

# ORNL contributions to the ENDF/B-VIII.1 library

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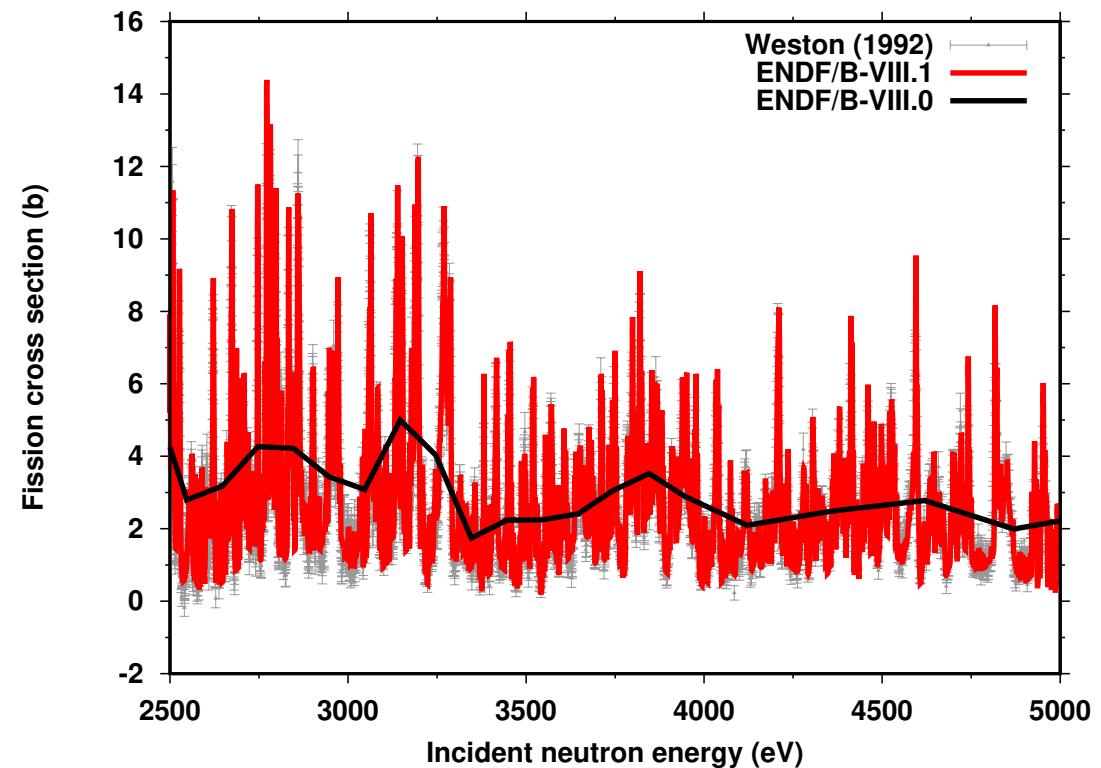
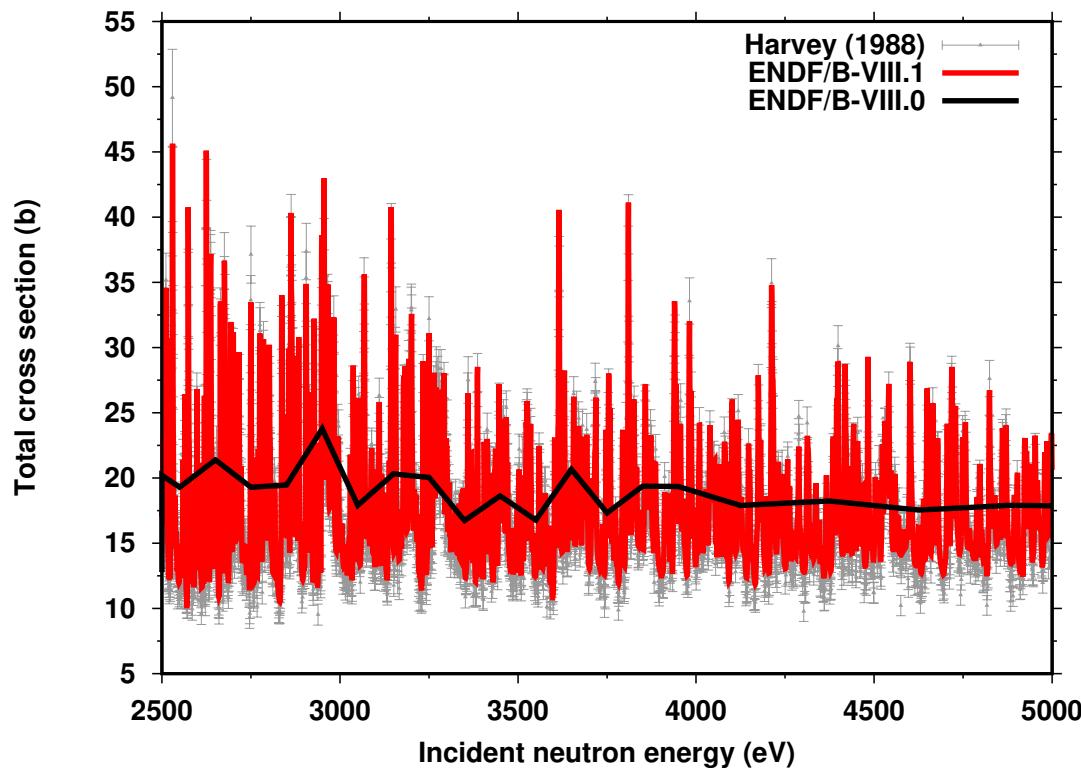
Cross Section Evaluation Working Group (CSEWG) Meeting, Neutron Evaluation Session  
Brookhaven National Laboratory (BNL), November 2023, Upton, NY

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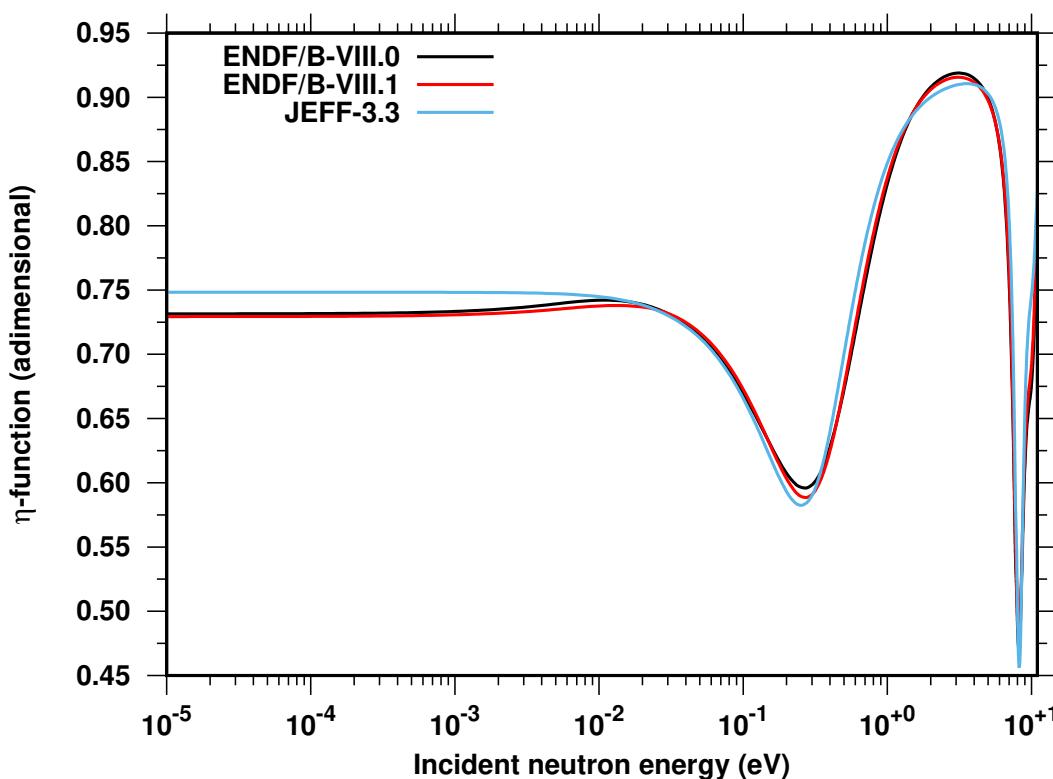
# $^{239}\text{Pu}$ Updates (I)

- Extension from 2.5 keV up to 5 keV by fitting transmission (Harvey) and fission (Weston) data. Capture estimated by the average capture widths



# $^{239}\text{Pu}$ (II)

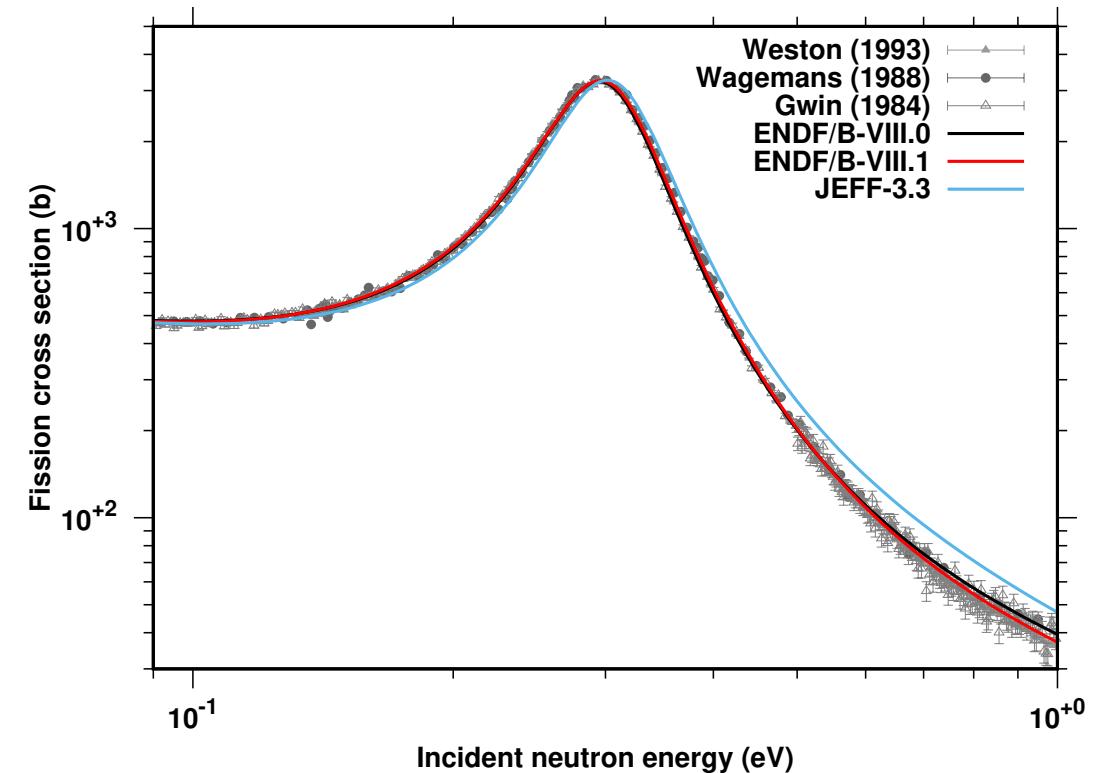
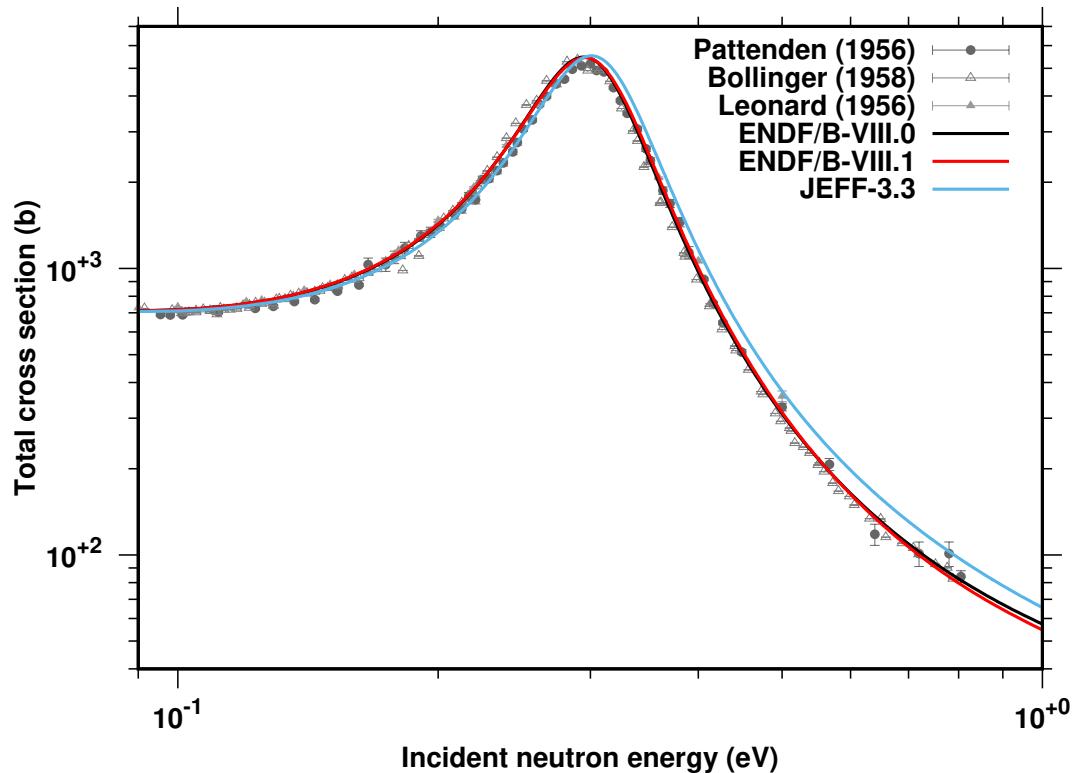
- Key points towards benchmarks performance



- Energy dependent  $\eta$ -function for three nuclear data libraries up to 10 eV
- Depletion calculations coupled to criticality safety benchmarks and Mistral-2 experiments that are particularly sensitive to the thermal and sub-thermal energy region respectively
  - Mistral-2:  $\approx 0.0253$  eV
  - Depletion:  $\approx 0.3$  eV
  - Criticality: from 0 up to 10 eV

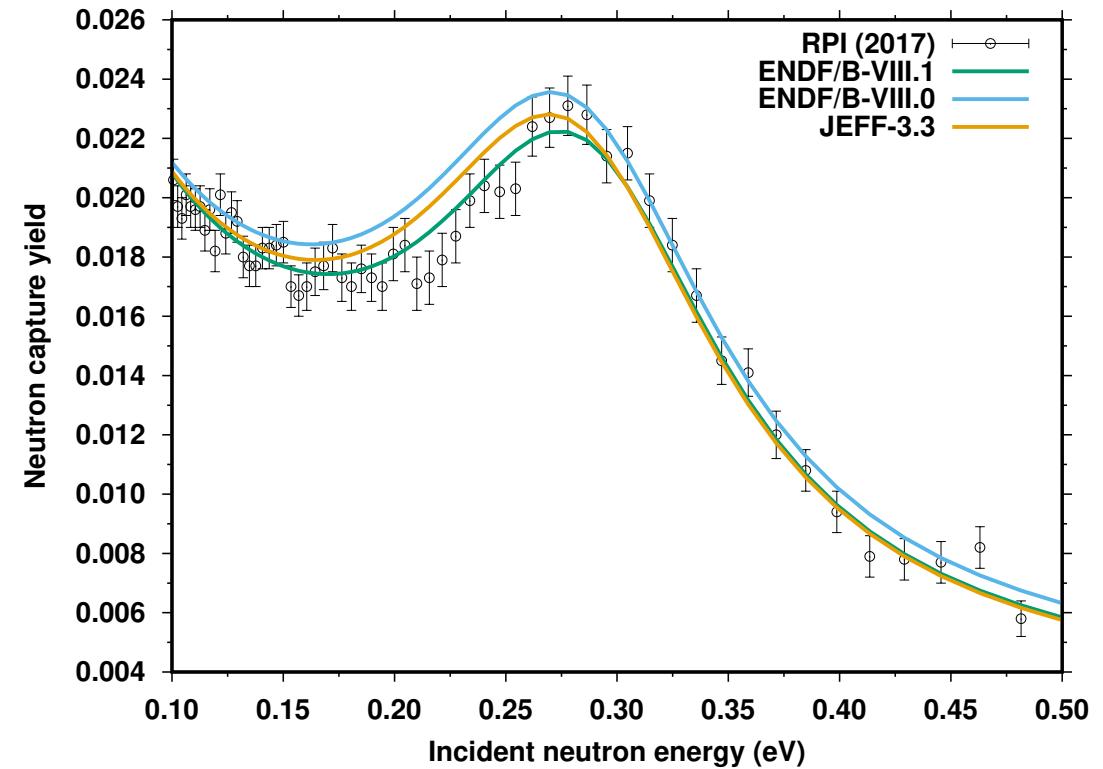
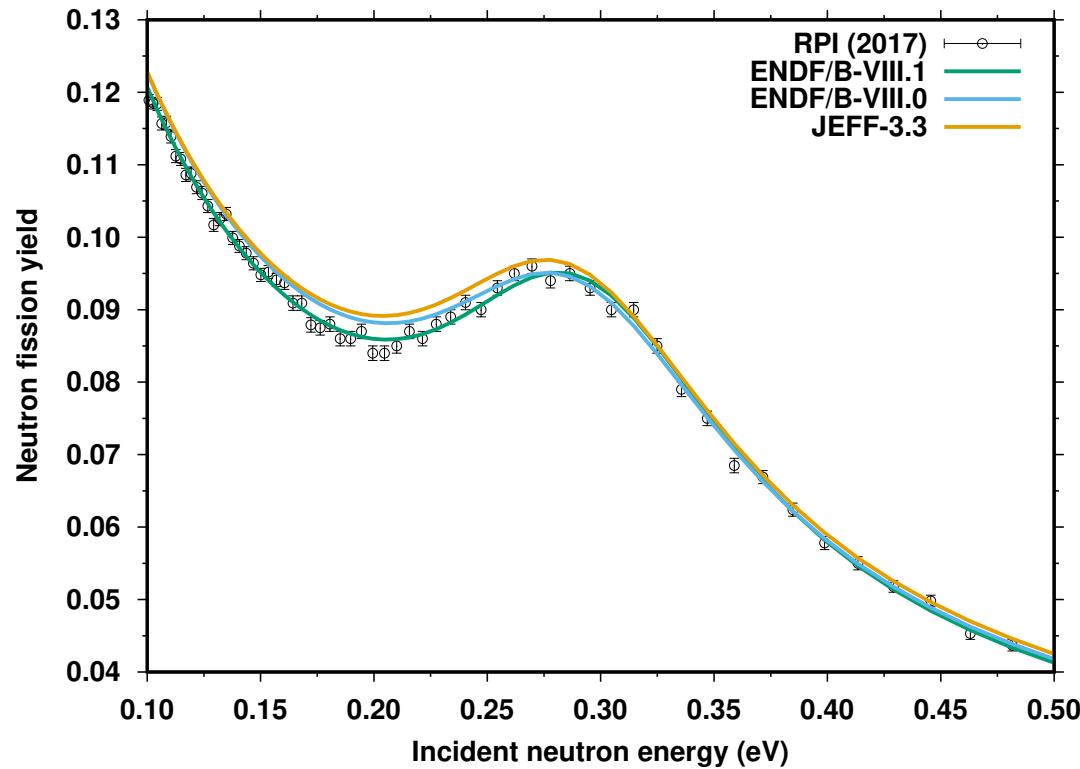
# $^{239}\text{Pu}$ (III)

- Compromise between depletion and criticality benchmarks. A shift of the resonance at 0.3 eV (JEFF-3.3) can improve criticality but inconsistent with measured data



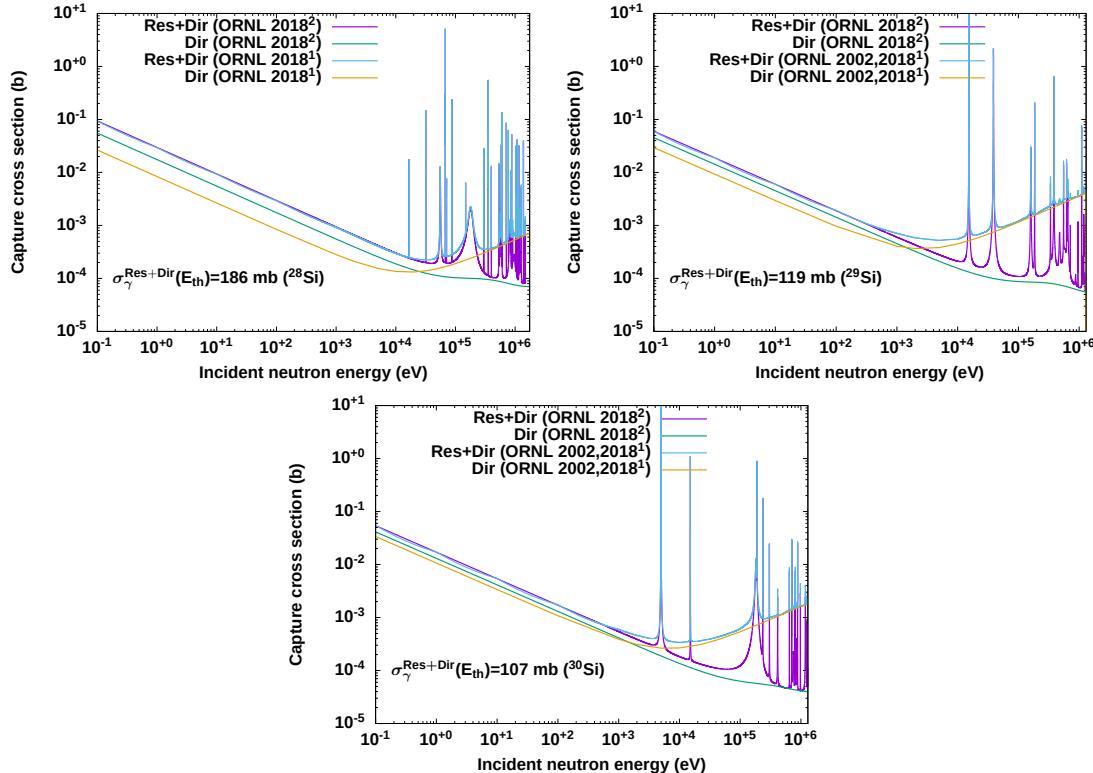
# $^{235}\text{U}$ Update

- Overall performance of criticality benchmarks (EALF dependence) preserved.



- Particular emphasis on fitting sequentially fission and capture yield for low-lying resonance. Depletion calculations are not affected

# Silicon evaluations



- Thermal constant + direct capture contribution recalibration<sup>a</sup>
- ≈800 pcm improved benchmark performance

<sup>a</sup>ORNL/LTR-2018/1044.

## EVALUATION AND VALIDATION OF $^{28,29,30}\text{Si}$ CROSS SECTIONS IN THE RESOLVED RESONANCE REGION

ORNL/LTR-2018/1044



# $^{88}\text{Sr}$ evaluation (Koehler 2000)

ORNL/LTR-2023/3004

## Resonance Parameter Evaluation of $n + ^{88}\text{Sr}$ reactions for ENDF/B-VIII.1 Library

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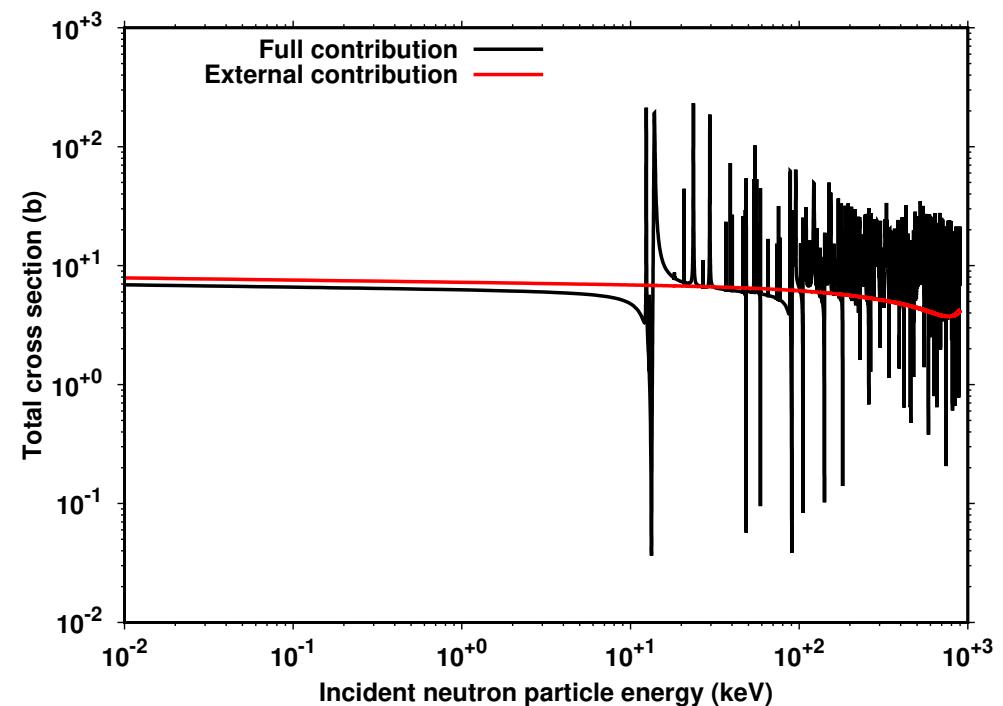
August 2023

Approved for public release.  
Distribution is unlimited.

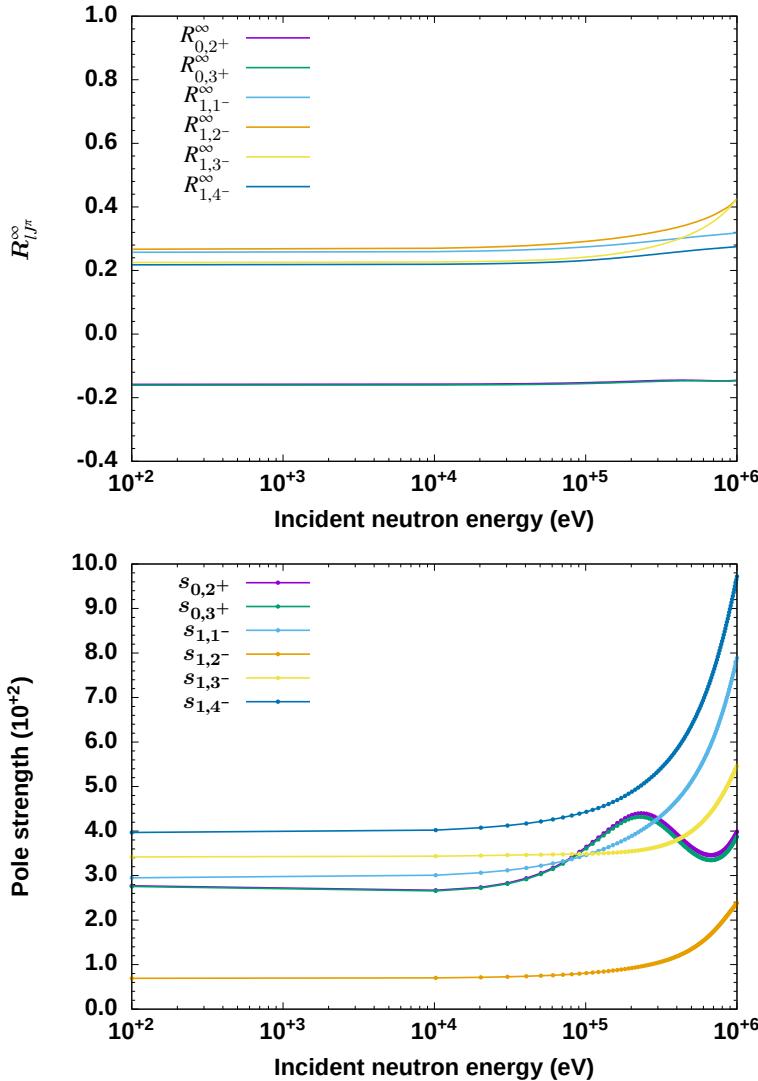
External contribution (in red) modeled by statistical parameters

$$R_{cc'} = \sum_{\lambda=1}^{\Lambda} \frac{\gamma_{\lambda c} \gamma_{\lambda c'}}{E_{\lambda} - E - i\Gamma_{\lambda \gamma}} + R_c^{\text{ext}}(E) \delta_{cc'}, \quad (1)$$

$$R_c^{\text{ext}} = R_c^{\infty,0} + R_c^{\infty,1} E - s_c^0 \ln \left( \frac{E_{\max} - E}{E - E_{\min}} \right) \quad (2)$$

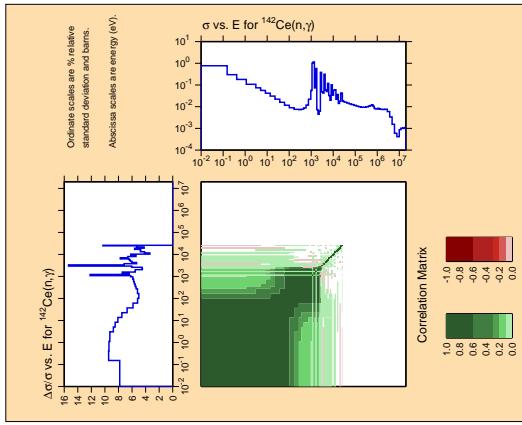
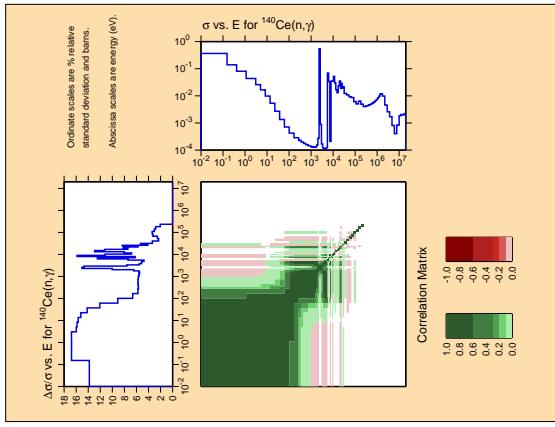
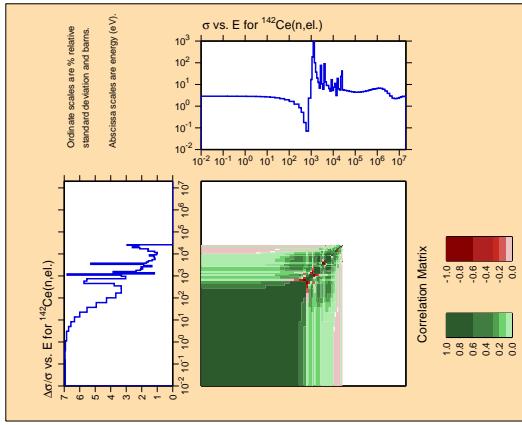
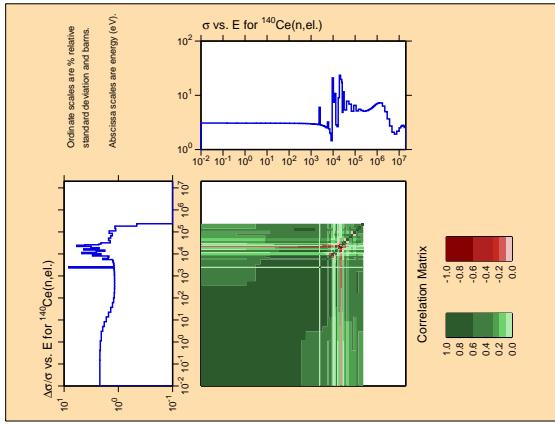


# External function of $^{233}\text{U}$ coupling to OMP



- Energy-dependent  $R^\infty$  and pole strength parameters for Optical Model Potential (OMP) calculations
- As the external-function parameterization became available in evaluated data files,  $^{233}\text{U}$  RRR analysis could be the first attempt for a fissile nucleus
- Overarching goal is to consistently link both Resolved and Unresolved resonance analyses to OMP calculations
- Inclusion of newly measured LANL data is in progress

# Cerium (covariance) evaluations



ORNL/TM-2023/2924

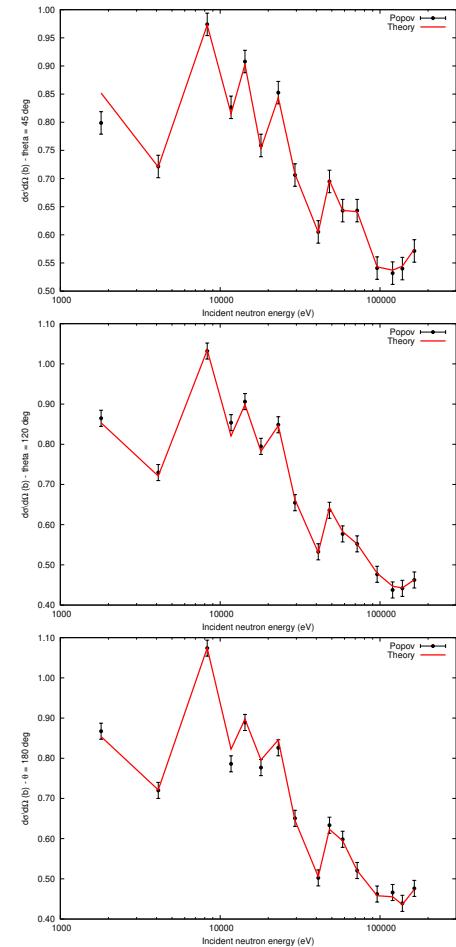
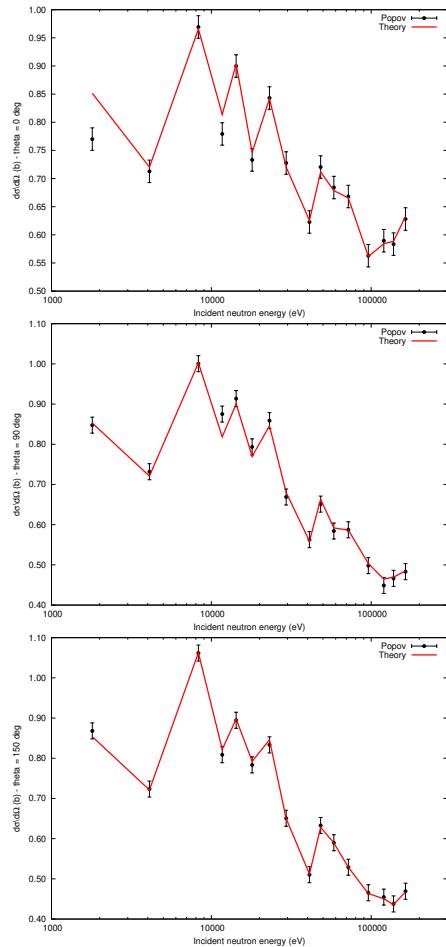
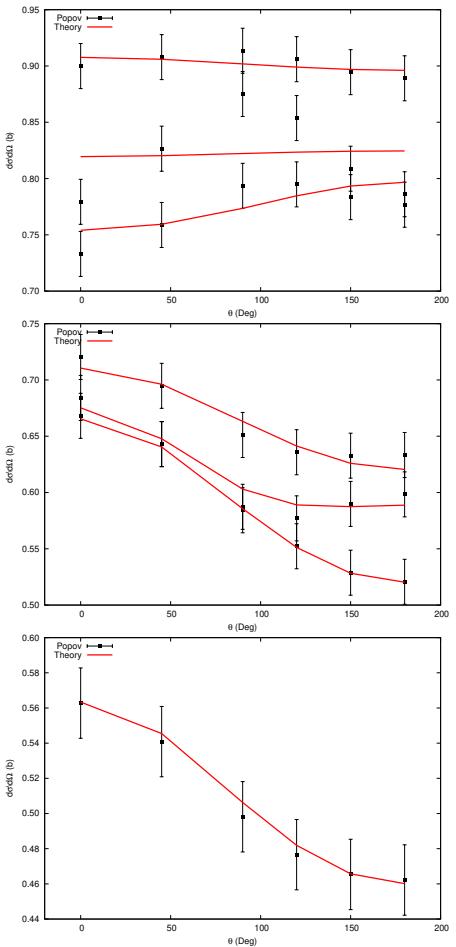
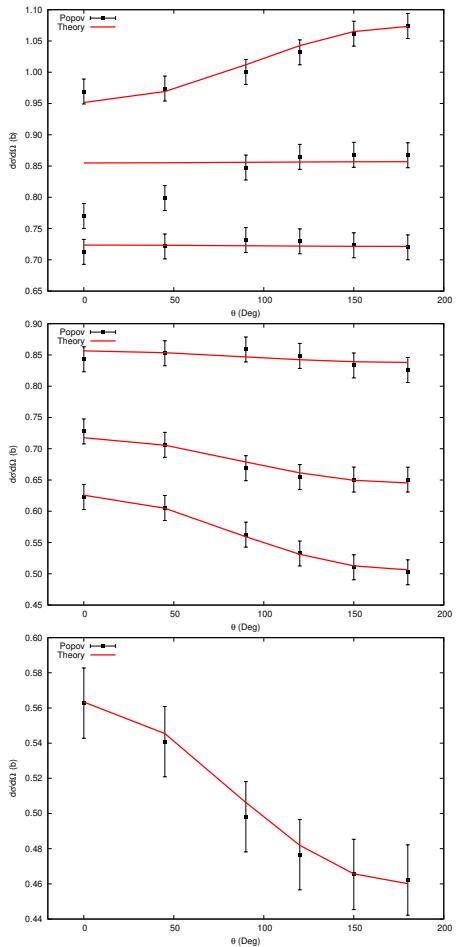
## R-matrix Resolved Resonance Region Evaluation of $^{140,142}\text{Ce}$



- For details on the evaluation work, see C.W. Chapman's ORNL/TM Report (to be released soon).

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# Copper (Legendre Polynomials) evaluations



- Fitting measured Legendre Polynomials (LP) (from energy-averaged data) or derived angular distributions (left) and excitation functions (right)
- Testing the inclusion of fitted LP into ENDF files assuming the fit of Popov's measured data should account for the correct resolution function

# Conclusions

- For uranium and plutonium isotopes, evaluation work is converging to a stable configuration with an overall satisfactory benchmark performance (more information on the validation tests after CSEWG)
- Strontium evaluation was included in the repository library and successfully tested by processing codes relative to an alternative quantification of the external function
- Cerium covariance matrices were updated to address review comments on the magnitude of the uncertainty. For future uncertainty quantification, theoretical observables should be properly decoupled from current measured guidelines
- Tests to correctly include LP (from resonance parameters) fitted to measured energy-averaged data are in progress. Current ENDF files contains experimental LP data.

# ACKNOWLEDGMENTS

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**ORNL TEAM:** D. Wiarda, K. Ramic, L. Leal, K. Guber, J. Brown

Thank you!