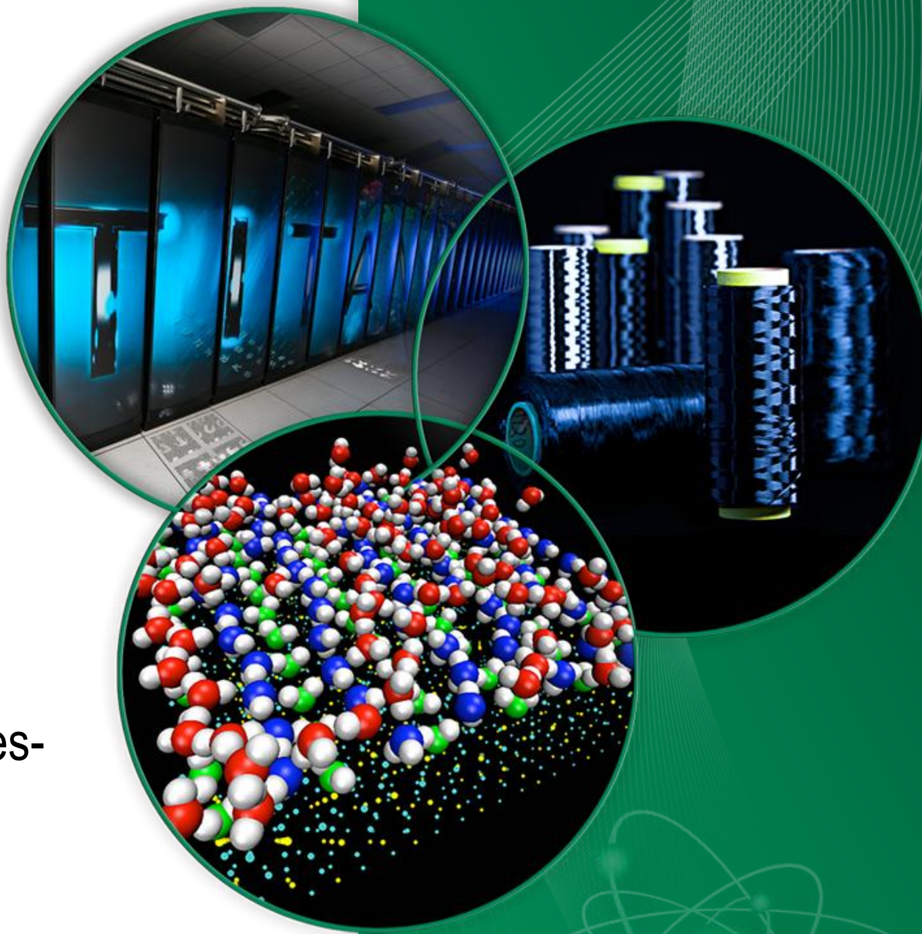
HYSPEC

Recent progress and polarization analysis capabilities



WINS 2014, May 2014

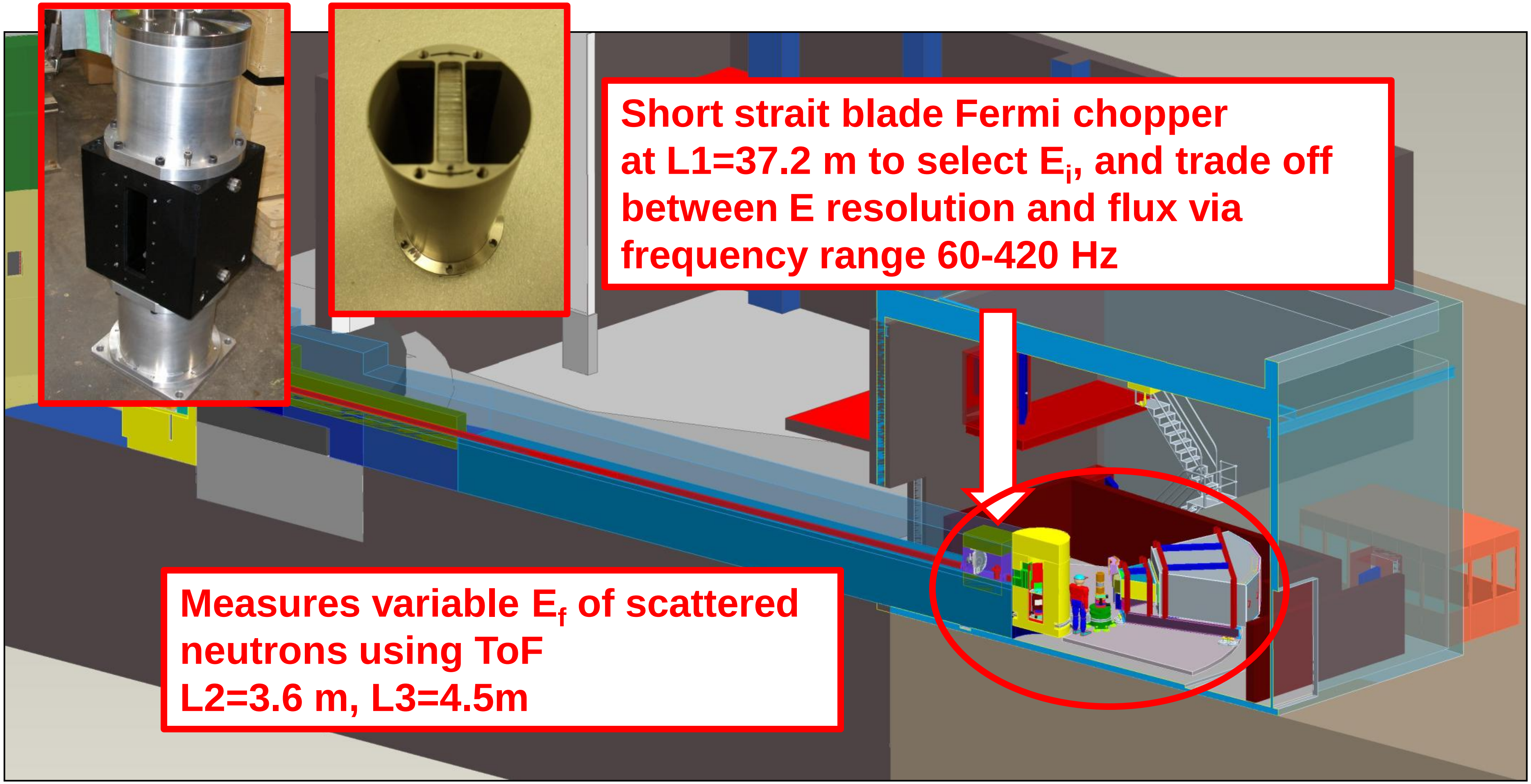
ORNL: B. Winn, V. Ovidiu Garlea, M. Graves-Brook, Peter Jiang, X. (Tony) Tong

BNL: L. Passell, S.M. Shapiro, I. Zaliznyak

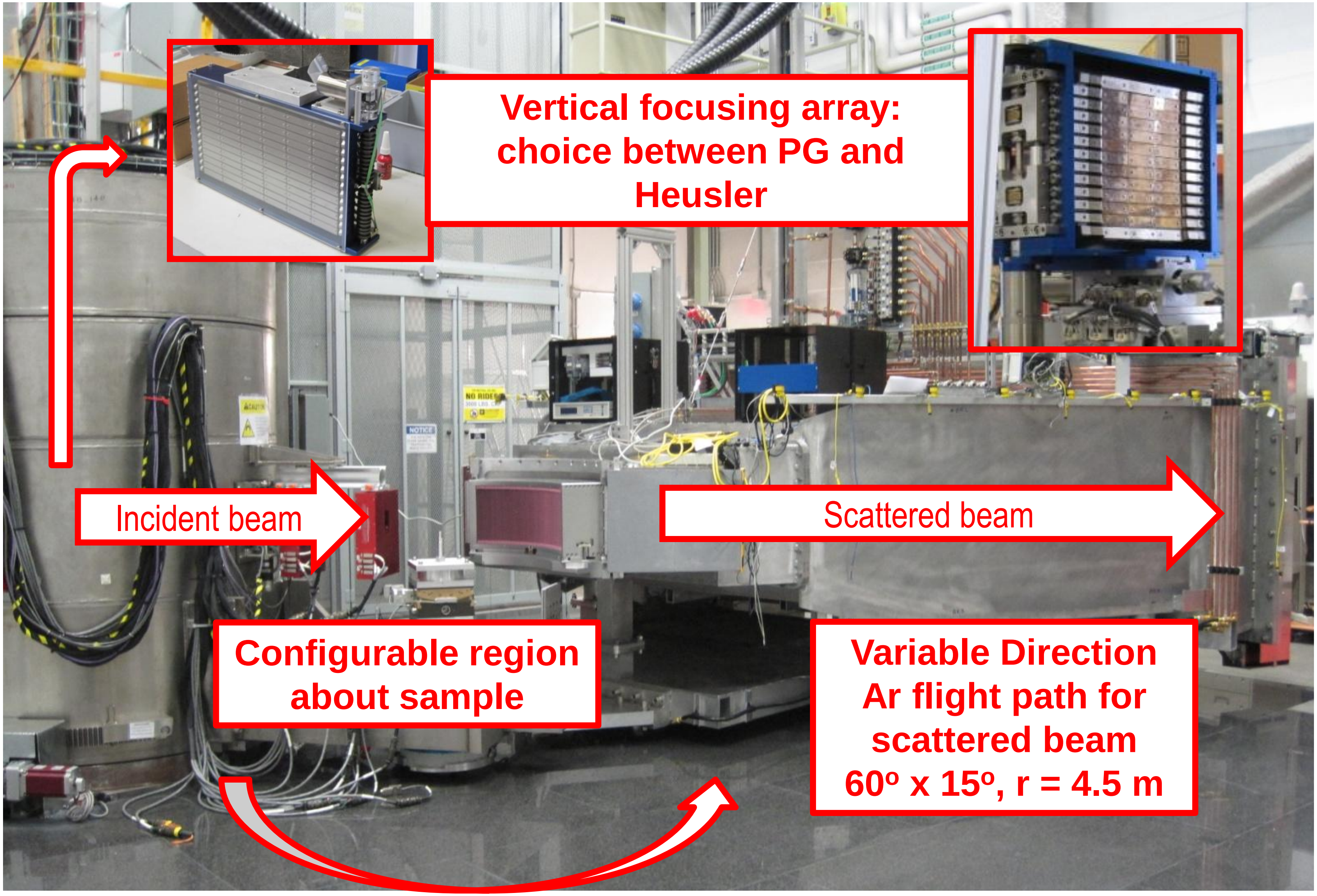
PSI: U. Filges, Michel Kenzelmann

ESS: M. Hagen (formerly ORNL)

Hybrid Spectrometer: a cross between a direct geometry spectrometer…



...and a Triple Axis Spectrometer

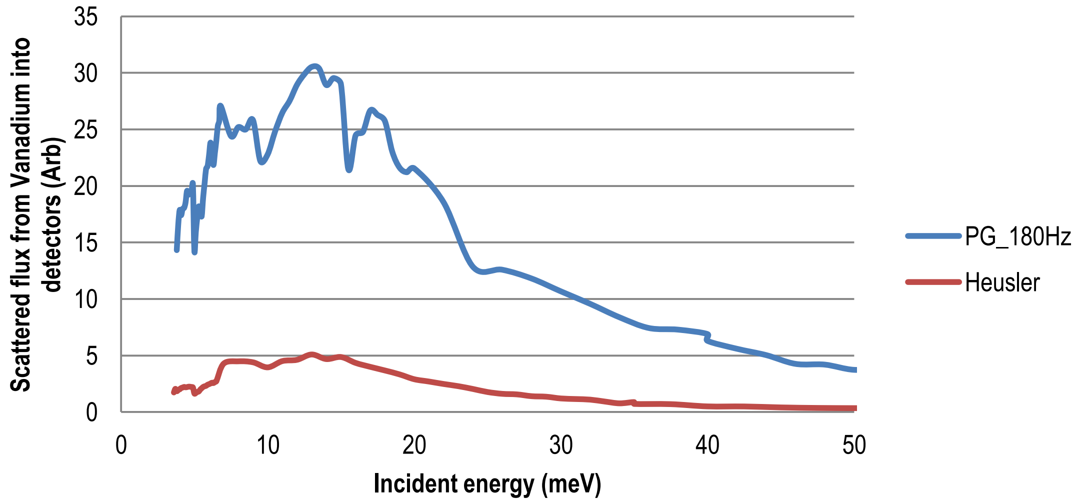


Intensity at sample, V scatter

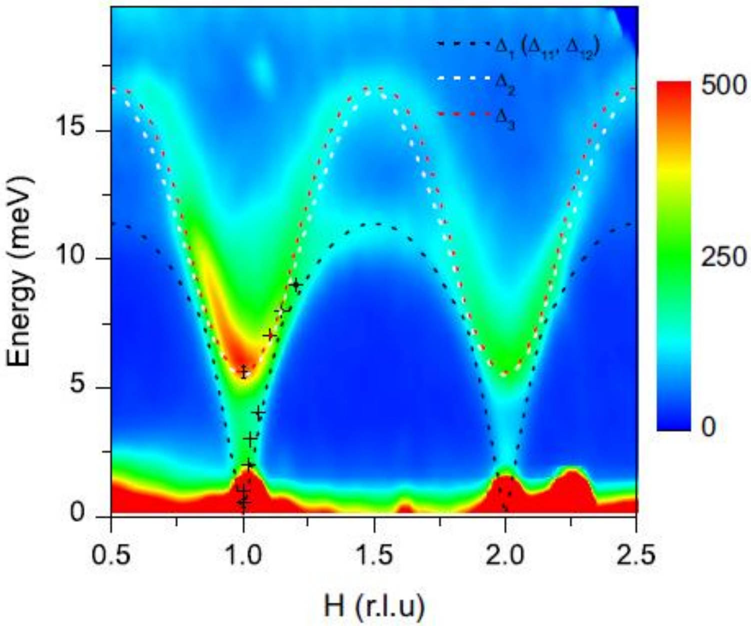
- 15 cm high beam from guide vertically focused to sample ~2.5 cm x 2.5 cm FWHM
- 4.2E5 n/s/MW/cm^2: Gold foil measurement at sample position, PG focus array to sample 1.8 m, Ei=15 meV, Fermi 180 Hz
- Plot: Vanadium incoherent isotropic scatter integrated over detector array at 40^o < 2Θ < 100^o, PG & Heusler

3.8 meV < Ei < 50 meV

Common Ei's:
3.8, 7, 15, 20, 27, 35 meV
Rare Ei: 50 meV

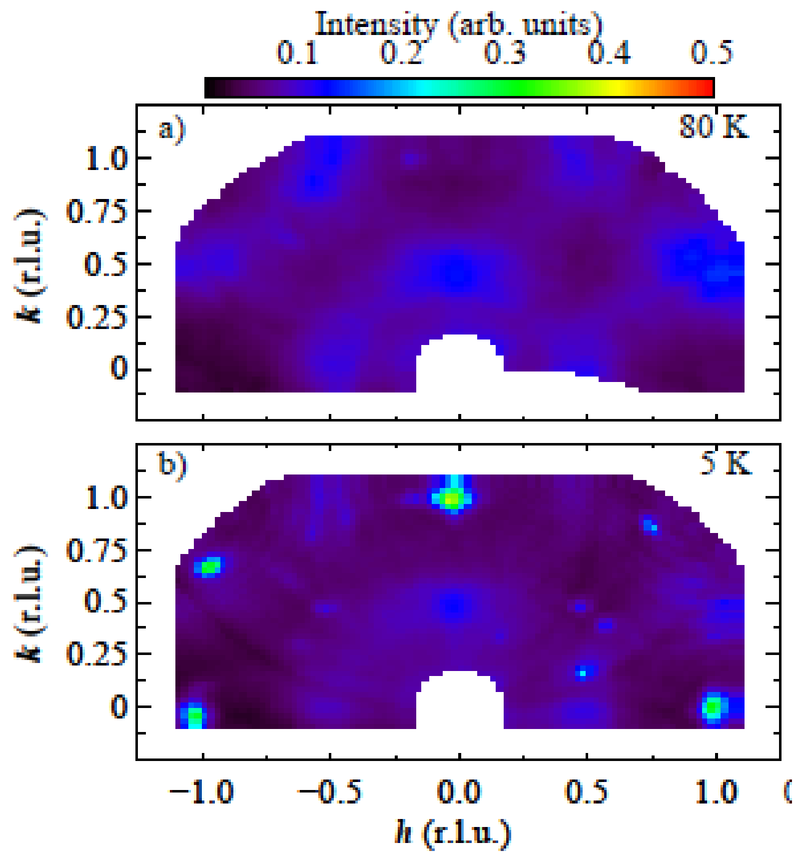


Active in User Program, Unpolarized



$Y_{0.7}Lu_{0.3}MnO_3$ at 4K: dotted lines show calculated spin wave dispersion with magnetoelectric coupling[1]

	# Experiments
Spring 2013	6
Fall 2013	17
Spring 2014	16

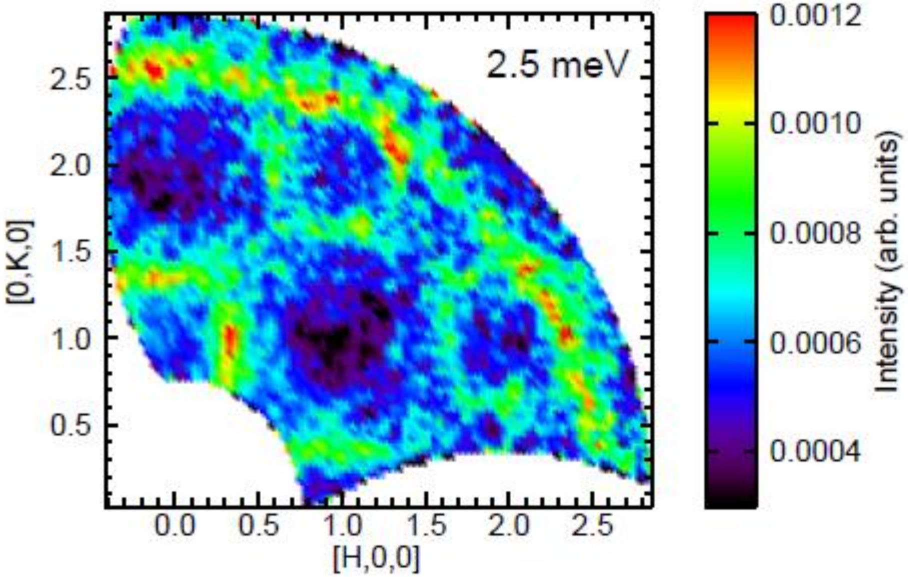


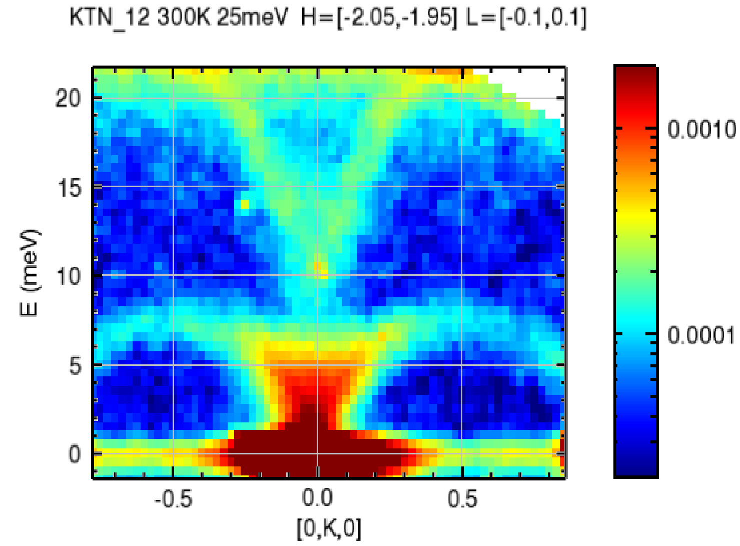
$Fe_{1.09(1)}Te$: :Bragg peaks visible at 5 K indicate increased Fe displacements from high-symmetry positions in the a-b plane[2]

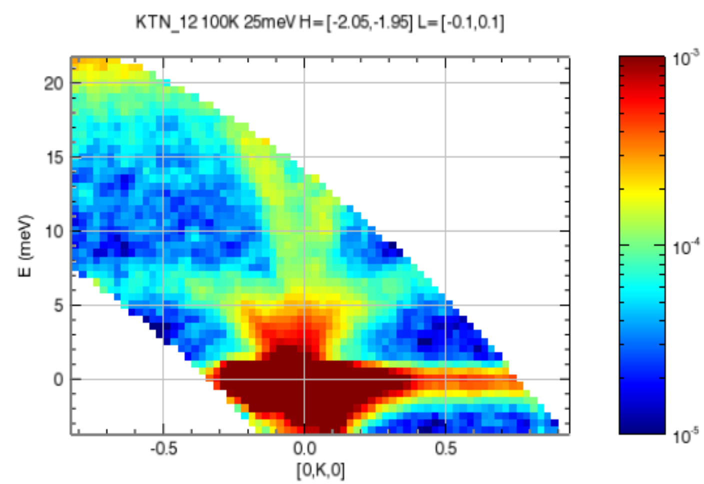
[1] W. Tian et al., Phys. Rev. B 89, 144417 (2014)

[2]D. Fobes et al., Phys. Rev. Lett, accepted

More Science







Spin waves in
S=1/2 square lattice
antiferromagnet $K_2V_3O_8$[1]

TO branch softening in $KTa_{0.88}Nb_{0.12}O_3$[2]

[1] **M. Lumsden, A. Christianson, in preparation,**
Ei=7 meV 180 Hz s2=-45º +/-0.1 meV,
L integrated. s1~90º range 0.5º step
[2]**O. Delaire et al, in preparation,**
TO branch softens on cooling from 300 to 120 K, approaching the Curie temperature for the ferroelectic transition at ~80 K

Fits into HFIR/SNS capabilities at Oak Ridge National Lab

(Green: Supports Polarization Analysis)	Cold Moderator / 2 meV < Ei < 100 meV	Thermal Moderator / 5 meV < Ei < 2000 meV	
1-3% elastic E resolution / less flux	CNCS	SEQUOIA	Direct Geometry Spectrometers
3-5% elastic E resolution / high flux	**HYSPEC**	ARCS	
Highest time-averaged flux, limited solid angle	CTAX	HB1A, **HB1**, **HB3**	Triple-Axis Spectrometers

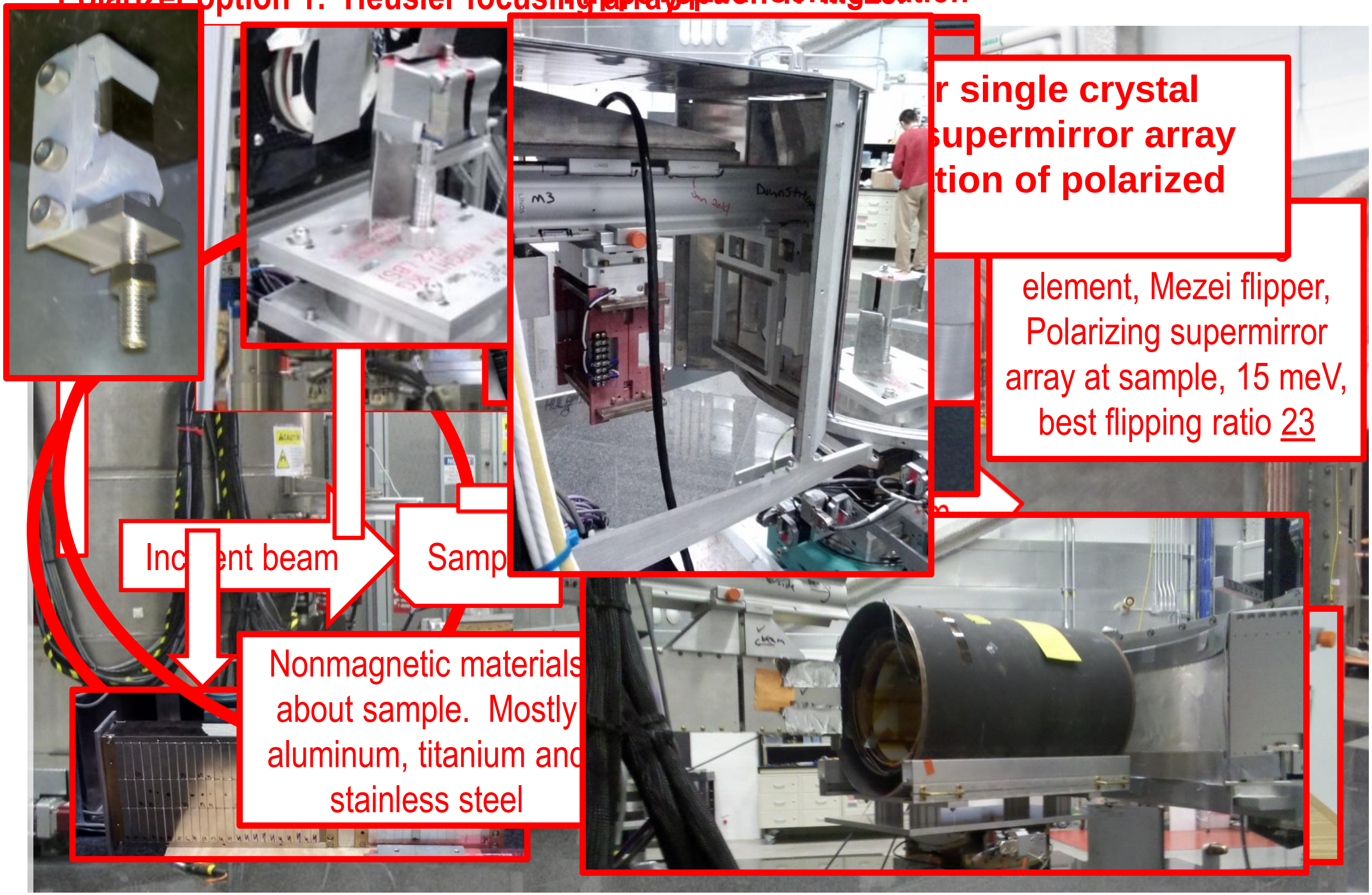
Stone et al, Rev. Sci. Instrum. **85** p 045113 (2014)

Polarization Capabilities

Polarizer option 1: Heusler focusing array

Flipper option 1: Mezei

Typical Configuration

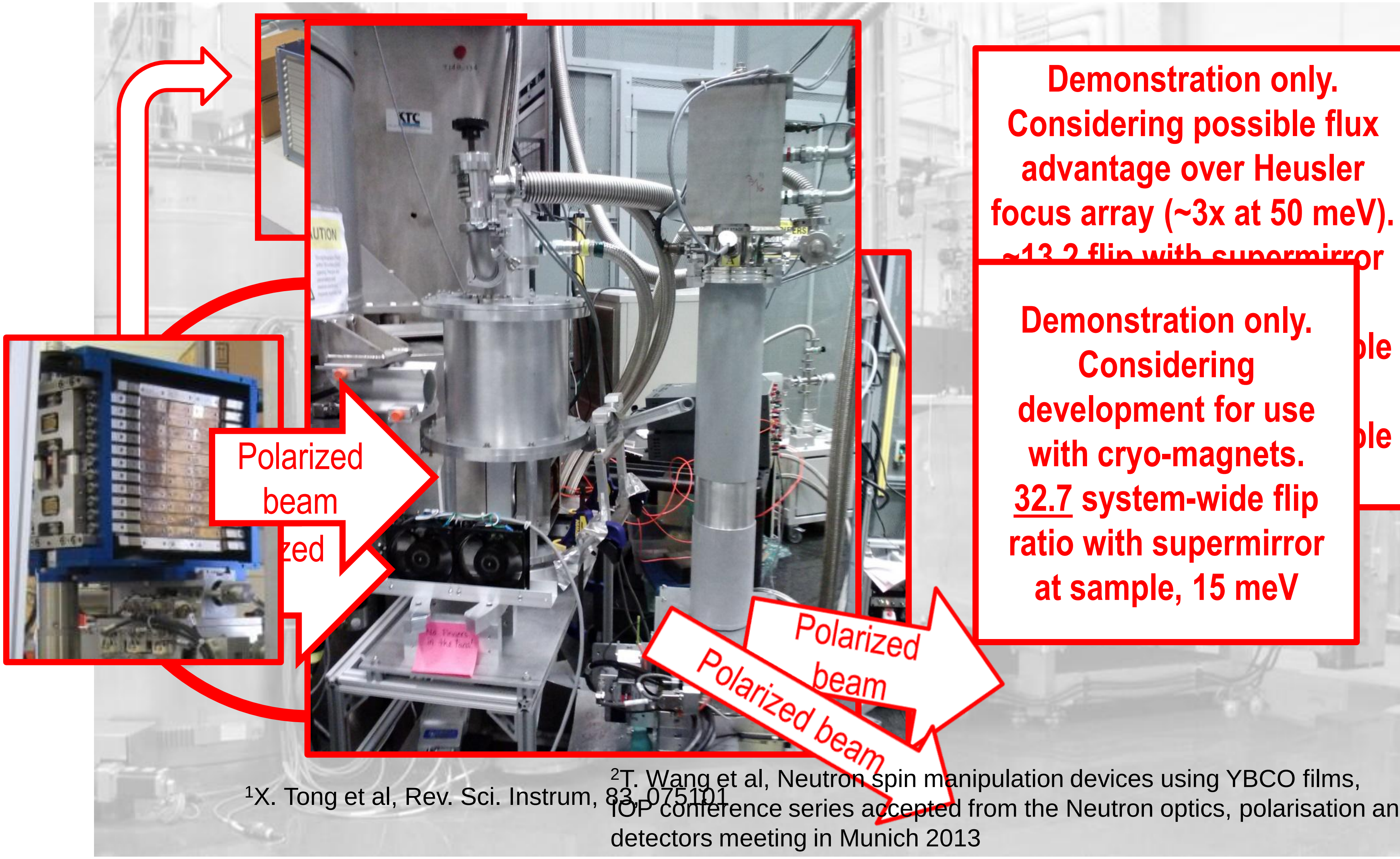


Magnetic Guide Field assemblies

Alternatives, polarized beam

PG focusing element for unpolarized beam

Polarizer option 1: Polarizing supermirror array, either reflection or transmission



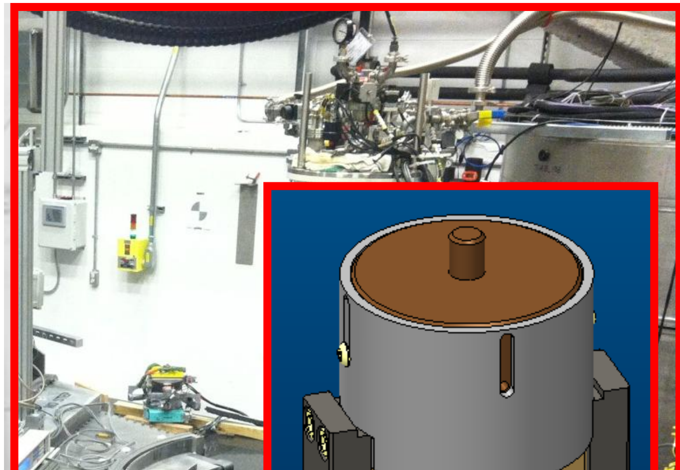
[1]X. Tong et al, Rev. Sci. Instrum, 83, 075101

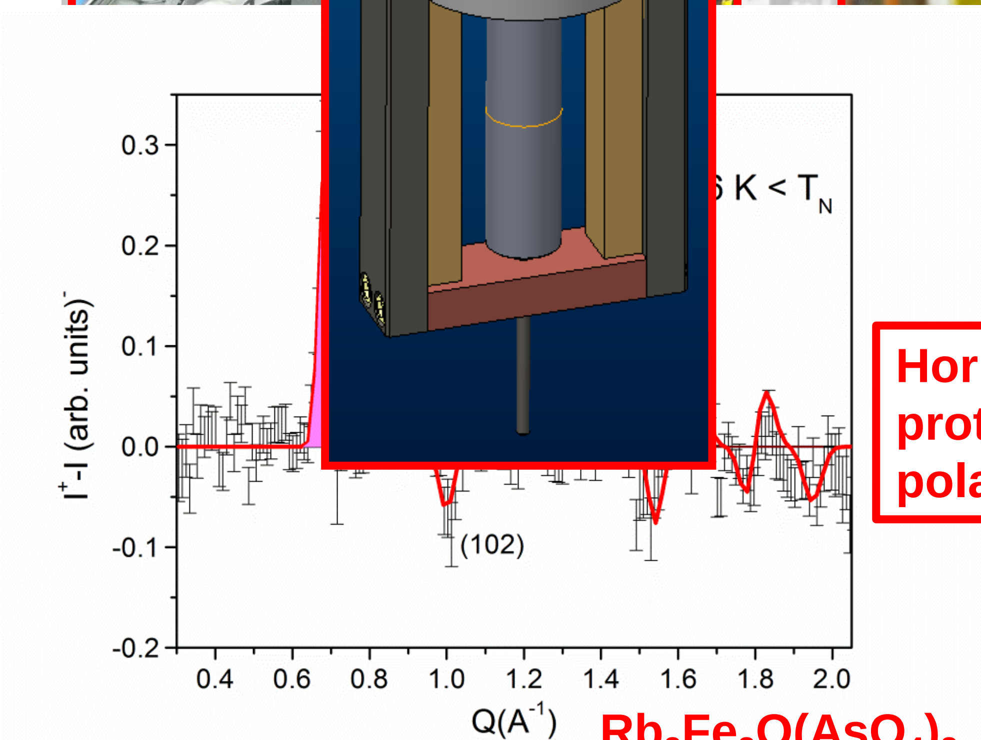
[2]T. Wang et al, Neutron spin manipulation devices using YBCO films, IOP conference series accepted from the Neutron optics, polarisation and detectors meeting in Munich 2013

Polarizer option 2: in-situ Spin Exchange Optical Pumped ^{3}He cell[1]

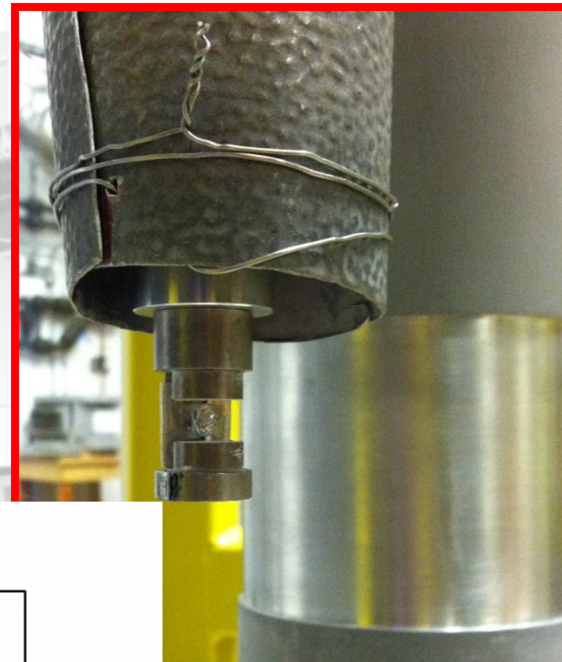
Flipper Option 2: High-Tc Cryo-Flipper[2]

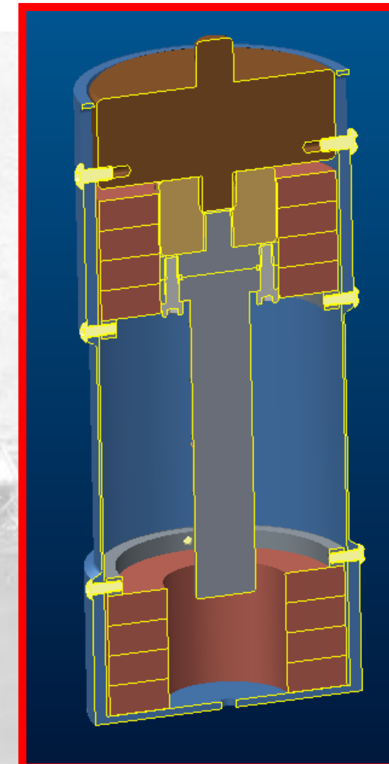
Half Polarized Experiments





$Rb_2Fe_2O(AsO_4)_2$





Horizontal field permanent magnet prototype. Flexibility during polarization commissioning

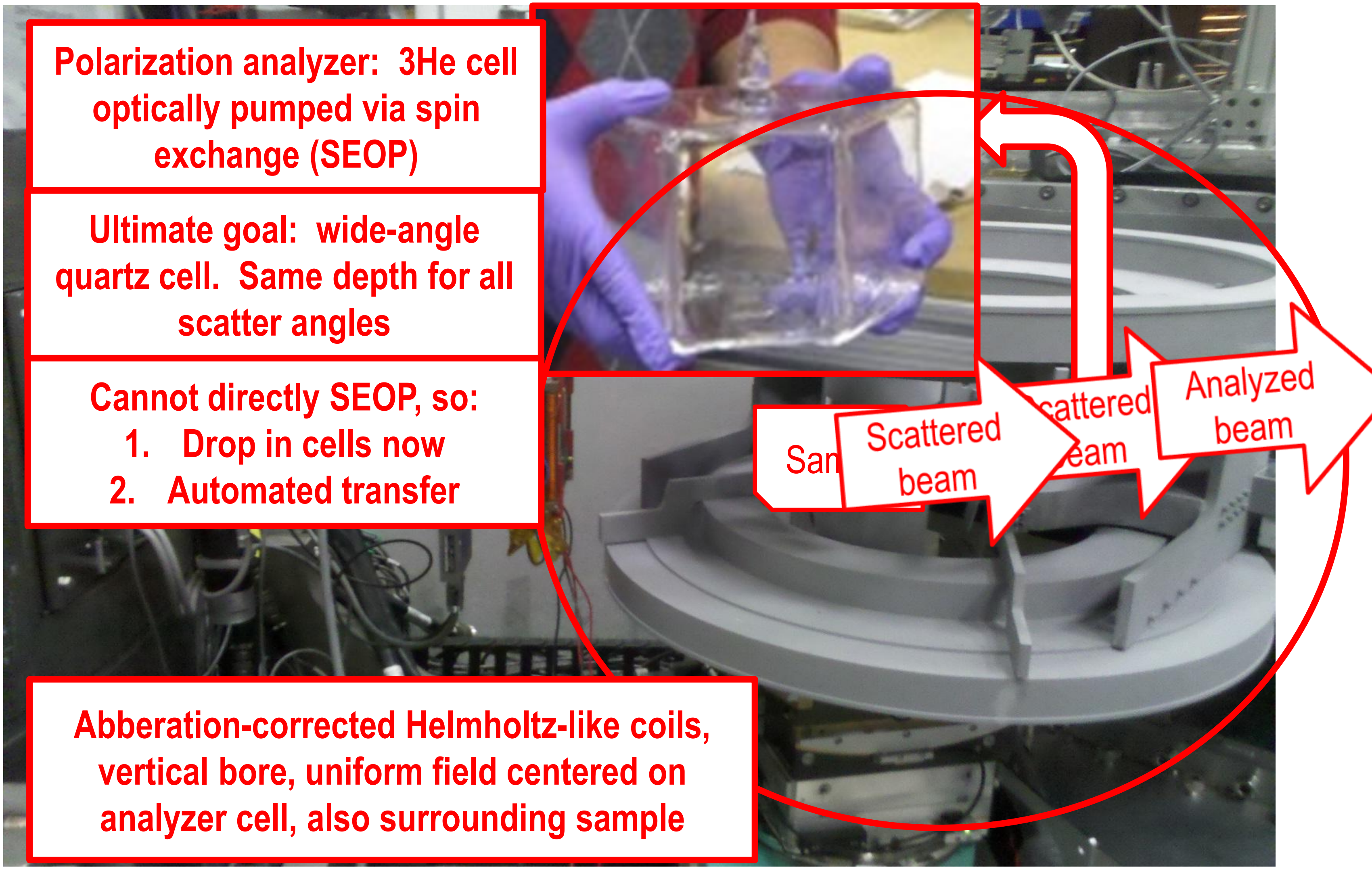
Polarization Analysis option 1: ^{3}He

Polarization analyzer: 3He cell optically pumped via spin exchange (SEOP)

Ultimate goal: wide-angle quartz cell. Same depth for all scatter angles

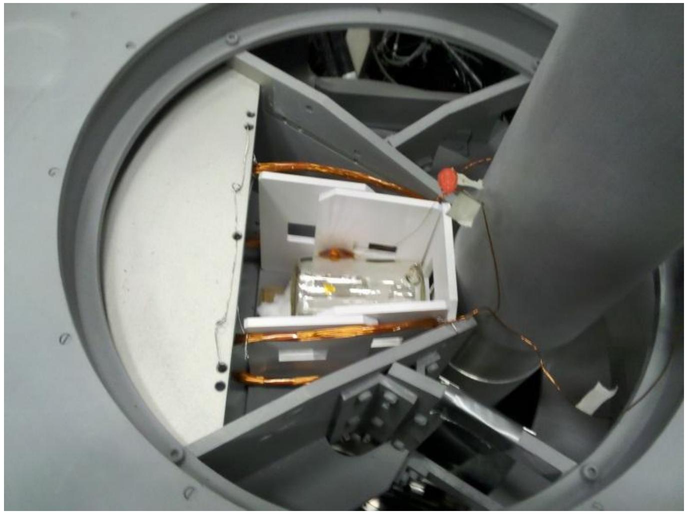
Cannot directly SEOP, so:

1. Drop in cells now
2. Automated transfer



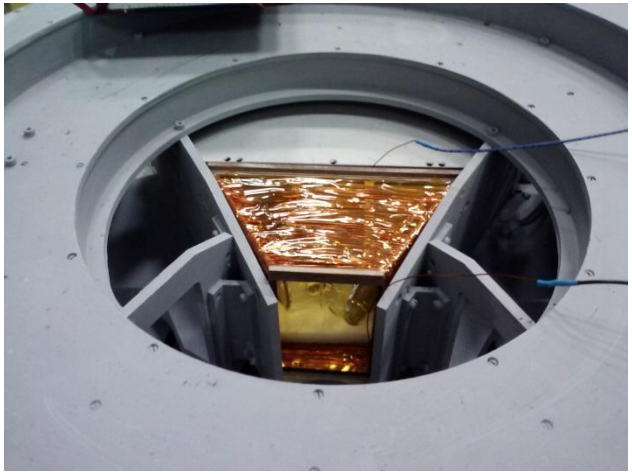
Abberation-corrected Helmholtz-like coils, vertical bore, uniform field centered on analyzer cell, also surrounding sample

Drop-in-cell Polarization Analysis



Cylindrical cell, limited solid angle

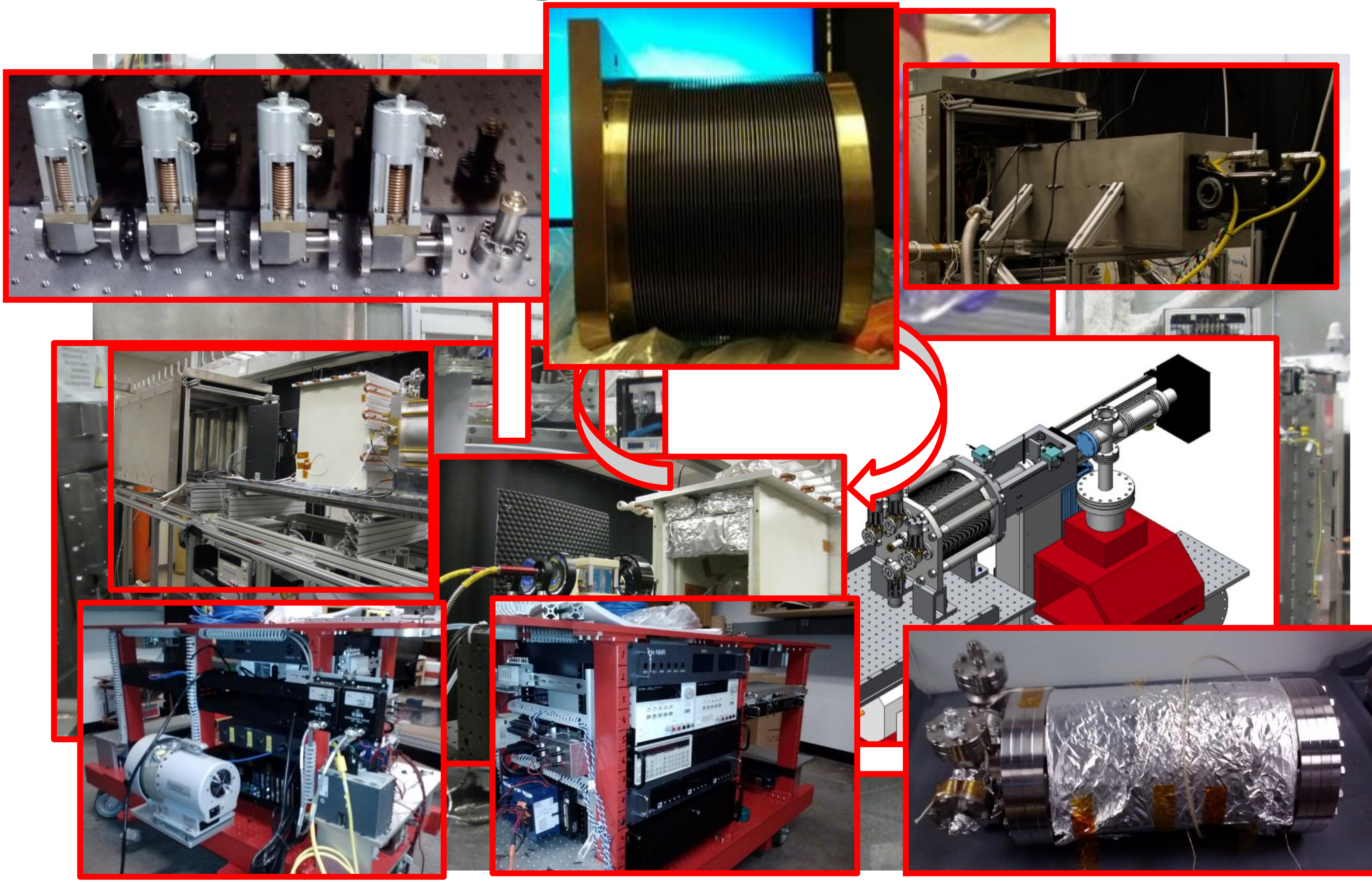
'banana' cell made at NCNR



Adiabatic Fast Passage coil to flip ^3He

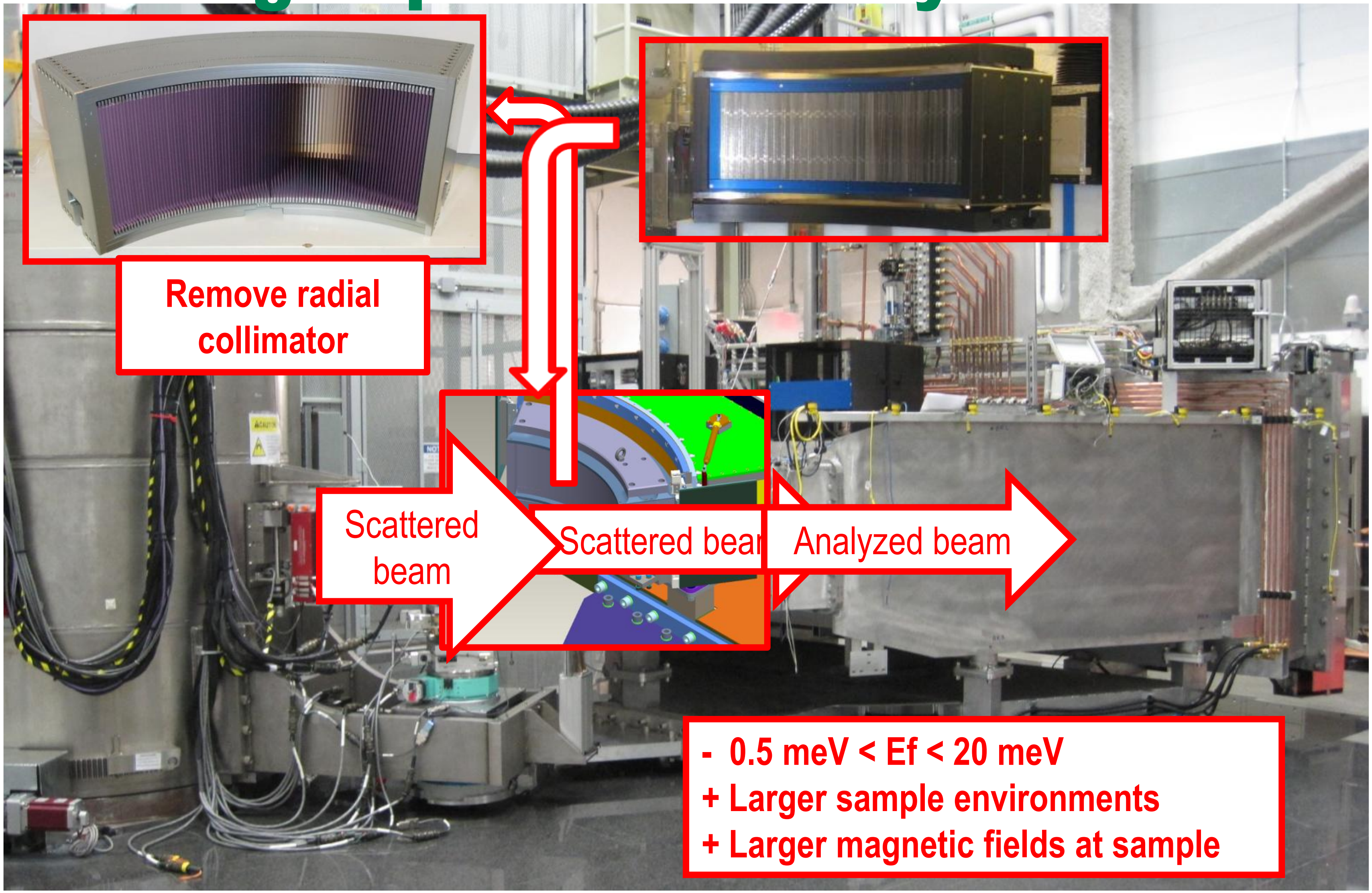
Lifetimes up to 100 hr
Direct beam transmission flip ratios
Through pinhole at sample
At 3.8 meV: unfocused: 16.3
focused: 21.8
Vanadium scatter measured ratio 1.47

Auto-Refill, Vary Pressure

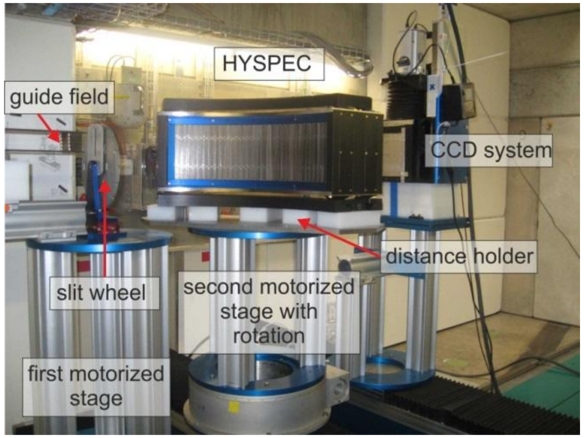


Rev. Sci. Instrum. 84, 065108 (2013), C. Y. Jiang, et al.

Polarization analysis #2: PSI Polarizing Supermirror Array

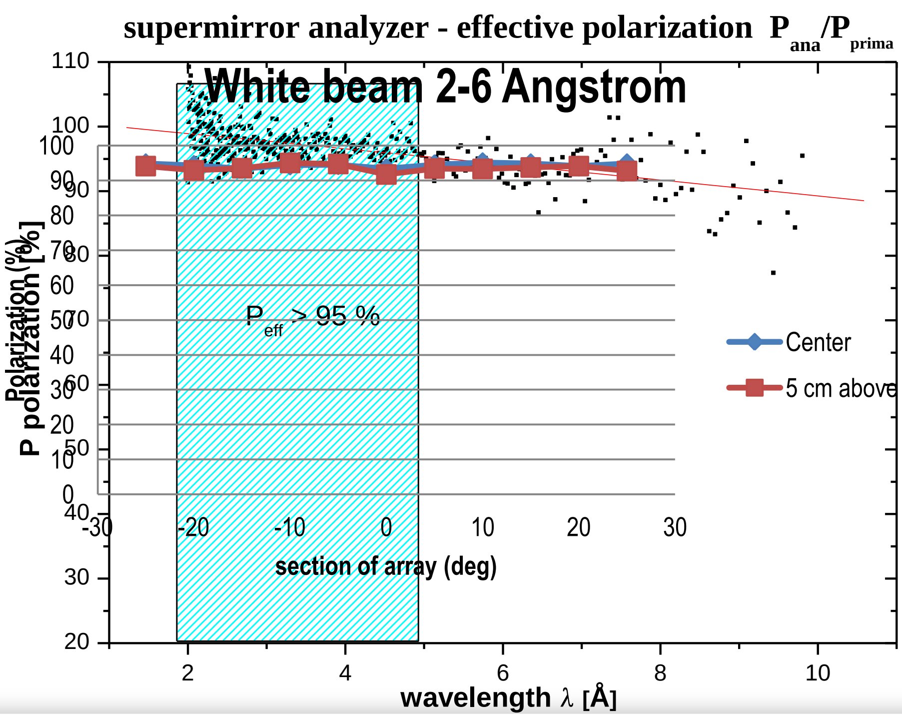


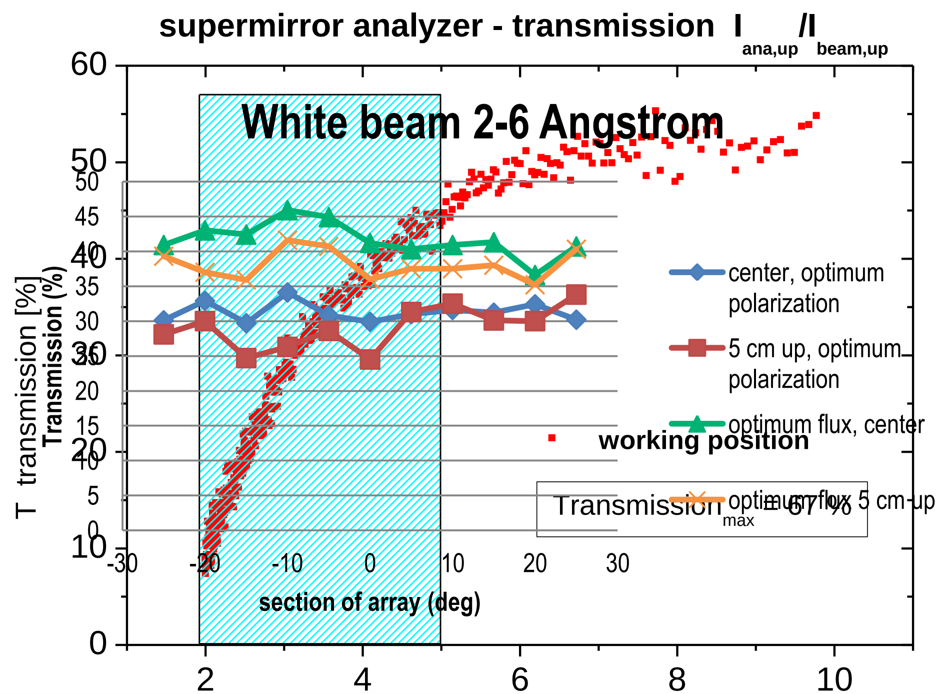
Performance and Preparations



960 supermirrors, 60º
U. Filges
BOA beamline at SINQ
Ready to ship

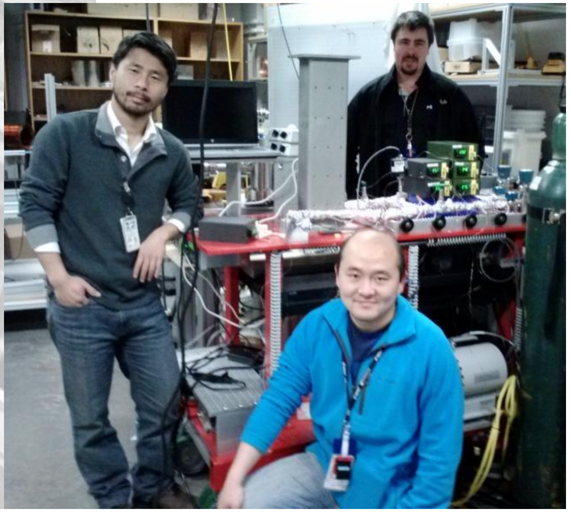
New magnetization unit at HYSPEC





HYSPEC History & Team

- Inception: BNL[1]
- Design and Development[2]:
  - Instrument Development Team
    - BNL: S. M. Shapiro, I. A. Zaliznyak, L. Passell, V. J. Ghosh, W. J. Leonhardt
    - PSI: U. Filges (polarizing supermirror array analyzer)
  - ORNL: M. E. Hagen, D. Anderson, T. Tong
    - Many support teams
- Install & Unpolarized Commissioning:
  - ORNL: MEH, M.Graves-Brook, B. Winn
  - Significant IDT & ORNL staff support
- User Program & Polarization Commissioning:
  - ORNL: MGB, BW, O. Garlea, T. Tong, P. Jiang, D. Brown



[1] I. Zaliznyak, V. Ghosh, S. M. Shapiro, L. Passell, Physica B **356**, 150 (2005).
[2] S. M. Shapiro, I. A. Zaliznyak, L. Passell, V. J. Ghosh, W. J. Leonhardt, M. E. Hagen, Physica B, **385-386**, 1107 (2006).