

# ORNL nuclear data evaluation contribution to NCSP (ND-2)

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<sup>(\*\*)</sup> GELINA

# $^{51}\text{V}$ and $^{103}\text{Rh}$ resonance evaluations

Isotope	Energy Range	Resonance Covariance Evaluation	Target date for delivery the evaluation
$^{51}\text{V}$	Thermal to 200 keV	RR + CV	Complete
$^{103}\text{Rh}$	Thermal to 8 keV	RR + URR (NNL) + CV	Complete

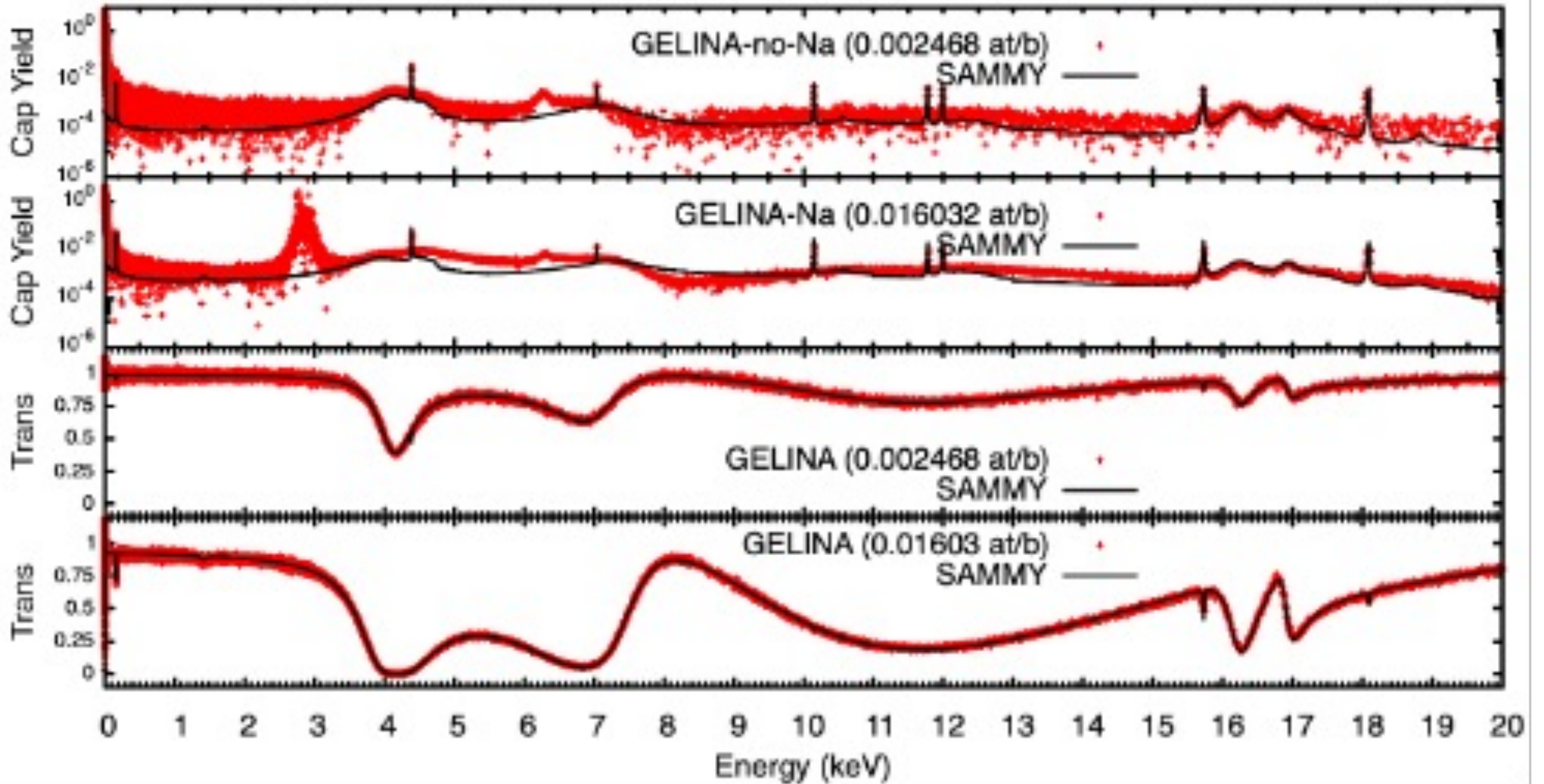
# **$^{51}\text{V}$ resonance evaluation features**

- Issues with resonance spin representation
- Extension of the resonance region from 100--200 keV
- SAMMY R-matrix analysis
- Transmission, capture yield data from GELINA used to extend the evaluation up to 200 keV
- Improve benchmark integral representation
- Use of LRF=7 for resonance parameter representation and LCOMP=2 (compact formalism)
- Covariance generation

# $^{51}\text{V}$ resonance evaluation measured data

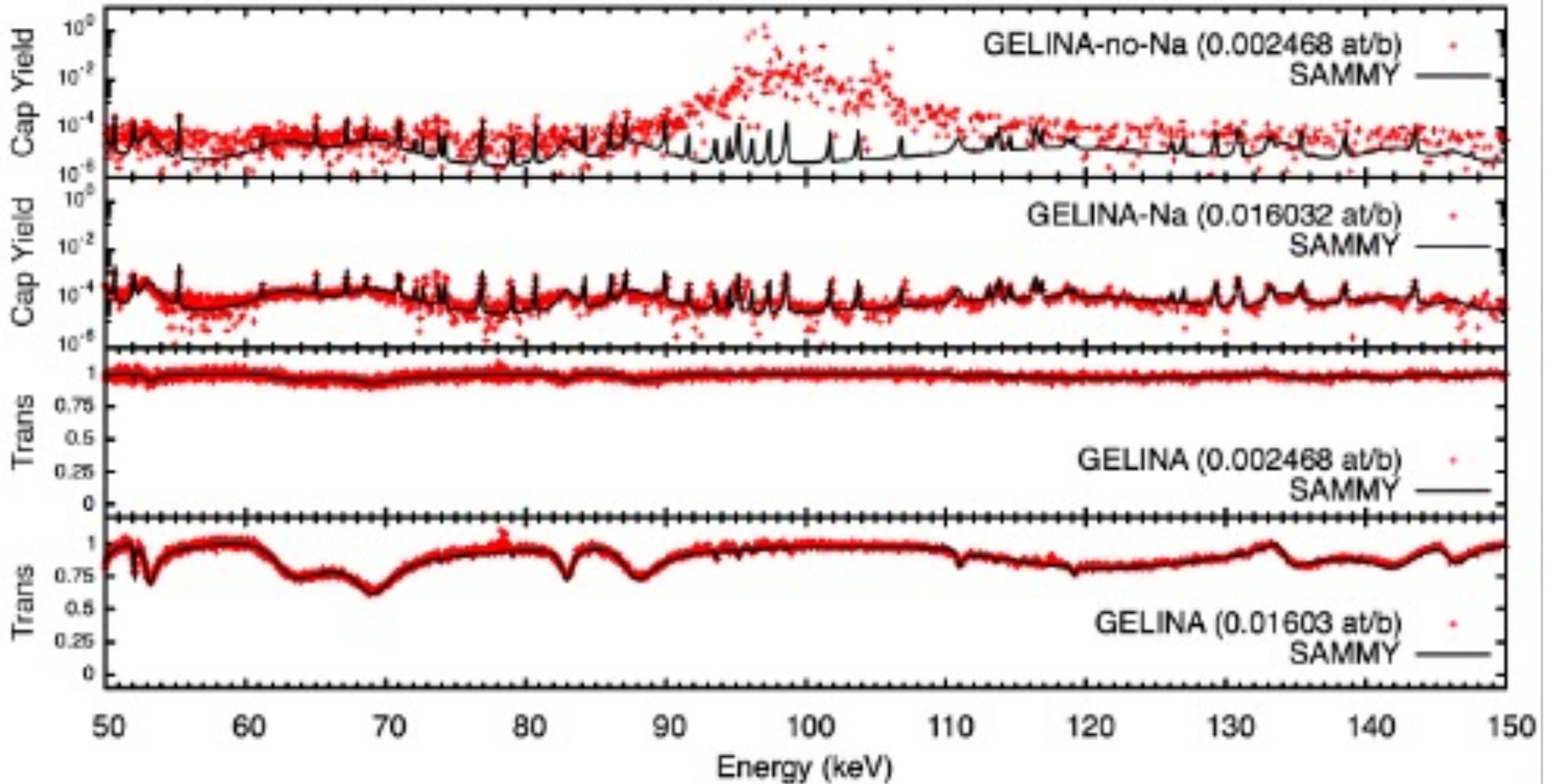
Data	Energy Range	Areal Number Density (at/b)	Flight-Path Length (meters)
Transmission	8 eV – 200 keV	0.016032	47.640
Transmission	8 eV – 200 keV	0.002468	47.640
Capture Yield	12 eV – 200 keV	0.016032	58.586
Capture Yield	12 eV – 200 keV	0.002468	58.586

# SAMMY fitting results for $^{51}\text{V}$

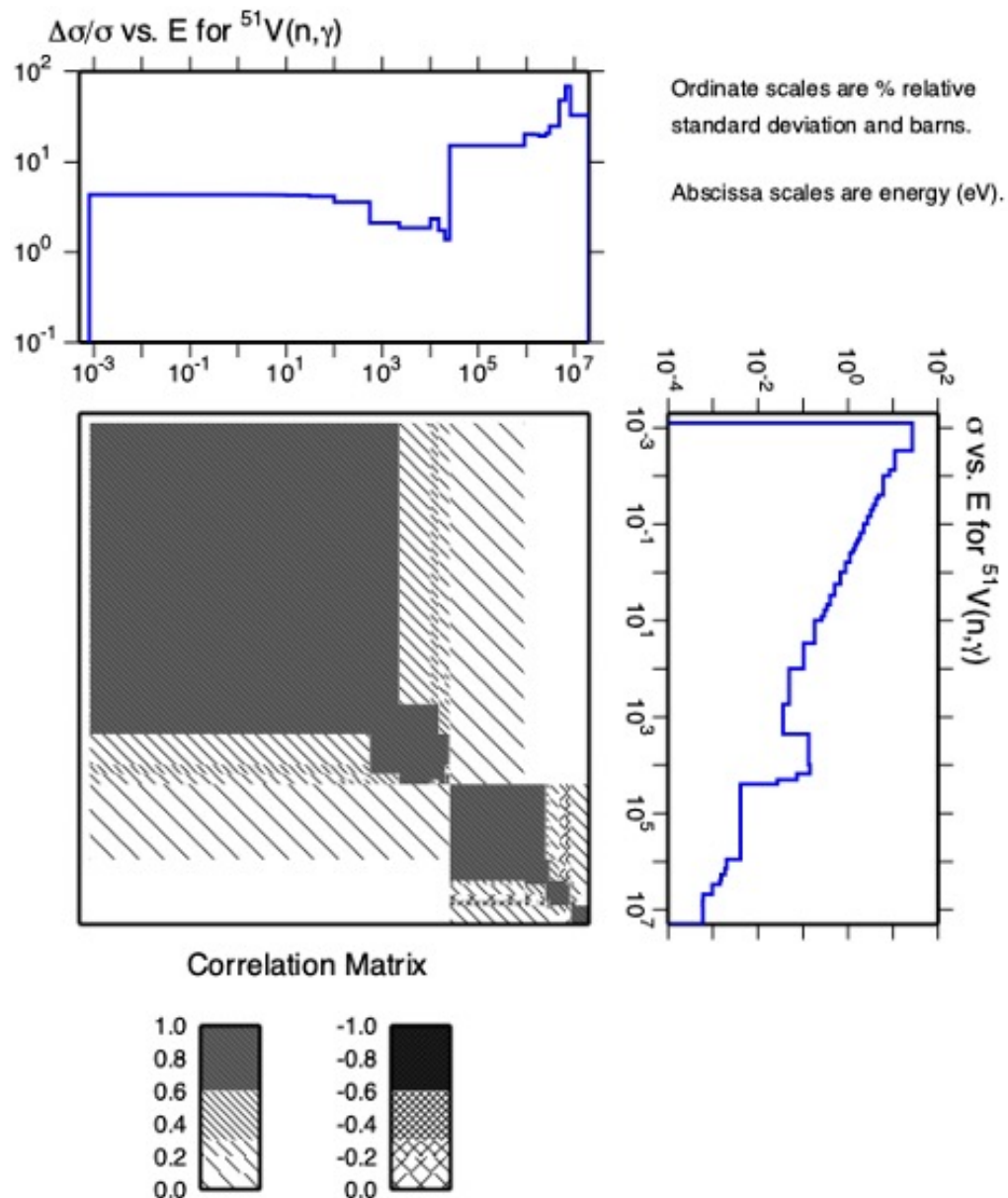




# SAMMY fitting results for $^{51}\text{V}$



# $^{51}\text{V}$ Capture covariance and thermal constants



Cross Sections and Resonance Integral	ORNL (barns)	ATLAS (barns)
$\sigma_t$	9.80(21)	—
$\sigma_\gamma$	4.88(21)	4.94(4)
$\sigma_s$	4.92(6)	4.90(6)
$I_\gamma$	2.57(23)	—

# $^{103}\text{Rh}$ resonance evaluation features

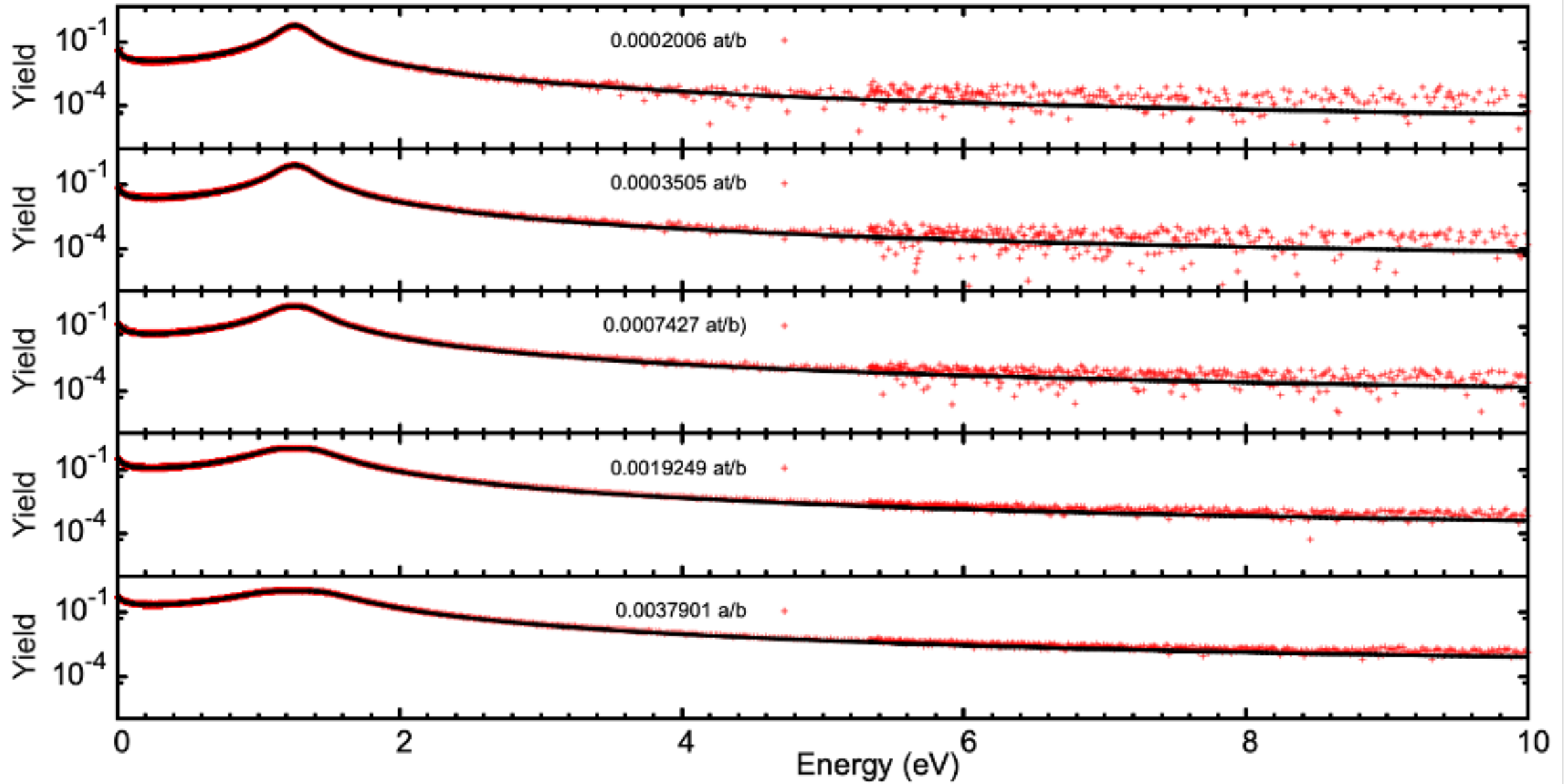
- Issues with resonance spin representation
- Extension of the resonance region from 4--8 keV
- SAMMY R-matrix analysis
- Transmission, capture data from GELINA used to extend the evaluation up to 8 keV
- Transmission, capture data from RPI used to extend the evaluation up to 2 keV
- Improve benchmark integral representation
- Covariance generation



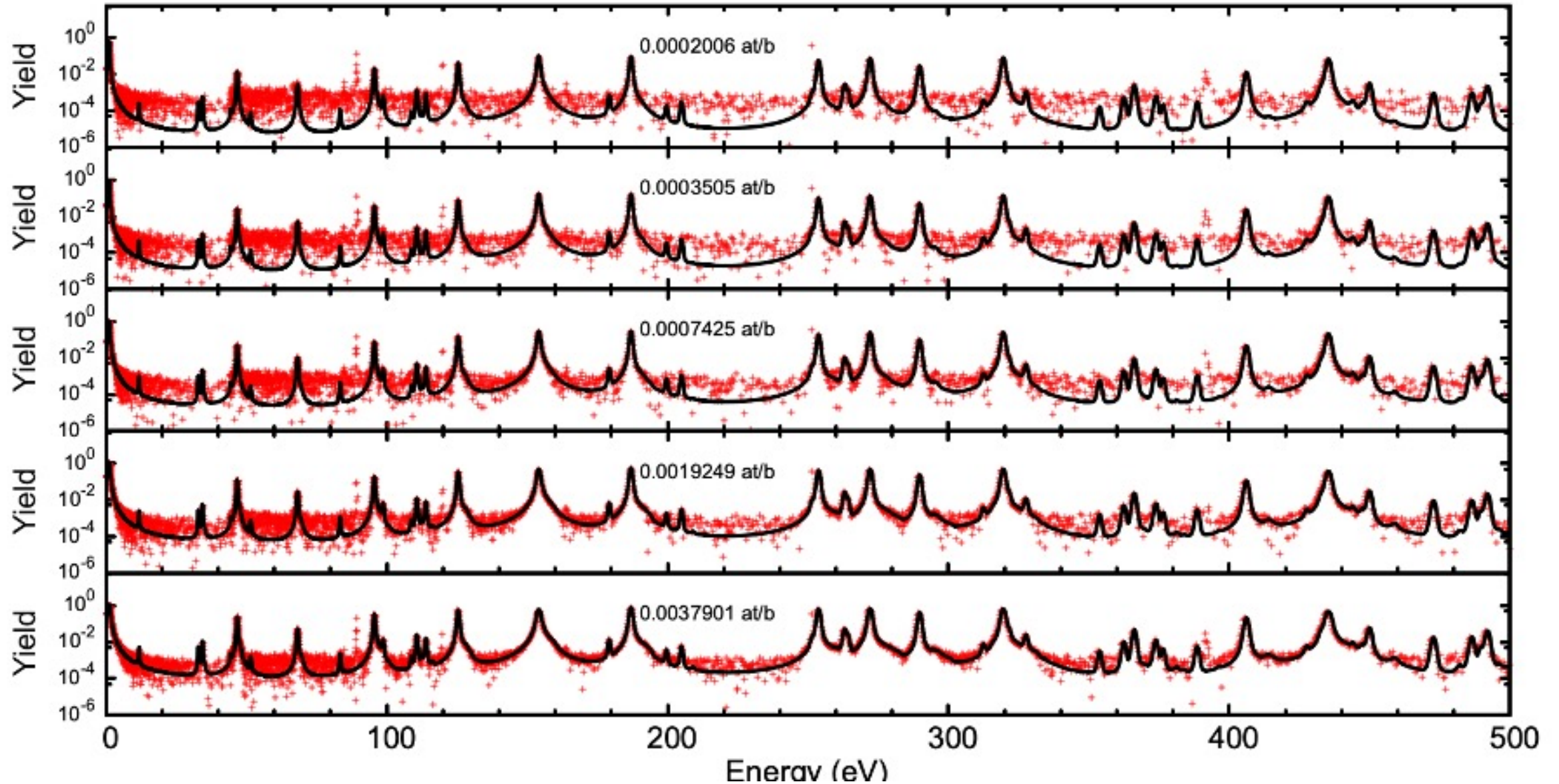
# <sup>103</sup>Rh resonance evaluation (GELINA Data)

Reference	Energy Range (eV)	Data
Transmission		
Brusegan	0.4 – 1000	49.3 m, 0.002207 at/b
Brusegan	0.4 – 1000	49.3 m, 0.000337 at/b
Ribon	18.0 – 95.0	53.7 m, 0.00608 at/b
Ribon	84.0 – 503.0	53.7 m, 0.0001487 at/b
Ribon	178.0 – 757.0	53.7 m, 0.05 at/b
Ribon	600.0 – 4000.0	103.7 m, 0.02435 at/b
Mihailescu	1.85 – 8000.0	49.343 m, 0.0458 at/b
Capture		
Brusegan	0.01 – 1000	14.3624 m, 0.00187 at/b
Mihailescu	1.72 – 8000.0	28.814 m, 0.000337 at/b
Mihailescu	1.72 – 8000.0	28.814 m, 0.00187 at/b

# SAMMY fitting results for $^{103}\text{Rh}$ (RPI data - thermal)

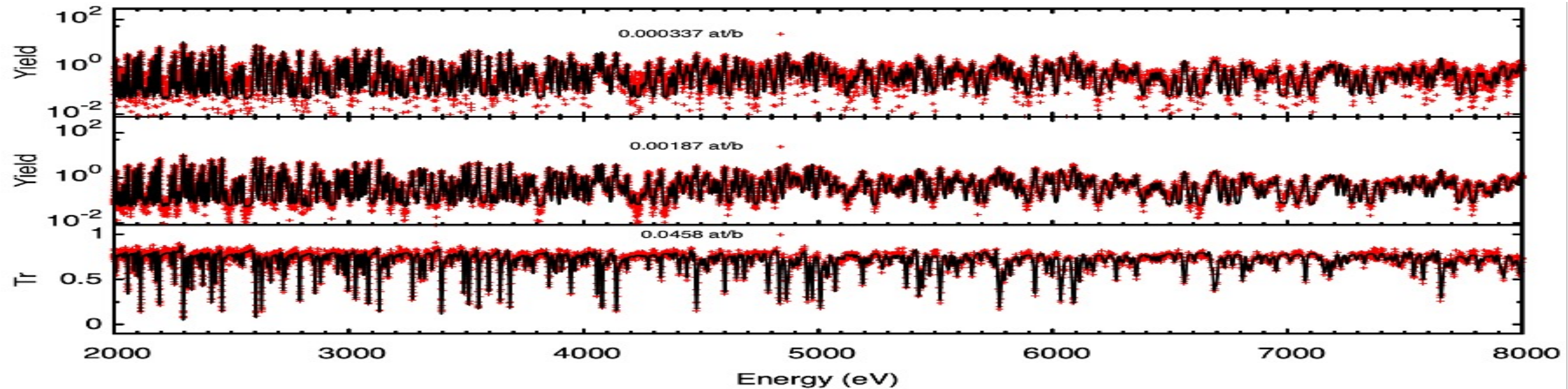
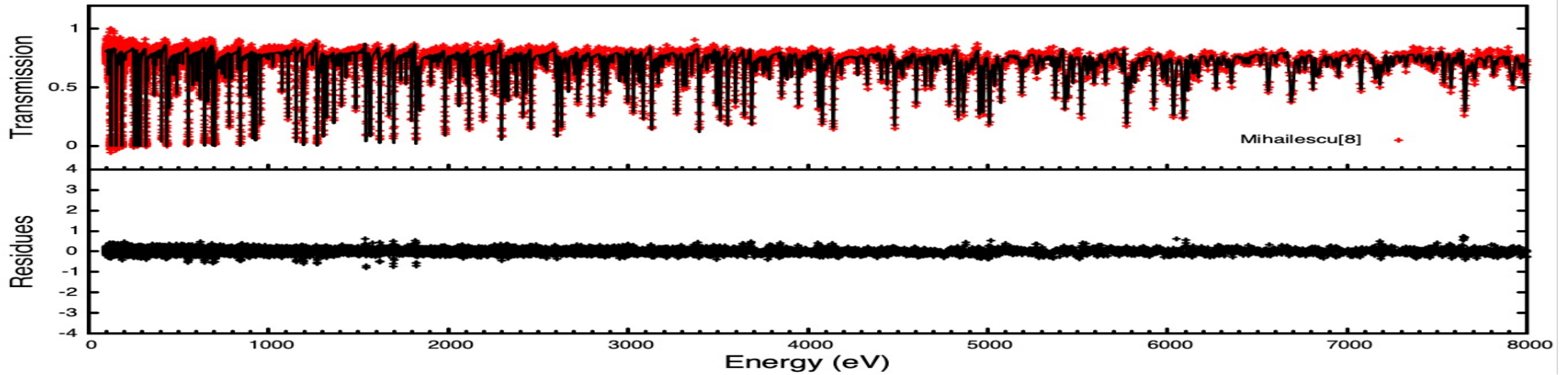


# SAMMY fitting results for $^{103}\text{Rh}$ (RPI data)

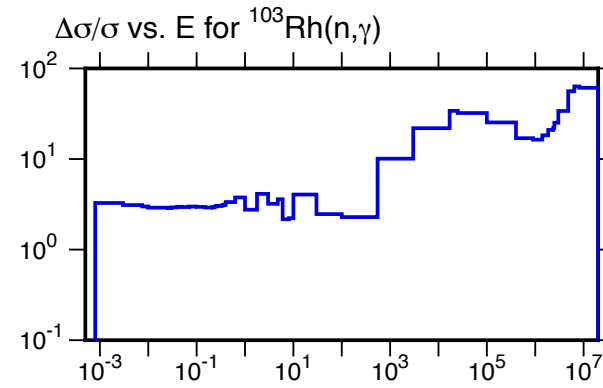




# SAMMY fitting results for $^{103}\text{Rh}$ (GELINA data)

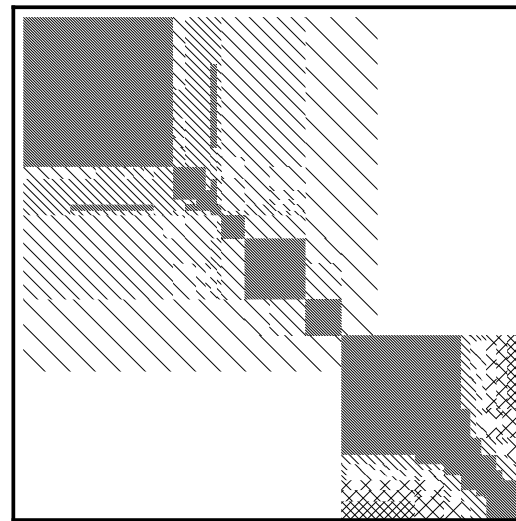


# $^{103}\text{Rh}$ capture covariance

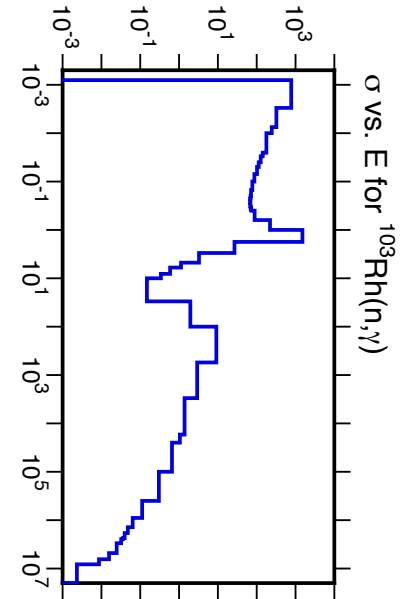
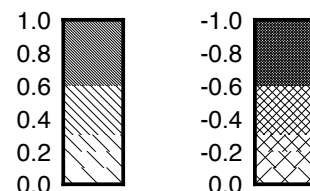


Ordinate scales are % relative standard deviation and barns.

Abscissa scales are energy (eV).

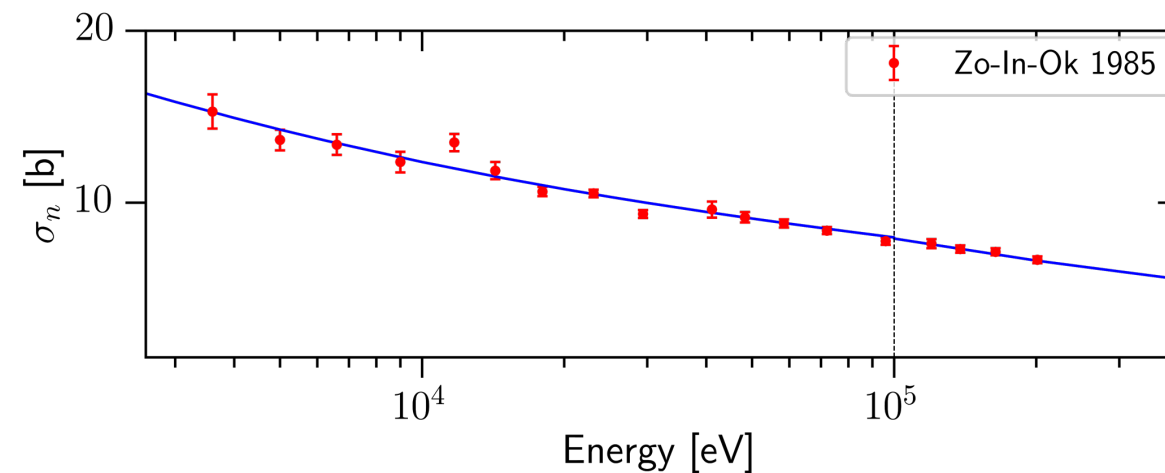
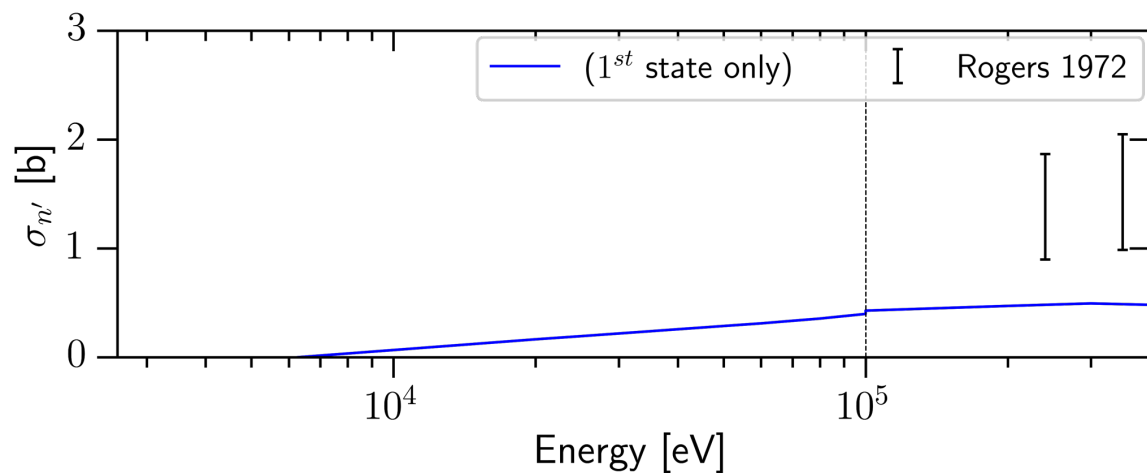
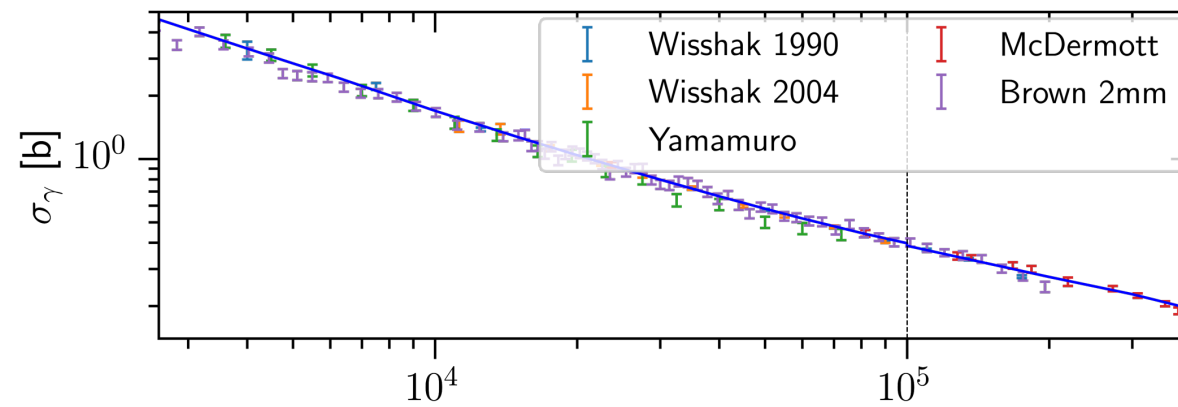
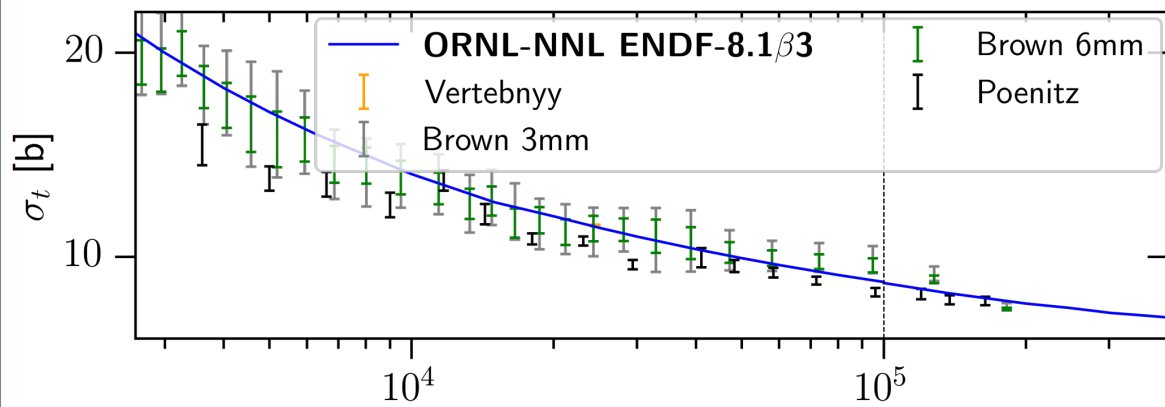


Correlation Matrix





# $^{181}\text{Ta}$ evaluation - update for ENDF/B-VIII.1 $\beta$ 3

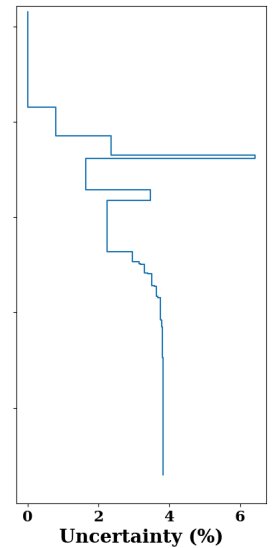
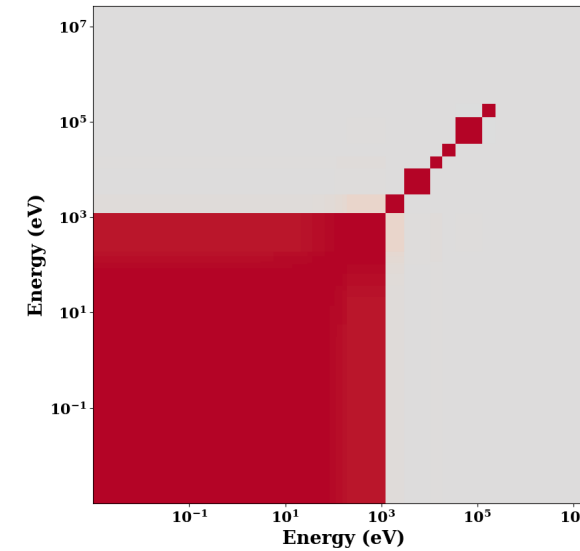
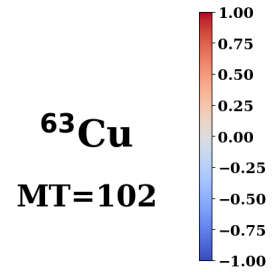
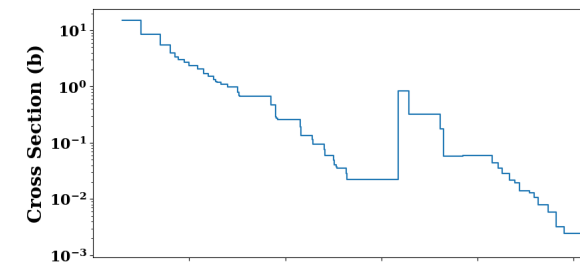
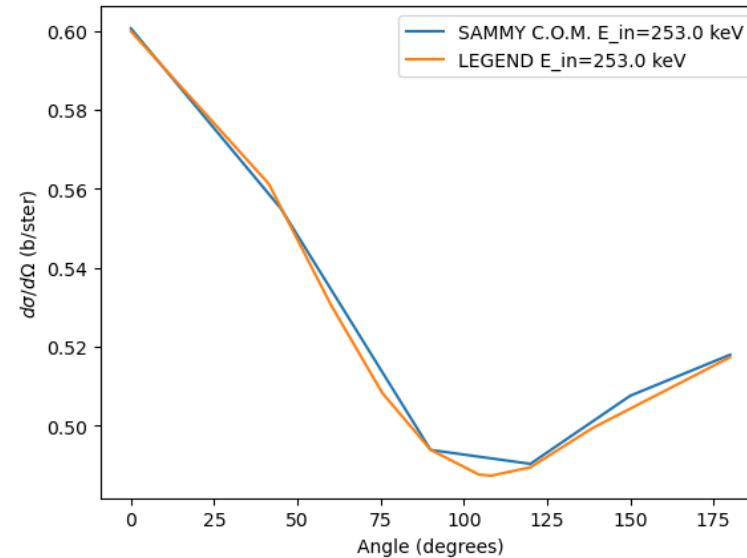
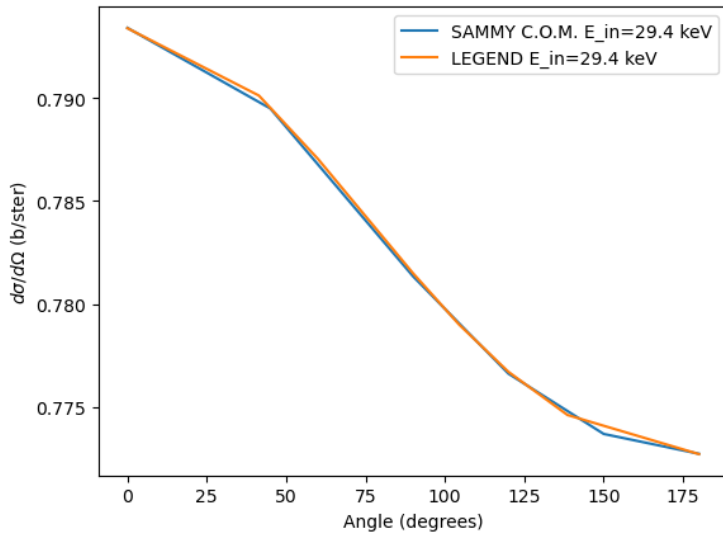


- RRR (ORNL/NNL < 2.5 keV) + **URR (ORNL)** + Fast Range (> 100 keV LANL)
- RPI-12mm data for validation rather than fitting - Changed:  $\sigma_{tot}, \sigma_\gamma, \sigma_n, \sigma_{n'} \sim -1\%$  around 2-20 keV

Insignificant changes to PMM003

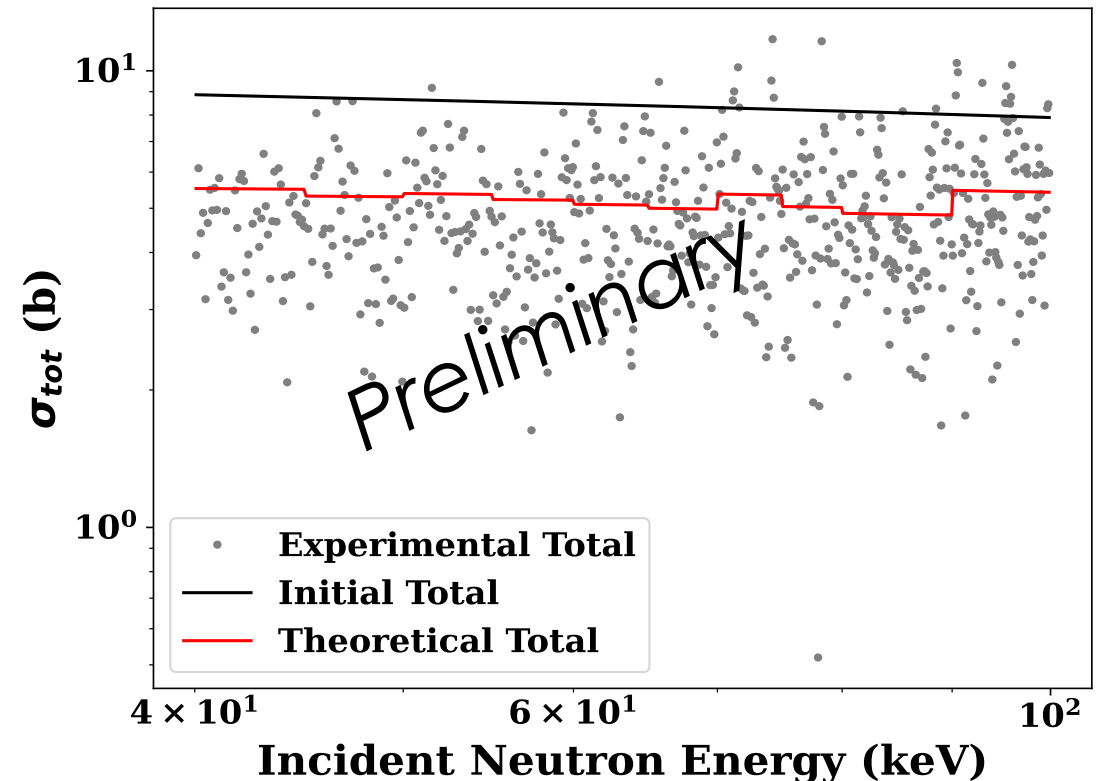
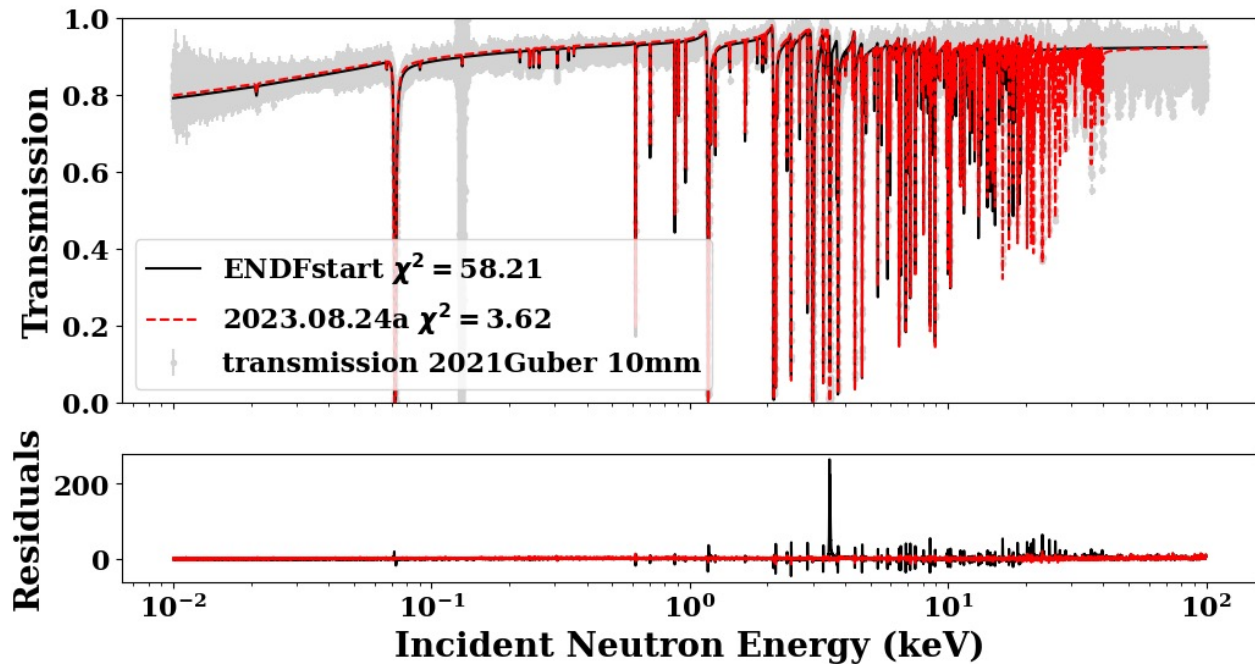
# $^{63,65}\text{Cu}$ resolved resonance range

- Preparations for ENDF/B-VIII.1:
  - Covariance analysis in the resolved resonance region (right)
  - *Validated* that SAMMY calculates angular distributions from resonance parameters correctly (below)



# $^{139}\text{La}$ resolved and unresolved energy range

- Extended resolved resonance region from 20 keV to 40 keV, fitting to recent transmission and capture data measured by Guber et al at GELINA.
- Unresolved resonance region parameterization from 40 keV to 100 keV. [in progress – to be completed FY2024]



# $^{140,142}\text{Ce}$ resolved resonance range (report completed)

- RRR evaluation completed
  - Technical report: <https://www.osti.gov/biblio/2217725>
- External testing showed unrealistically small uncertainties
- Covariances were adjusted to give more reasonable uncertainties
  - Submitted to ENDF/B-VIII.1  $\beta$ 2 repository for review
- Updated resonance parameters and covariances submitted to NNDC for inclusion in ENDF/B-VIII.1 release

# Evaluations on fissile actinides

Milestone: planned by FY24 

Submitted to ENDF/B repository 

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233

## Features:

- Updates to thermal constants and PFNS
- Fourfold extension up to 2.5 keV
- Increased (n,f)
- Fission >> capture
  - Small changes in fission => capture largely impacted (important for criticality)
- Neutron multiplicities
- Criticality benchmarks (thermal) fixed in ENDF/BVIII.1β3.

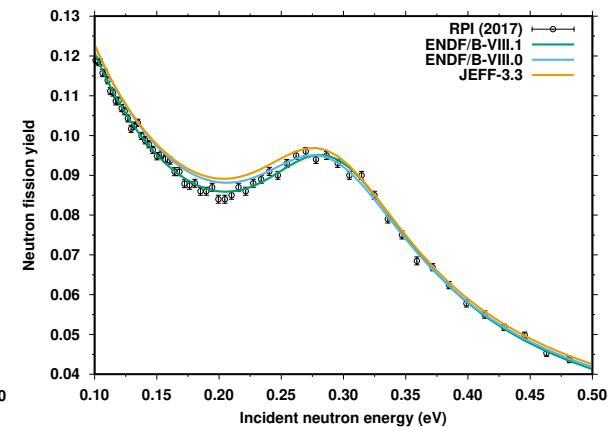
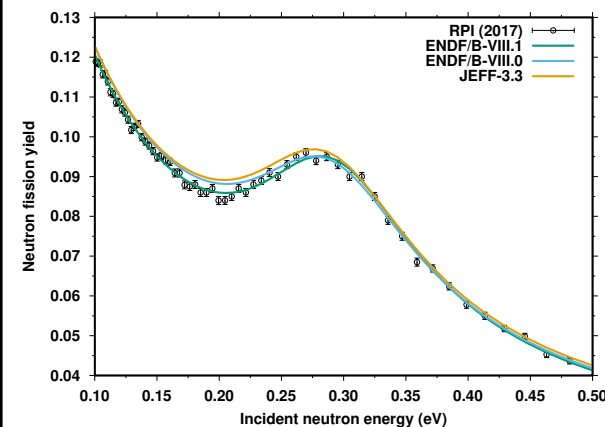
Milestone: planned by FY24 

Submitted to ENDF/B repository 

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## Features:

- Minor updates to the low-lying resonance
- Overall performance preserved
- Small impact on depletion





# Evaluations on fissile actinides

Milestone : planned by FY25 

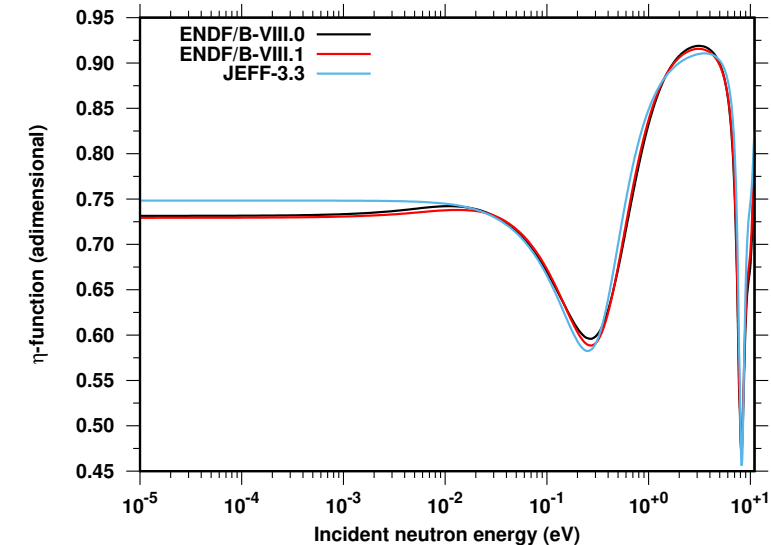
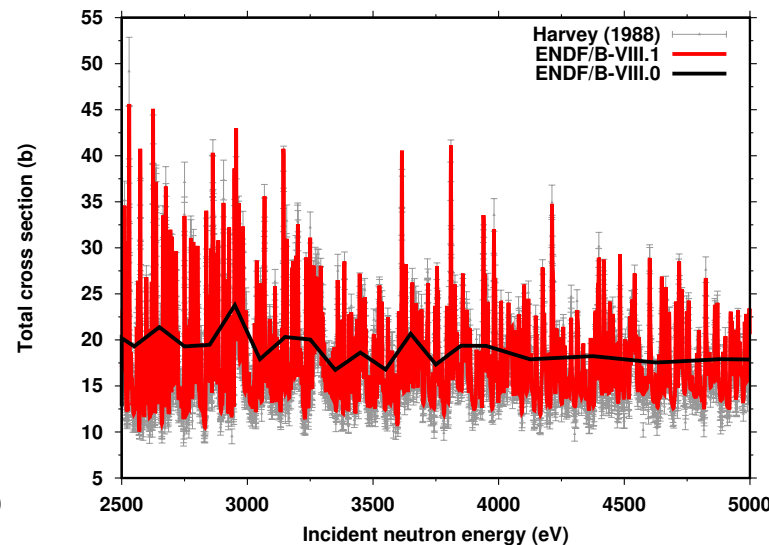
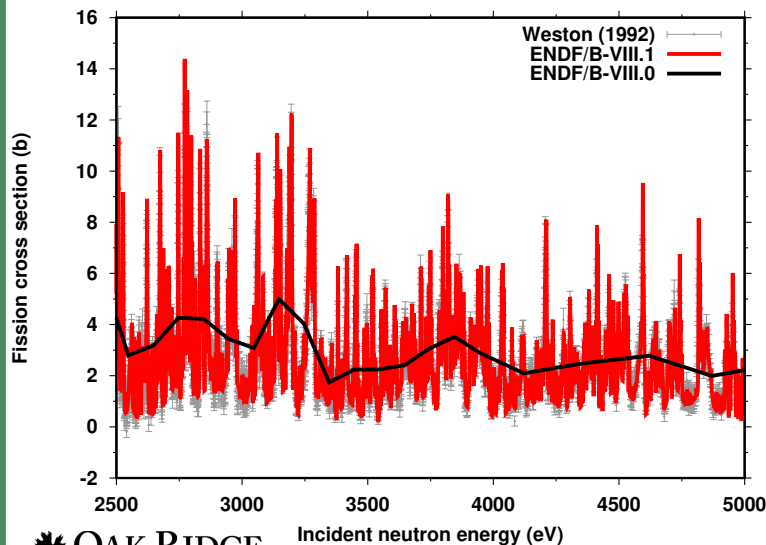
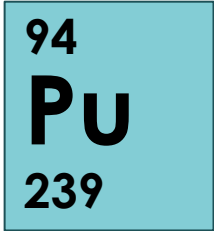
Submitted to ENDF/B repository 

Features:

- Updates to thermal constants and PFNS
- Twofold extension up to 5 keV
- Sub-thermal ratio capture-to-fission trend
- Fluctuating neutron multiplicities

○ Key-points in reactivity

- Mistral-2:  $\approx 0.0253$  eV
- Depletion:  $\approx 0.3$  eV
- Criticality: up to  $\approx 10$  eV



# Evaluations on alkaline earth-metals and halogens

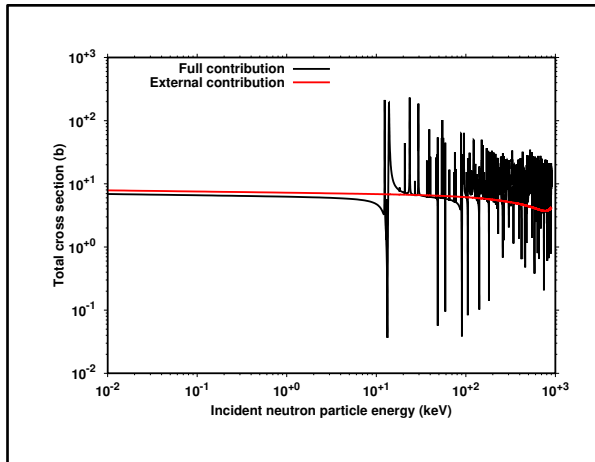
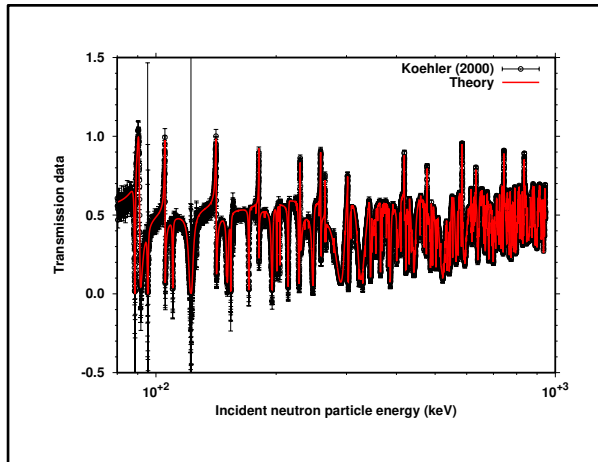
Milestone: completed ✓

Submitted to ENDF/B repository ✓

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Features:

- Novel external contribution
- Threefold extension up to 1 MeV
- Updated thermal capture value



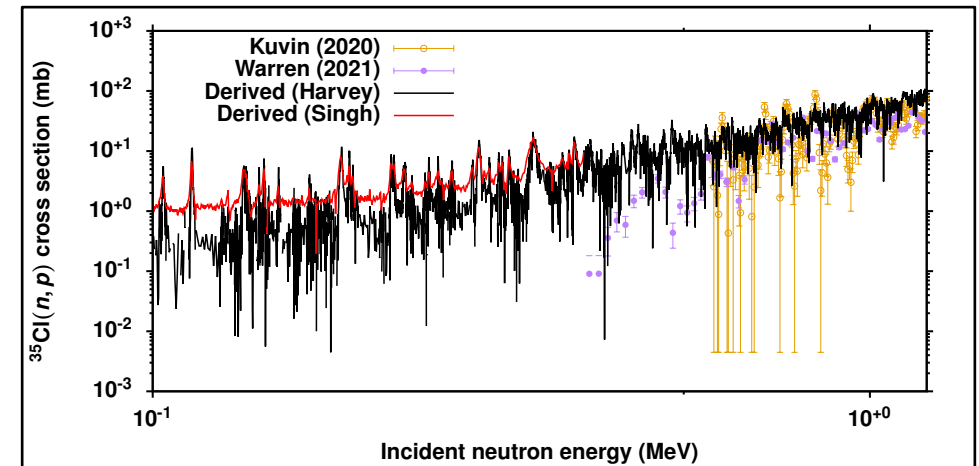
○ Reference : ORNL/LTR-2023/3004

Milestone: planned by FY25 ⌚

Features (in progress):

17  
Cl  
35,37

- Updating boundary condition
- Particle pairs including  $\alpha$ -particle emission
- Updating proton reaction channel
  - Quantification of missing data



○ Reference : Progress in Nuclear Energy 157 (2023)

# Evaluations on alkaline earth-metals and halogens

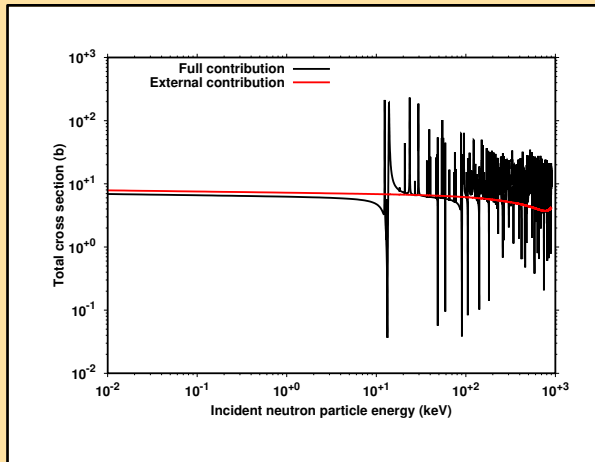
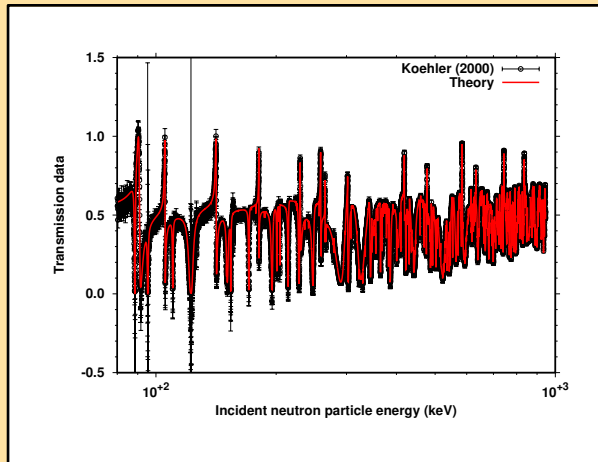
Milestone: completed ✓

Submitted to ENDF/B repository ✓

Features:

- Novel external contribution
- Threefold extension up to 1 MeV
- Updated thermal capture value

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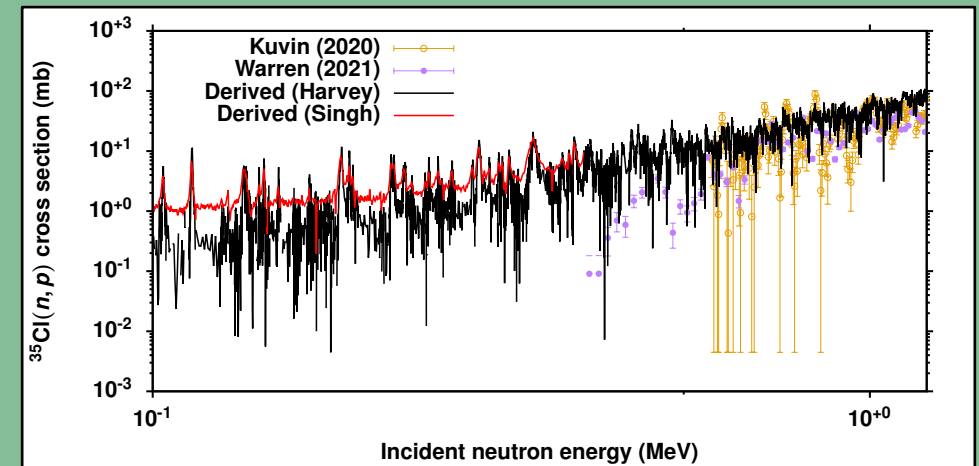
○ Reference : ORNL/LTR-2023/3004

Milestone: planned by FY25 ⌚

Features (in progress):

- Updating boundary condition
- Particle pairs including  $\alpha$ -particle emission
- Updating proton reaction channel
  - Quantification of missing data

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Cl  
35,37



○ Reference : Progress in Nuclear Energy 157 (2023)

# ACKNOWLEDGMENTS

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Thank you!