

Cross Section Measurements and Analysis at Rensselaer

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Measurements Completed This Year

- Mo
 - High energy (0.4-20 MeV) transmission
 - High accuracy filtered beam transmission (0.024 - 0.9 MeV)
- Be
 - High energy (0.4-20 MeV) transmission
- C
 - High energy (0.4-20 MeV) neutron scattering
- Cd
 - Thermal (0.01-20 eV) transmission measurements on thin natural metallic samples

Planned Measurements

- Transmission and capture on ^{153}Eu and natural Eu
- High energy (0.4-20 MeV) Transmission for Zr
- High energy (0.4-20 MeV) neutron scattering from Be and Mo
- Resonance region (1 eV- 400 keV) transmission for Mo
- Isotopic Mo – ORNL is developing methods for sample production

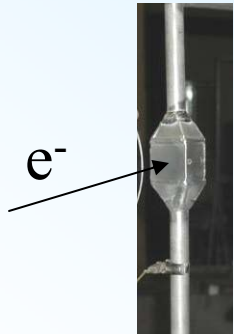
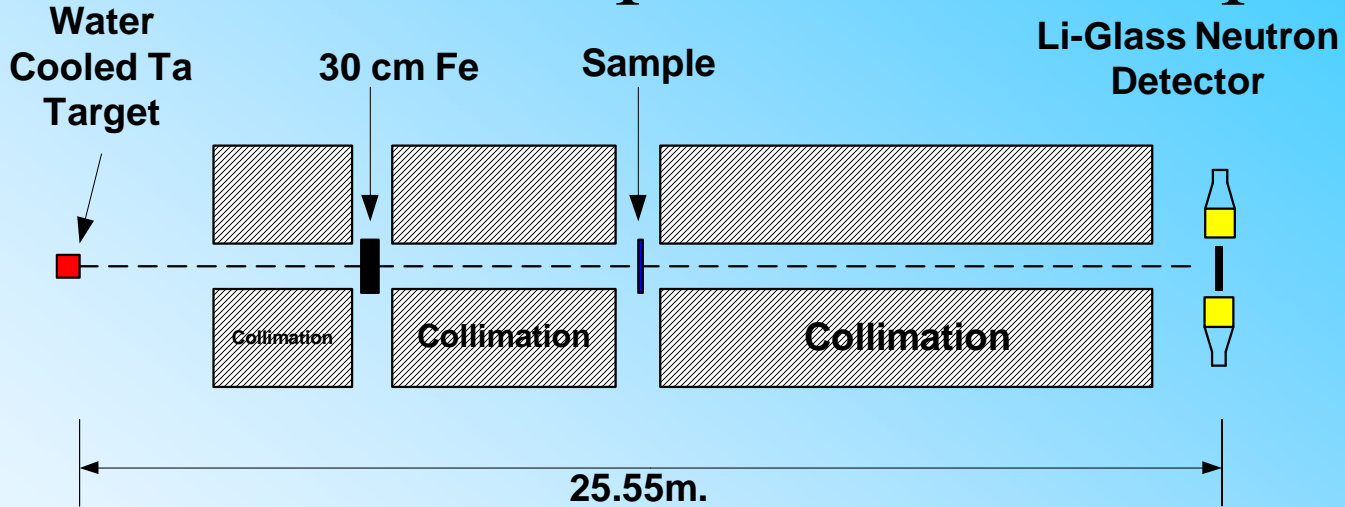
Data Analysis

Sample	Status
Rh	SAMMY analysis pending
Cd	SAMMY/REFIT analysis pending (Moxon has our data)
Re	Data analysis in progress
Mo	Paper presented in ND2007, Final analysis in progress.
U-236	Sammy analysis in progress
Dy	Data reduction and SAMMY analysis in progress.

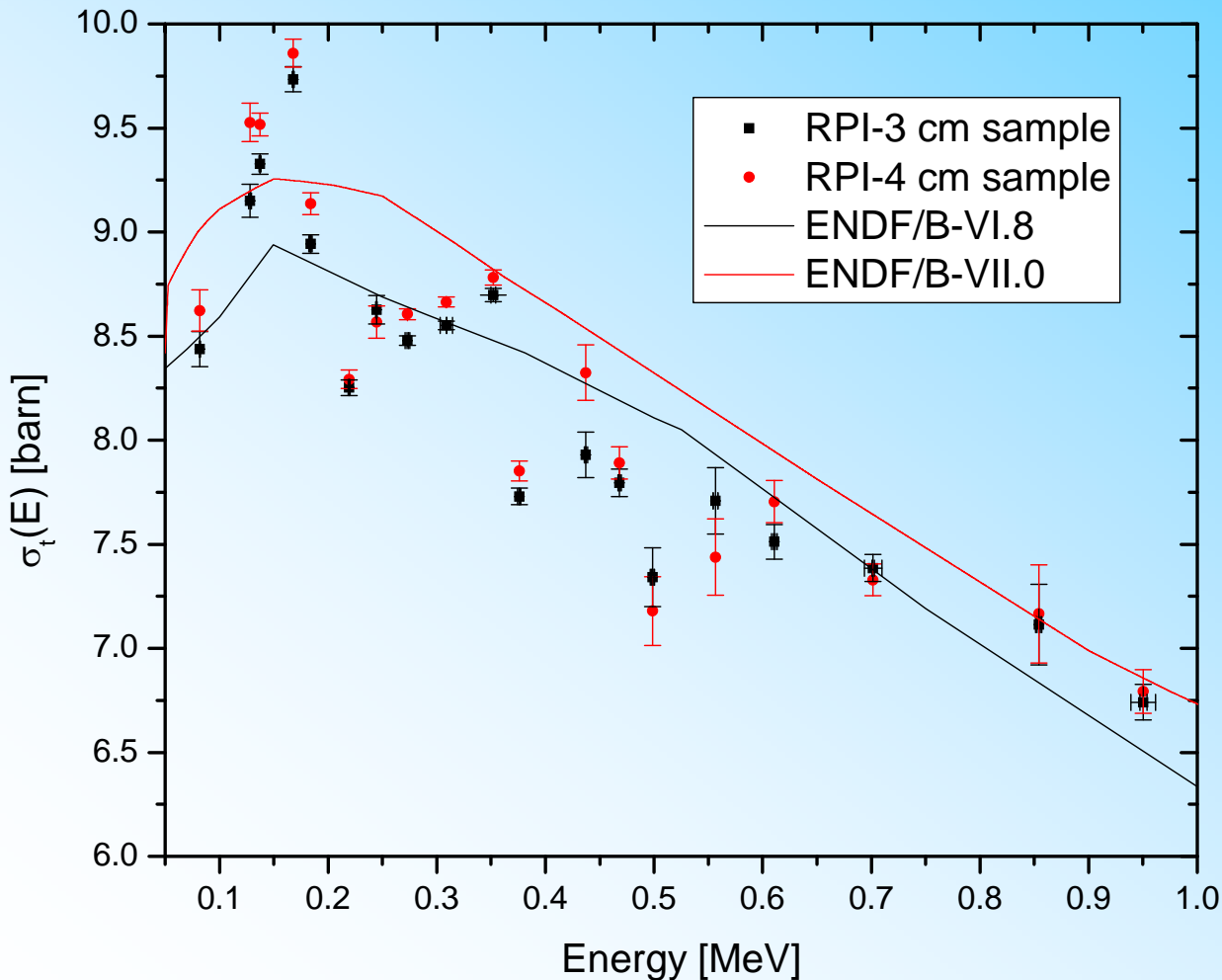
New Capabilities

- Transmission Measurements at 100m flight path
 - High energy transmission and spectra measurements in the energy range 0.2-20 MeV. The system is installed and running, results will be shown
 - New resonance region detector is under construction
- Scattering detector array at ~30m flight path for the energy range 0.2-20 MeV
 - A digital data acquisition system allows pulse shape analysis with dead time on the order of the detector response time (~100ns)
 - Testing with graphite completed, flux measurements completed
- High precision filtered beam transmission measurements.
 - Discrete points in the energy range from 0.2 - 0.9 MeV
 - Cross section accuracy of $\leq 1\%$ was demonstrated with graphite, Be and Mo

Iron Filter Experimental Setup

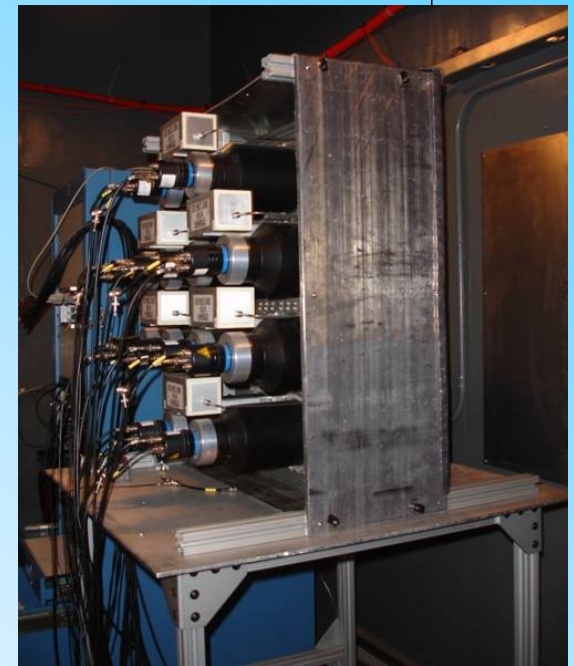
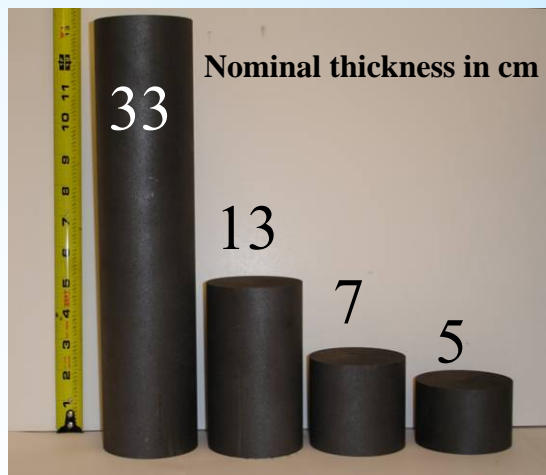
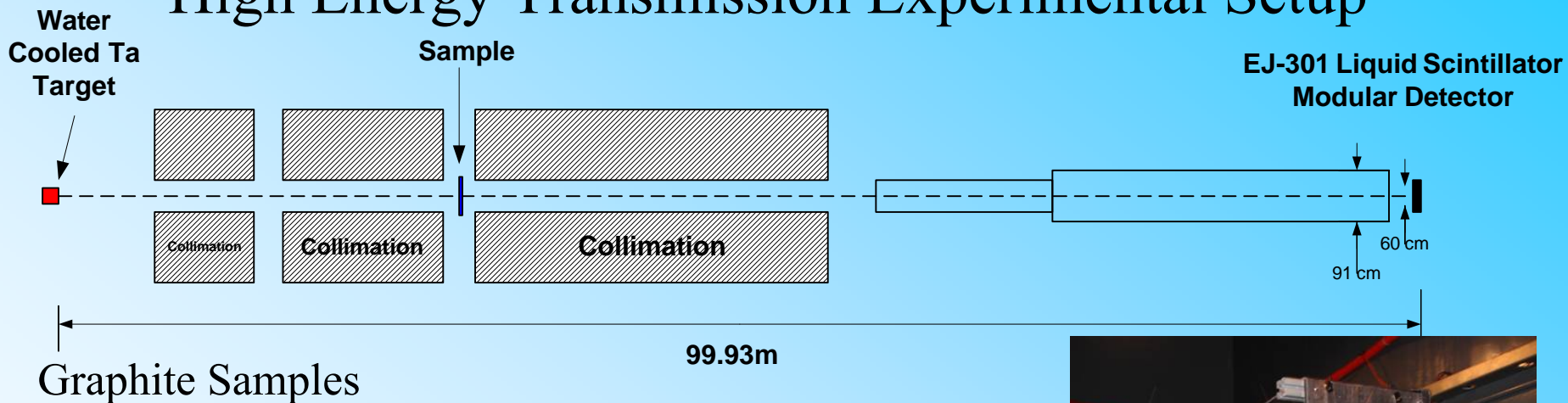


Mo Total Cross Section (filtered beam)

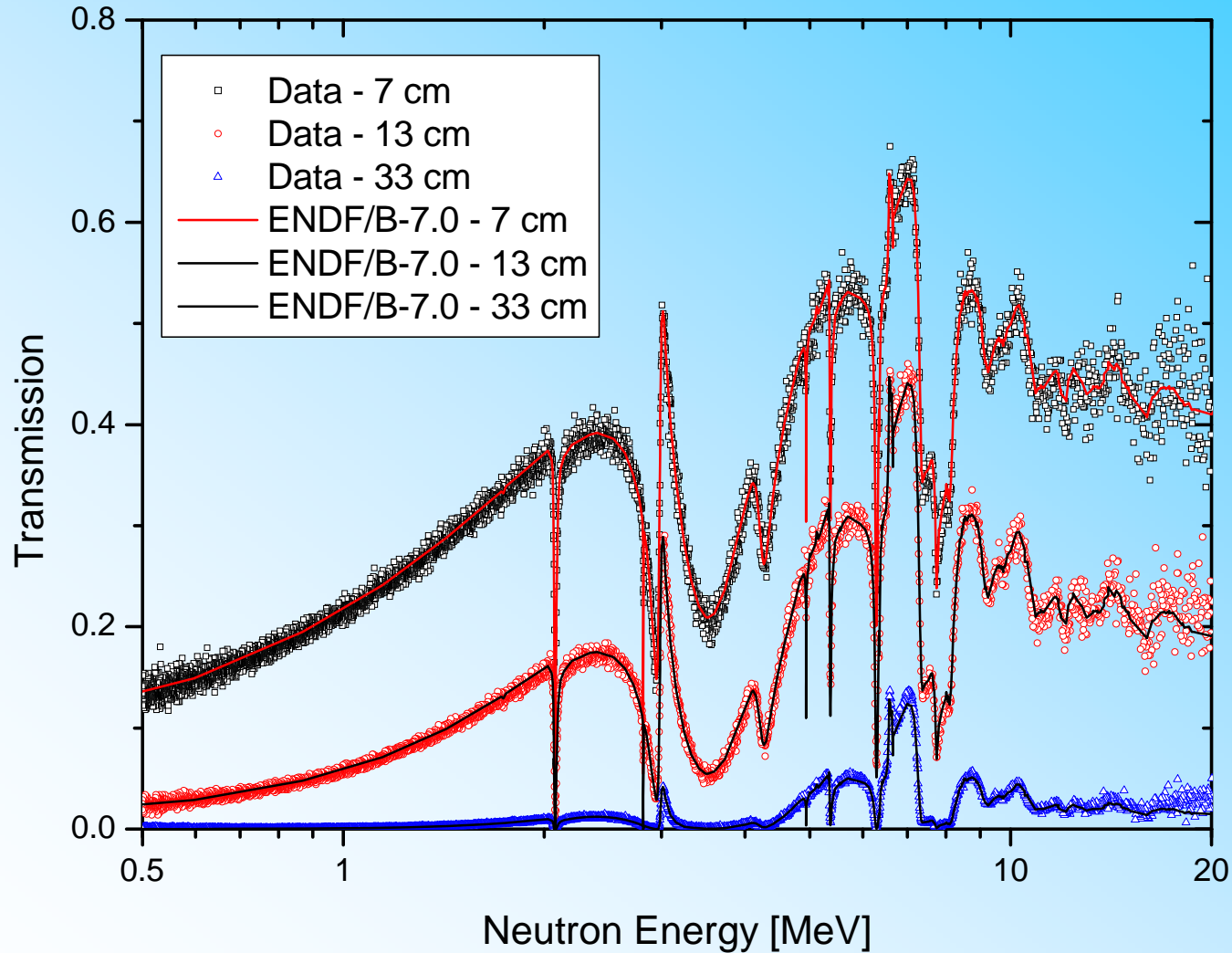


- Data shows evidence of structure
- Data points overlap within 2*error.
- Between 0.2 MeV to 0.8 MeV the data closer to ENDF/VI.8
- In general in this energy region ENDF/B-VII.0 tends to have smoother cross sections than previous versions
- More on structure later

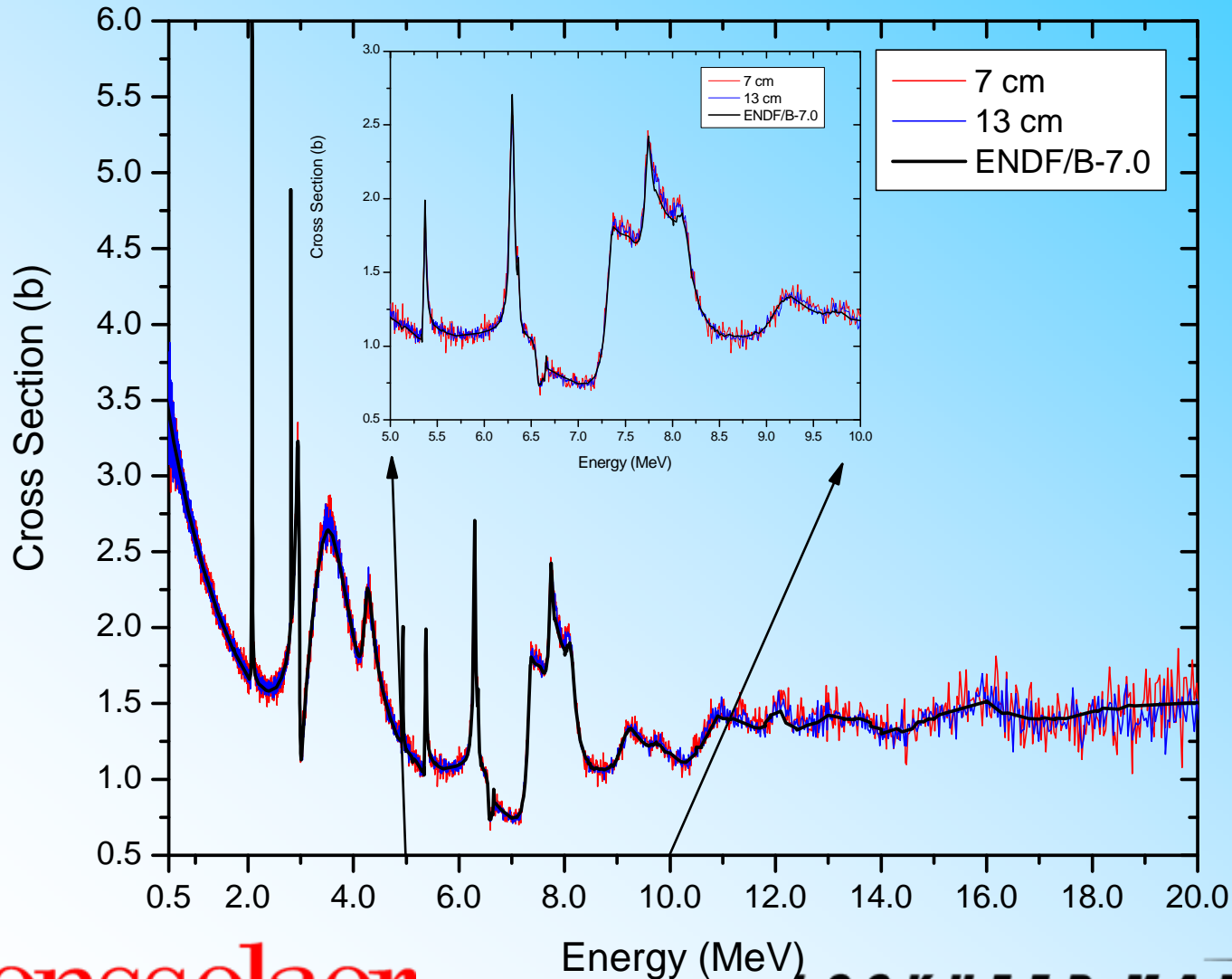
High Energy Transmission Experimental Setup



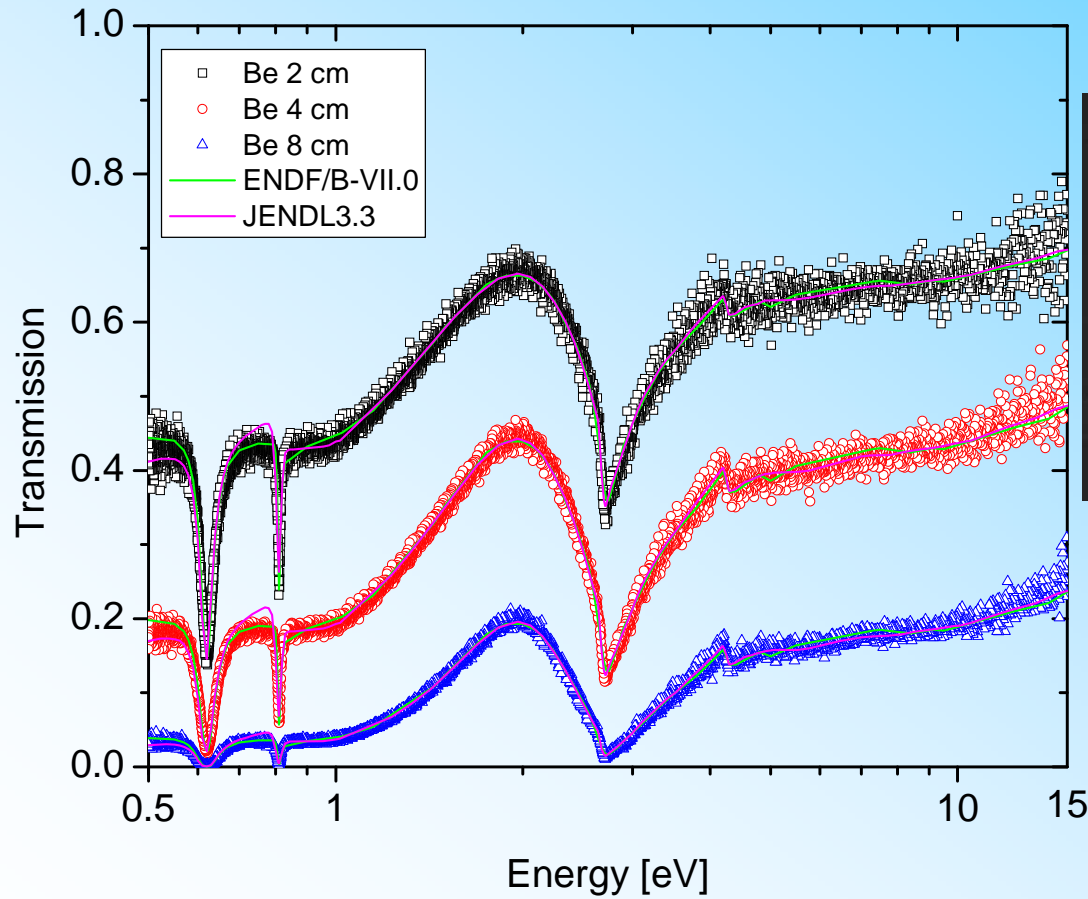
Graphite Transmission



Results – Carbon Total Cross Section



Beryllium Transmission



Beryllium samples

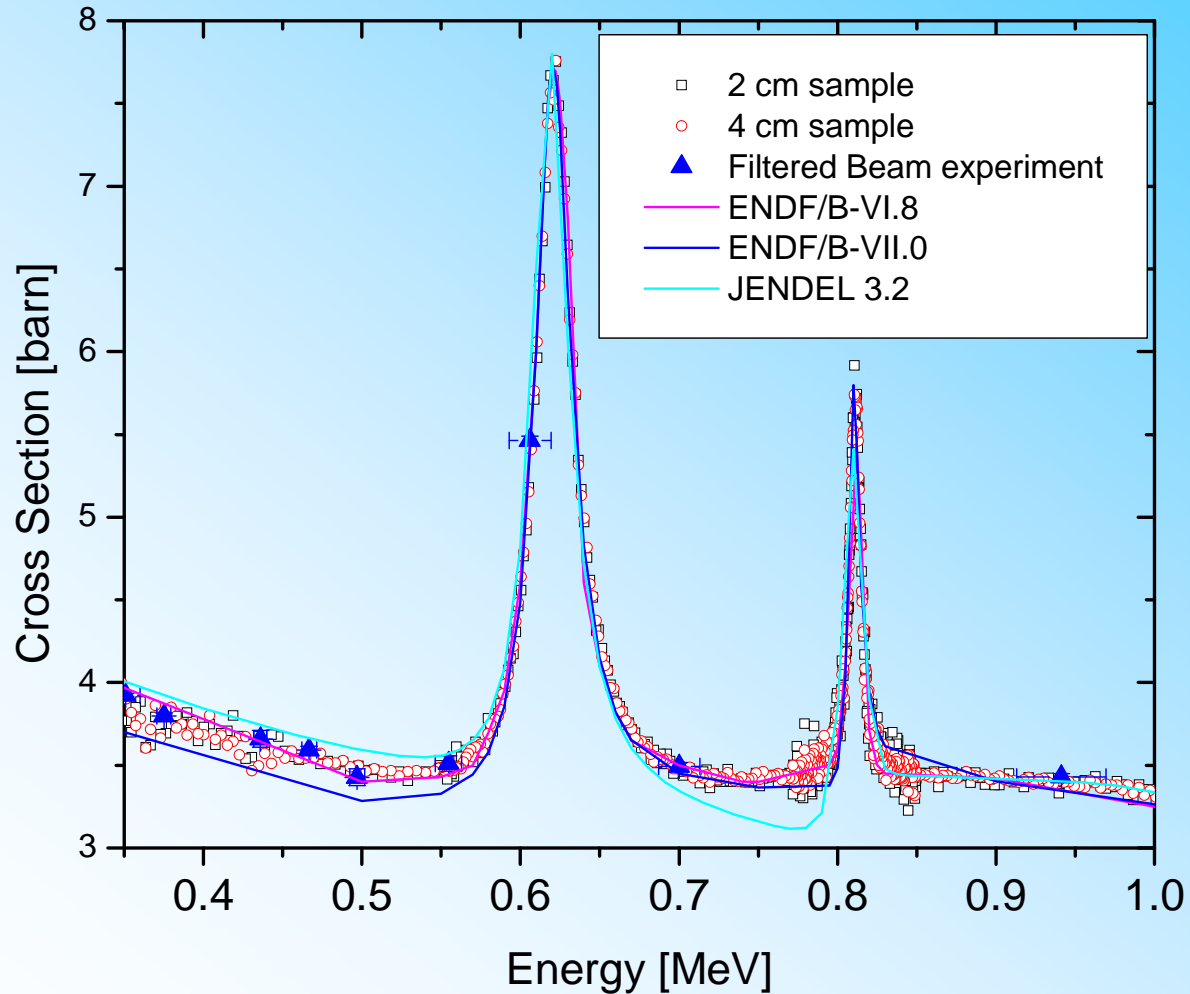
Sample thickness is given in cm



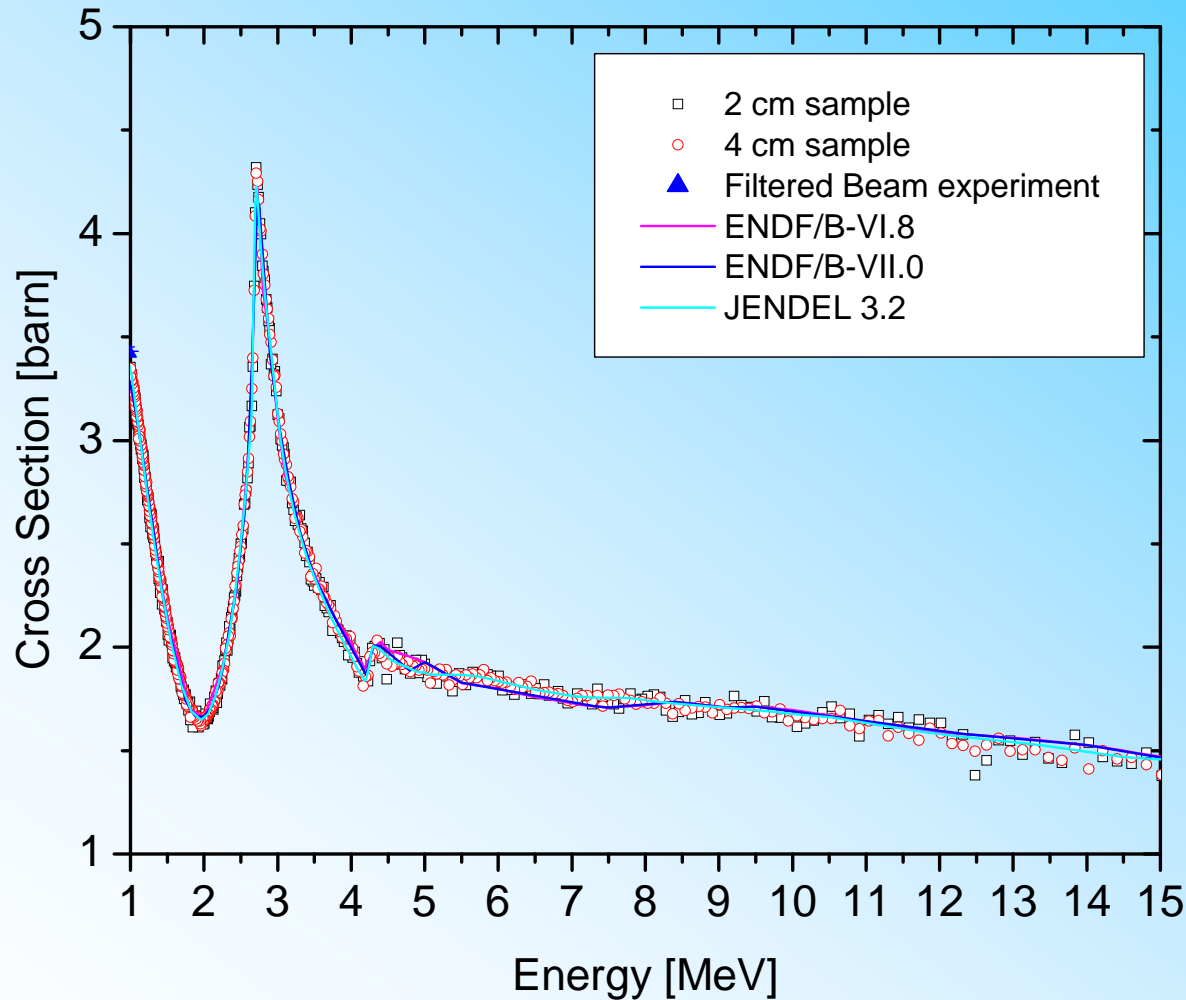
Reconfigured the detector with two units to reduce background



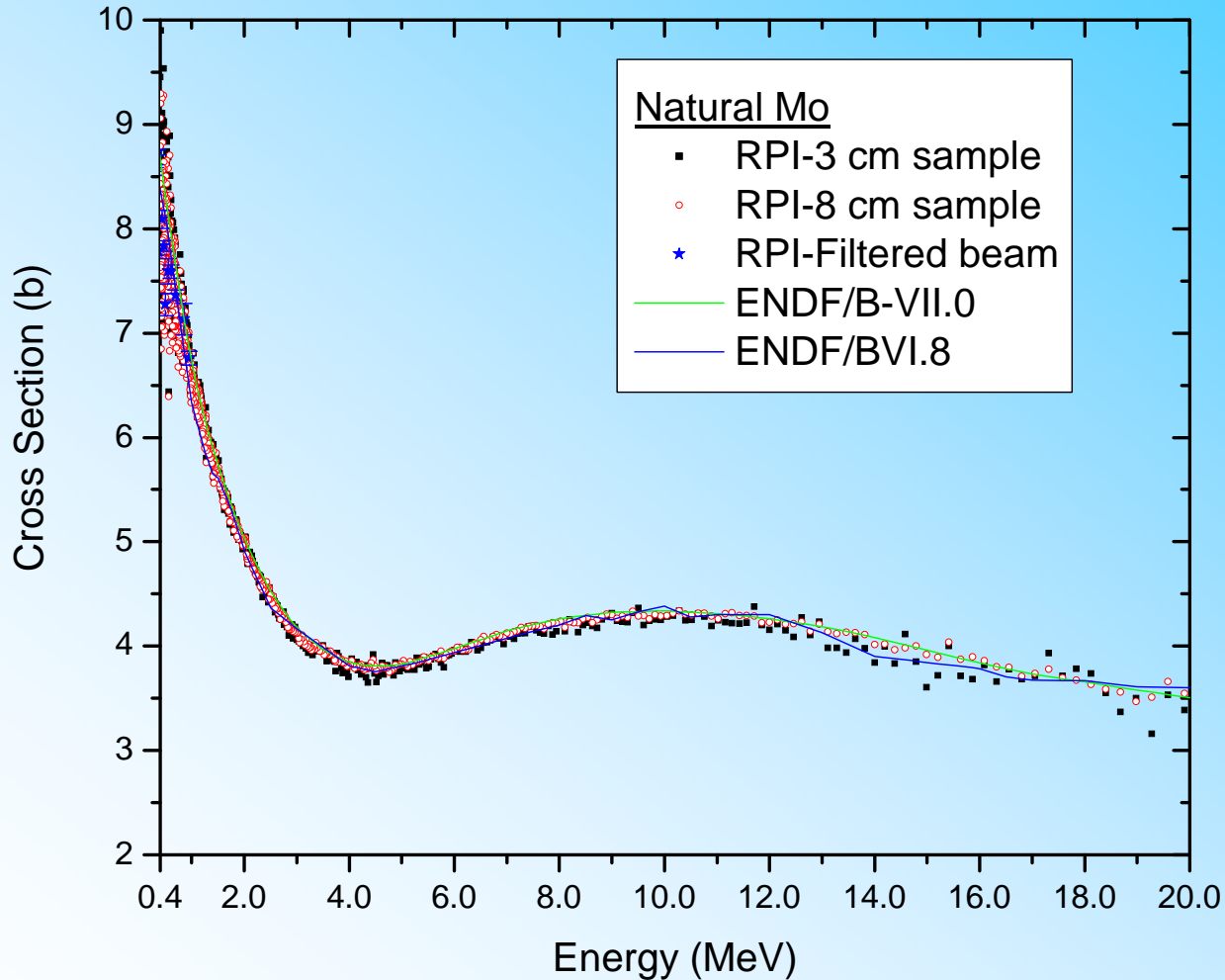
Beryllium Total Cross Section (Low Energy)



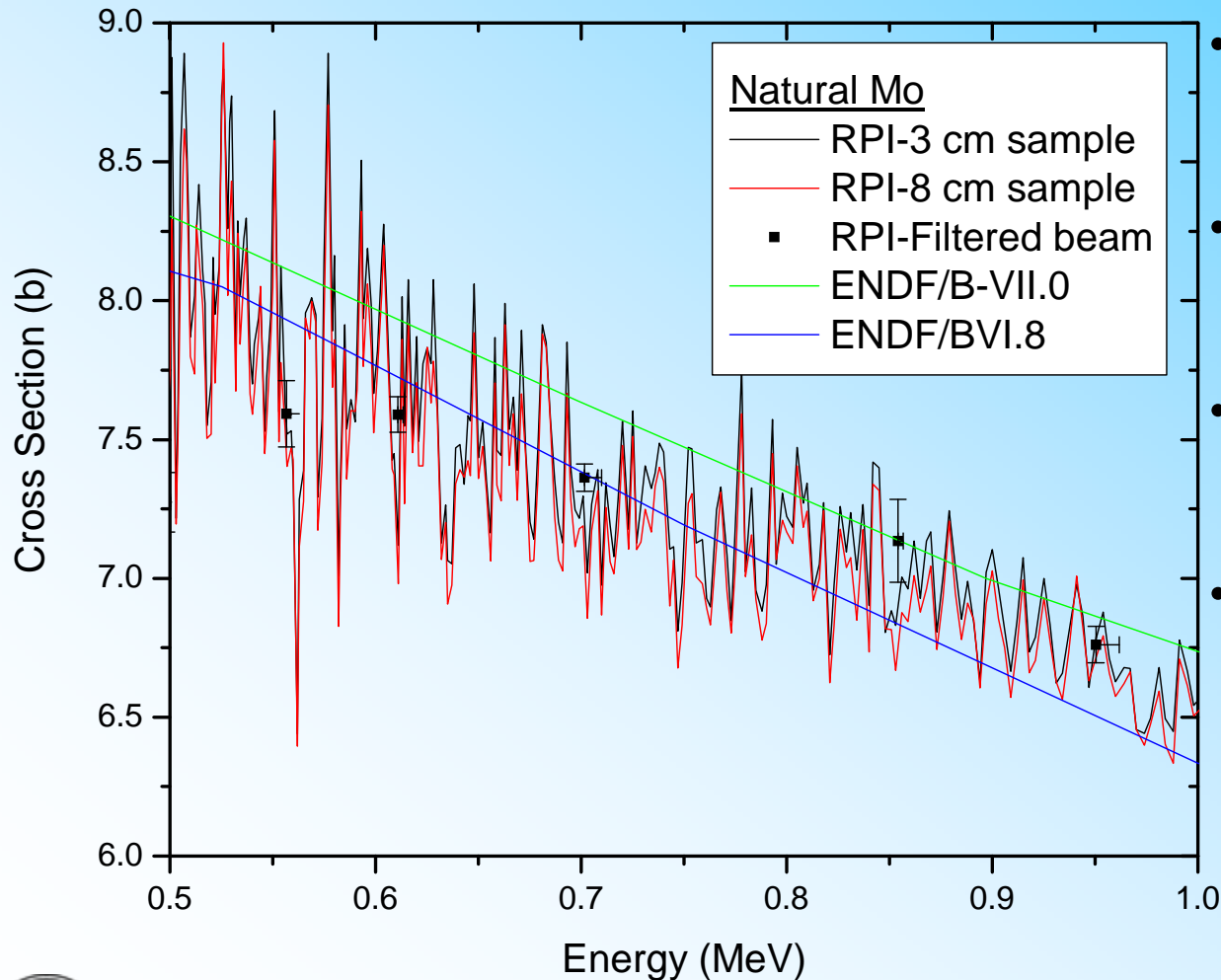
Beryllium Total Cross Section (High Energy)



Mo transmission initial analysis



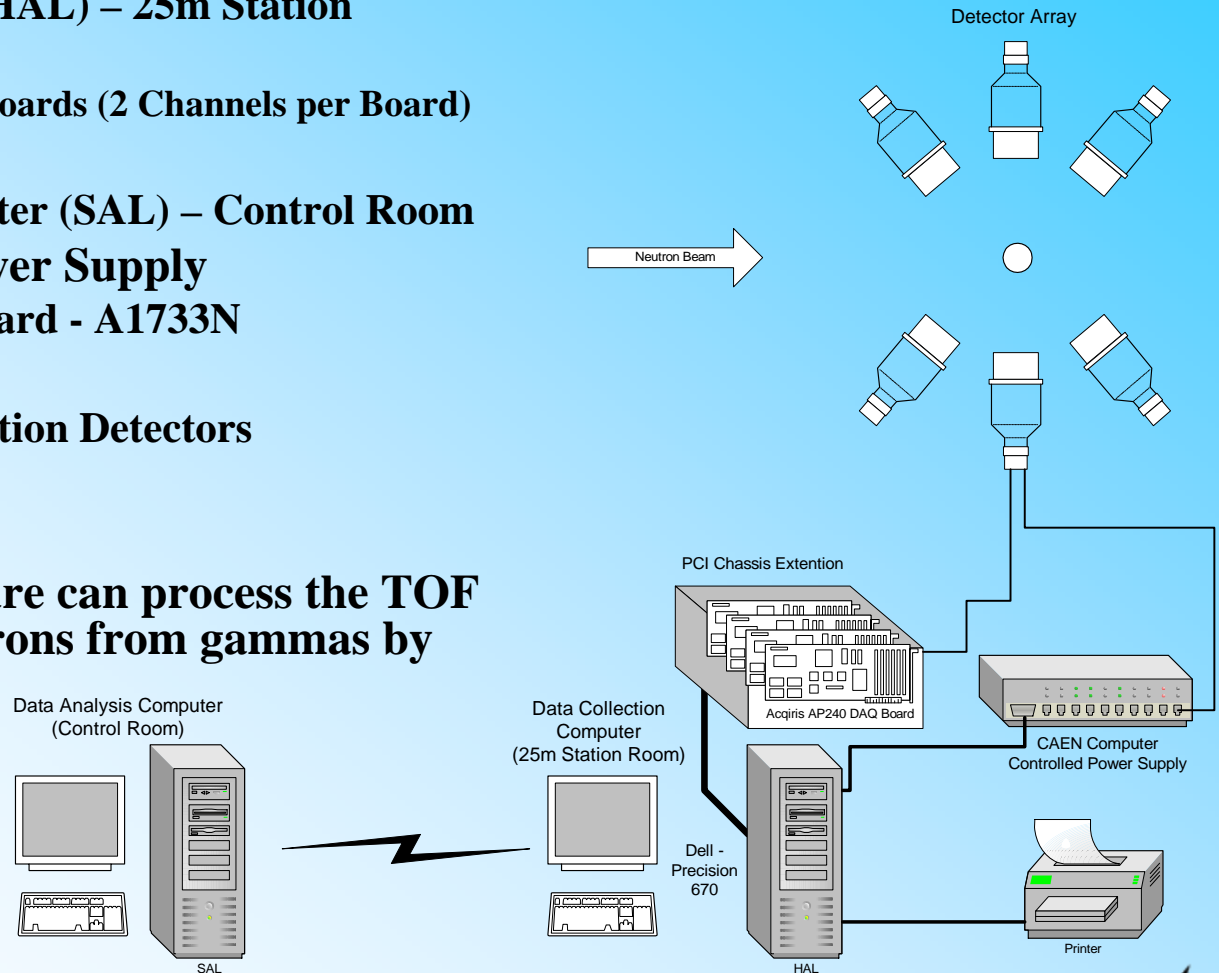
Mo Data Below 1 MeV



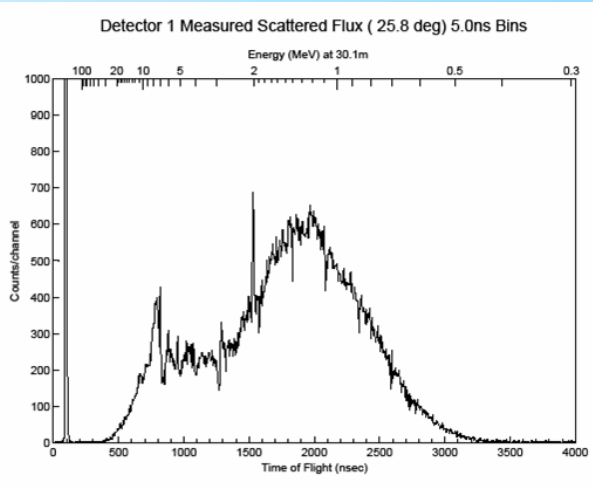
- Notice the visible structure in the cross section
- Better agreement with ENDF/B-VII.0. below 0.8 MeV
- Should ENDF evaluations include some of this structure ?
- The filtered beam transmission data is in good agreement with the transmission data

Scattering Detection System: Experimental Setup

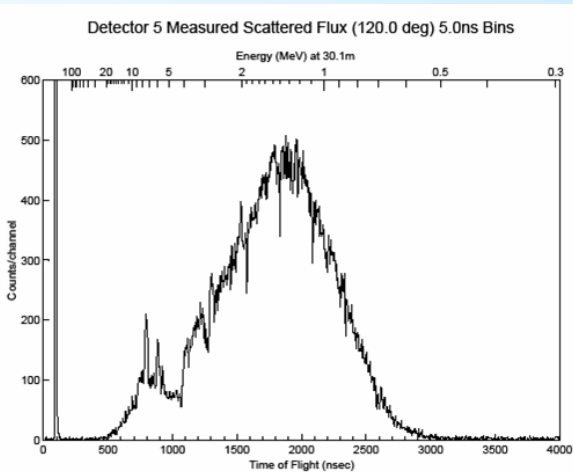
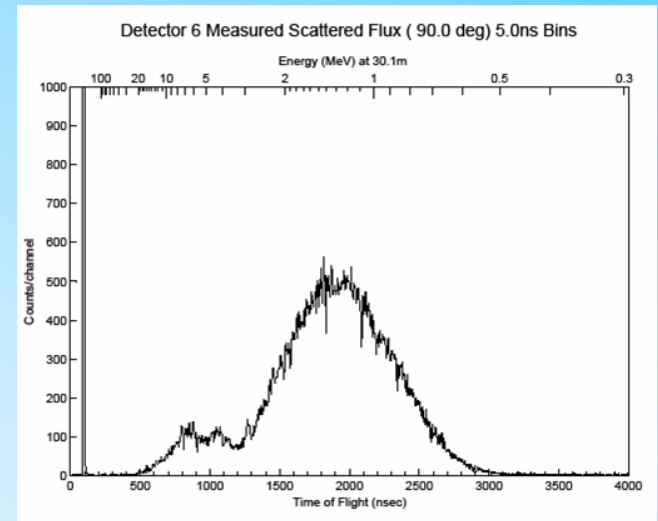
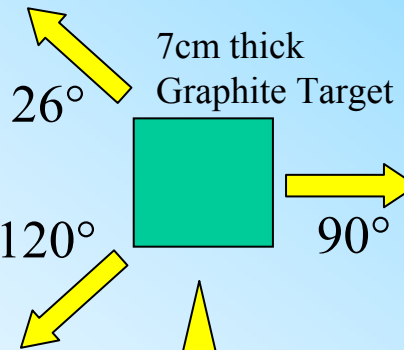
- **Data Acquisition System**
 - Main DAQ Computer (HAL) – 25m Station
 - PCI Extension Chassis
 - Acqiris AP240 DAQ Boards (2 Channels per Board)
- **Data Processing System**
 - Data Processing Computer (SAL) – Control Room
- **Computer Controlled Power Supply**
 - Chassis - SY 3527 Board - A1733N
- **Detector Array**
 - 8 EJ301 Liquid Scintillation Detectors
 - Detector Stands
- **Sample Holder / Changer**
- **The RPI developed software can process the TOF data and distinguish neutrons from gammas by pulse shape analysis**



Preliminary Carbon Scattering Results



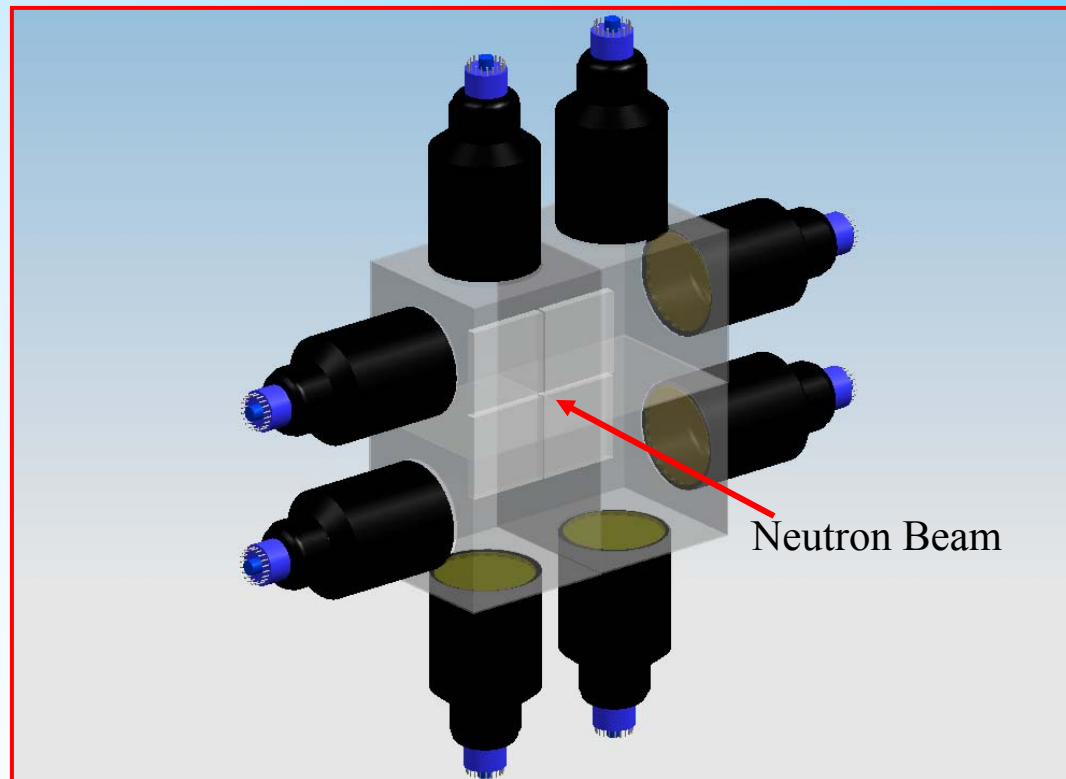
New data emphasizes the low energy (0.5-5 MeV) region



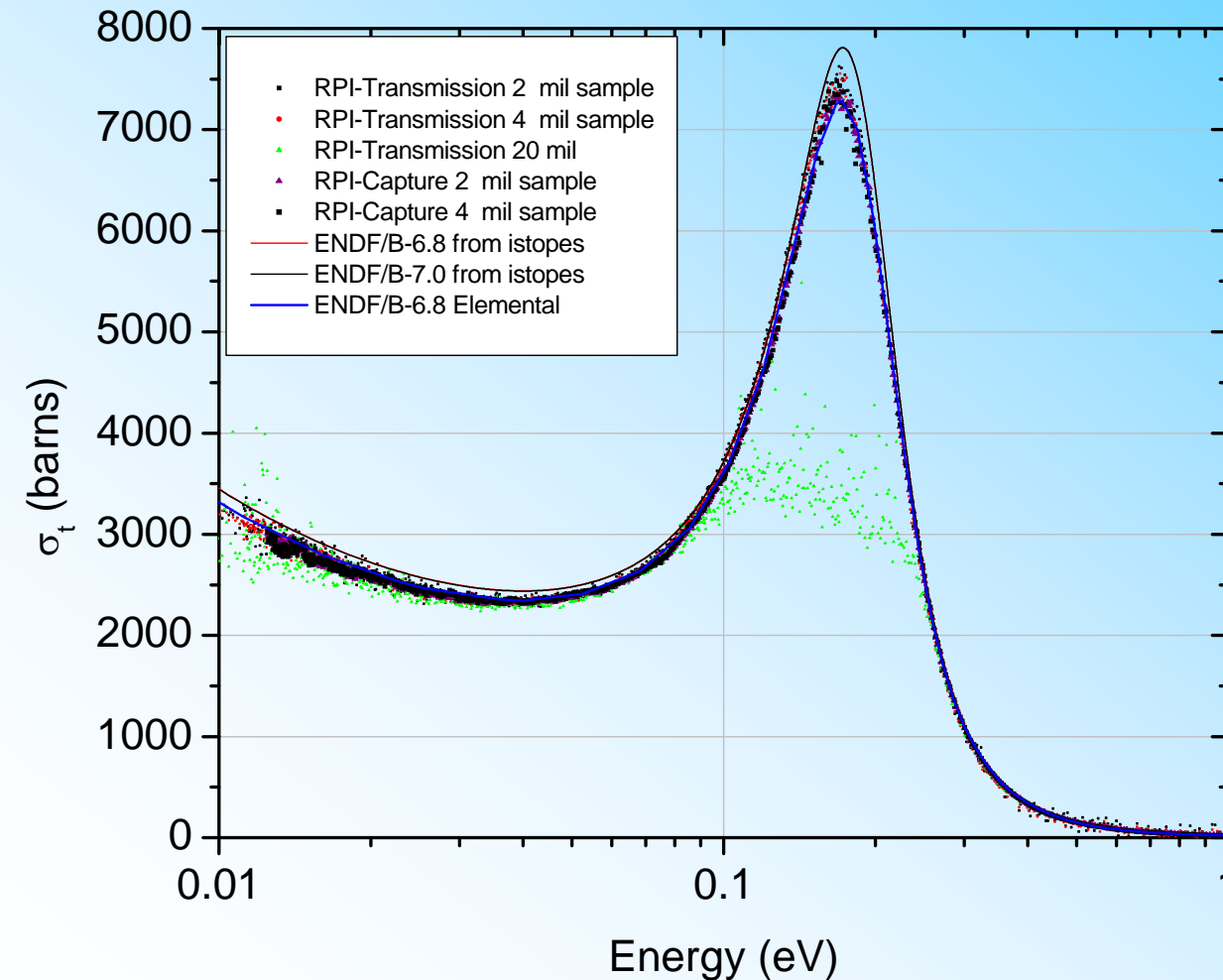
Pulsed Neutron Beam

High Resolution Transmission Detector

- Modular Li-Glass detector will be positioned at 100m flight path
 - Extends our capabilities up to the unresolved resonance region

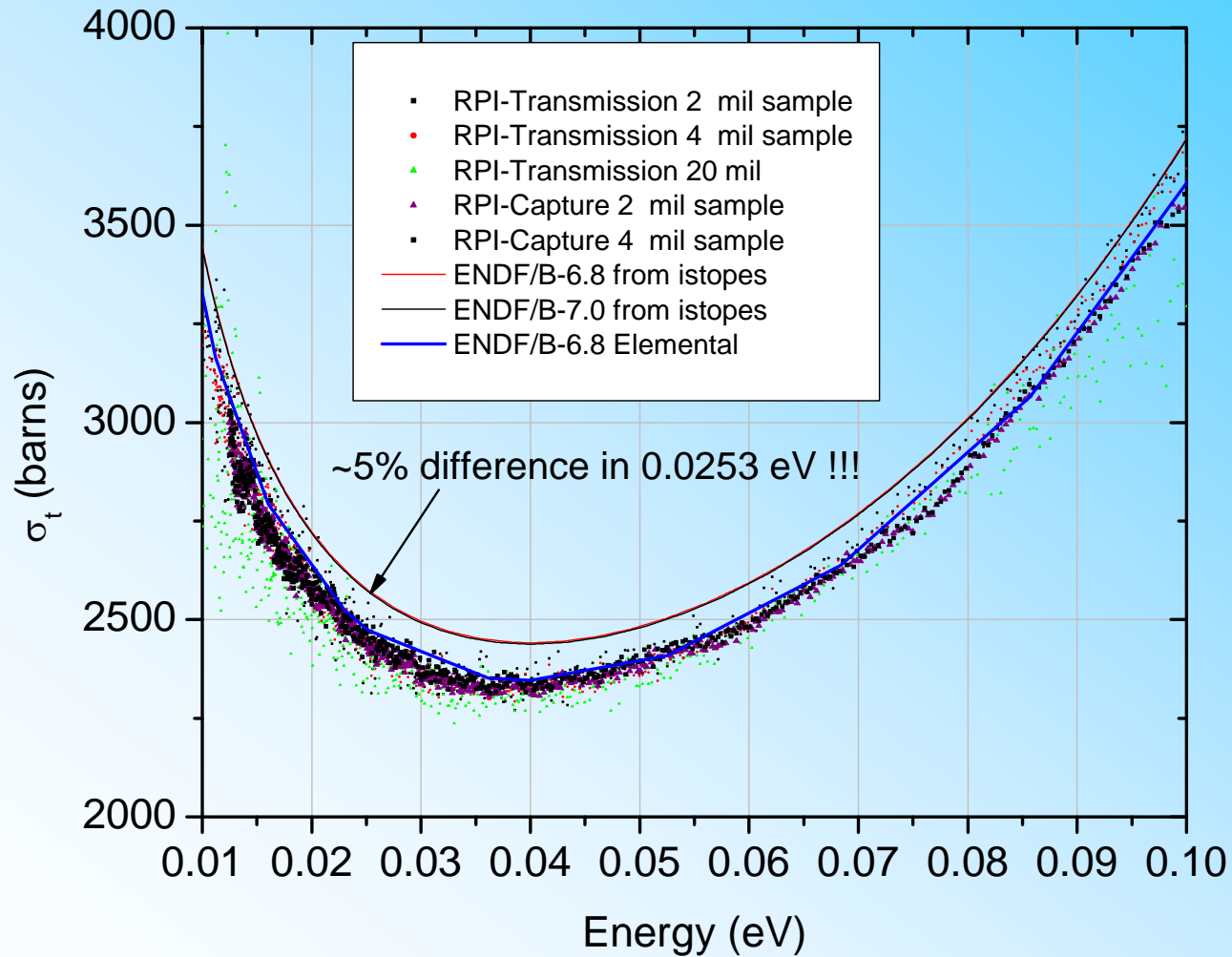


Thermal Total Cross Section of Natural Cd - I



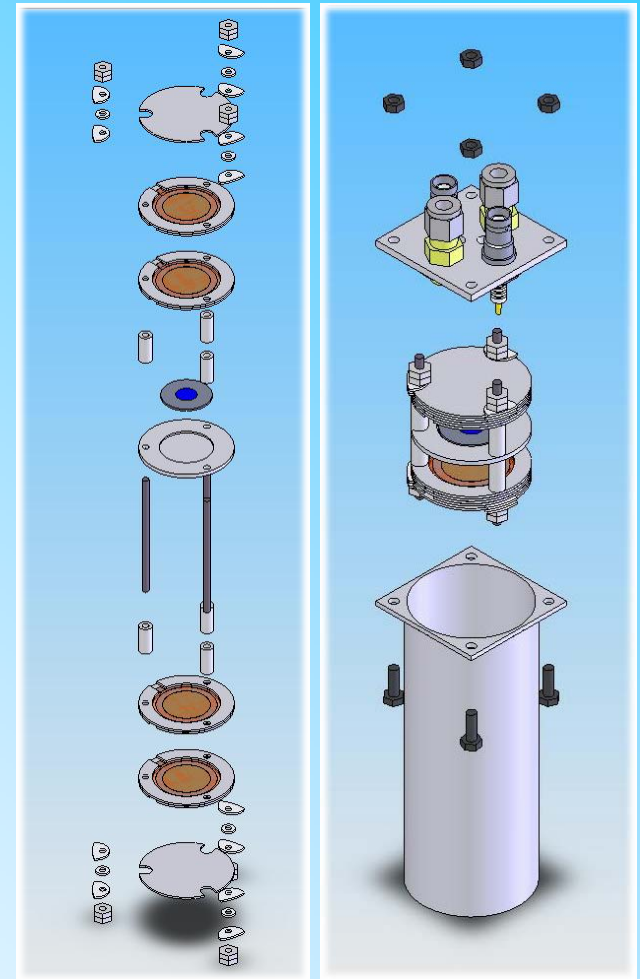
- The transmission and capture data are in very good agreement
- The data is in good agreement with ENDF/B-VI.8 elemental but not with the isotopic ENDF/B-VI.8 and ENDF/B-VII.0
- Surprisingly there are not many measurements of the thermal value.

Thermal Total Cross Section of Natural Cd - II



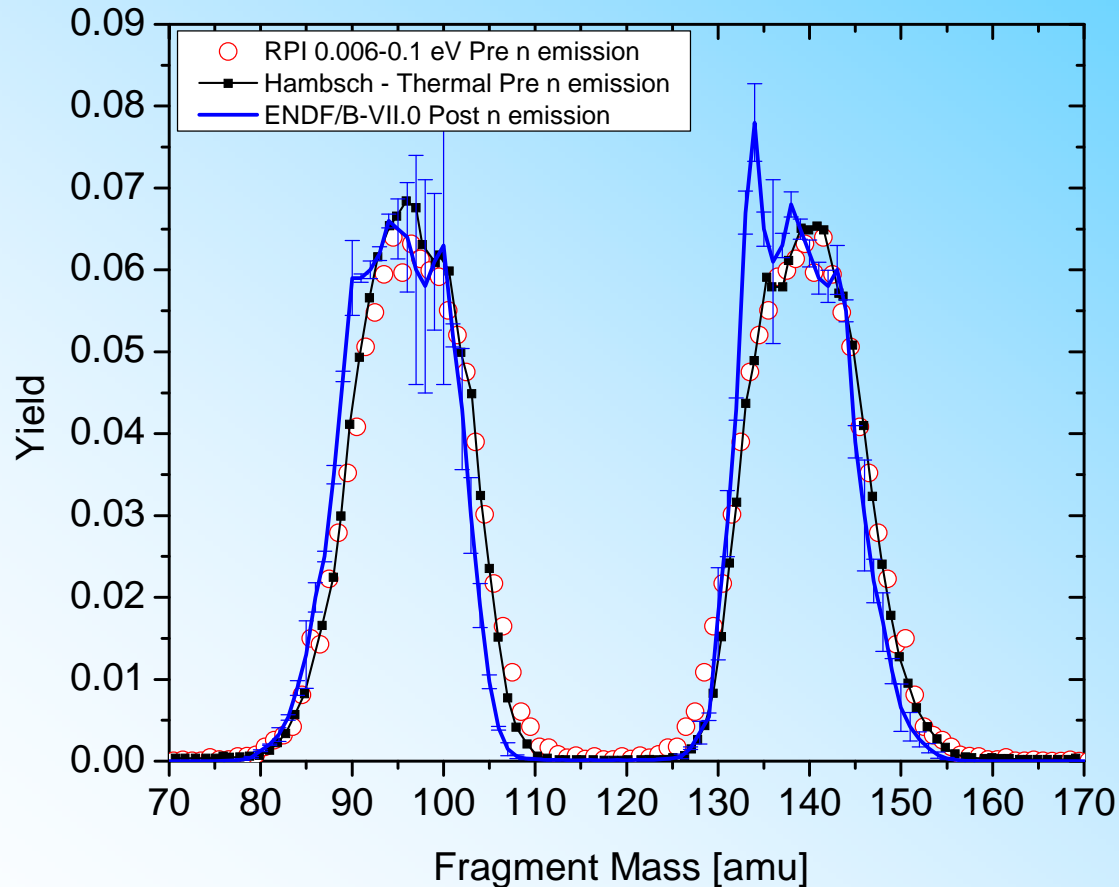
Lead Slowing Down Spectrometer

- Fission cross section and fission fragment spectroscopy
 - Measure a ^{235}U sample to get more data with improved setup.
 - Run a ^{239}Pu sample
- Detectors for (n, α) measurements are being developed
 - Compensated Solar Cells
 - Compensated PIPS detectors
 - Compensated GEM amplified detectors (shown on the right)



RPI-LSDS post neutron emission fission fragments mass distribution ^{235}U (Preliminary)

A 27 μg ^{235}U sample is used to test our method



Summary

- Re, Rh, Cd, ^{236}U , Dy and Mo measurements are currently being analyzed
- New detector systems for transmission and scattering are now operational
 - High energy transmission measurements on C, Be and Mo were completed
 - Scattering data on graphite is being analyzed.
- An Iron filtered beam is used for high precision transmission measurements in the energy range from 0.24 keV to 0.9 MeV
 - Measurements on C, Be and Mo were completed
- New transmission detector for high resolution resonance measurements is under construction.
- A Lead slowing down spectrometer is used for fission and (n, α) cross section measurements.