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Updates to the n+^{63,65}Cu RRR+URR Evaluations

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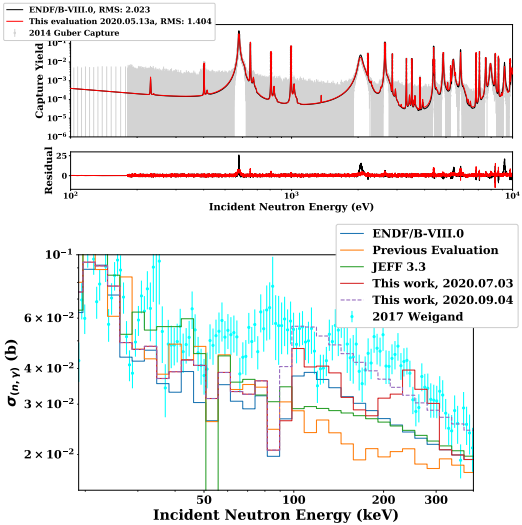
INTRODUCTION

- This work updates neutron reactions on ^{63,65}Cu
- Motivation: To correct deficiencies in benchmark performance since critical assembly configurations* use Cu as reflector
- Incorporates URR parameters fit to 2017 ^{63}Cu(n,γ) measurement by Weigand et al., as well as preliminary work on angular distributions
- Validation against copper-sensitive ICSBEP benchmarks is ongoing

*This work was supported by the Nuclear Criticality Safety Program, funded and managed by the National Nuclear Security Administration for the US Department of Energy

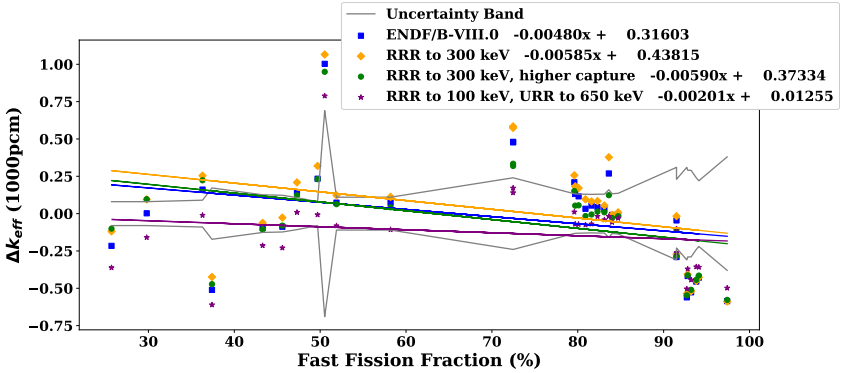
COMPARISON TO EXPERIMENTAL CAPTURE DATA



- The highest priority was given to $^{63}\mathrm{Cu}(n,\gamma)$, as ^{63}Cu is 69% of natural copper
- Three strategies were considered:
  - RRR (300 keV), fit to Guber (2014) capture
  - RRR (300 keV), fit to Guber (2014) with large scaling factor above 100 keV
  - RRR (100 keV)+URR (650 keV) fit to Weigand (2017)

BENCHMARK RESULTS*

For copper-sensitive benchmarks, Δk_{eff} are *similar* to ENDF/B-VIII.0



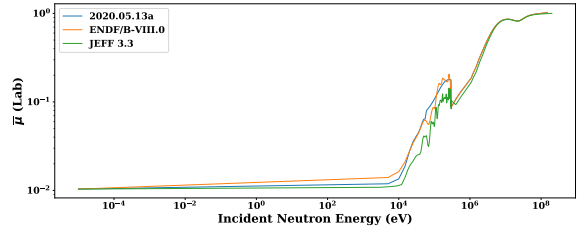
*Measured k_{eff} from International Criticality Safety Benchmark Evaluation Project.

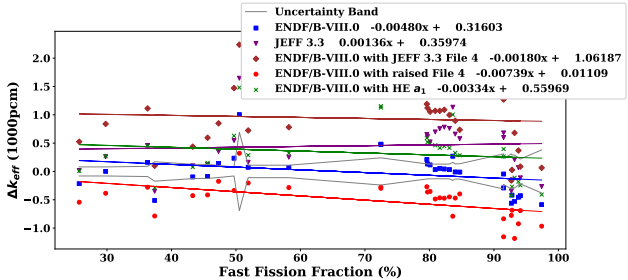
ANGULAR DISTRIBUTIONS (PRELIMINARY)

The $\overline{\mu}_{\text{lab}}$ for both ^{63,65}Cu is characterized by a marked discontinuity at 300 keV

"Exercise": Patch the discontinuity, and observe the impact on benchmark calculations

- Replace ENDF/B-VIII.0 (File 4) with JEFF 3.3
- Match RRR by raising the high energy $\overline{\mu}$
- Match high energy by lowering RRR $\overline{\mu}$





CONCLUSIONS

- *R*-matrix analysis coupled to consistent average parameters used in the URR have been performed for ^{63,65}Cu isotopes
  - Despite large uncertainty in measured (n,γ) data above 100 keV, an increase in the capture cross section is suggested
  - Moreover, due to the increasing sensitivity of the benchmarks above 100 keV, the upper energy range for the RRR is still under investigation
- Future work will focus on the angular distributions
  - Discontinuity issue at 300 keV
  - Detailed analysis on the impact on the benchmarks
- Analysis of additional data measured on natural Cu sample is in progress

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