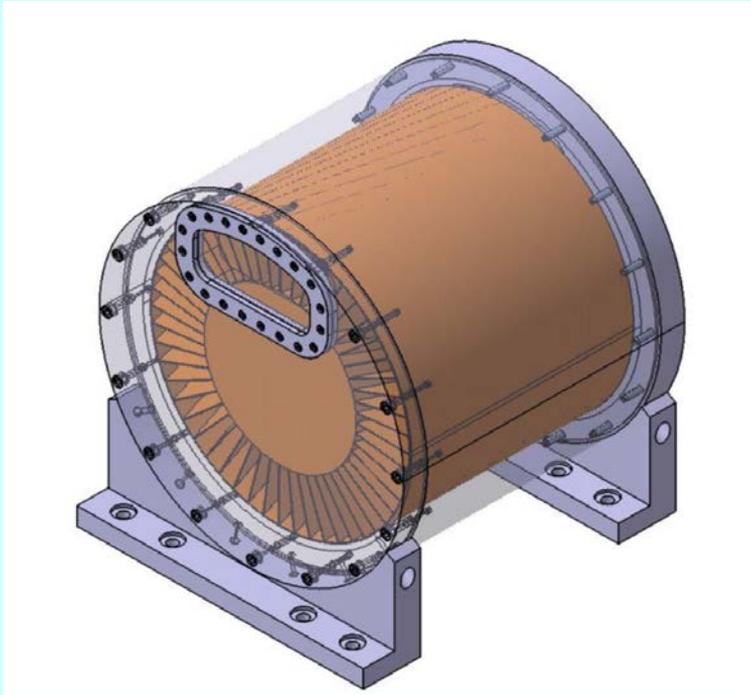
Six Inelastic Analyzer Modes of Operation



BT-7 Velocity Selector

- Project started July, 2010
- Capital Equipment request Sept. 2010
- Capital Equipment request Approved FY' 13
- Requisition finalized 2013
- Requisition awarded to Astrium Sept. 2013
- Finalized Review of Astrium April 2014
- Velocity Selector Delivered June 2015
- Velocity Selector Installed December, 2016
- Friday afternoon, **Vacuum Failure!**
- Monday Morning—Vacuum Gauge Replaced!

BT-7 Velocity Selector (Astrium)



Neutron Window:
 $L = 150 \text{ mm} \times 77 \text{ mm}$

Rotor length, $L = 250 \text{ mm}$

Rotor outer radius, $r_2 = 145 \text{ mm}$

Blade height 75 mm (rotor inner radius, $r_1 = 70 \text{ mm}$)

Number of blades, $N = 72$ (center – center separation 5° , $t = 0.4 \text{ mm}$ thick)

Screw angle, 11.7° . $\Delta\lambda/\lambda \approx 40\%$

The velocity selector is designed for the unrestricted wavelength range between 1.2 \AA and 3.1 \AA .

$E_i = 8.5 \text{ meV} \rightarrow 60 \text{ meV}$ (60,000 rpm); Energy range around 5 meV as well.

BT-7 Velocity Selector (Astrium)

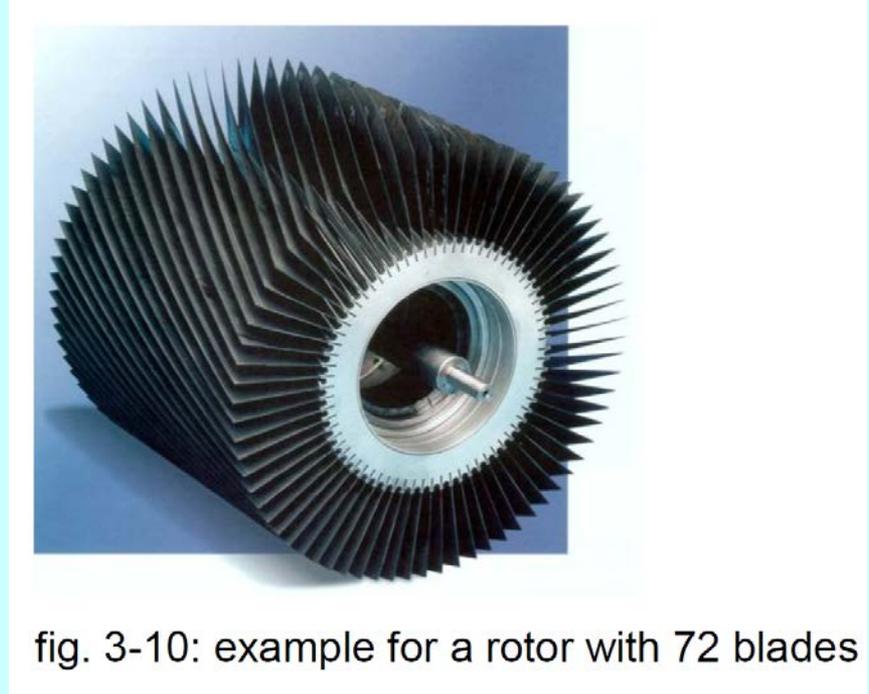
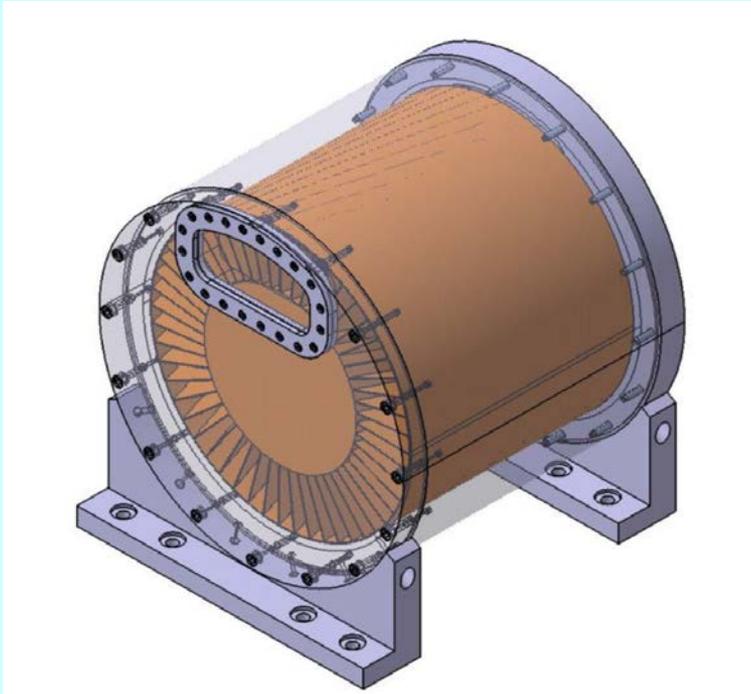


fig. 3-10: example for a rotor with 72 blades

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The velocity selector is designed for the unrestricted wavelength range between 1.2 \AA and 3.1 \AA .

$E_i = 8.5 \text{ meV} \rightarrow 60 \text{ meV}$ (26,000 rpm); Energy range around 5 meV as well.

BT-7 Velocity Selector

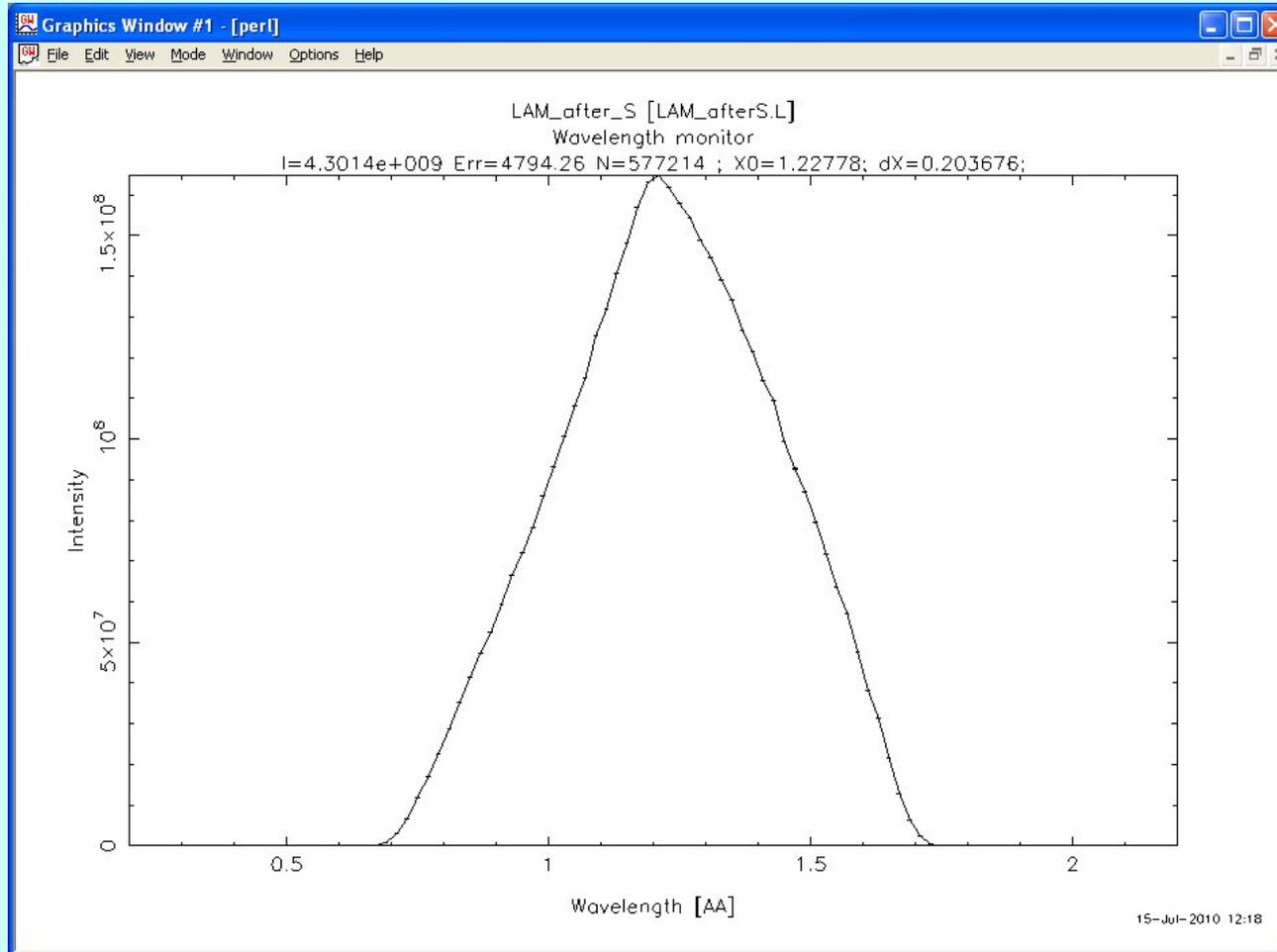


Tested



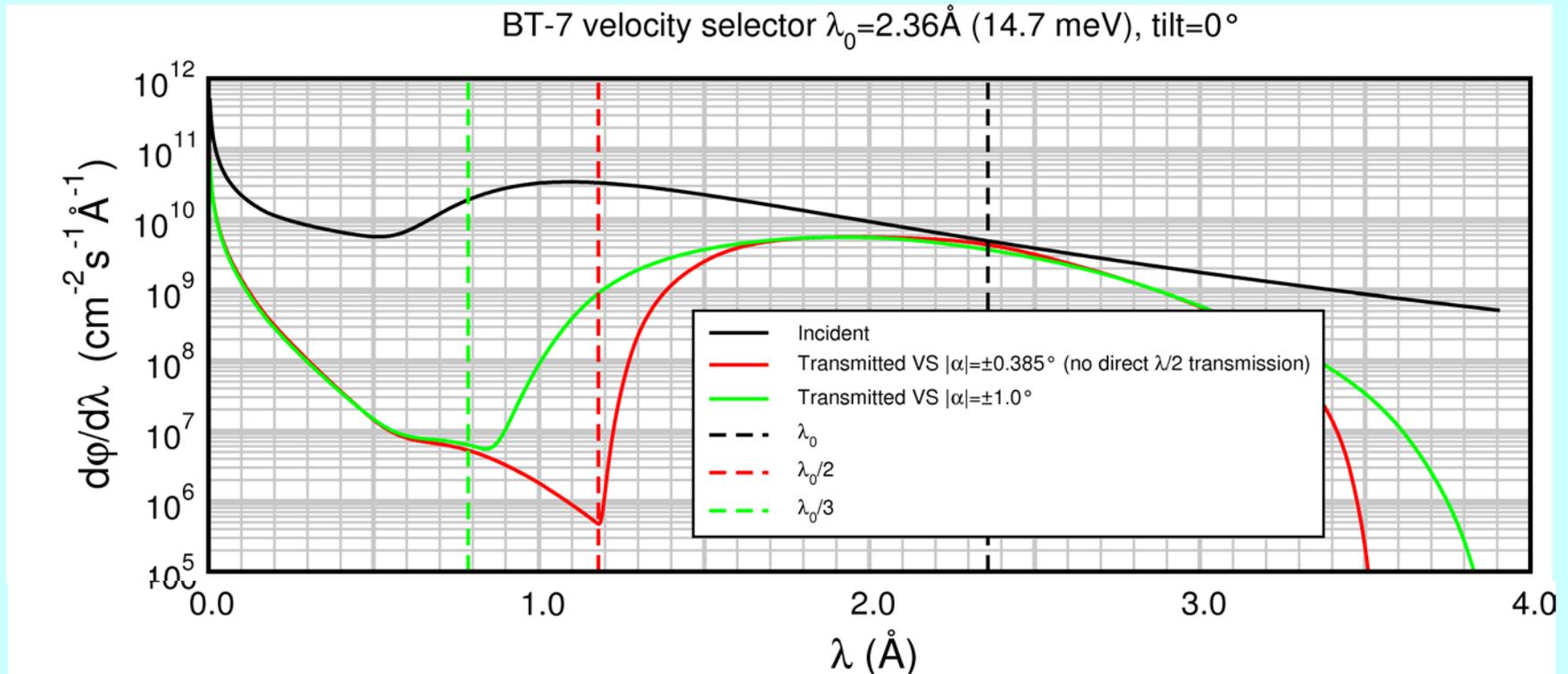
Installed

Velocity Selector Calculated Transmission (from the vendor)



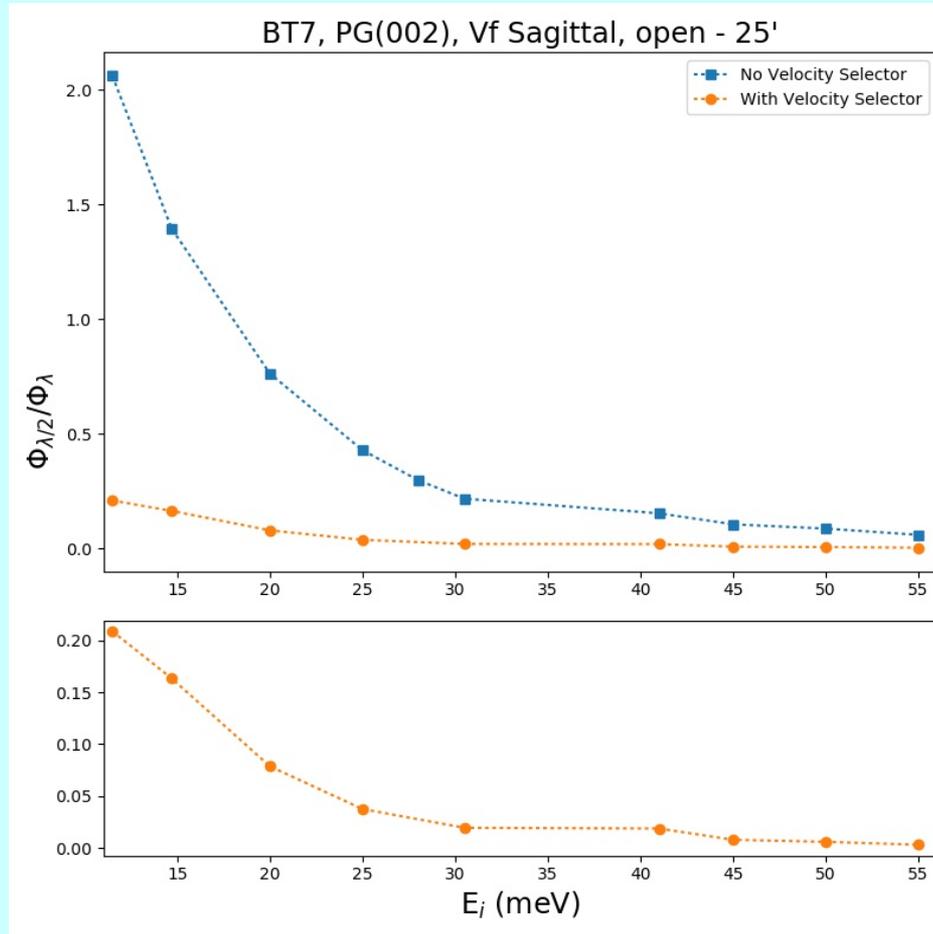
Calculated Velocity Selector Transmission

Selector runs up to 26000 rpm, $E_i = 60$ meV



Jeremy Cook

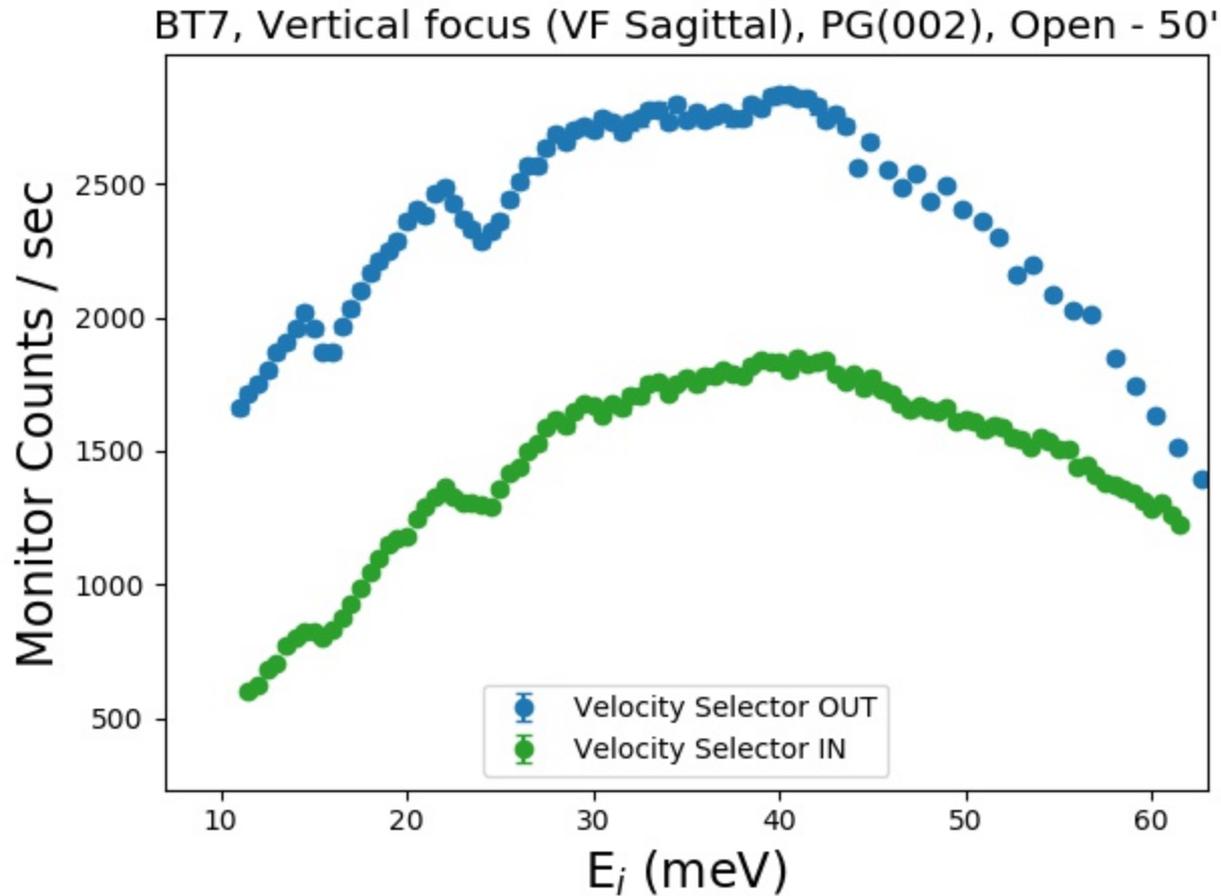
Measured BT-7 Velocity Selector Performance



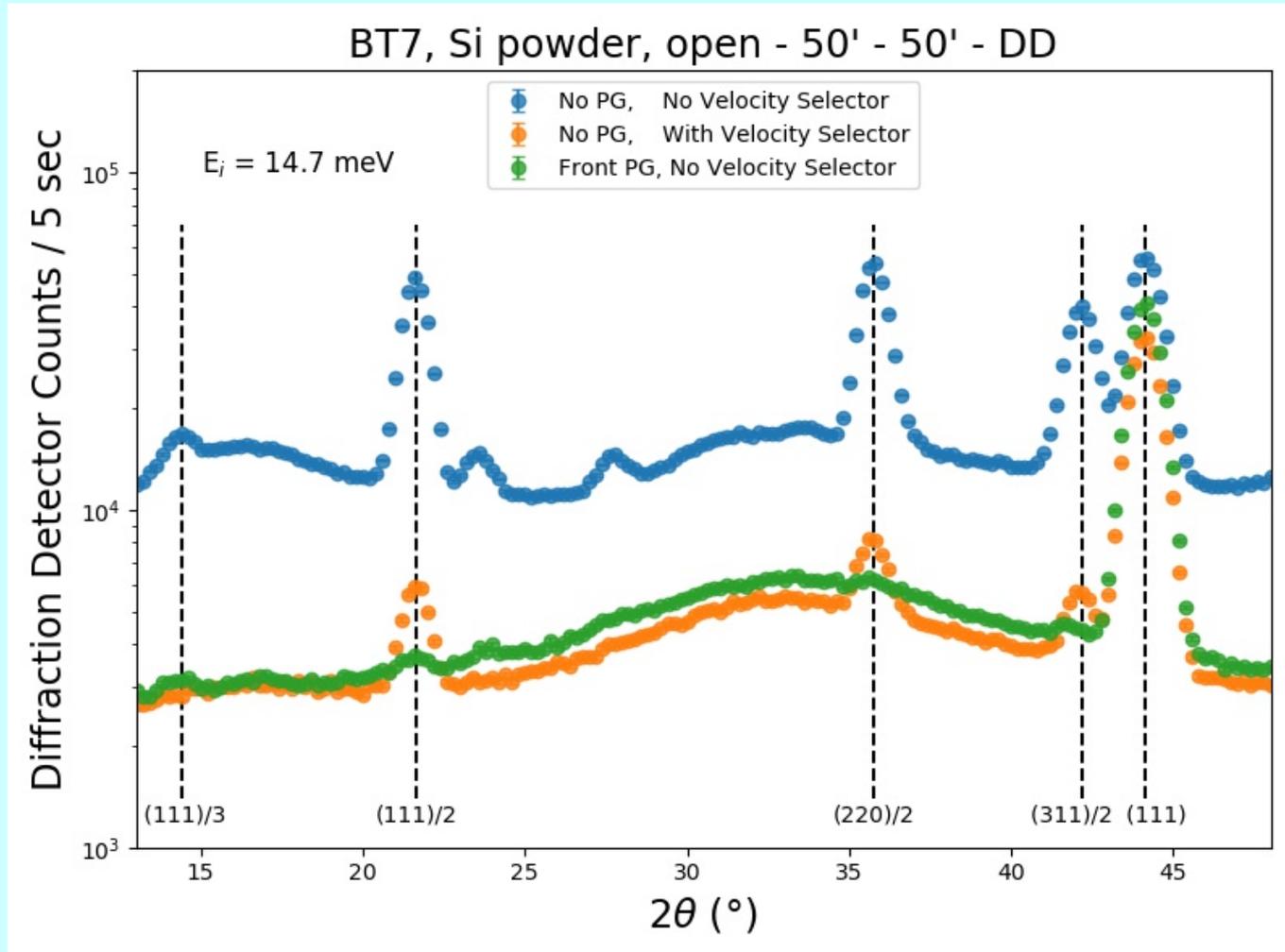
Suppression of second-order wavelength

There is also a window where we can use PG(004).

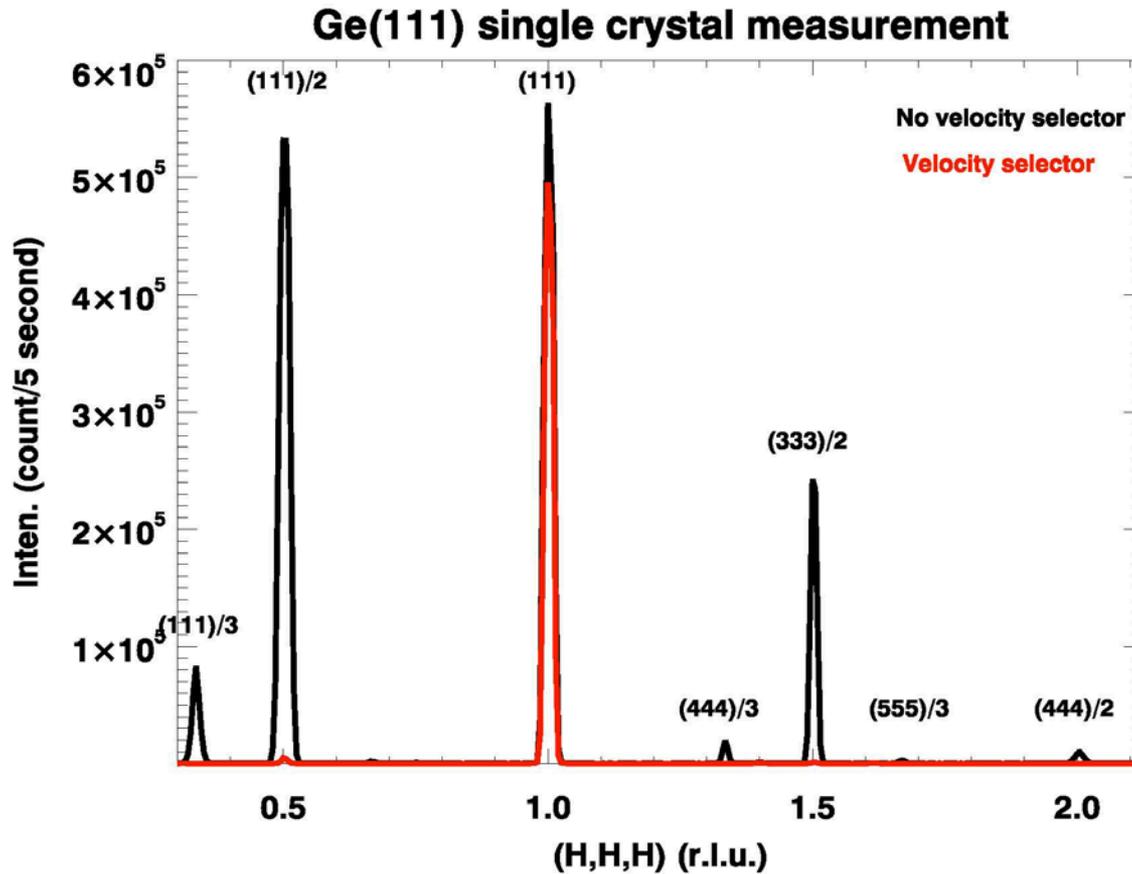
Neutrons measured by the incident beam monitor detector



BT-7 Velocity Selector Performance



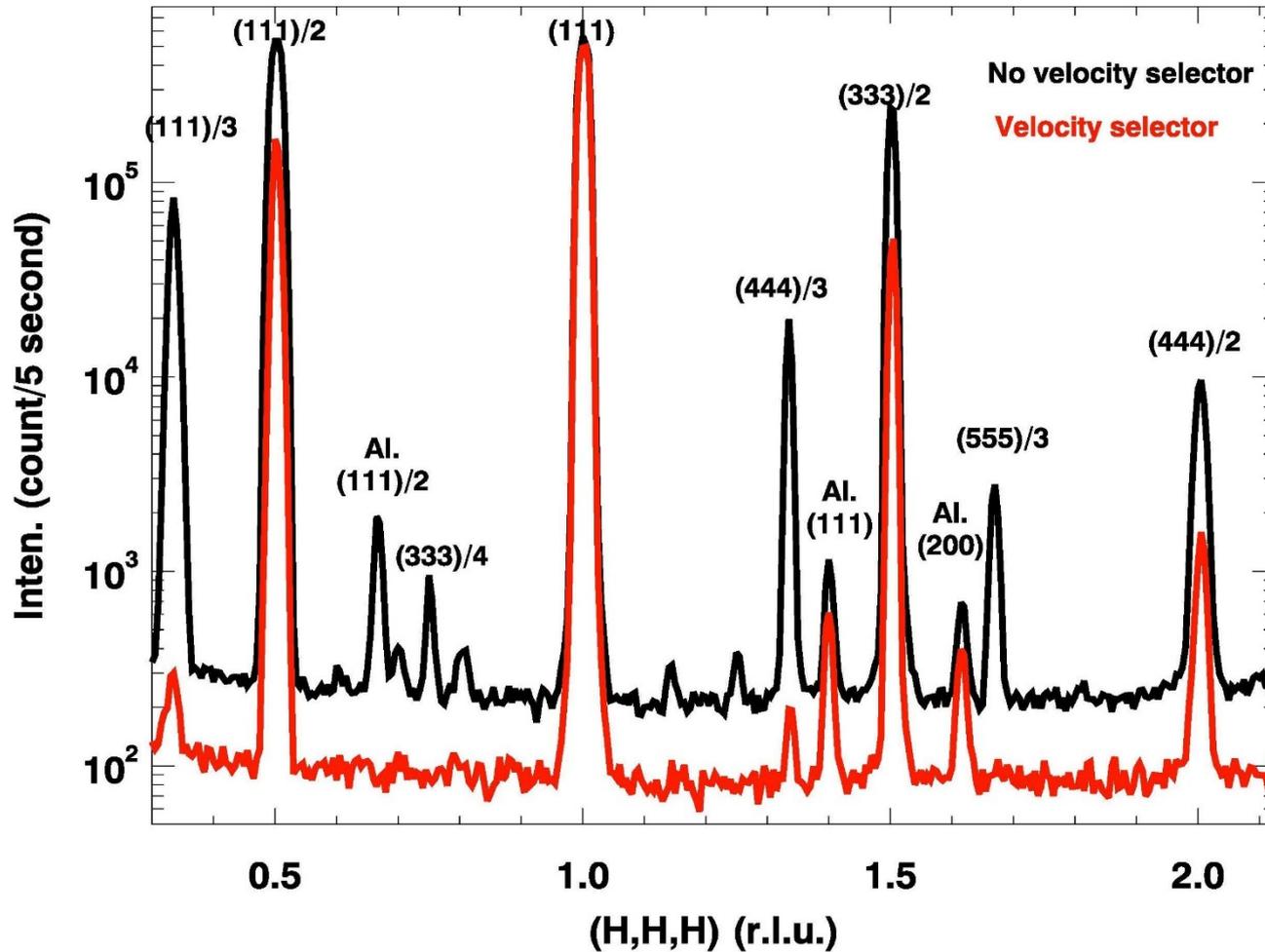
BT-7 Velocity Selector



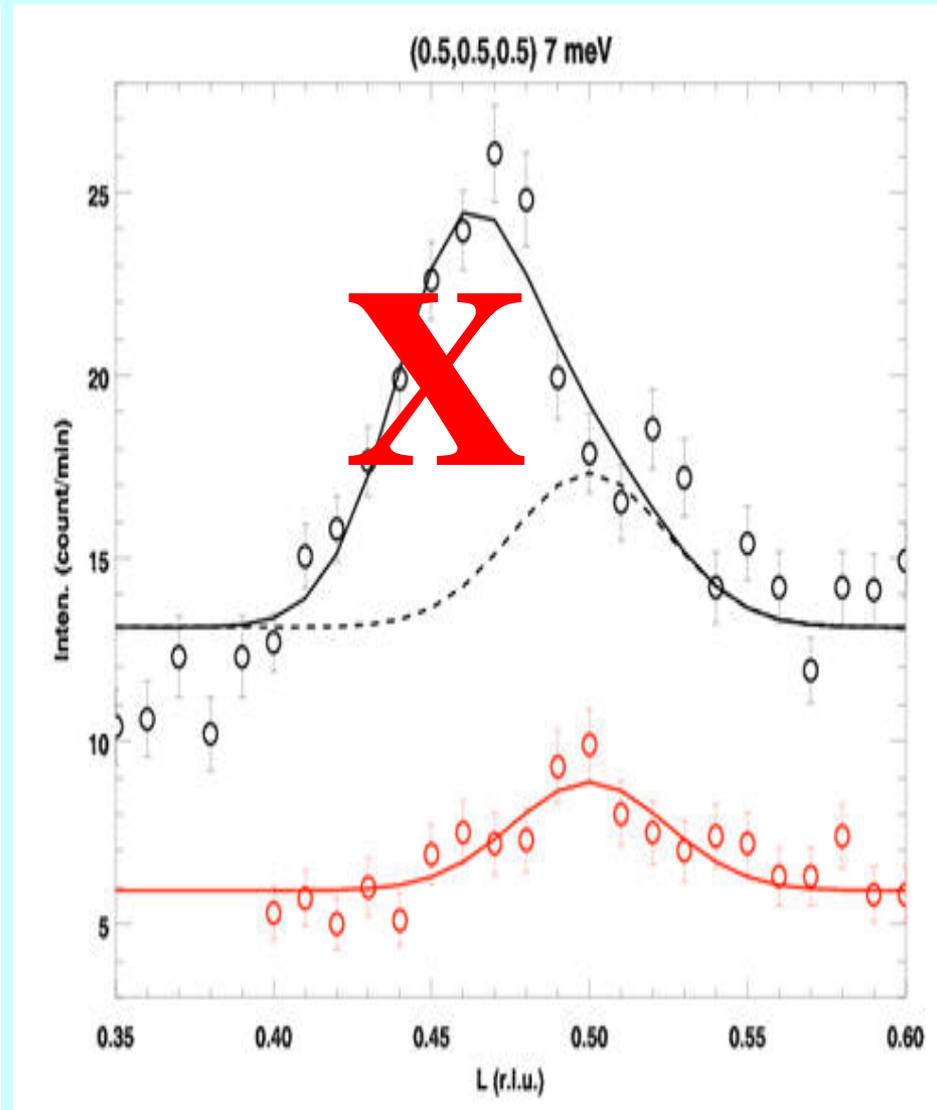
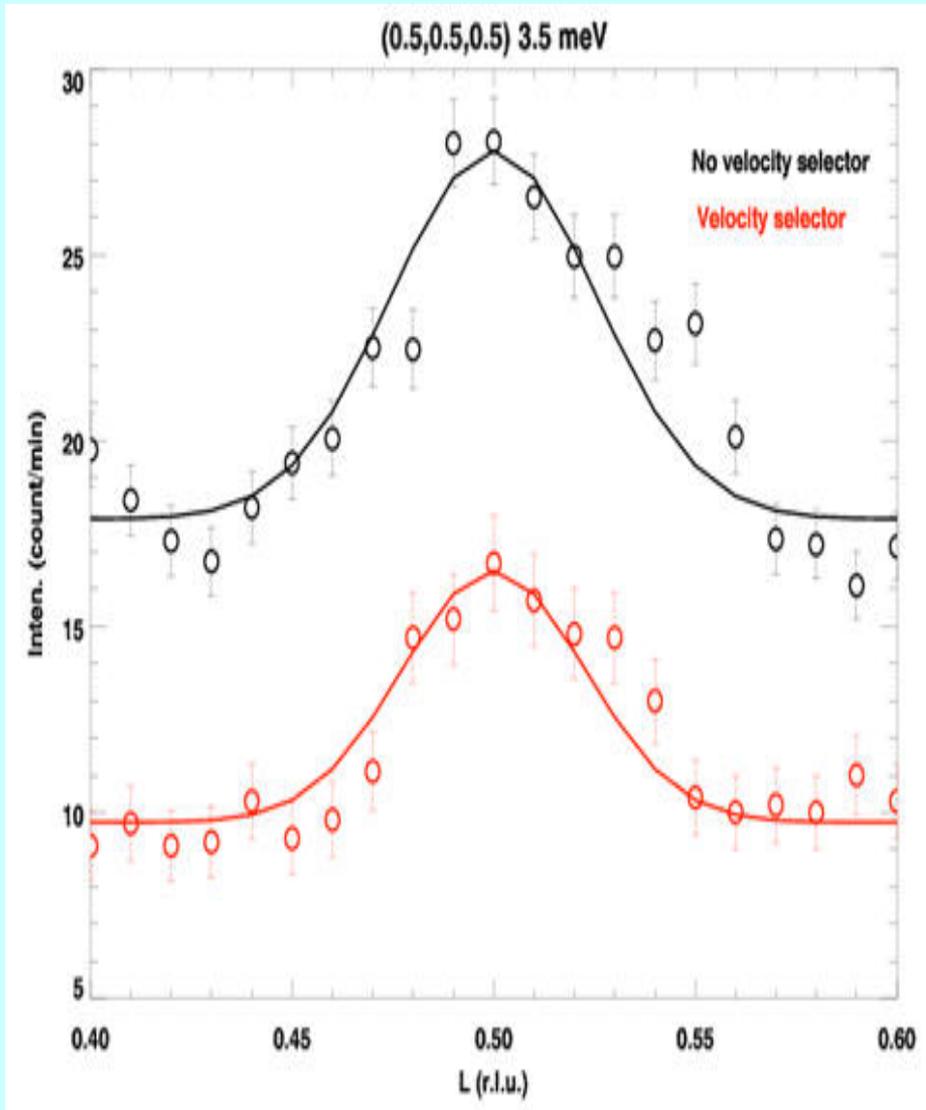
BT-7 Velocity Selector

$E_i = E_f = 14.7$ meV, 25-50-S-50-open, single detector

Ge(111) single crystal measurement



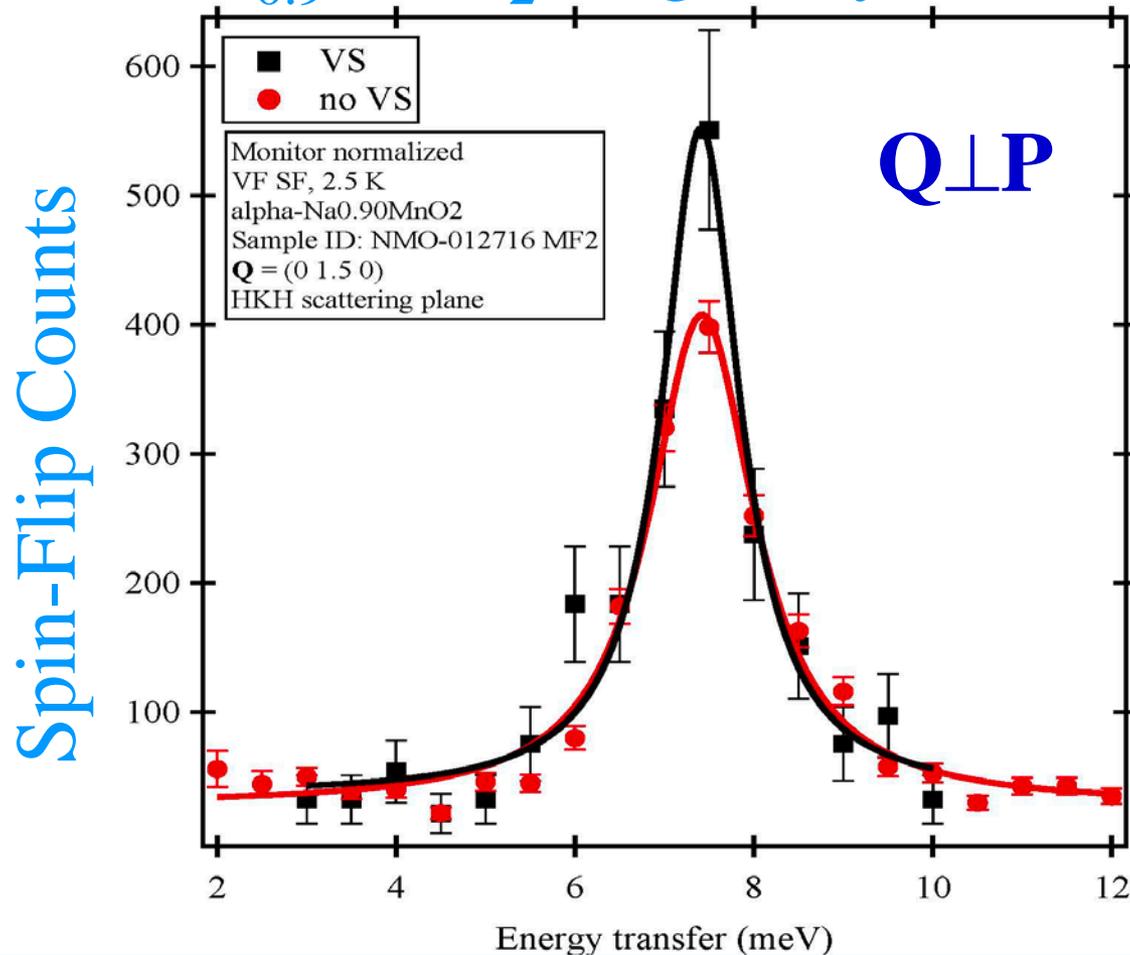
Inelastic Scattering (BiFeO_3)



Improved signal to noise; (right) elimination of spurious peak!
Monitor rate = 0 when VS stopped.

Polarized Beam

$\text{Na}_{0.9}\text{MnO}_2$ single crystal



Improved Signal-to-noise!

Summary

- Installed December, 2016
- 306 Reactor Days so far
- 140 Days In-beam
- Only maintenance is replacement of vacuum and vibration sensors

Double Focusing Thermal Triple Axis Spectrometer at the NCNR, J. W. Lynn, Y. Chen, S. Chang, Y. Zhao, S. Chi, W. Ratcliff, B. G. Ueland, and R. W. Erwin
J. Research NIST **117**, 61-79 (2012).