ORNL FY2024 Nuclear Data Evaluation Contributions: Cu, La, N, and Ta

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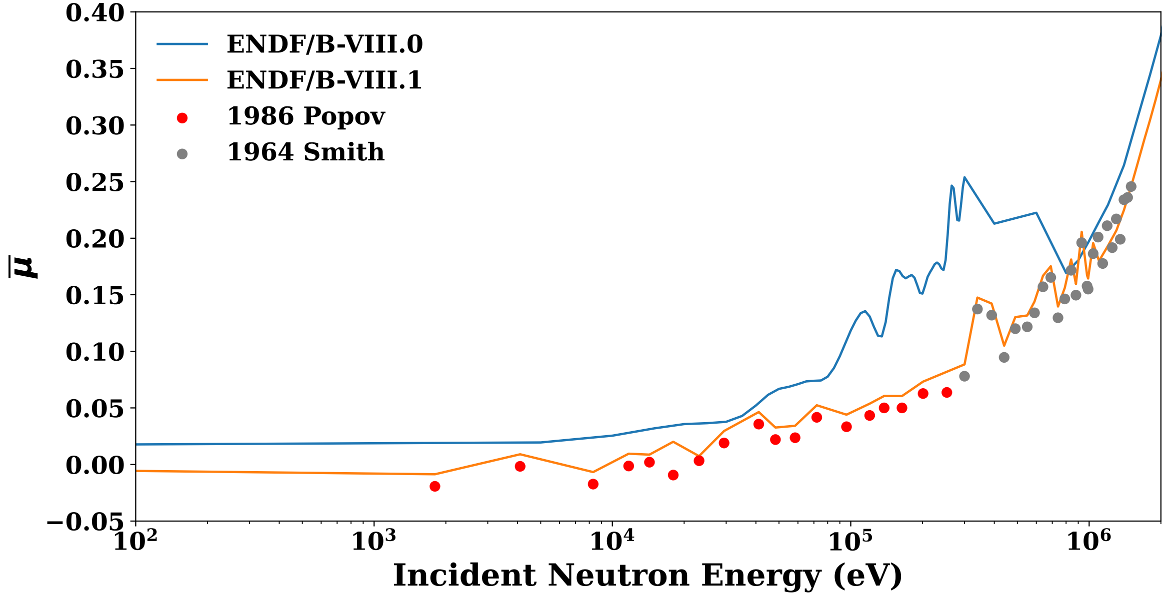
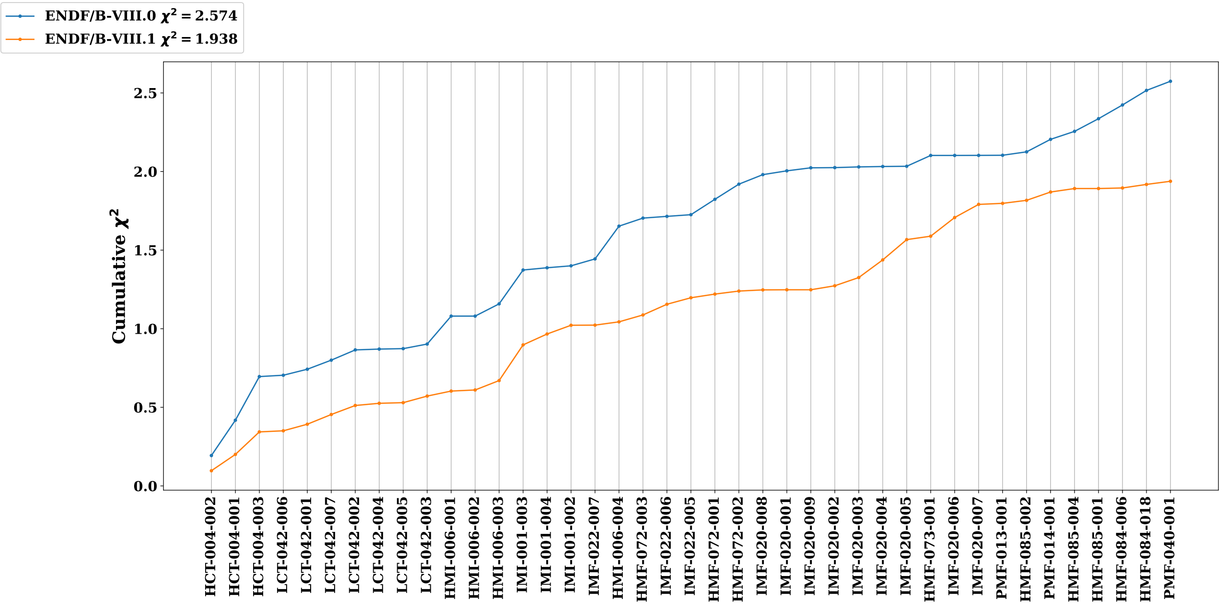
Outline

- Summary of $^{63,65}Cu$ Evaluation: Angular Distribution Parameters
- ^{139}La: Resolved and Unresolved Resonance Regions
- ^{14}N: R-matrix Analysis
- ^{181}Ta: Consistency of Covariance Evaluation

^{63,65}Cu Angular Distribution Parameters

- In collaboration with INDEN, the choice was made to use Legendre coefficients derived from differential experiment values (Popov) rather than reconstructed from resonance parameters.
    - This was compensated by a small adjustment to the elastic cross section
    - This combination accurately reflects differential data *and* performs well in integral benchmark computations



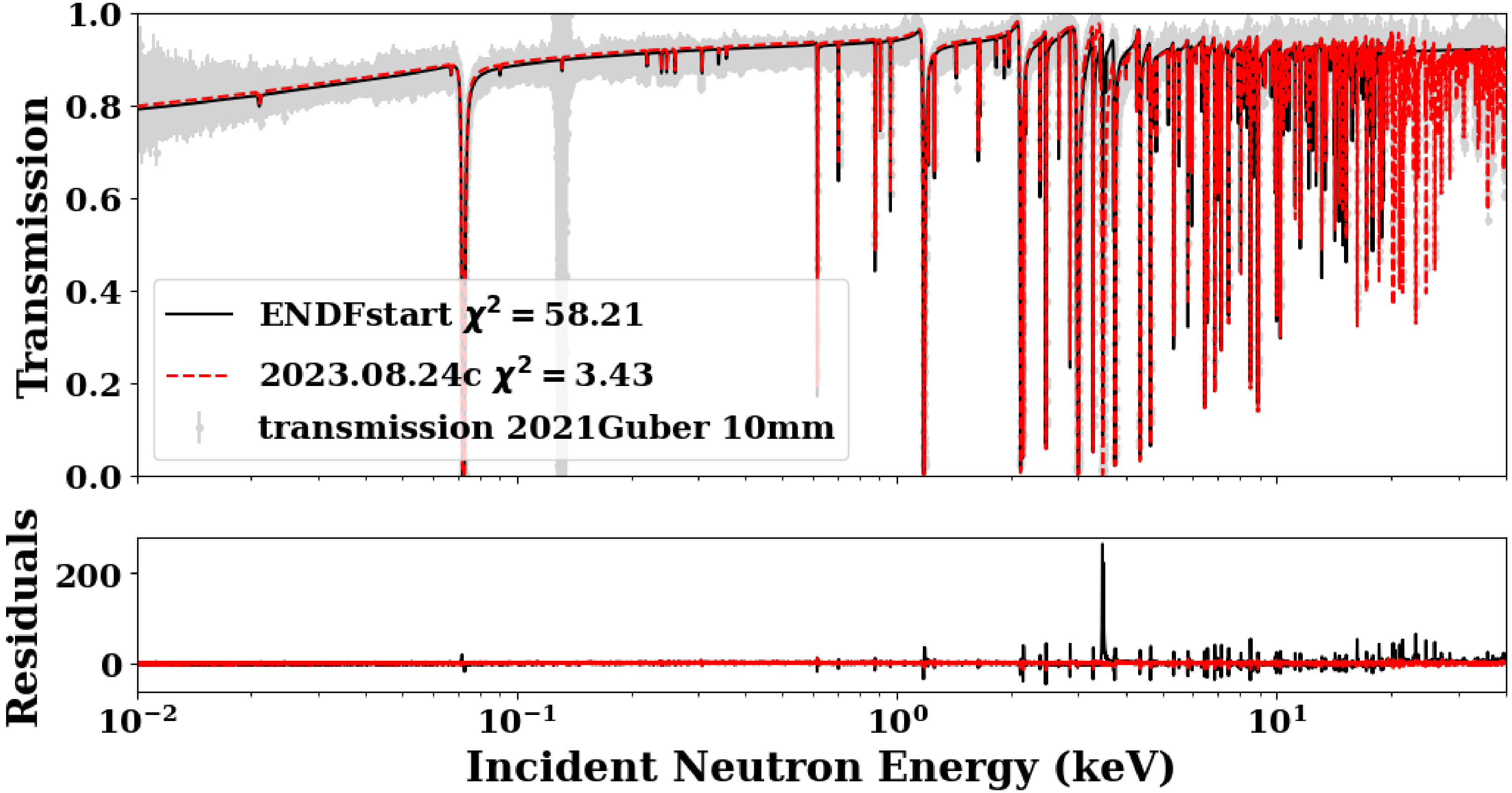


^{139}La RRR Evaluation

- Motivation: ^{139}La is a stable fission product, contributing to fission product credit in NCS analyses. Improved covariance also needed to contribute to S/U analyses.
- Model: *R*-matrix analysis with SAMMY
    - $B = S$ boundary condition
    - ENDF/B-VIII.0 parameters as prior
- Validation: Analysis of fission product credit cases.

^{139}La RRR Evaluation

Starting from the resonance parameters of ENDF/B-VIII.0 (MLBW), new Reich-Moore Limited parameters and covariances were obtained via an *R*-matrix fit with SAMMY to transmission and capture data measured by Guber et al.

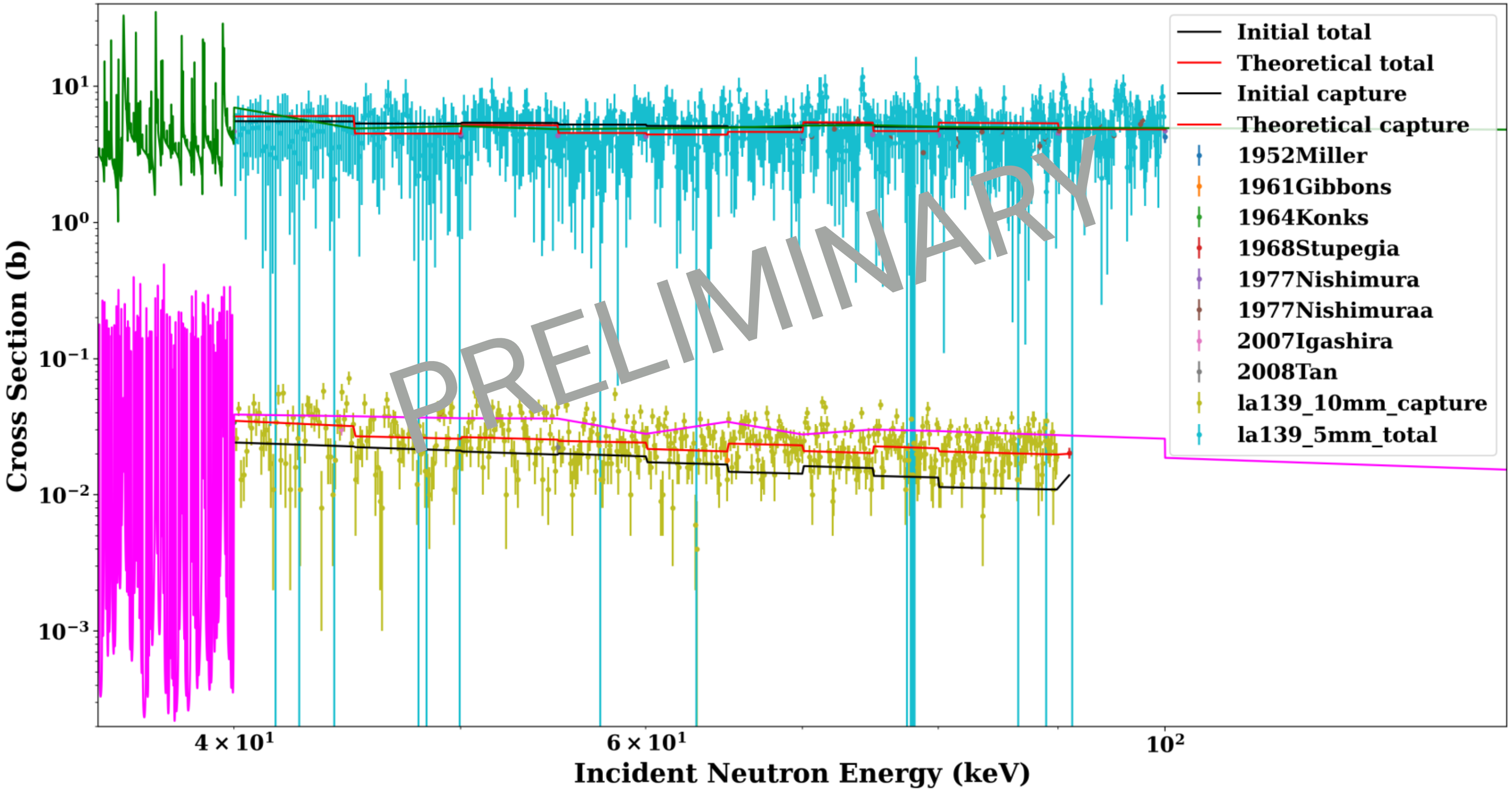


The resolved resonance range was extended from 20 keV (ENDF/B-VIII.0) to 40 keV (this work).

^{139}La URR Evaluation

Average resonance parameters in the URR, in the energy range 40 keV – 100 keV, were obtained with the FITACS module of SAMMY.

The merging with the high energy evaluation by LANL revealed issues with the continuity of the radiative capture cross section. The resolution of this issue is ongoing.



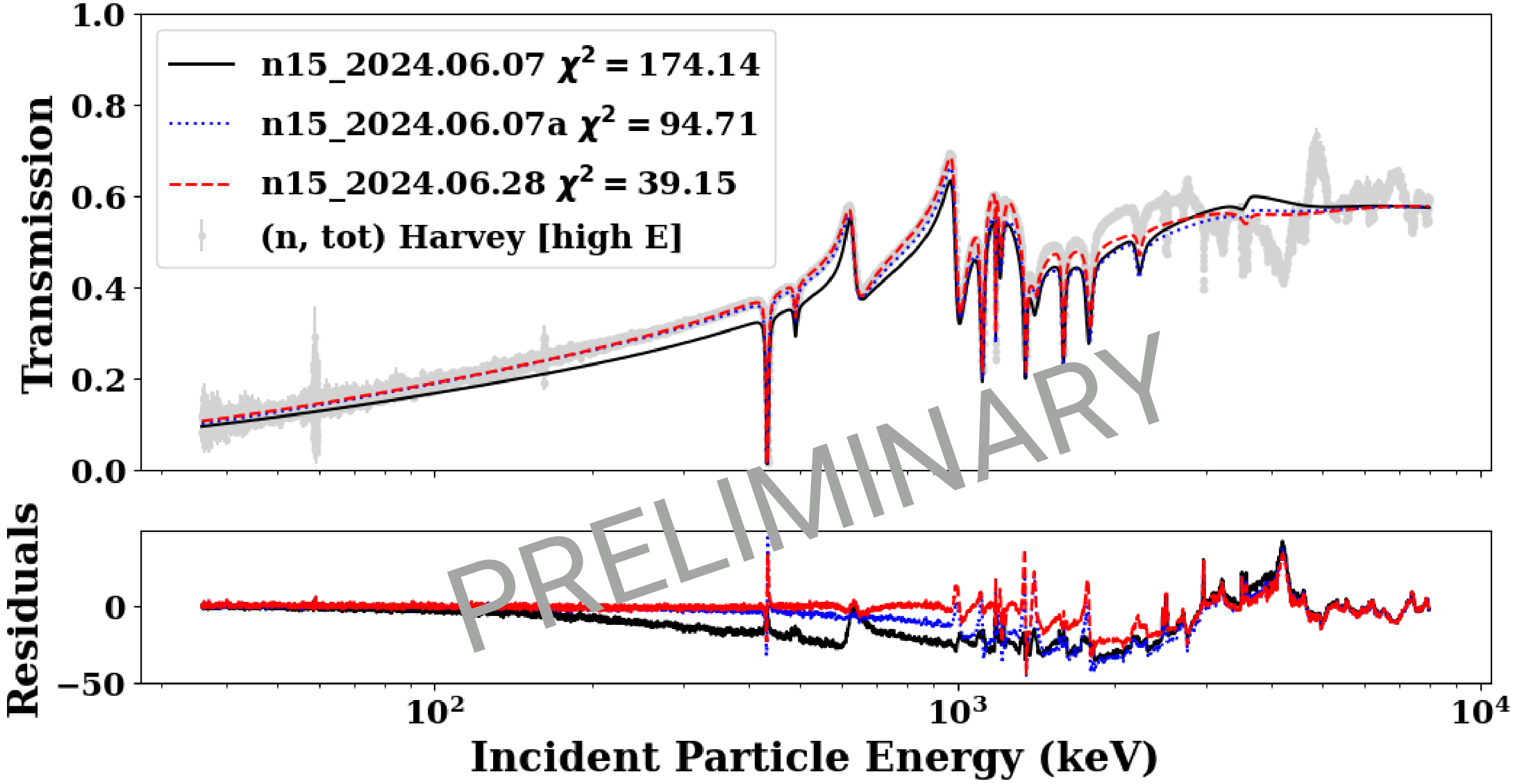
^{14}N RRR Evaluation

- Motivation: Nitrogen cross sections play a vital role in analyses related to reprocessing.
- Model: *R*-matrix analysis with SAMMY
    - $B = -\ell$ boundary condition
    - Using a fit from AZURE as prior
- Validation: Criticality benchmarks sensitive to ^{14}N.

^{14}N RRR Evaluation

Starting from an analysis by R. J. de Boer performed with AZURE, we used LLNL's Ferdinand tool to convert AZURE parameters to ENDF-6 format. From the ENDF-6 file, we continued the analysis with SAMMY to incorporate SAMMY's suite of experimental effect corrections.

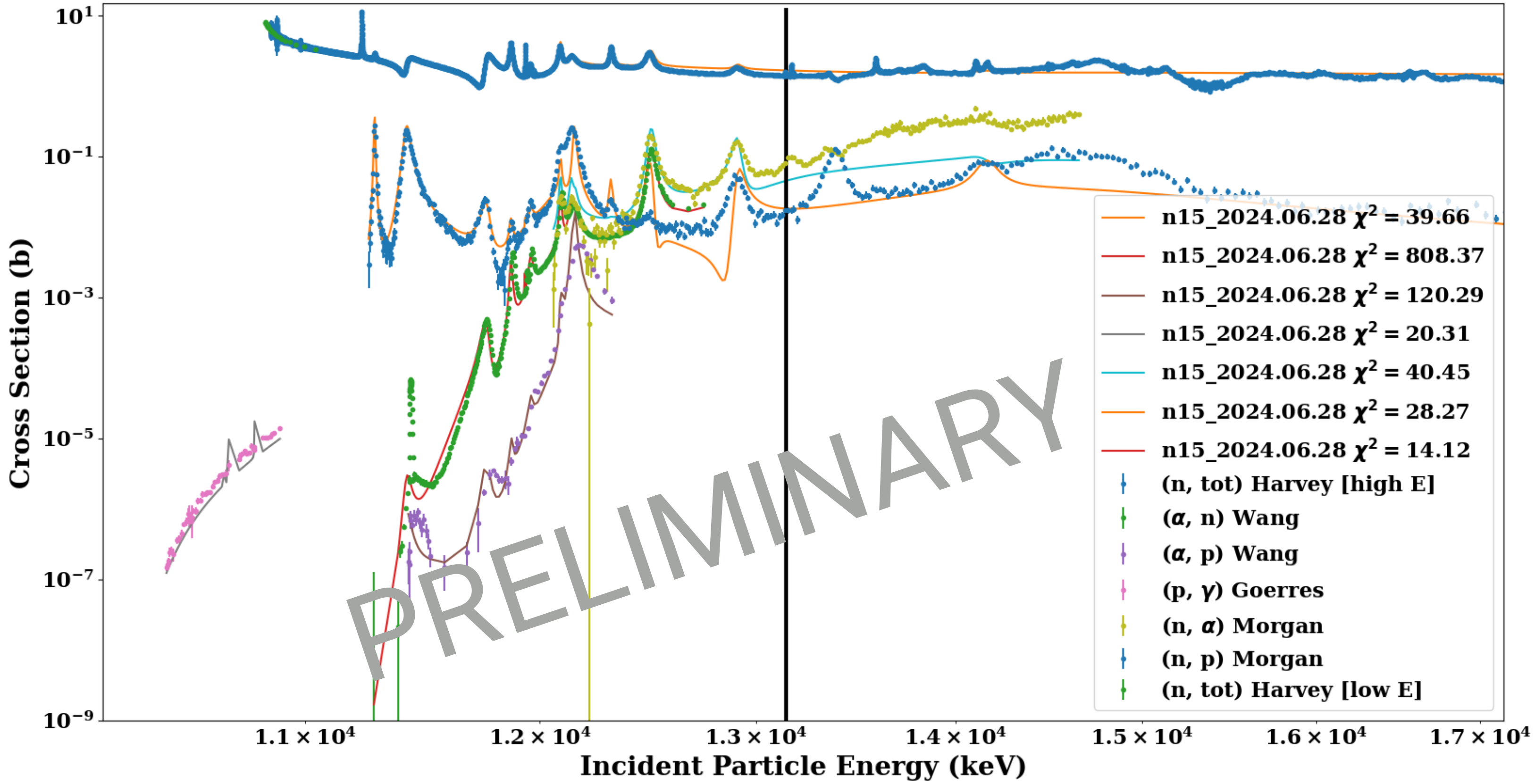
This analysis exercises SAMMY's new capability for handling the inversion of incident/exit particles within a channel.



^{14}N RRR Evaluation

Early results have established resonance parameters that produce good agreement between the model and experimental data for each channel at lower reaction energies.

Continuing work will refine the fit to data at higher energies, especially by adjusting external resonance parameters.



Ta-181 URR Covariance: Error found in $\beta 4$ and VIII.1

Cross sections = correct
Covariance = incorrect

First off:

Goal of Ta-181 evaluation was to split between 3 evaluators:

- Devin Barry: RRR (1e-5 -> 2.5e3 eV)
- Jesse Brown: URR (2.5e3 -> 100e3 eV)
- Mike Herman: Fast (100e3 -> max)

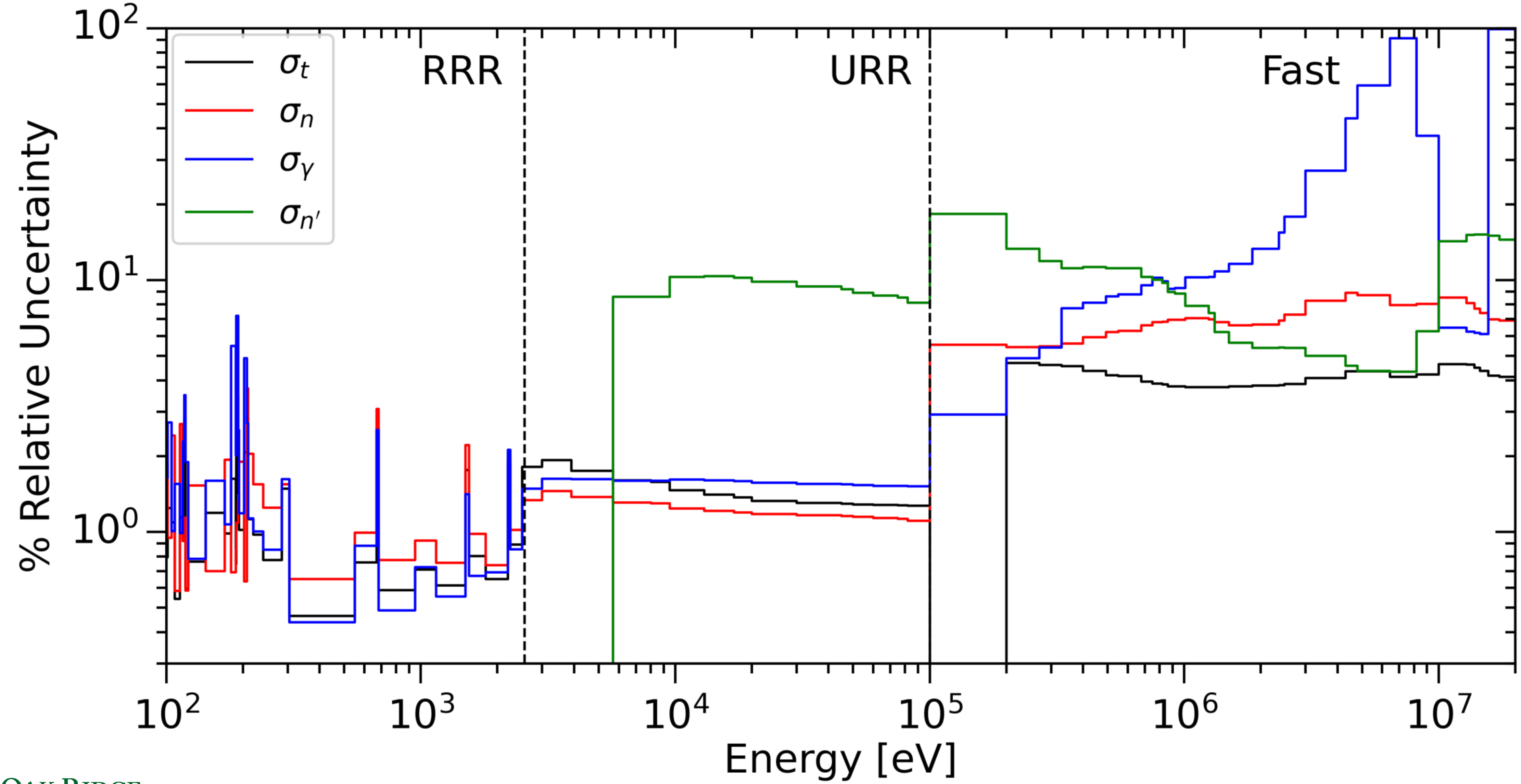
and to match cross sections closely at boundaries

During compilation of the 3 evaluations, covariance in the URR was overwritten in $\beta 4$, went into final VIII.1

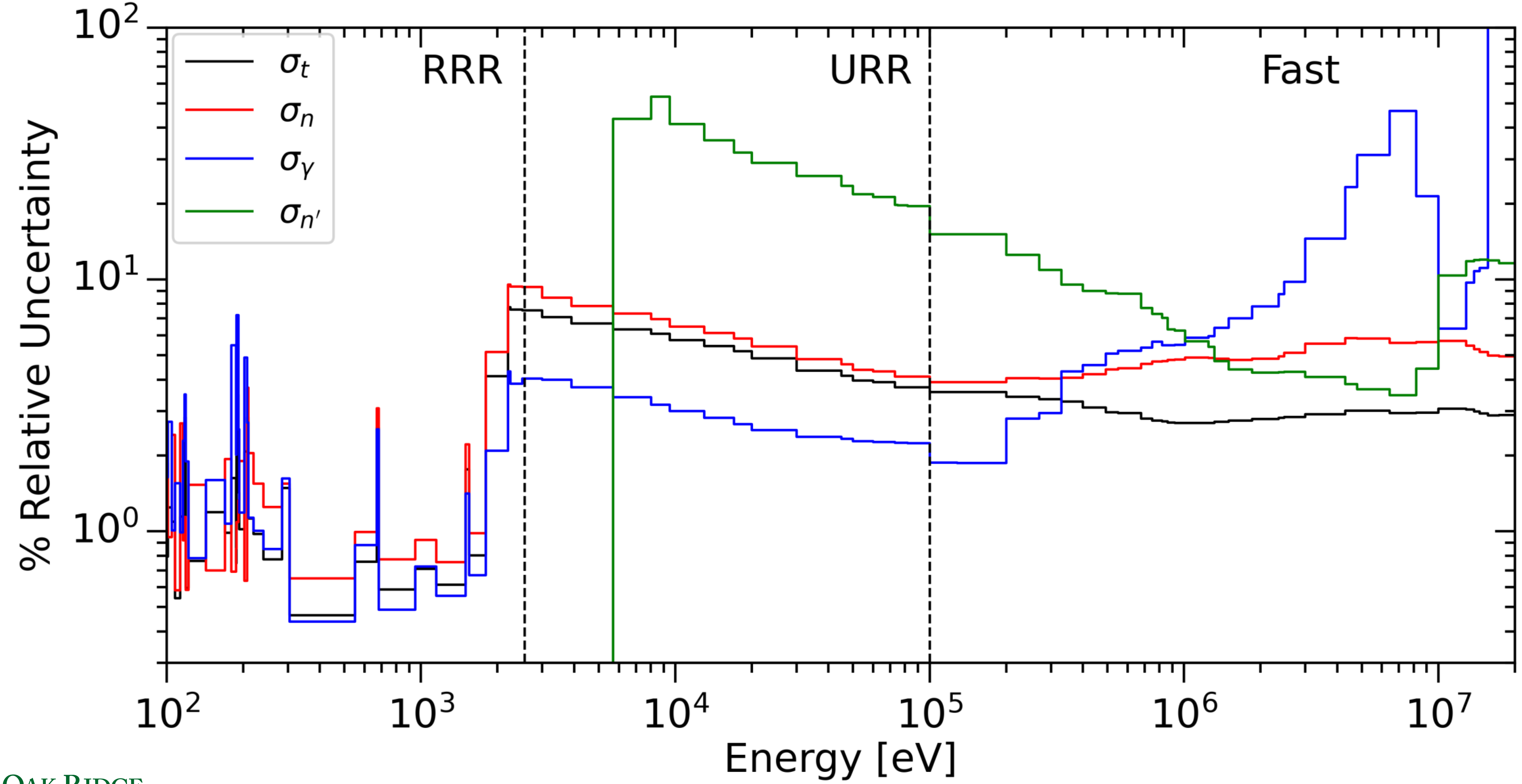
Cross sections and covariances in the URR are inconsistent

Erroneous covariance is ***conservative***, so impact is only ***increasing*** application uncertainty

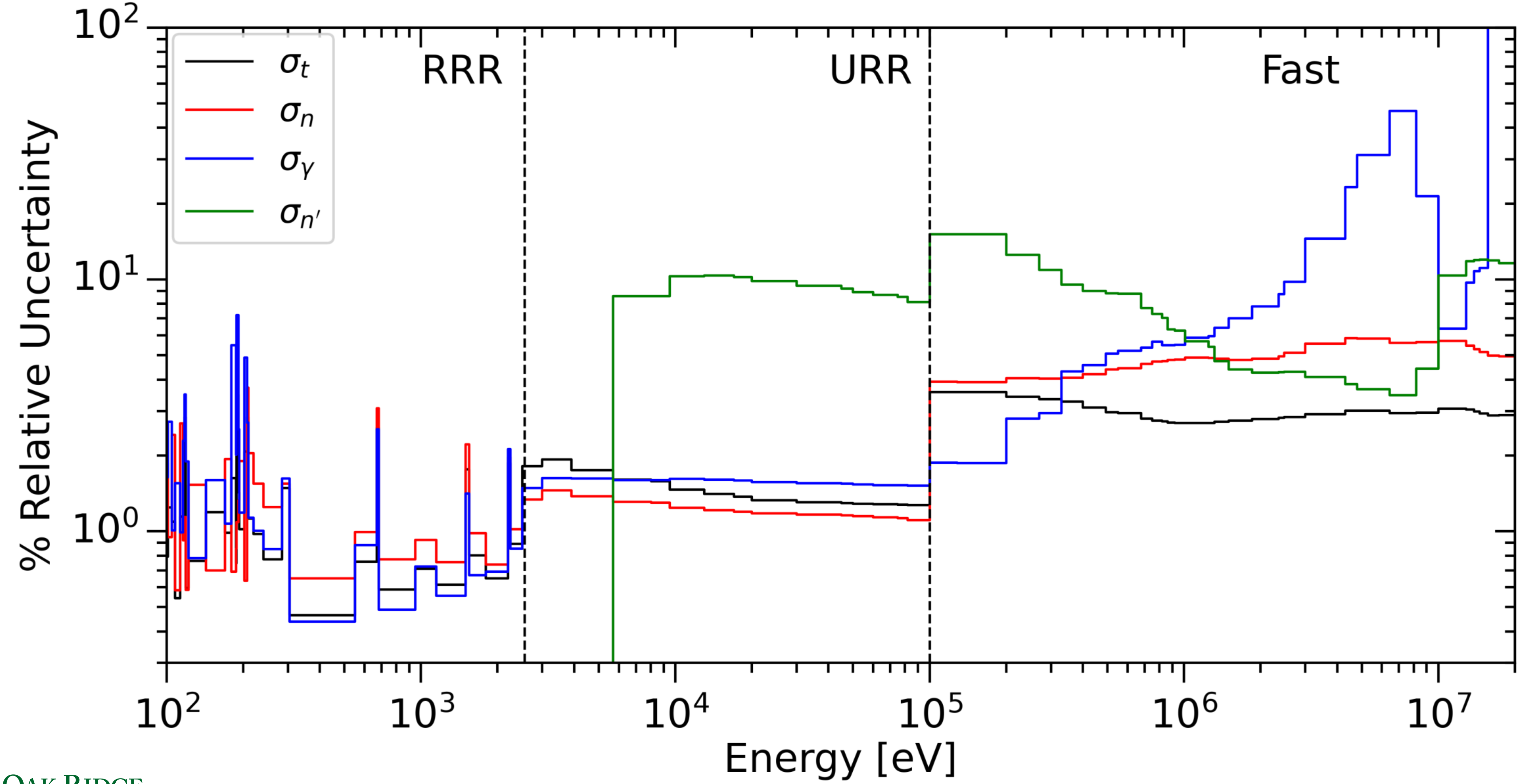
Standard deviation in $\beta3$



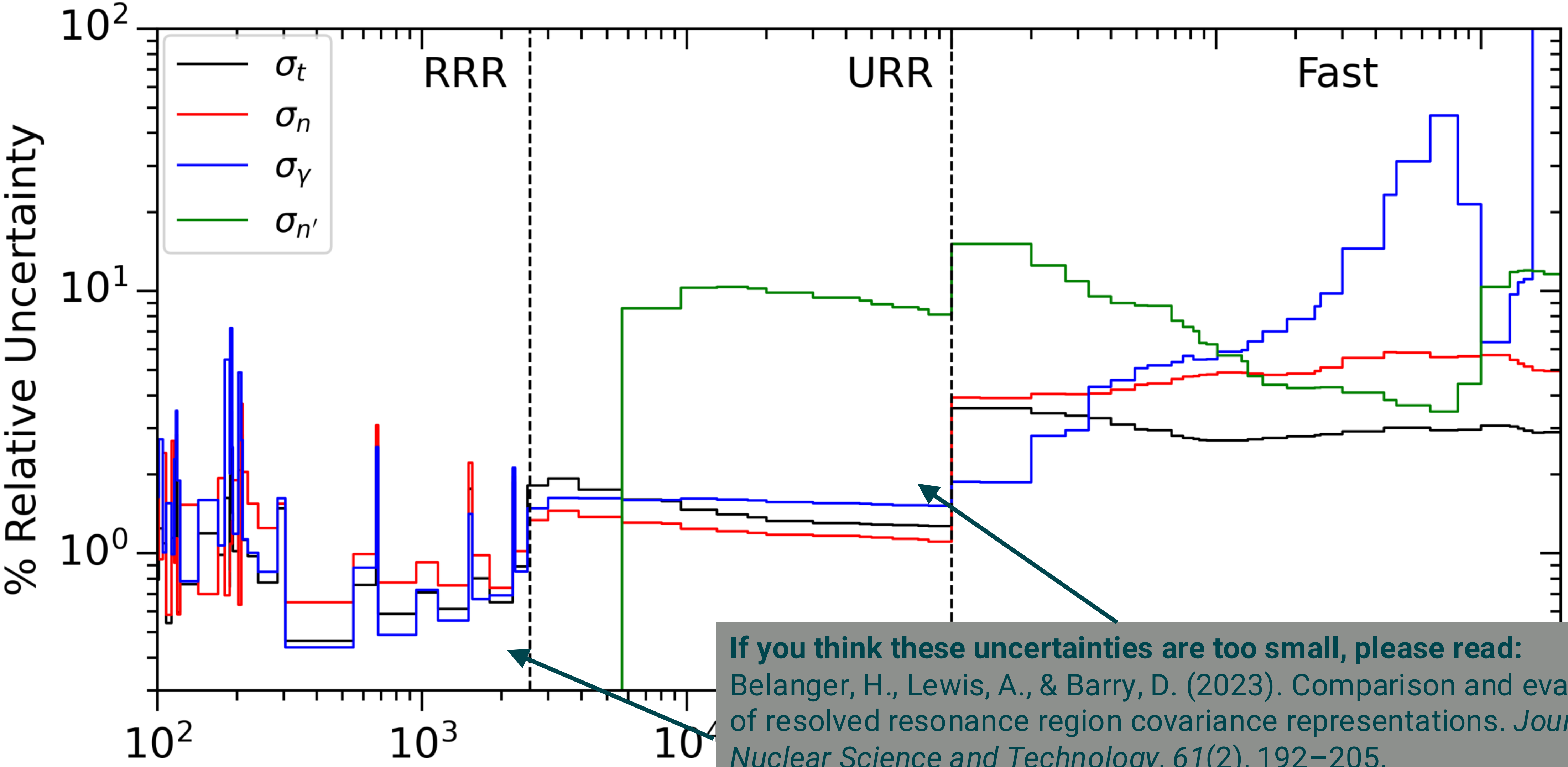
Standard deviation in VIII.1



Standard deviation for *Errata*



Standard deviation for *Errata*



If you think these uncertainties are too small, please read:
Belanger, H., Lewis, A., & Barry, D. (2023). Comparison and evaluation of resolved resonance region covariance representations. *Journal of Nuclear Science and Technology*, *61*(2), 192–205. https://doi.org/10.1080/00223131.2023.2279303

Summary

- $^{63,65}Cu$ angular distributions resolved for ENDF/B-VIII.1, consistent with both differential data and integral benchmark performance
- ^{139}La RRR and URR evaluations will be merged with the LANL high energy evaluation, and to be submitted to the future ENDF-B release (post-VIII.1)
  - Extends RRR from up to 40 keV (compared to 20 keV in ENDF/B-VIII.0)
  - Covariance analysis of both RRR and URR ongoing
- ^{14}N RRR evaluation is planned to produce n+^{14}N, p+^{14}C, and α+^{11}B contributions to be submitted to the future ENDF-B release (post-VIII.1)
  - Resonance parameters to be included in incident neutron file
  - Experimental effect corrections accounted for
- ^{181}Ta covariances repaired and reported as intended in an errata to ENDF/B-VIII.1

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