

Cross Section Measurements and Analysis at Rensselaer

Report at CSEWG meeting 2006

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Measurements Completed This Year

- U-236
 - One ~50mg sample of 99.8% enrichment
 - Complements transmission measurement performed with larger samples of 89.2% enrichment.

Planned Measurements

- Transmission and capture on ^{153}Eu and natural Eu.
- High energy (0.4-20 MeV) transmission of Be and Mo.
- High precision filtered (0.024 - 0.9 MeV) transmission measurements of Be and Mo.

Data Analysis

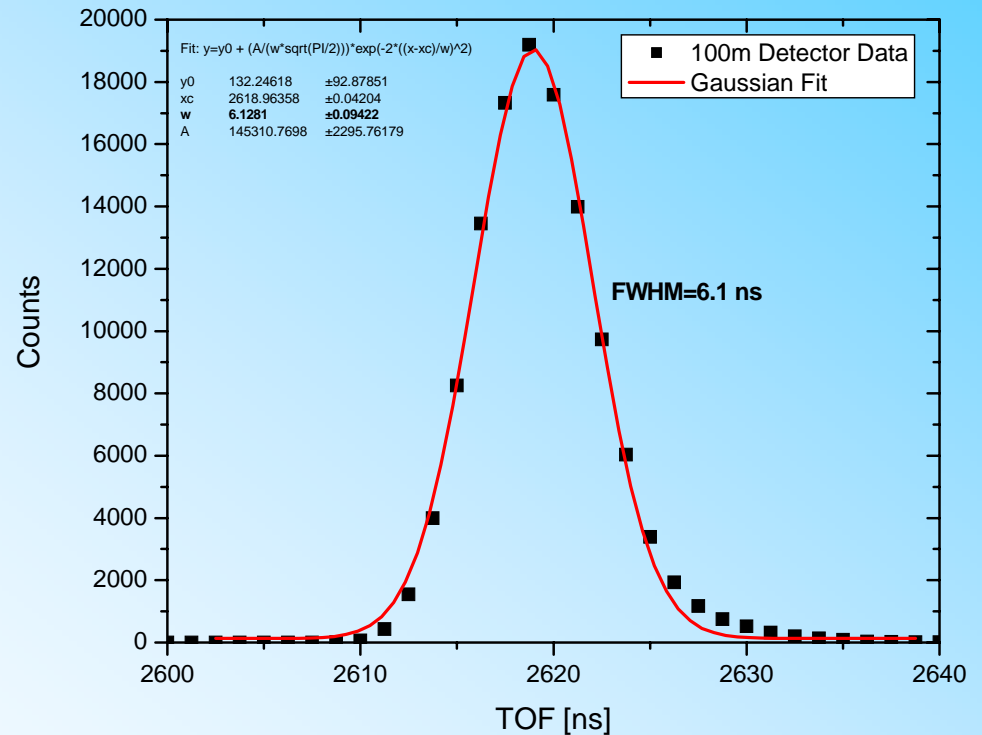
| Sample | Status |
|---------------|--|
| Nd | NS&E paper was published |
| Nb | NS&E paper scheduled to be published in November |
| Gd | NS&E paper scheduled to be published in November |
| Rh | SAMMY analysis pending |
| Cd | SAMMY/REFIT analysis pending |
| Re | Data analysis in progress |
| Mo | SAMMY analysis in progress. |

New Capabilities

- LINAC Injector upgrade completed
 - Provides shorter pulses (~6 ns), higher current (several amperes peak current), better emittance, commercially available spare parts
 - A larger cathode gun is now under testing expected to improve the intensity by 50% to 100%.
- Transmission Measurements at 100m flight path
 - High energy transmission and spectra measurements in the energy range 0.2-20 MeV.
 - Completed tests with graphite samples.
- 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 of the order of the detector response time (~100ns).
 - Initial tests with graphite samples were completed.
- High precision filtered beam transmission measurements.
 - Discrete points in the energy range from 0.2 - 0.9 MeV
 - Cross section accuracy of 1% was demonstrated with graphite.

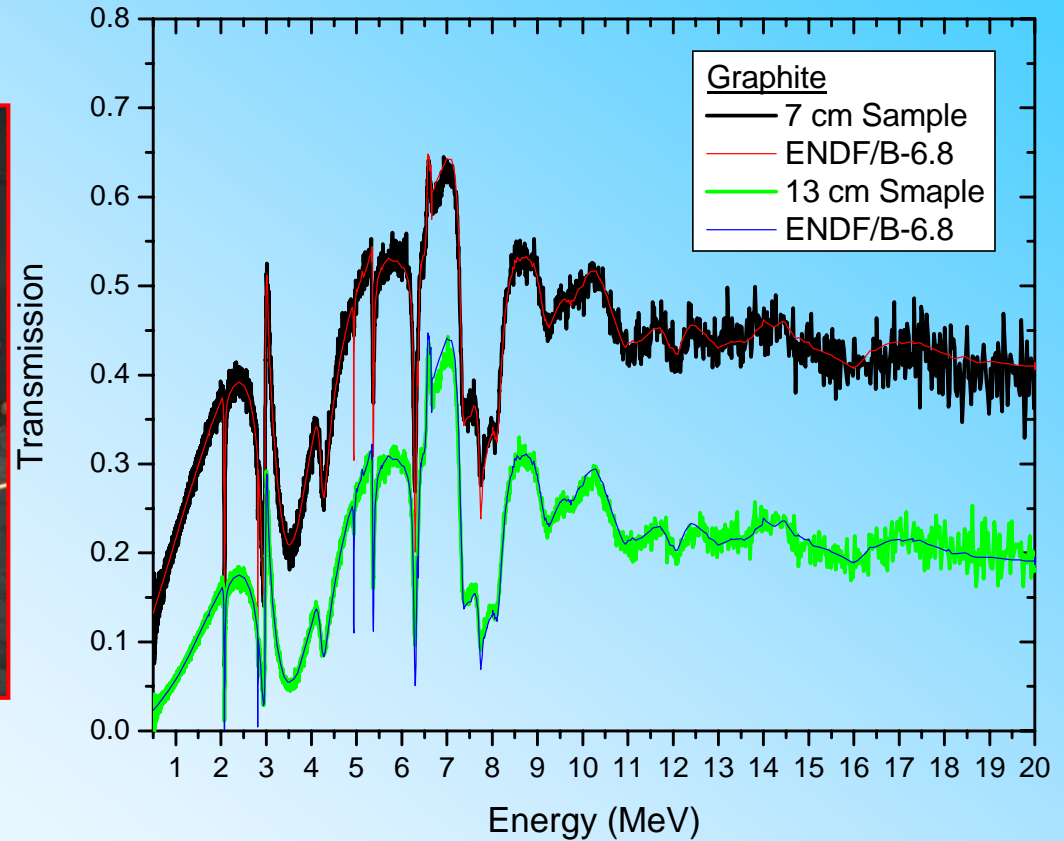
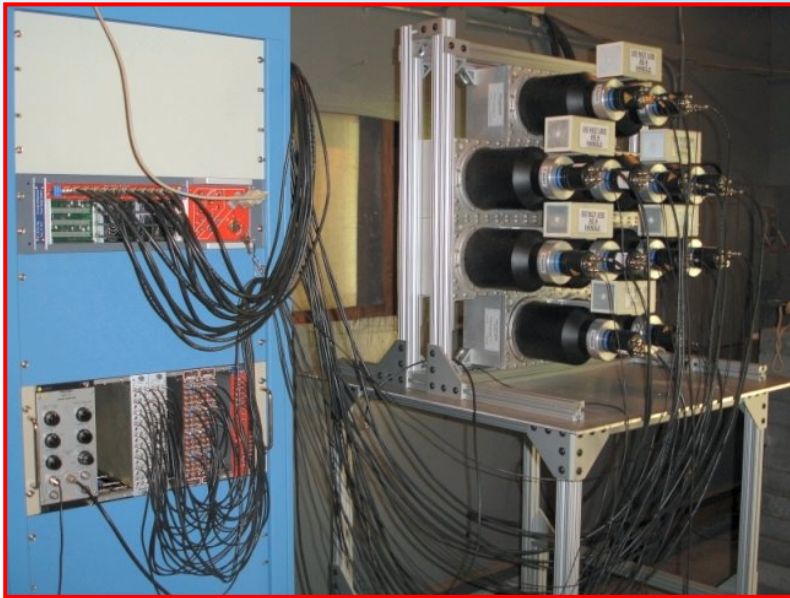
LINAC Injector Upgrade

- The Injector system is now installed and functional.
- A 6 ns gamma flash pulse is now measured routinely.



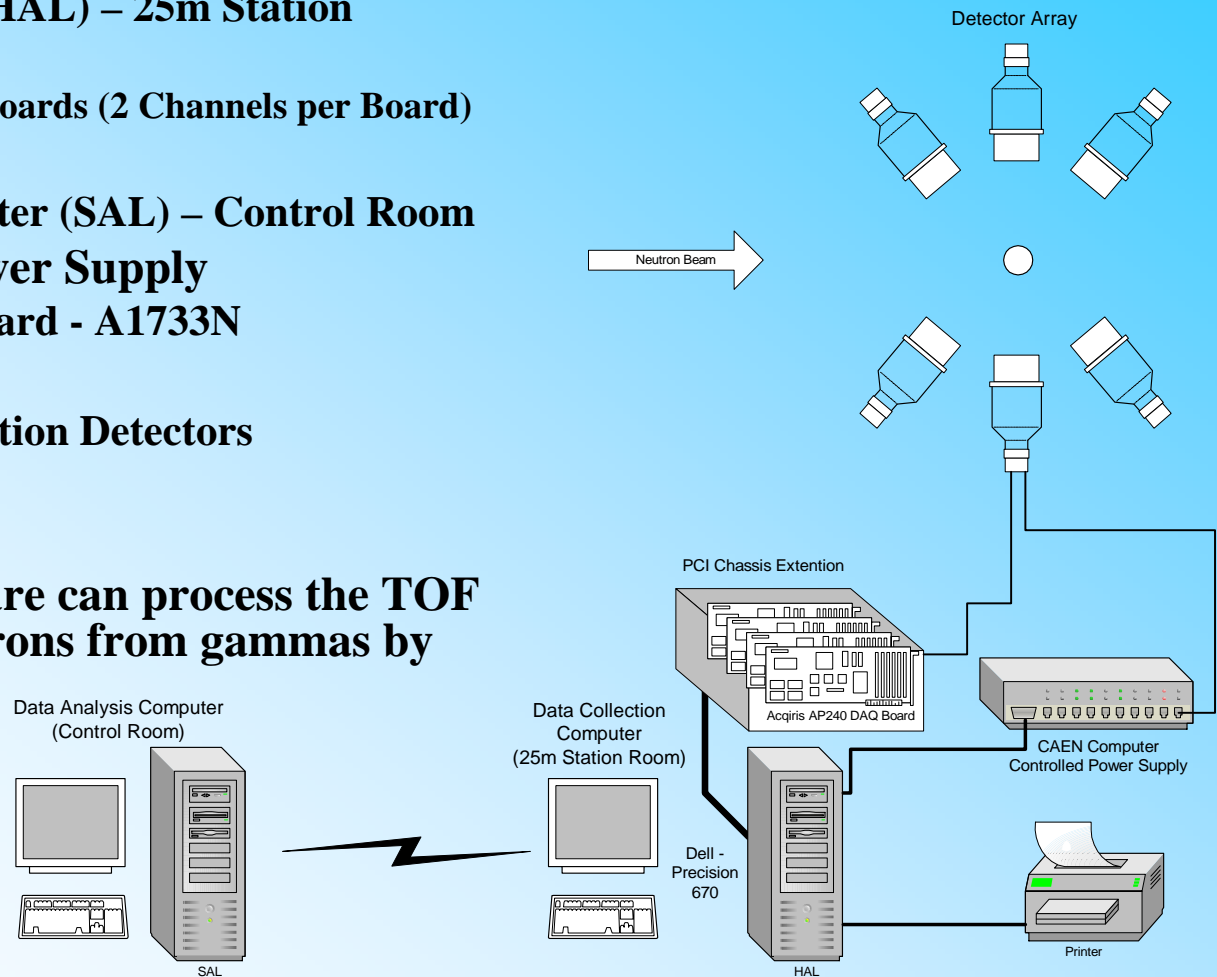
Graphite Measurements at 100m Flight Path

- Modular EJ-301 5" thick liquid scintillator detector
- Short pulse width of 6 ns

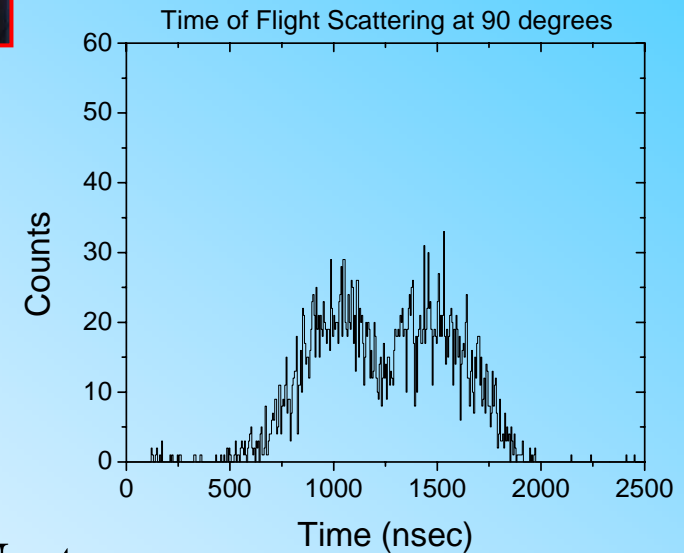
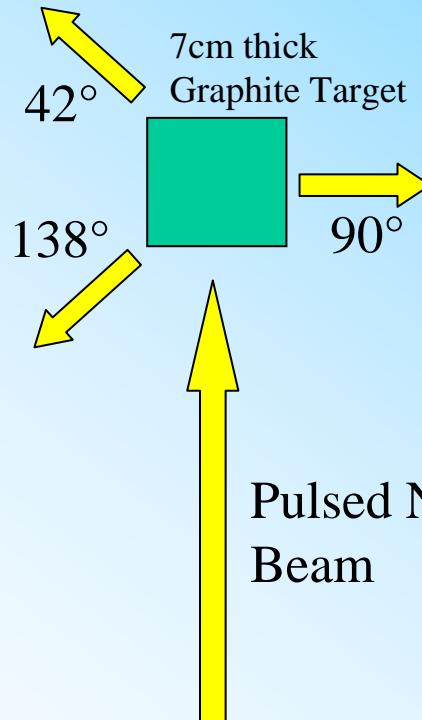
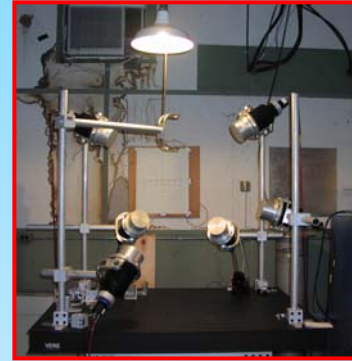
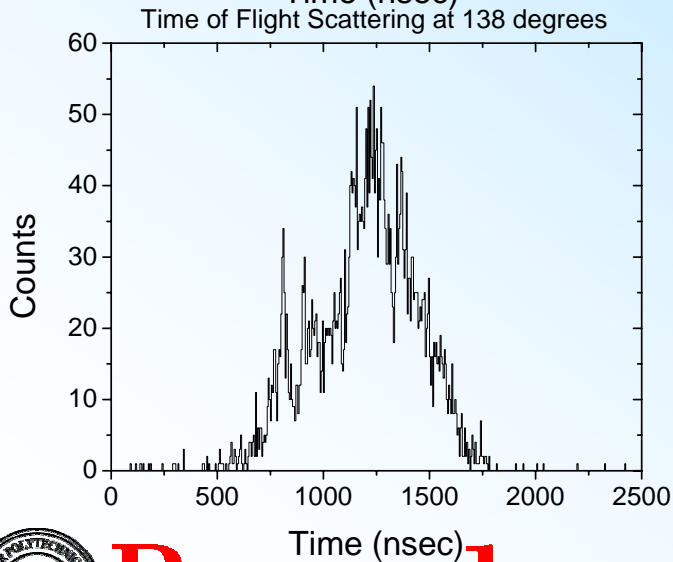
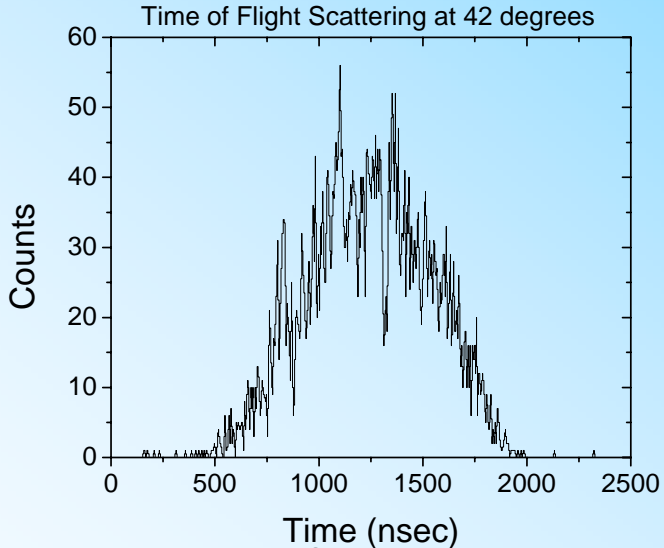


Scattering Detection System: Experimental Setup

- **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**



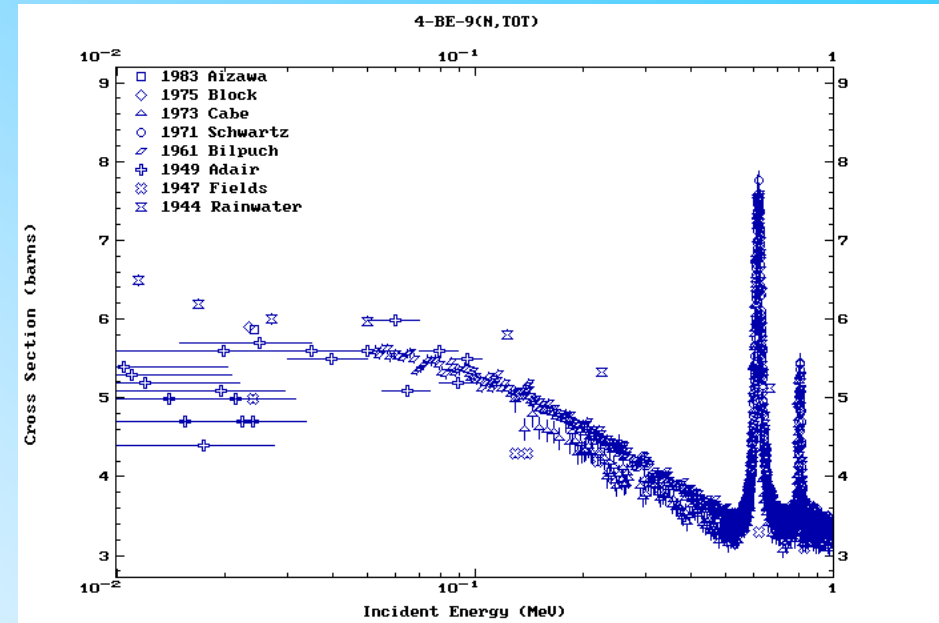
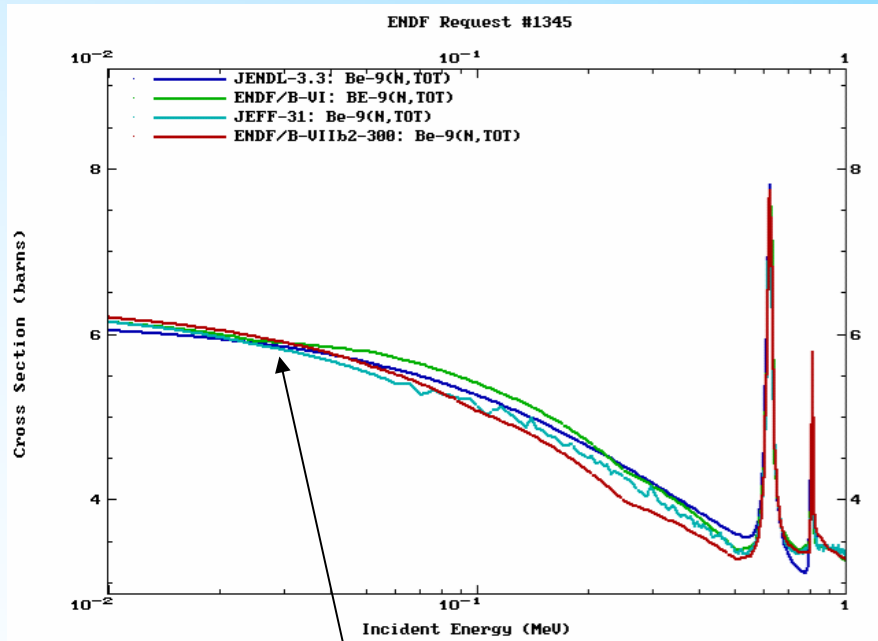
Preliminary Carbon Scattering Results



High Precision Cross Section Measurements Using Filtered Beams

- Recent Phys. Rev. Let. papers on hydrogen scattering using Iron and U-238 filtered beams.
 - R. Moreh, R. C. Block, Y. Danon, and M. Neumann, “Search for anomalous scattering of keV neutrons from H₂O-D₂O mixtures”, *Physical Review Letters*, 94, 185301 (2005).
 - R. Moreh, R. C. Block, Y. Danon, and M. Neuman, “Scattering of 64 eV to 3 keV neutrons from CH₂ and graphite and the coherence length problem”, *Physical Review Letters*, 96 055302, (2006).
- This work prompted us to reconsider iron filtered beams for precision cross section measurements of beryllium and other materials.
 - Effective energy range 24 keV to 900 keV.

Iron Filtered Beam For Beryllium Total Cross Section Measurements

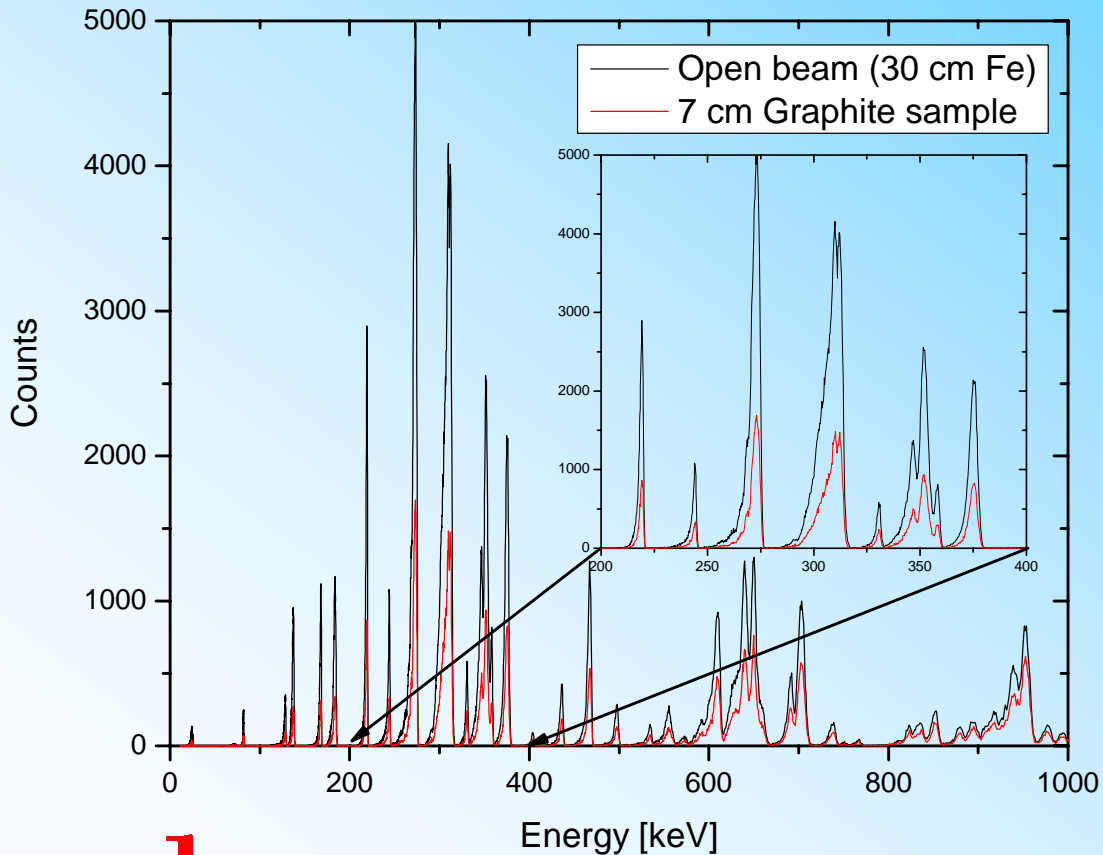


Notice the evaluations were forced through the 24 KeV point of Block et al.

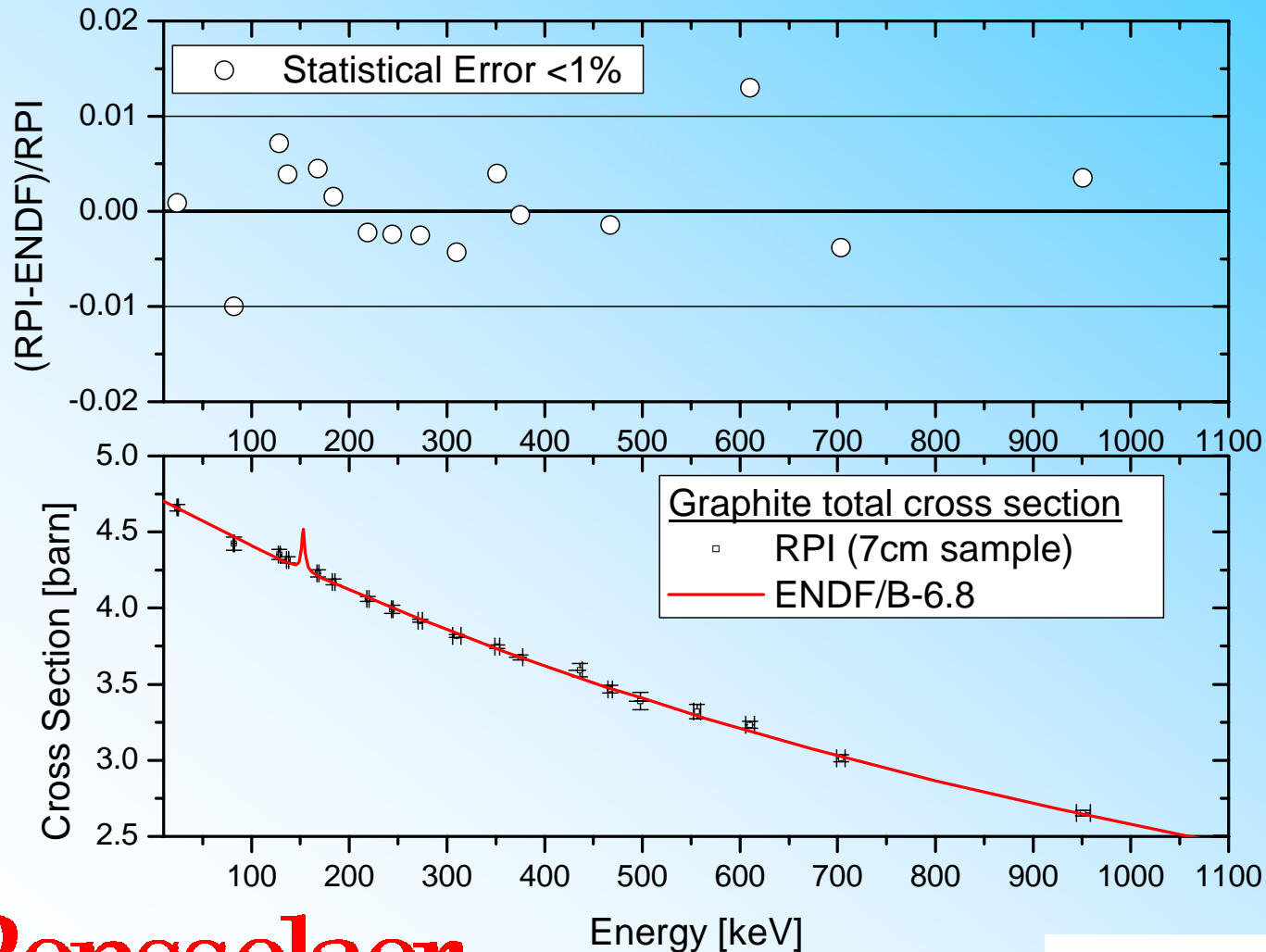
R.C.Block, Y.Fujita, K.Kobayashi, T.Oosaki, Precision neutron total cross-section measurements Near 24 keV, *J. of Nuclear Science and Technology*, Tokyo Vol.12, p.1, 1975

Transmission through a 30 cm Iron Filter

- Advantages:
 - High signal to background ratio
 - High neutron count rate and low gamma count rate

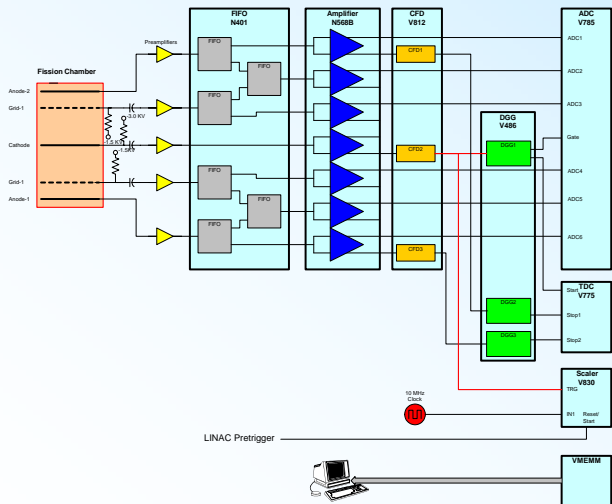
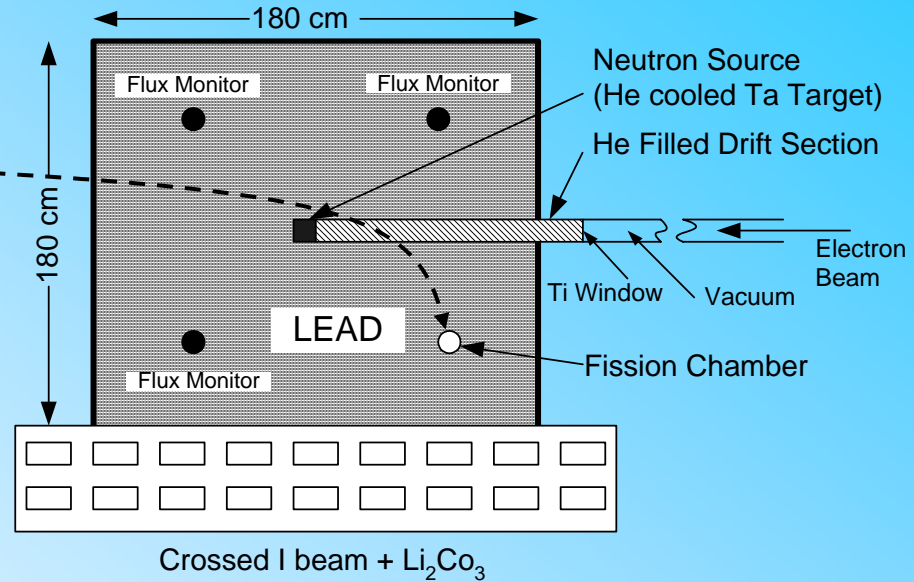
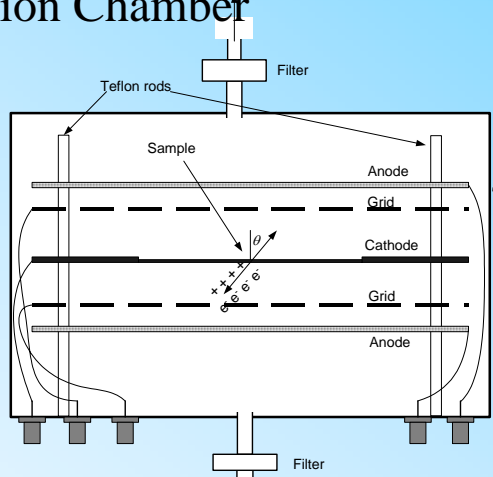


High Accuracy Graphite Transmission Using an Iron Filtered Beam



Fission Fragment Kinematics

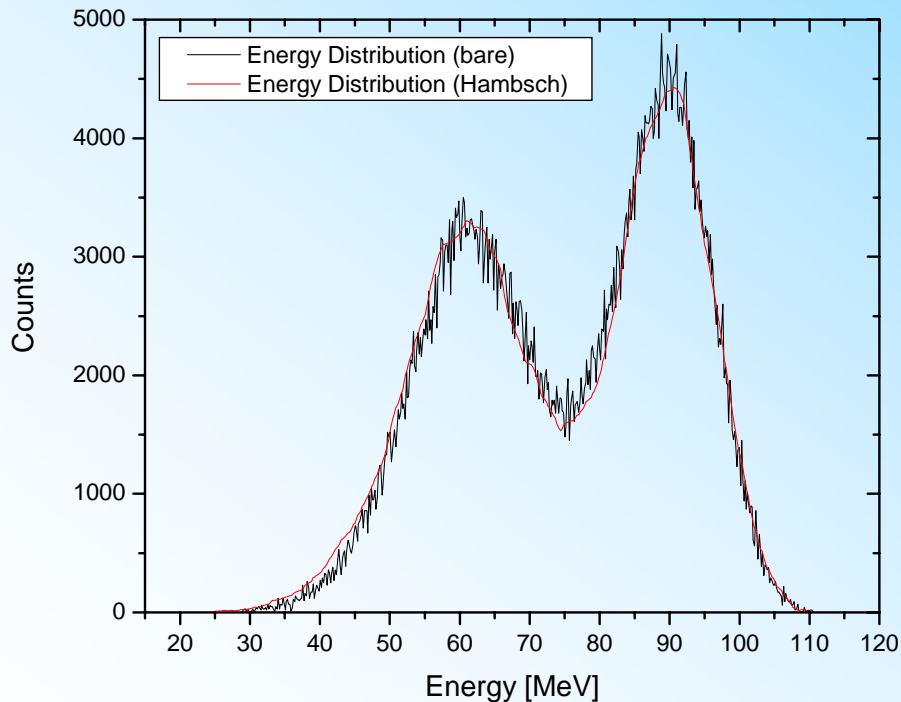
Double Gridded Fission Chamber



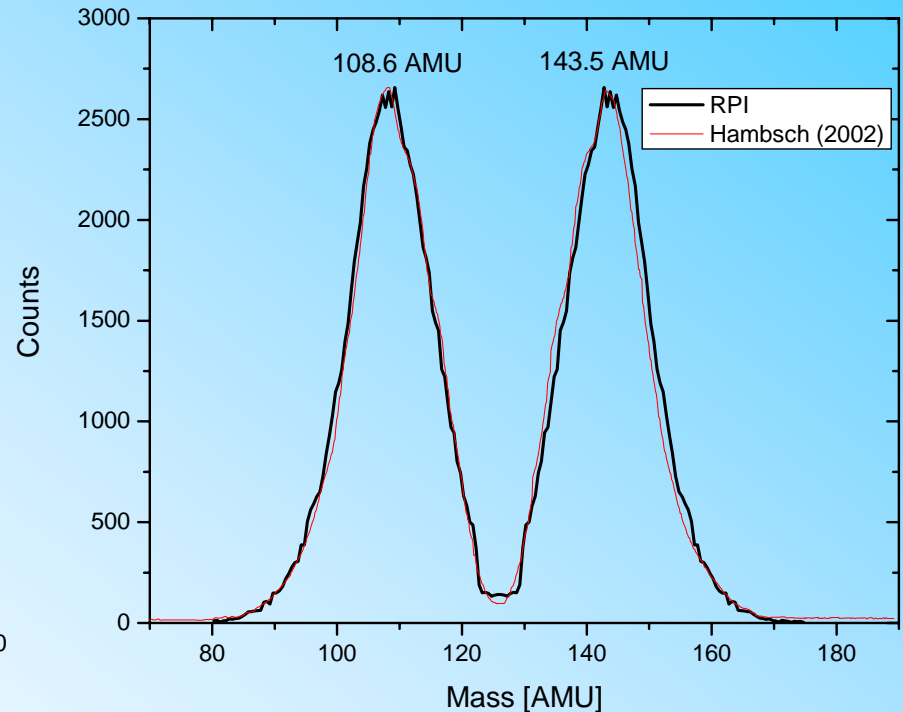
Multiparameter DAQ

Test data for a ^{252}Cf source and CH_4 gas

Energy Distributions



Mass Distributions



Summary

- New resonance parameters for Nd, Nb and Gd submitted to NS&E.
- Re, Rh, Cd and Mo measurements are currently being analyzed.
- New detector systems for transmission and scattering are now operational.
- LINAC injector upgrade completed and successfully tested to provide 6 ns pulses.
- An Iron filtered beam is used for high precision transmission measurements in the energy range from 0.24 keV to 0.9 MeV.