Recent Refurbishment of the Oak Ridge Electron Linear Accelerator and New Cross-Section Measurements

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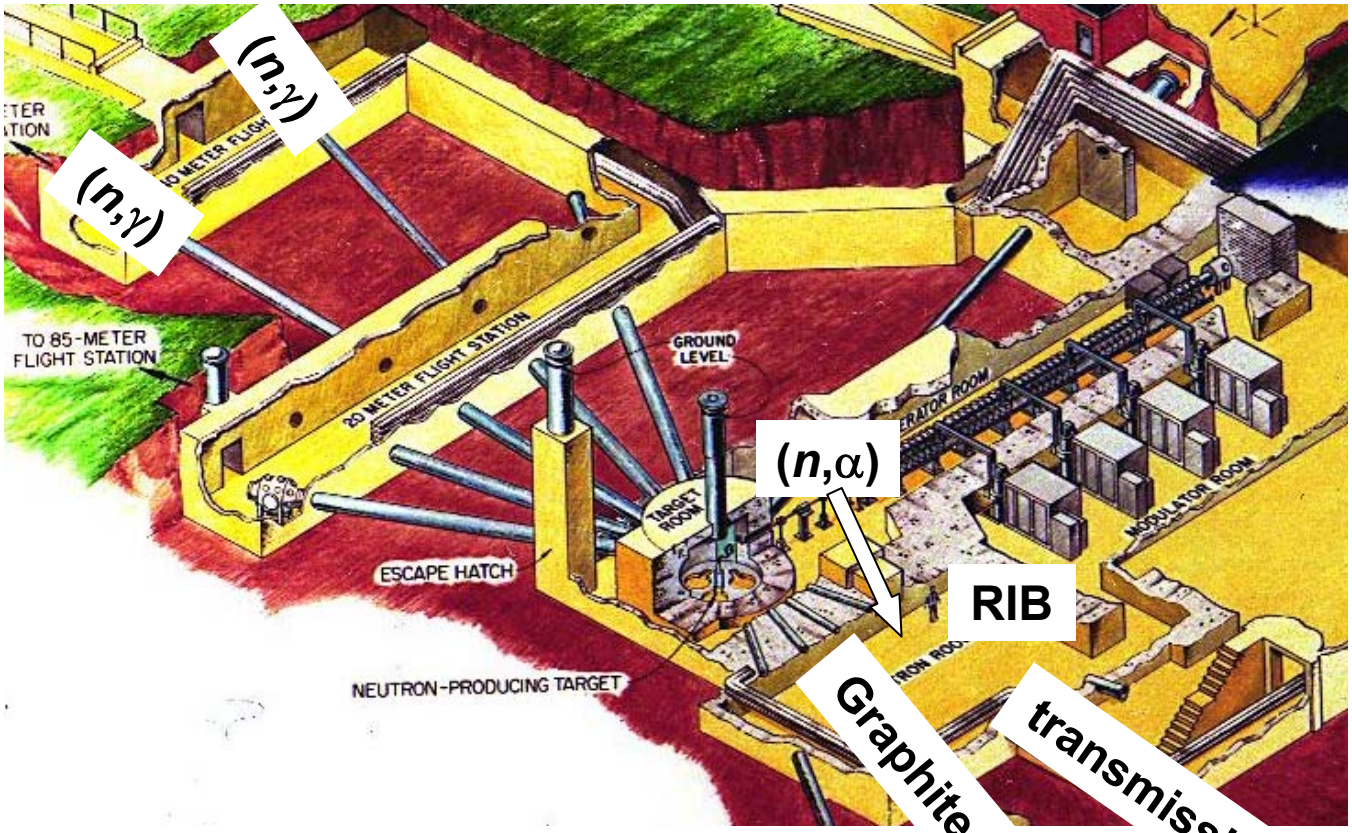
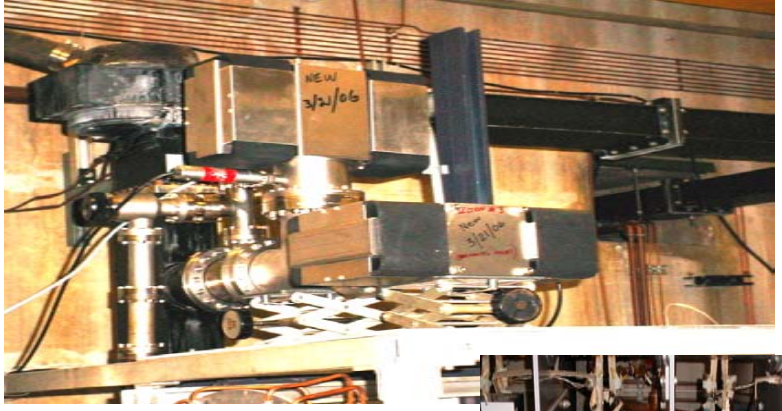
Existing Experiments at ORELA



- 11 Flight paths
- Flight Stations:
  - 8-18, 20, 35, 40, 85, 150, and 200 m

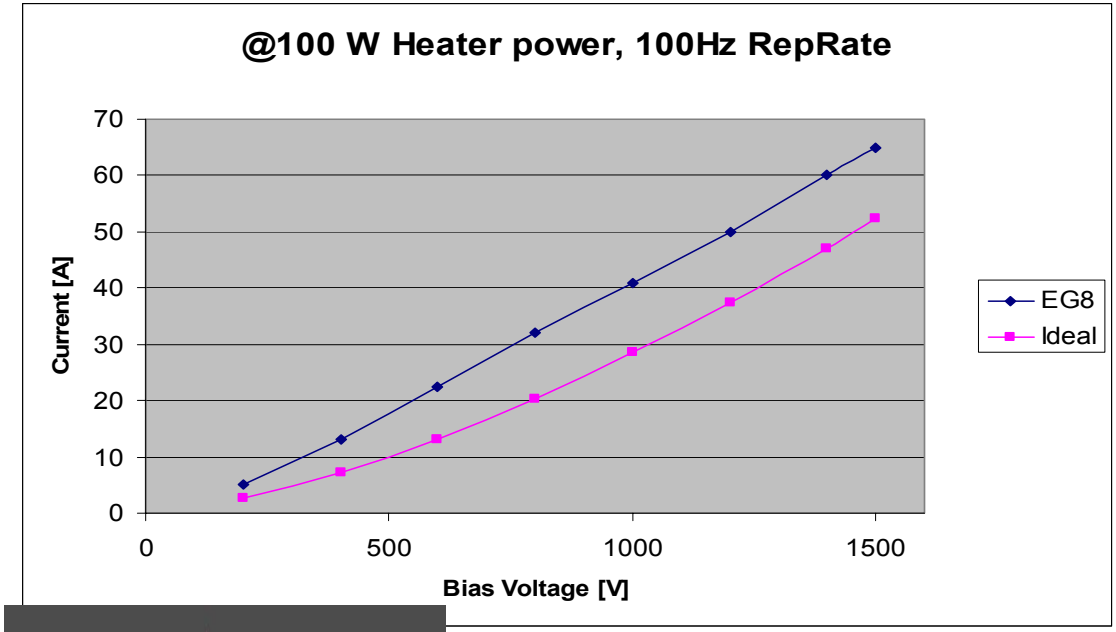
ORELA Vacuum Refurbishment

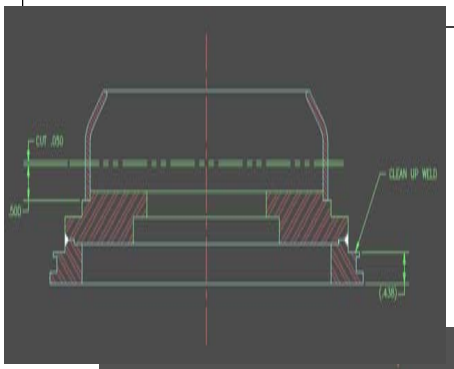
- All 10 VacIon pumps (60 l/s) were replaced; pumps had reached end of lifetime. HV power supplies and cables debugged.
- Modulators debugged.
- Installed new 300 l/s turbo pump
  - Facilitate startup of VacIon pumps
  - Improved operation of residual gas analyzer—facilitated leak check of whole system
- Guard Vacuum System Refurbished in all Accelerator Sections
  - Controls leaks from cooling water lines into high vacuum—installed in 1990
  - System refurbished and modernized with new pumps and automatic valves to prevent pump oil from back streaming
  - New O-rings installed

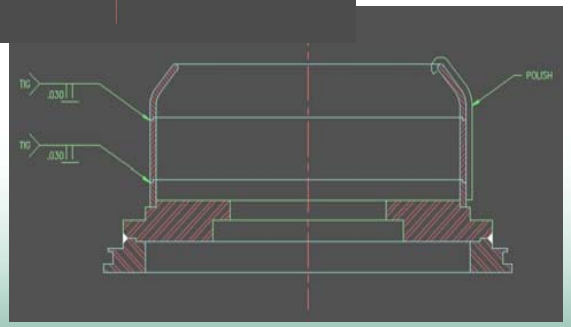


ORELA Electron Gun Improvement

- After extended R&D gun leak problem was identified
- New design—shield inside gun extended by 1" to better protect ceramic from arcs
- New filament design was tested and installed in gun.
- Gun performed excellent on test stand
- Excellent high voltage behavior
- Gun behaved well on ORELA over 500 hours of beam this year, but cathode got poisoned
- New Gun already on ORELA

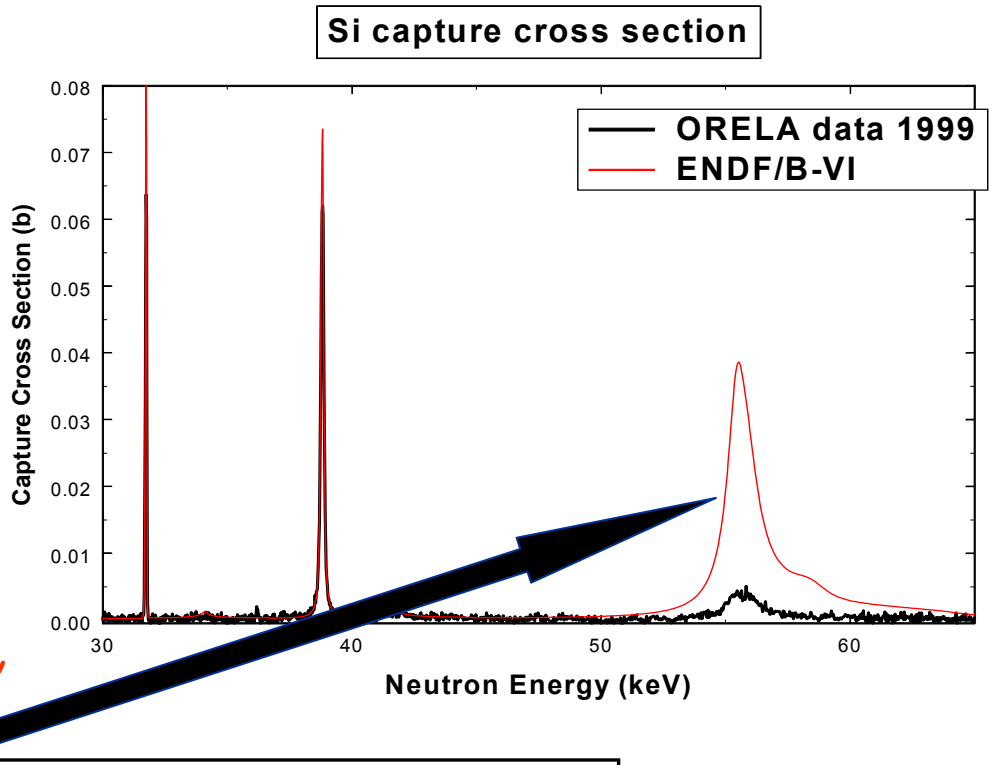






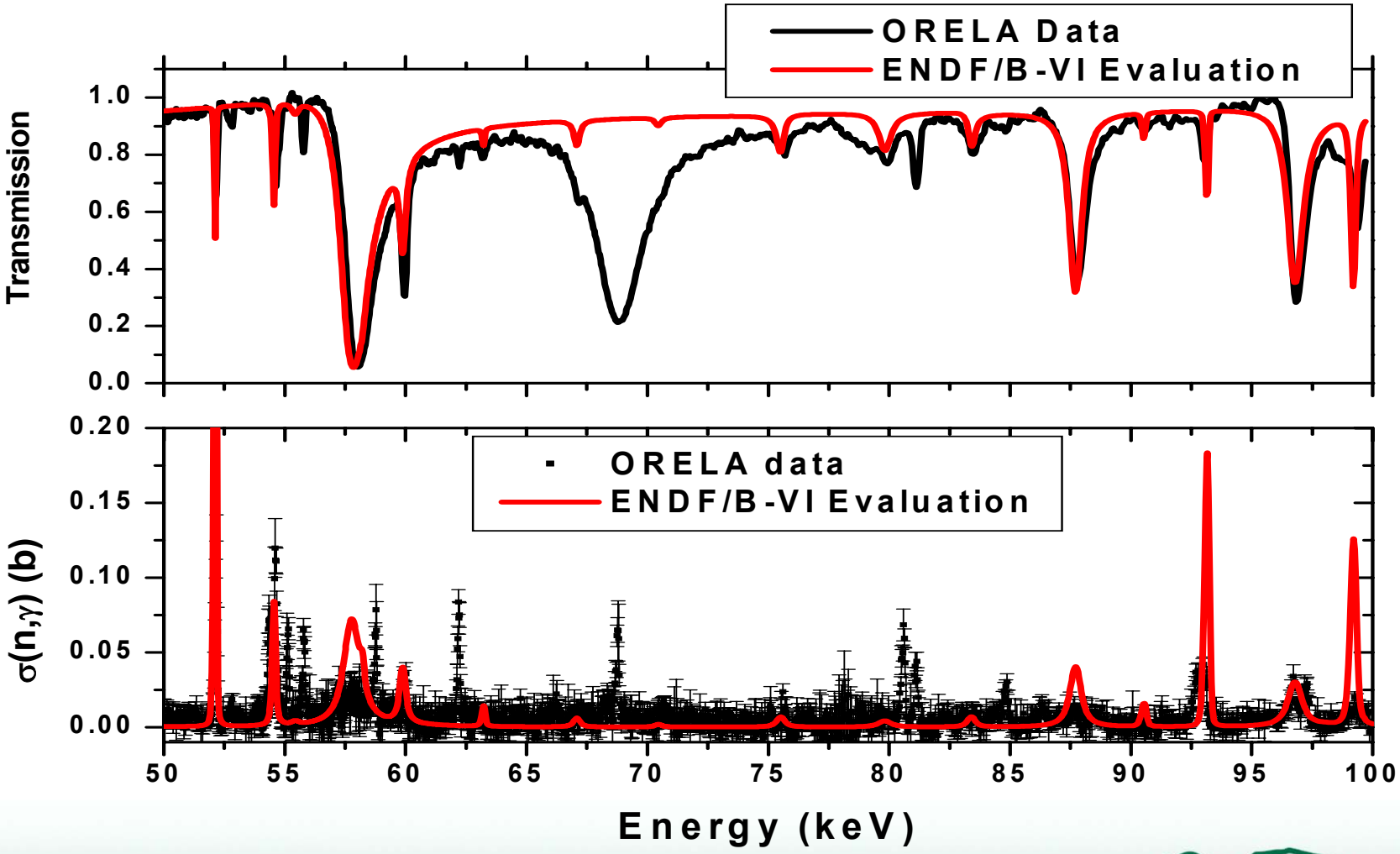
Much of the Old Neutron Data (on Which Current Evaluations Are Based) Are Seriously Incorrect

- Some problems with the old data:
  - Underestimated neutron sensitivity correction
  - Low-energy cut off of 3 keV
  - No high energy (>100 keV) data
  - Incorrect weighting function
  - Poor resolution
  - Poorly characterized samples, i.e. water in the sample

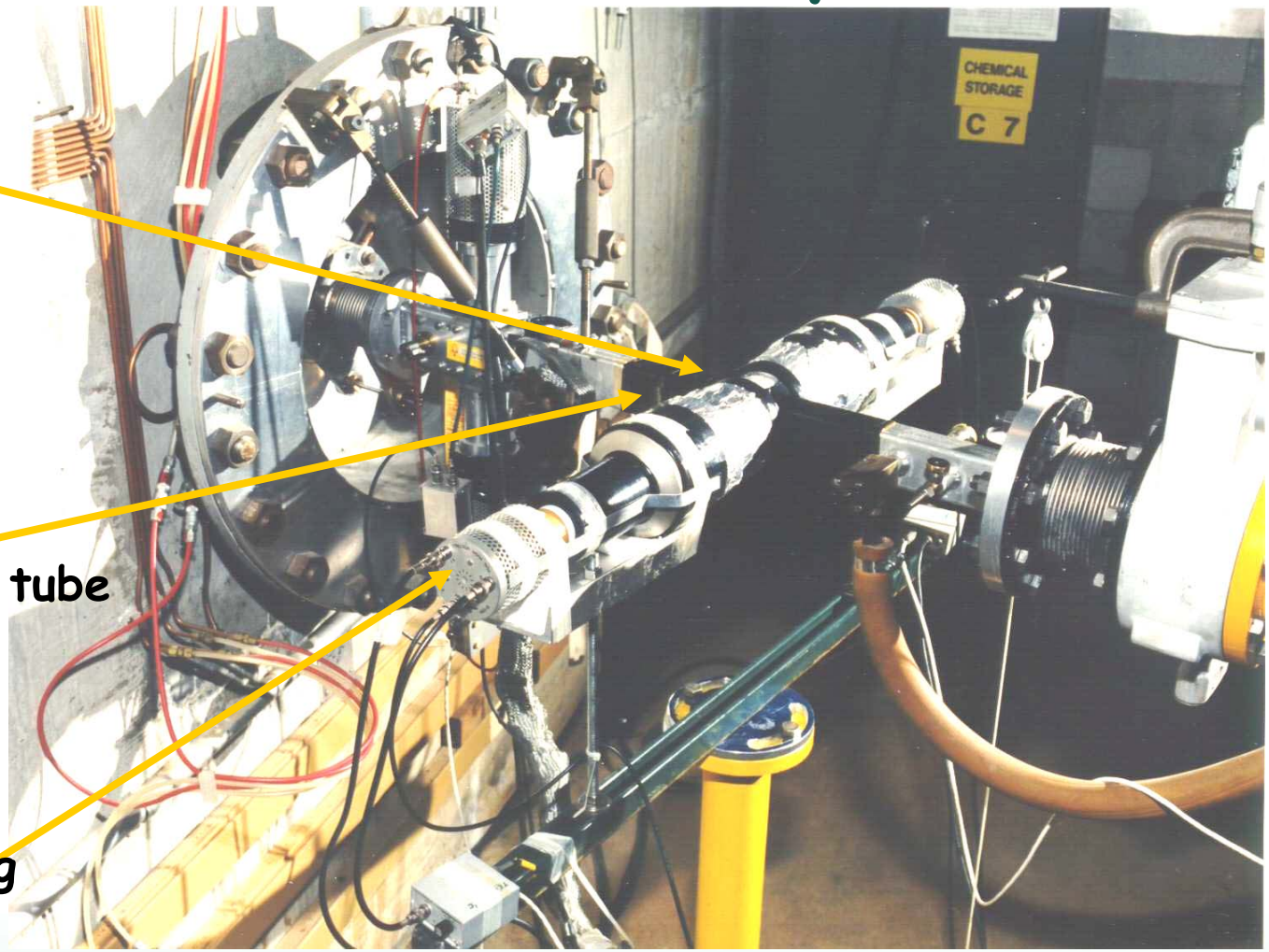


Ex: Large neutron sensitivity of older measurements led to many erroneously-large resonance areas in current evaluations.

ORELA capture and Transmission Data for K compared to ENDF/B VI: Several resonance areas too large (neutron sensitivity) in the evaluation, resonances are missing

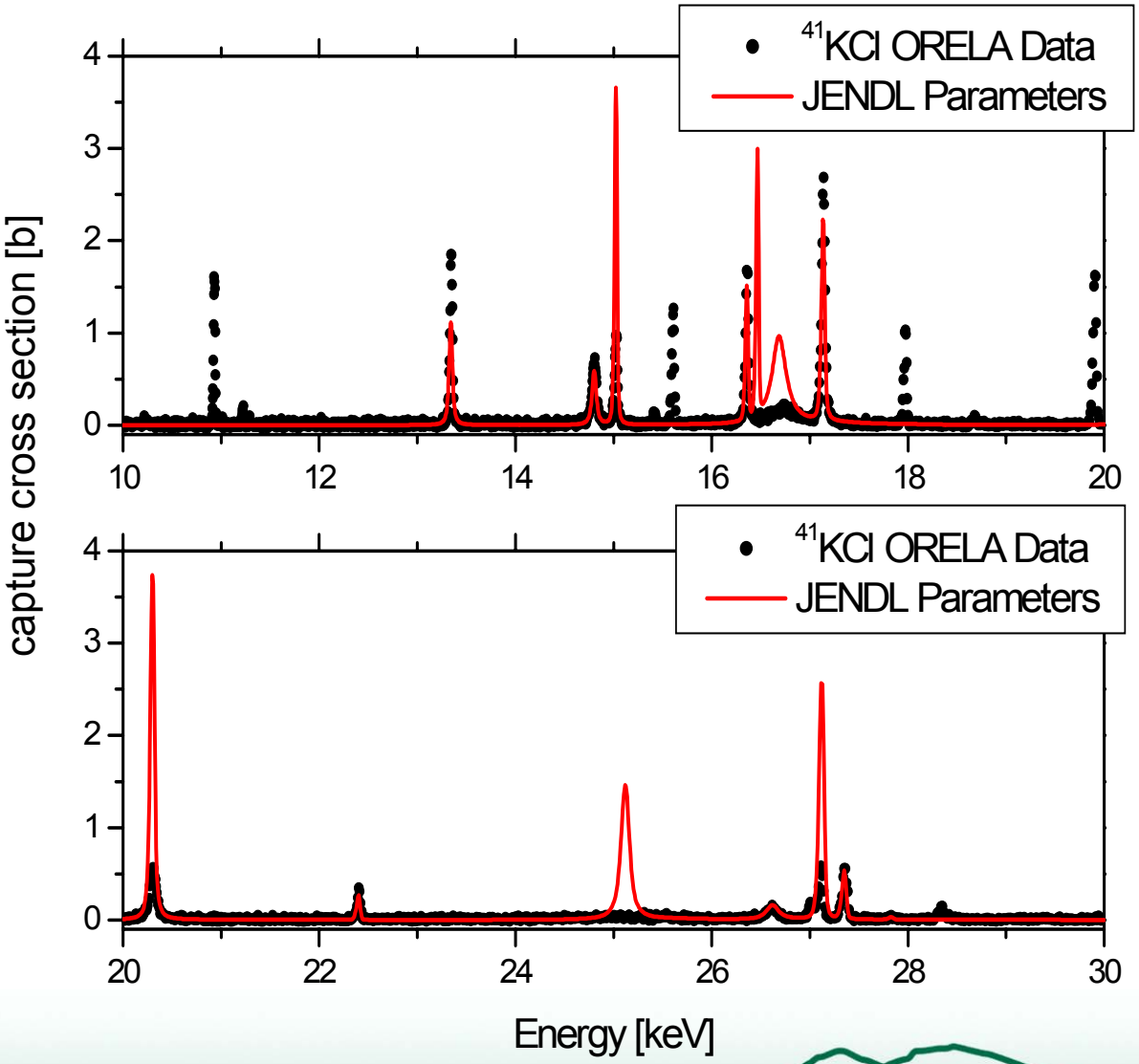


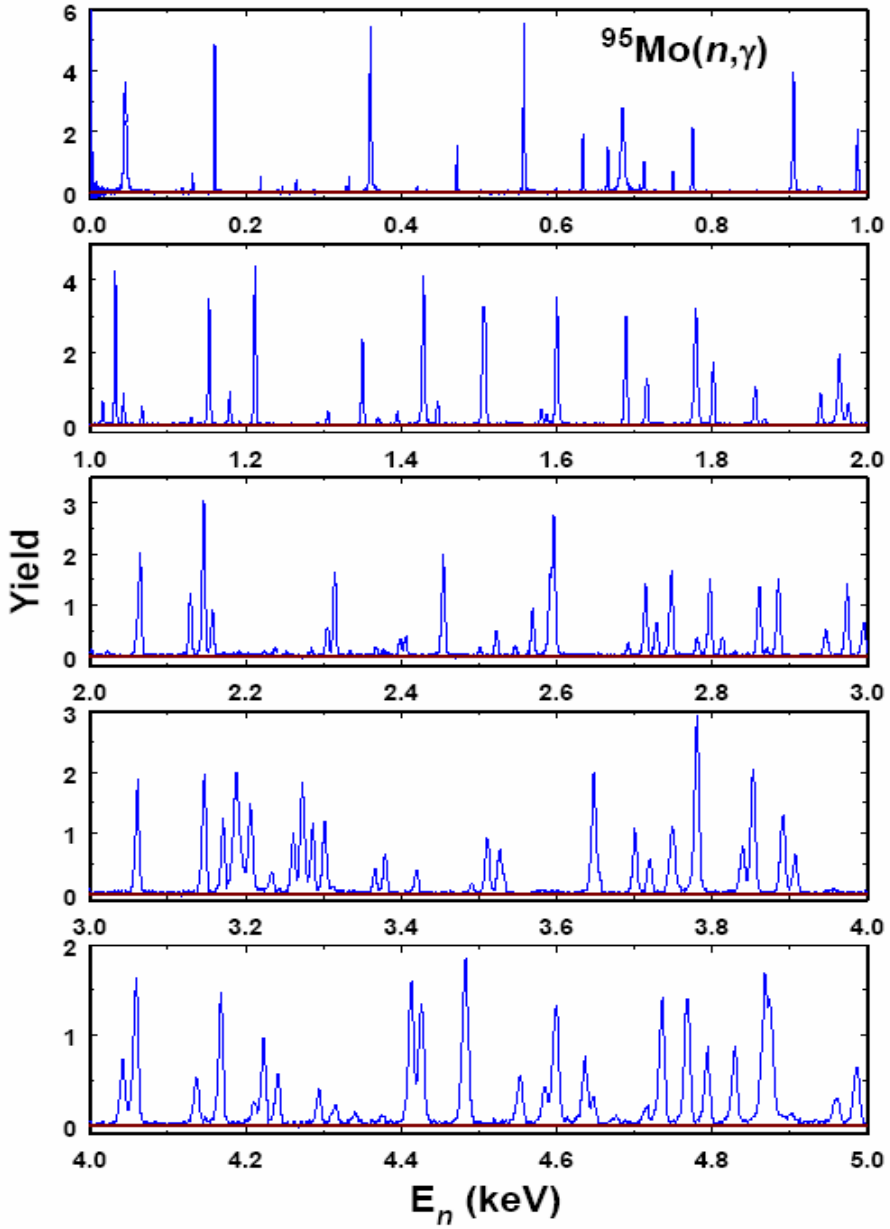
Modified neutron capture apparatus has much reduced neutron sensitivity



Recent ORELA Capture Measurements

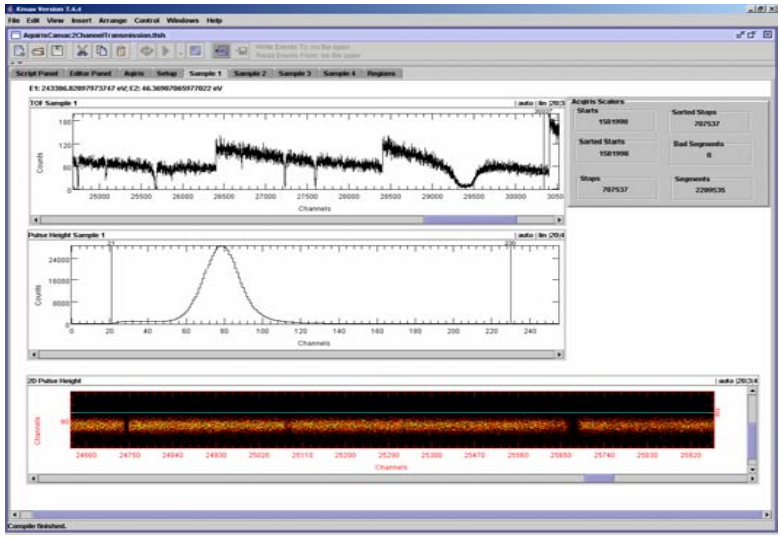
- **^{41}K**
- 99% enriched ^{41}KCl sample
- Flight path 7 at 40 m
- 525 Hz, 8 ns pulse width and 4kW power
- New electron gun design
- Accelerator vacuum remained stable during 3-week run
- Further improvements in power expected as refurbishments and tuning continue

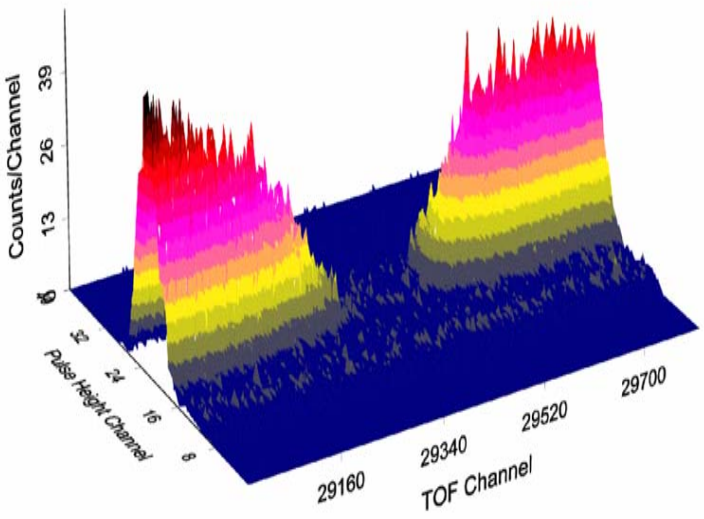




New C_6D_6 Apparatus on ORELA FP6 at 40-m Station

- New system for (n,γ) experiments built in collaboration with JNC.
- Two C_6D_6-detectors.
- L = 38.5 m, 2.5-cm diameter beam at sample.
- ^{6}Li-glass flux monitor.
- First test measurement: ^{95}Mo(n,γ).



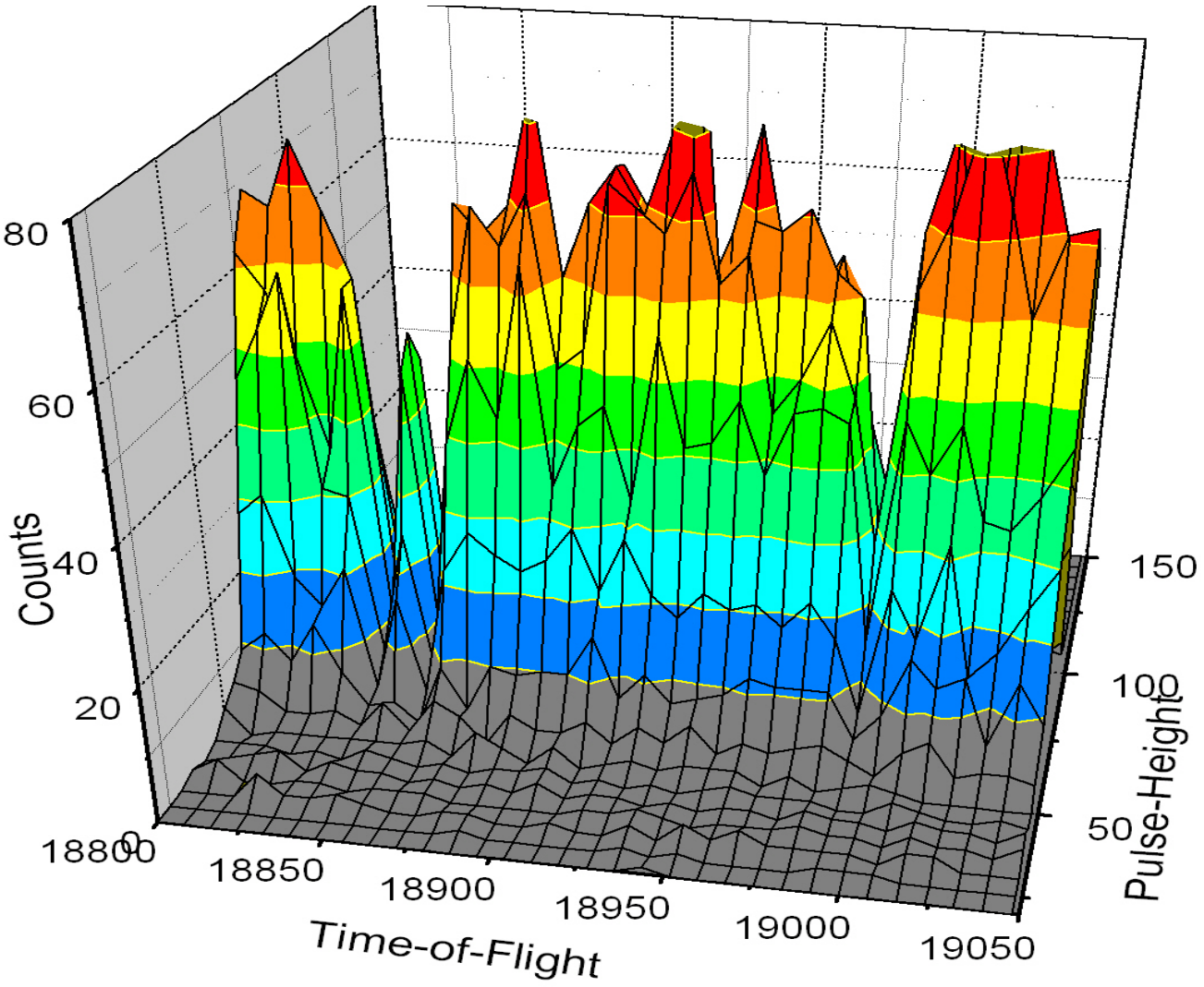


2D: Counts as a function of pulse-height and TOF

New Set-up for Transmission Measurements

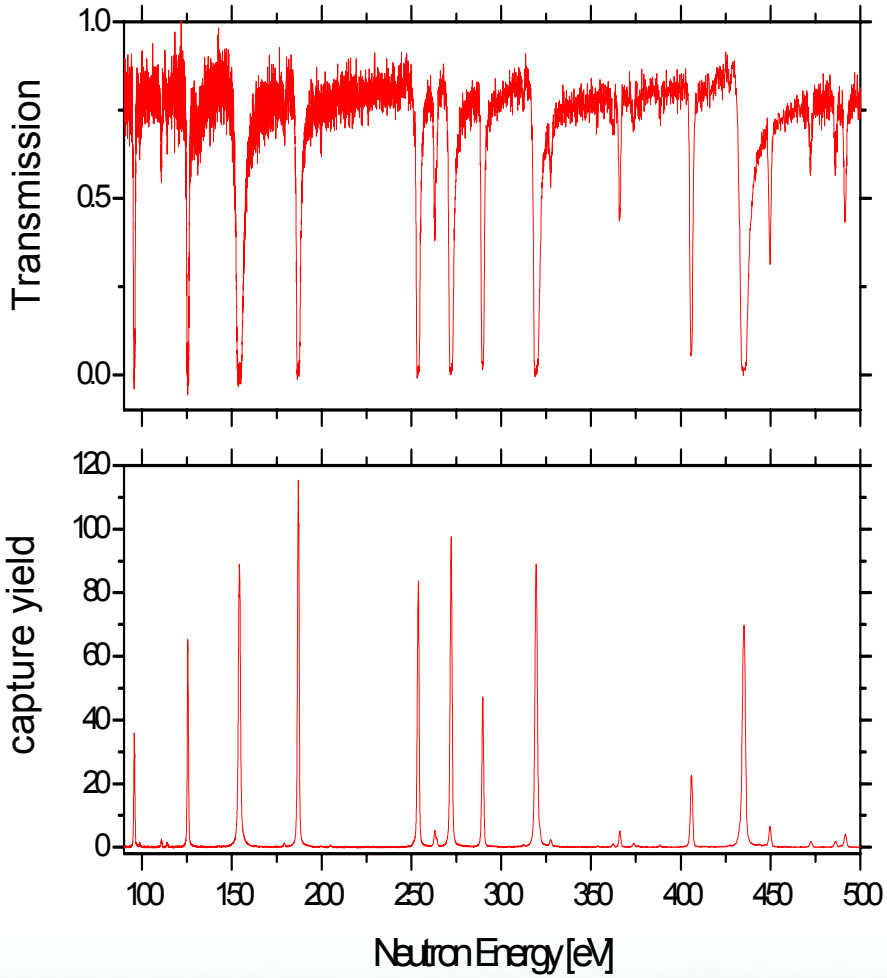
- Time and pulse-height signals are digitized in two channels of an Acqiris digitizer
- Allows to take 2D spectra: Counts as a function of TOF and pulse-height
- Fewer electronic components, thus simpler and more reliable
- Unlimited stops per start
- Easy upgrade path to allow the use of ^{6}Li-glass and NE110 simultaneously in the same transmission measurement. This would allow to cover the whole energy range with the most efficient detector.

More Detail of 2D ^{95}Mo Transmission Data at ORELA

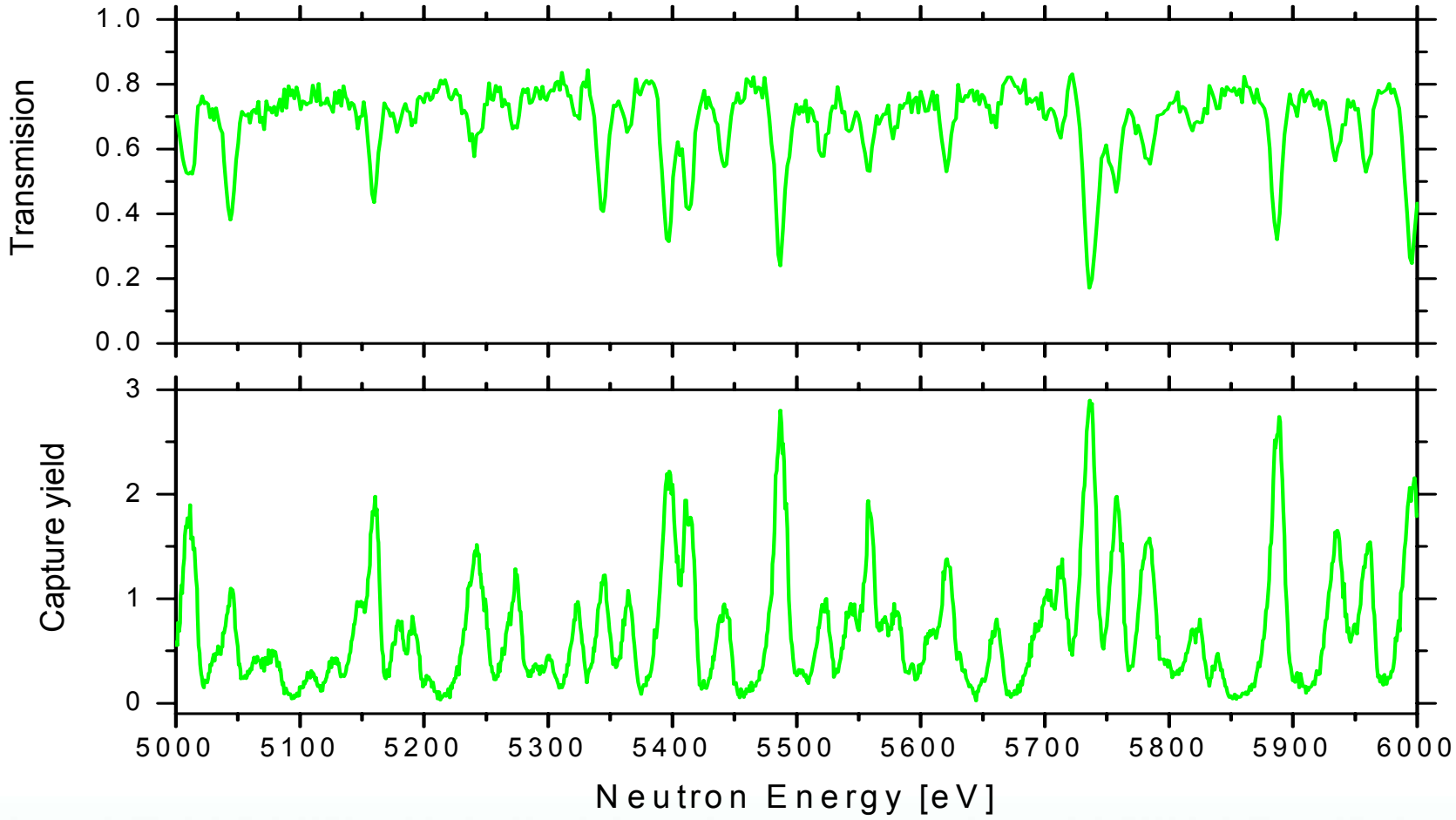


High Resolution Transmission and Capture Data for ^{103}Rh in the low Energy range at GELINA

- Experimental Conditions:
  - 400 Hz and 800 Hz Rep Rate runs
  - Pulse width of the neutron beam 1nsec.
- Two types of experiments were performed:
  - Total cross section (transmission) at 26.45 m flight path with a ^{6}Li glass detector using 0.000337at/b of ^{103}Rh and at 49.32m using a 0.0458at/b sample.
  - Neutron capture using the pulse height weighting technique with two C_6D_6 detectors at a distance of 28.1m. Sample thickness for ^{103}Rh was 0.00187and 0.000337at/b.
- Additional run with background filter were performed, as well as sample out runs.

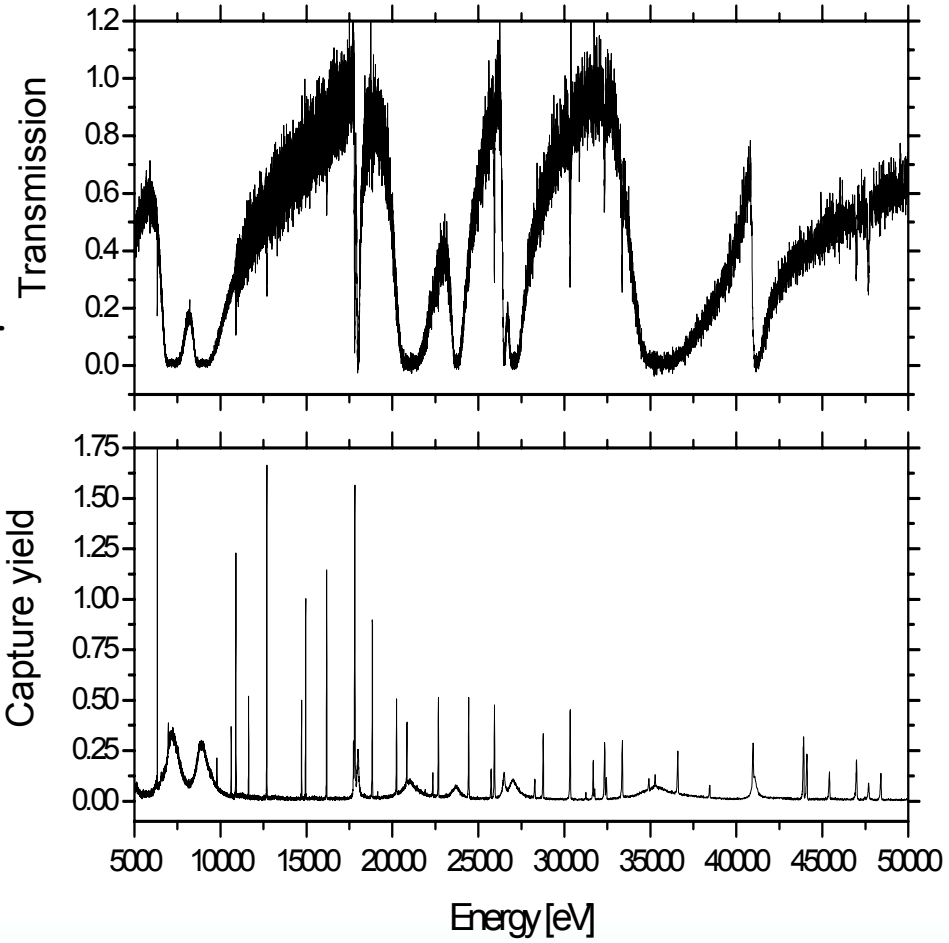


Terra Incognita for Transmission and Capture of ^{103}Rh

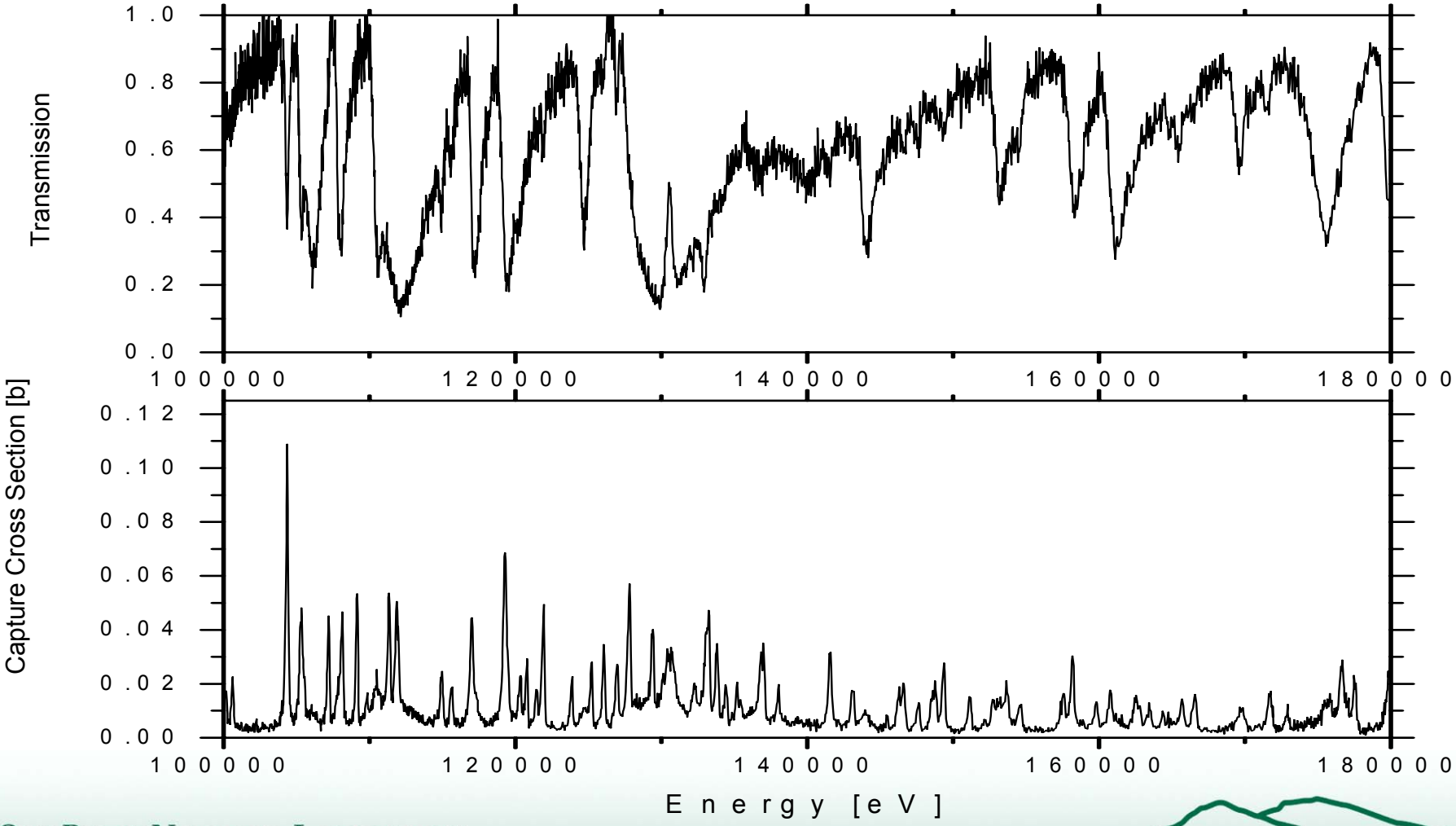


High Resolution Transmission and Capture Data for ^{55}Mn in the keV Energy range at GELINA

- Experimental Conditions:
  - 400 Hz and 800 Hz Rep Rate runs
  - Pulse width of the neutron beam 1nsec.
- Two type of experiments were performed:
  - Total cross section (transmission) at 26.45 m flight path with a ^{6}Li glass detector using ^{55}Mn sample with 0.1182at/b.
  - Neutron capture using the pulse height weighting technique with two C_6D_6 detectors at a distance of 58.1m. Sample thickness for ^{103}Rh was 0.00187and 0.000337at/b.
- Additional run with background filter were performed, as well as sample out runs.



Transmission and Capture for 55Mn in the high Neutron Energy Range



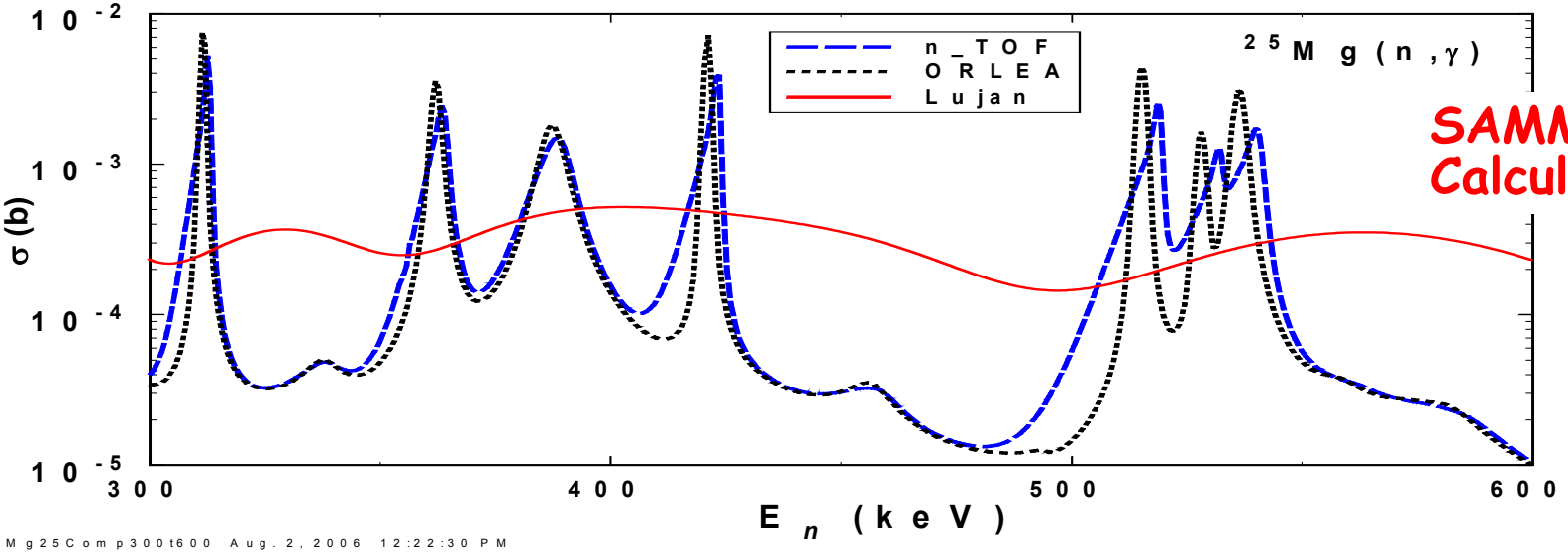
Outlook

- Continue with refurbishment
  Restore power to previous level
  Replace old, worn components
  Build spare electron guns of new design
- Perform new total and capture cross section measurements for the NCSP, i.e. ^{55}Mn, ^{58}Ni, ^{60}Ni, ^{63}Cu, ^{65}Cu
- Continue nuclear astrophysics experiments
  Finish ^{95}Mo(n,γ) and σ_t, ^{64}Zn(n,α)
  Future experiments include (n,γ) and σ_t for ^{86,87}Sr and ^{149}Sm(n,α)

Factors Contributing to TOF Resolution

- Flight path length, L, the longer the better
  L<200 m at ORELA (L=40-80 typical)
- Pulse width, Δt, the shorter the better:
  - Δt>2 ns at ORELA (Δt=8 ns typical)
- Source moderation distance, ΔL (flight path uncertainty), the smaller the better
  - ΔL is a function of neutron production target design
    - ORELA ΔL is small ($\approx$2 cm) because 180 MeV electrons stop in a short distance in Ta target and moderator is small.
  - ΔL typically much larger at spallation sources because high-energy protons require larger target and moderators typically are large and/or optimized for thermal neutron flux.
    - Causes large low-energy tails on resonances.
    - Hinders resolution of closely spaced resonances
    - Produces background in unresolved energy range

The Influence of Resolution



SAMMY Calculations

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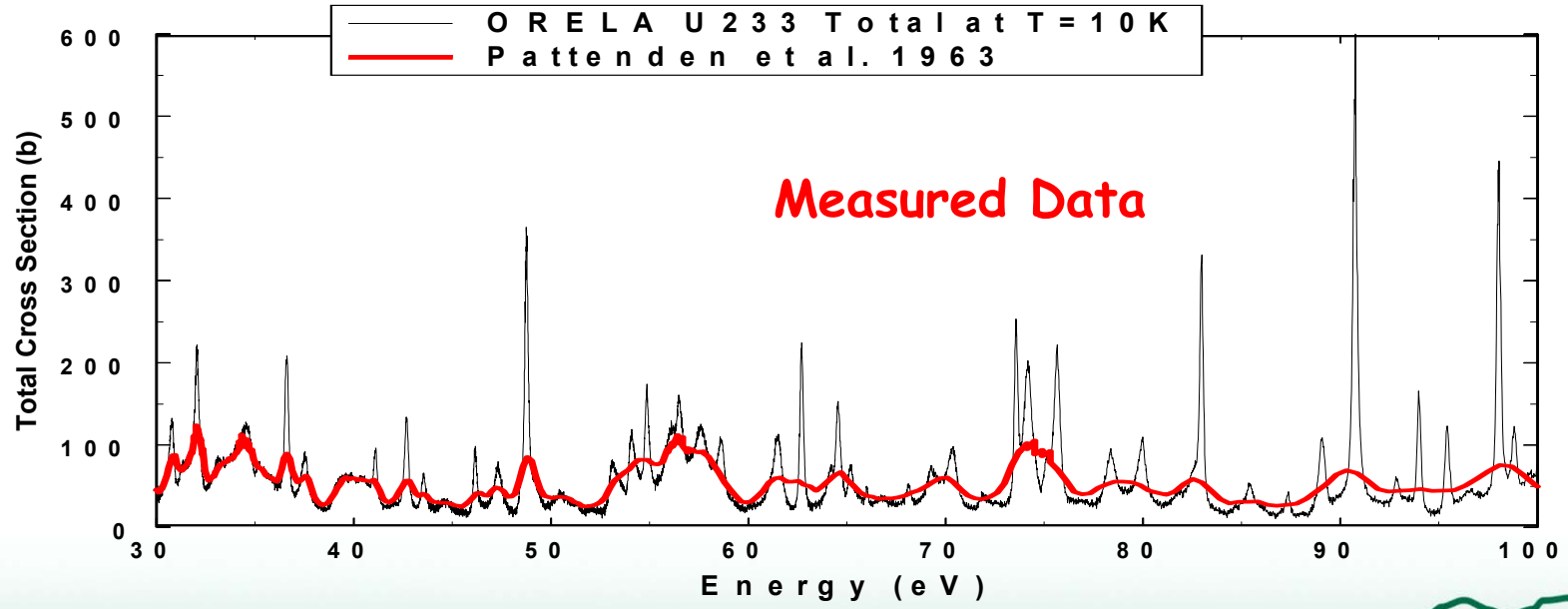

Measured Data

Doppler - Resolution Broadening for ^{241}Pu