Updates to the n+^{63,65}Cu Evaluations: RRR and Angular Distributions

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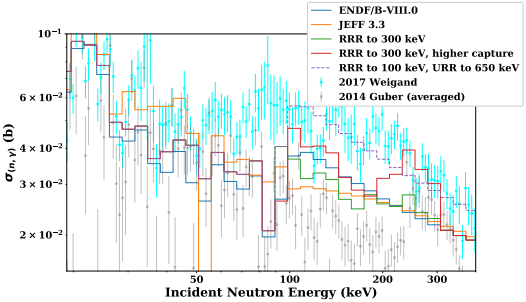
INTRODUCTION

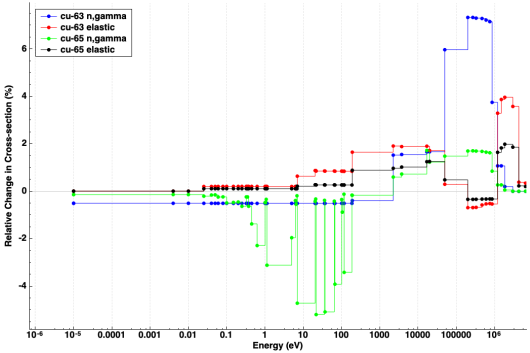
- This work updates the evaluation of $n+^{63,65}$Cu for neutron energies in the resolved resonance region (RRR) and slightly higher energies.
- The updates strive to improve the statistical properties of the resonance parameters and the continuity of the evaluation between the RRR and the high-energy region while preserving or improving critical assembly benchmark performance.
- We will review our work on the resonance parameters and present the current status of our angular distribution analysis.

REVIEW OF RESONANCE REGION ANALYSIS

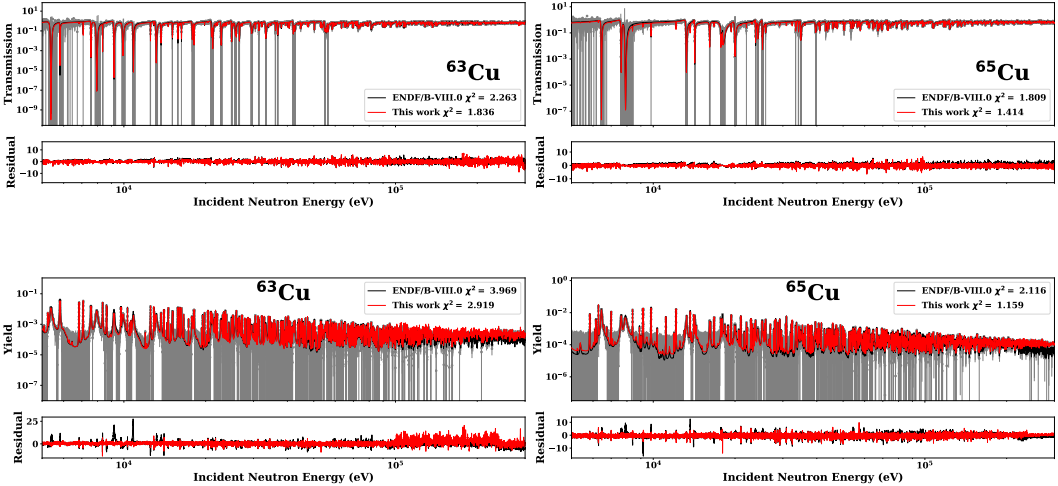
A small increase in the ^{63}Cu(n,γ) cross section above 100 keV was found to modestly improve benchmark performance.

However, the available experimental data do not support *R*-matrix analysis above 100 keV for ^{63}Cu. An unresolved resonance analysis was considered as a possible solution.





RESONANCE REGION ANALYSIS



ANGULAR DISTRIBUTIONS

The elastic scattering angular distributions are described in ENDF File 4 via *Legendre coefficients*.

The Legendre coefficients can be reconstructed from *R*-matrix parameters.

While a high resolution for the Legendre coefficients in the RRR has been shown in the literature to improve benchmark performance, the ENDF format limits the amount of data that can be stored.

A compromise is to generate Legendre coefficients on a dense energy grid and subsequently collapse the coefficients into coarser bins with a “smoothing” function.

ANGULAR DISTRIBUTIONS

- This work endeavors to clarify the role of the copper angular distributions for the performance of the copper-reflected benchmarks.
- The work of Shaw et al suggested that *reverting* the ^{65}Cu File 4 to that of ENDF/B-VII.1 improves benchmark performance.
- The discontinuity between the RRR and high energy region must be replaced with a smooth transition.

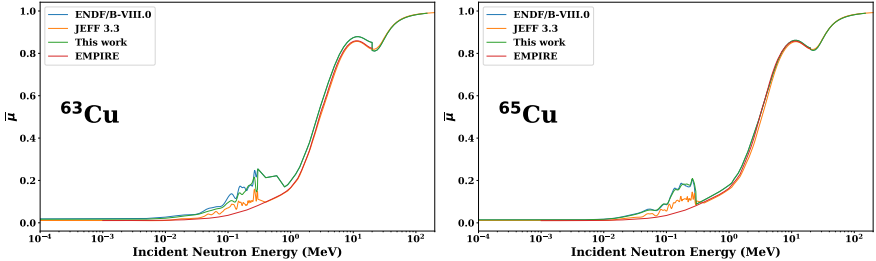


Figure 1: $\bar{\mu}$ for ^{63,65}Cu

BENCHMARK PERFORMANCE - PRELIMINARY

The ^{63}Cu $\overline{\mu}$ drives the reactivity high if it is too low (purple triangles), such as with the EMPIRE or ENDF/B-VII.1 coefficients. The ENDF/B-VIII.0 angular distribution for ^{63}Cu is the better starting point.

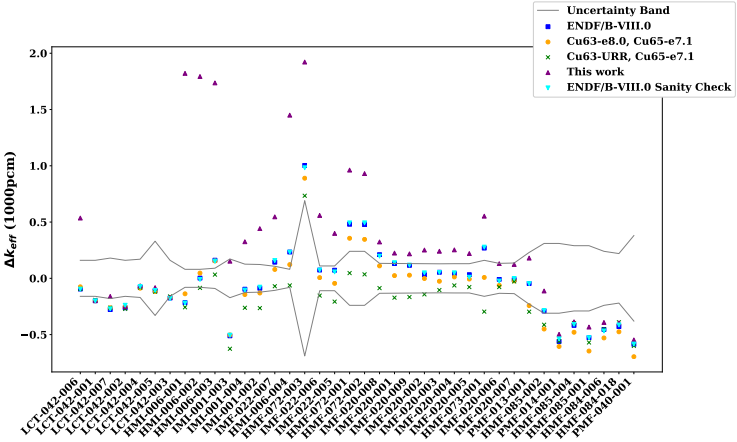


Figure 2: Performance of copper-sensitive ICSBEP benchmarks

CONCLUSIONS

- We are making progress towards resonance parameters and angular distribution coefficients that reproduce differential data, are consistent with each other, and *preserve benchmark performance*.
- Adjustments to the angular distributions will be constrained by the quasi-differential measurements performed by Blain et al at RPI.
- The benchmark performance is very sensitive to the elastic scattering angular distributions, and we are iterating towards the resolution.
- The next steps also include covariance analysis above 100 keV.

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