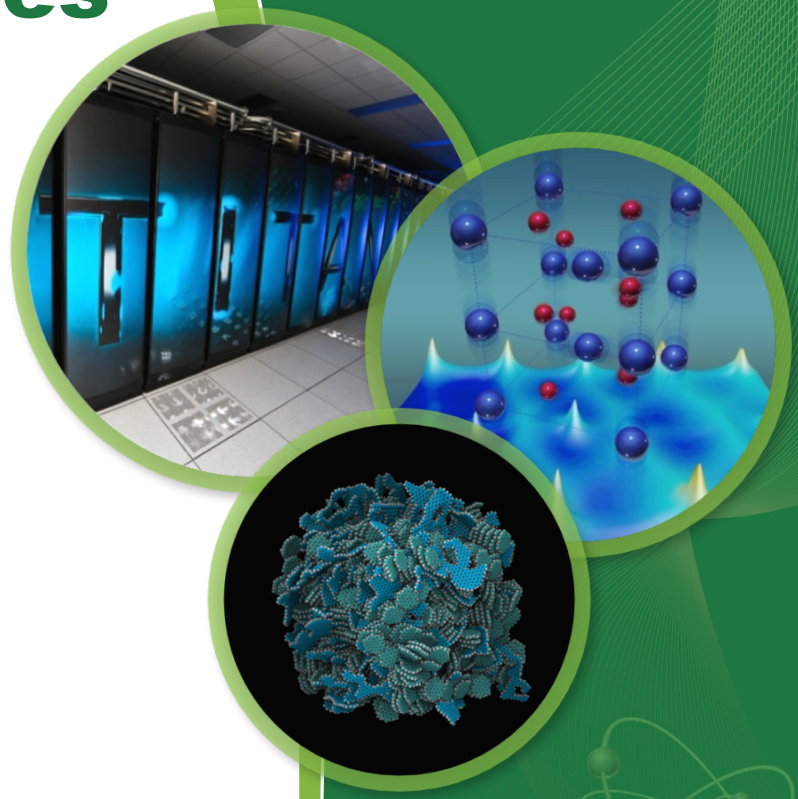
Consistency between ENDF/B Cross sections and Covariances

Mark Williams

Doro Wiarda

B. J. Marshall

Oak Ridge National Laboratory



2017 CSEWG Meeting

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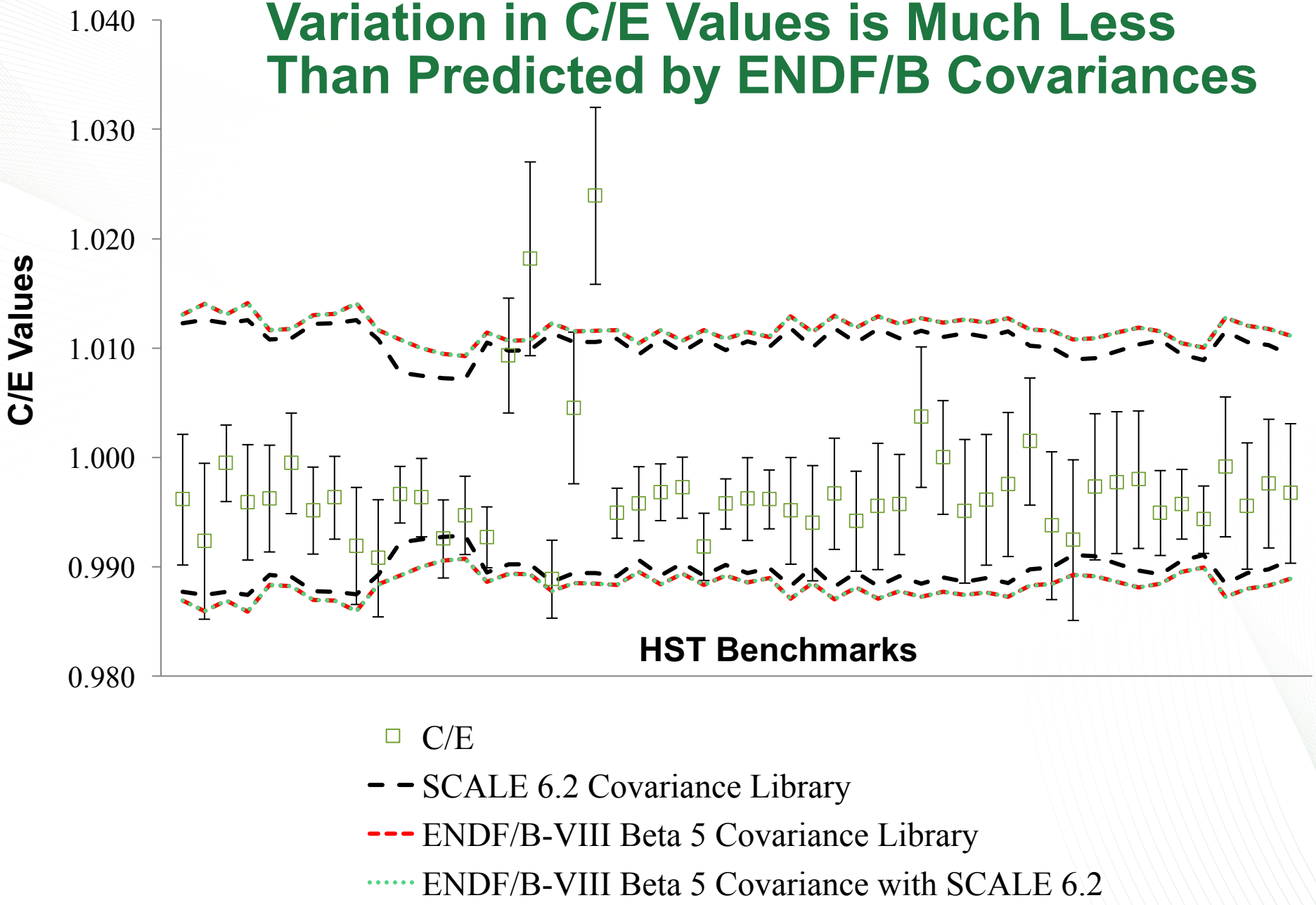
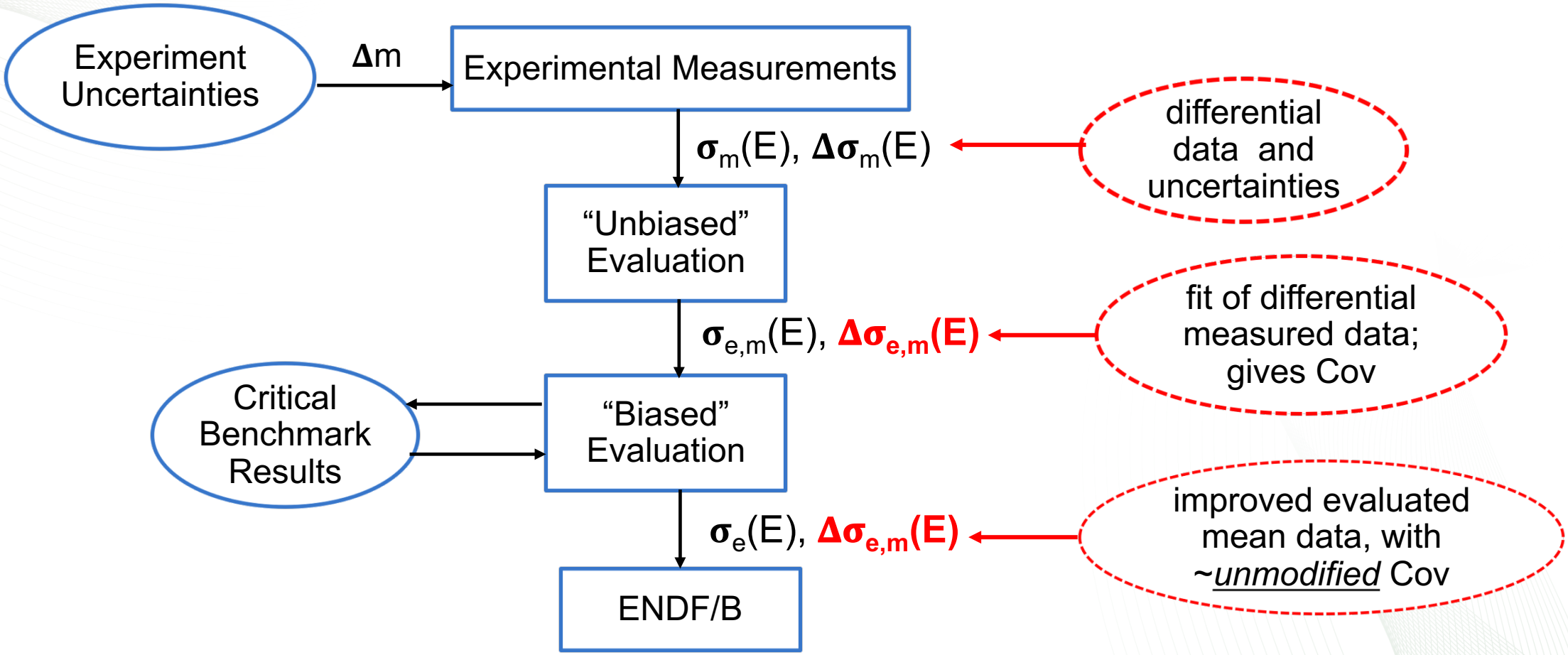
Variation in C/E Values is Much Less Than Predicted by ENDF/B Covariances



Why ENDF/B Covariance Data May Be Inconsistent



- ENDF covariance data are not consistent with evaluated XS data!

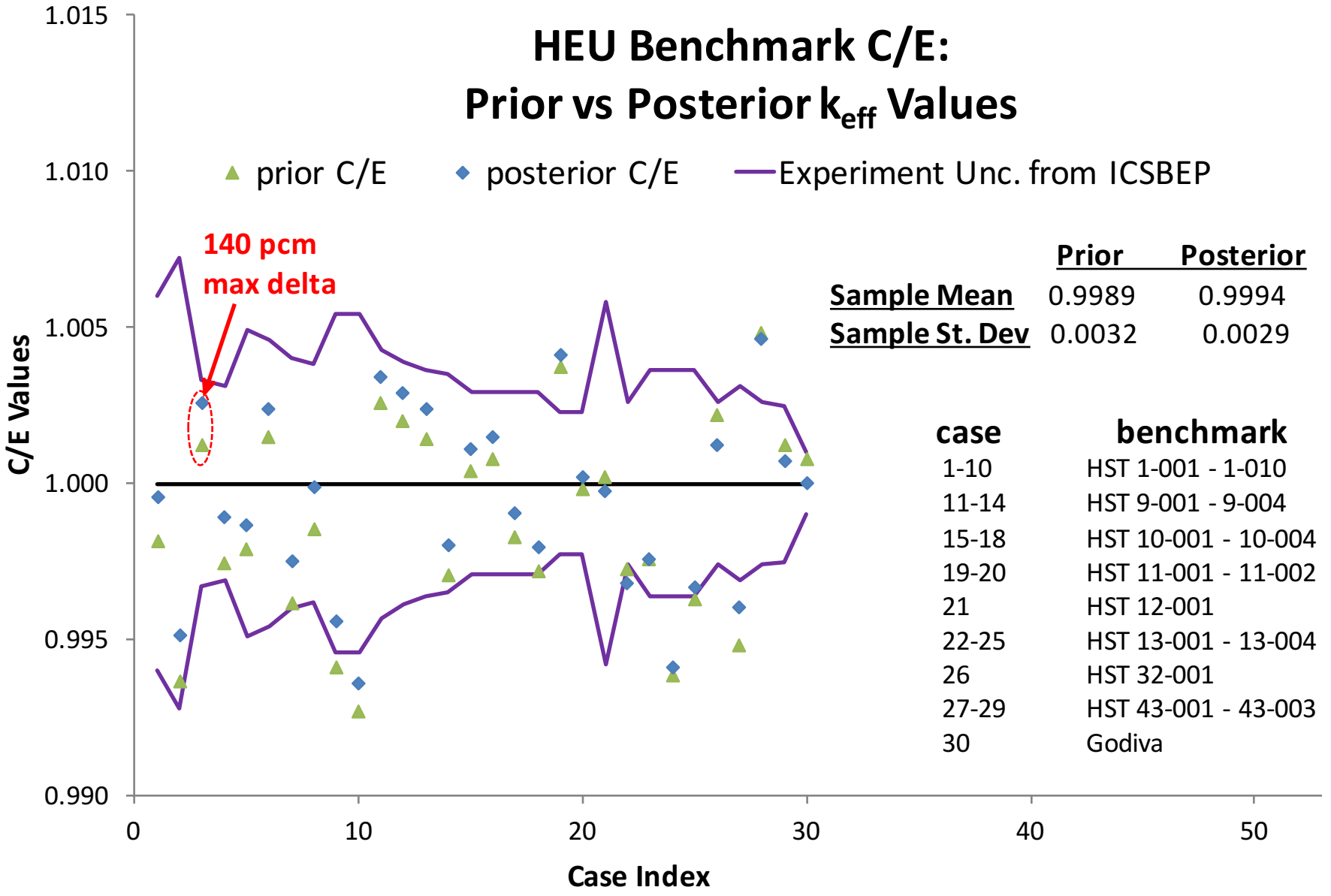
How to Make Covariance Data Consistent with XSs?

GLSS makes uncertainties consistent with mean values

Example for ENDF/B-VII.1 U235 data:

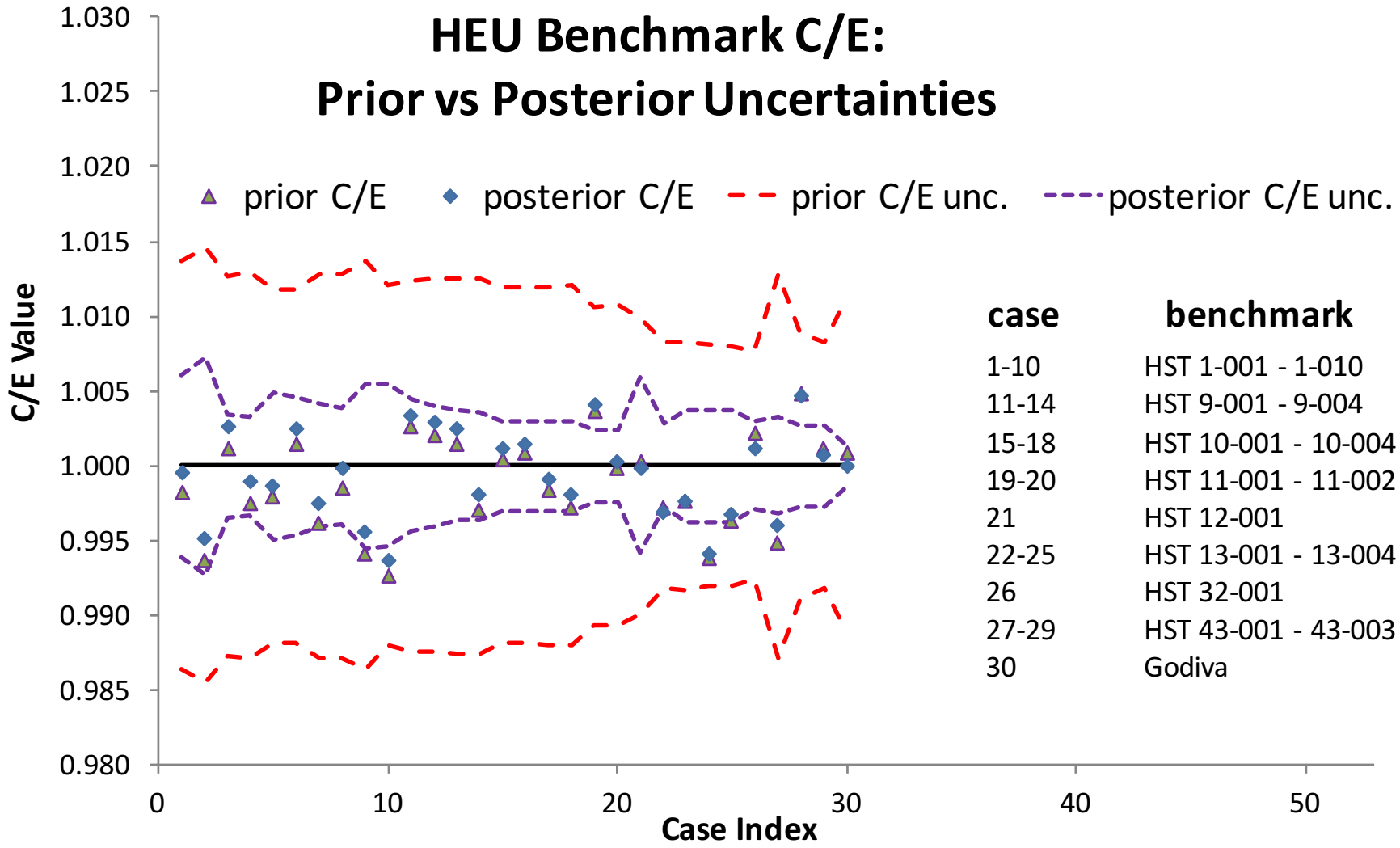
- HEU critical experiments used in CSEWG data testing were selected to span thermal->fast energy range
  - Benchmarks are sensitive mainly to U235 data
- GLLS consolidation was performed with TSURFER to obtain consistent XSs and uncertainty data
  - XS values only change small amount
  - Uncertainties change large amount
- Use POSTERIOR covariances with PRIOR ENDF cross sections

HEU Benchmark C/E: Prior vs Posterior k_{eff} Values



	Prior	Posterior
Sample Mean	0.9989	0.9994
Sample St. Dev	0.0032	0.0029

case	benchmark
1-10	HST 1-001 - 1-010
11-14	HST 9-001 - 9-004
15-18	HST 10-001 - 10-004
19-20	HST 11-001 - 11-002
21	HST 12-001
22-25	HST 13-001 - 13-004
26	HST 32-001
27-29	HST 43-001 - 43-003
30	Godiva



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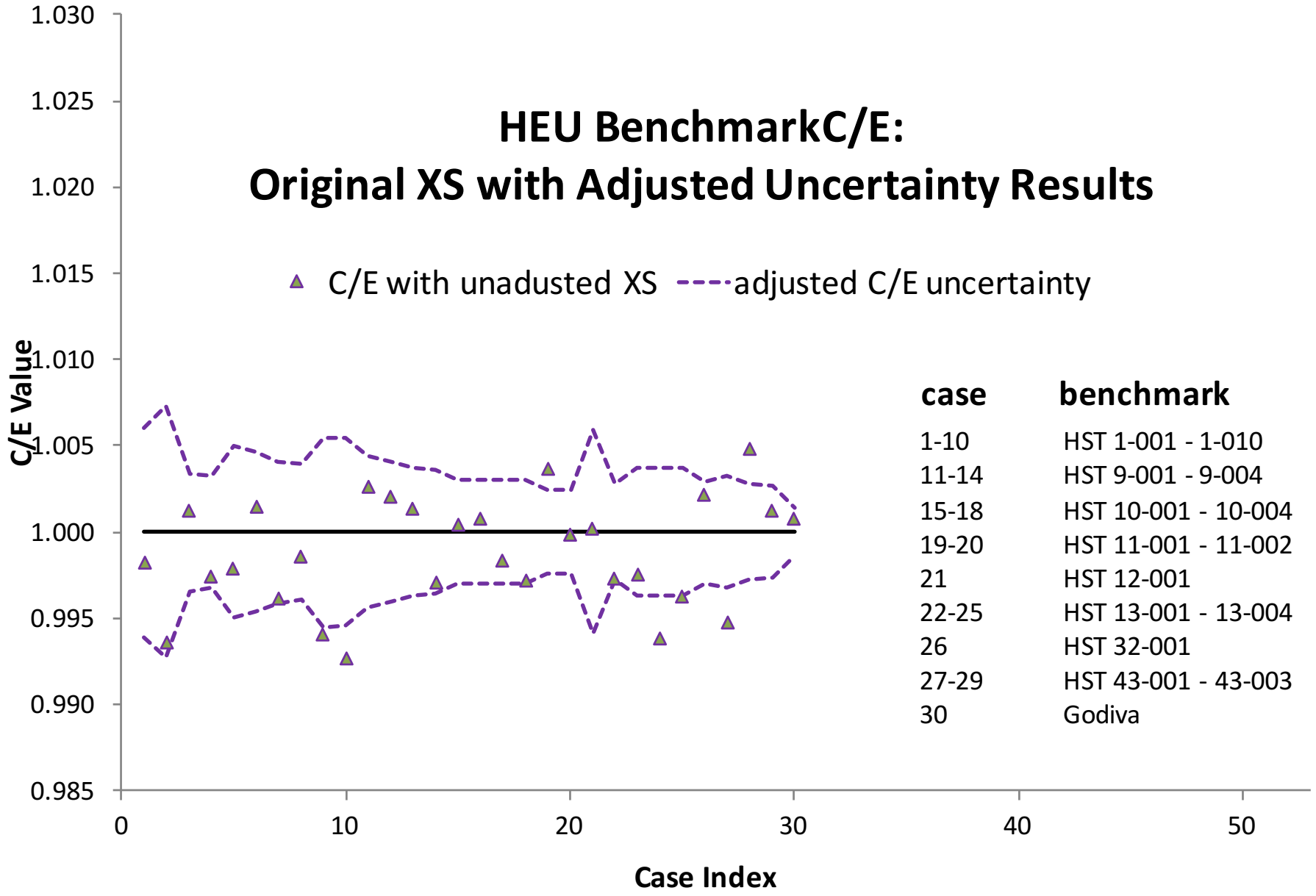
HEU BenchmarkC/E:
Original XS with Adjusted Uncertainty Results



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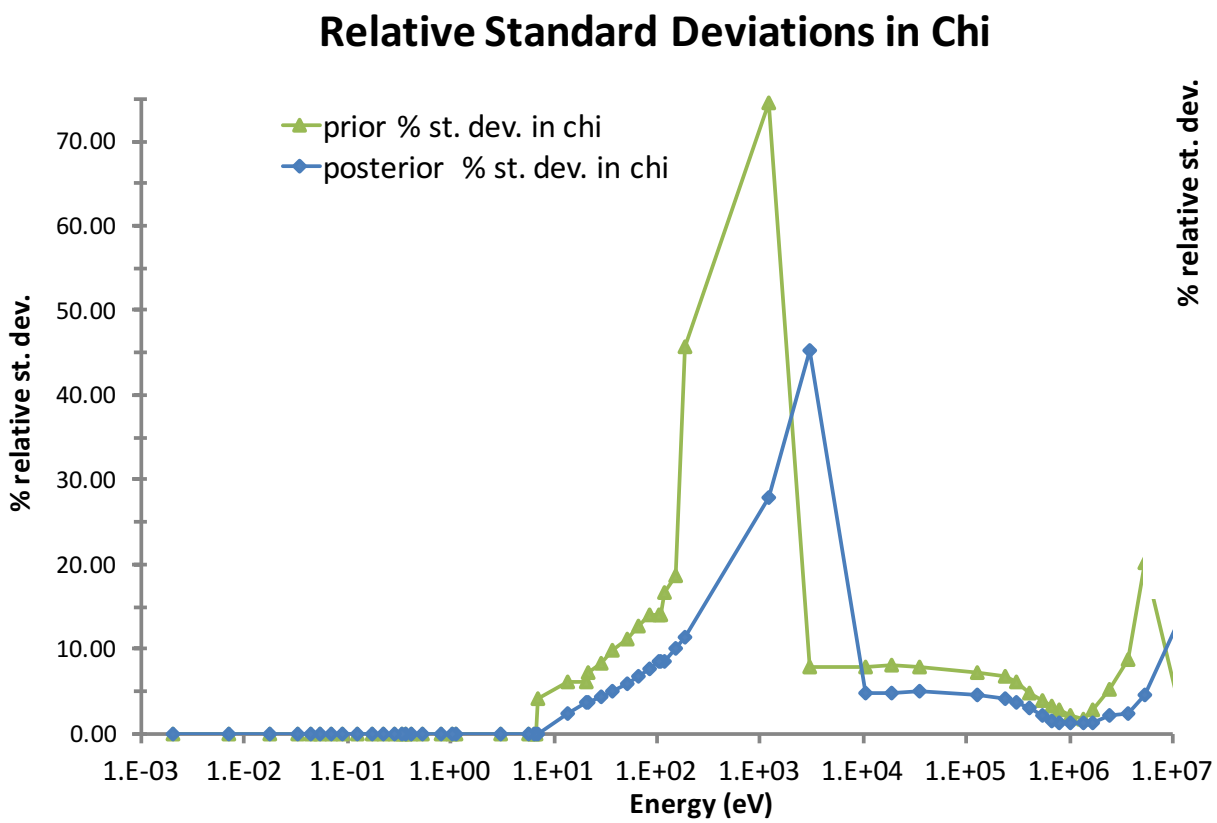
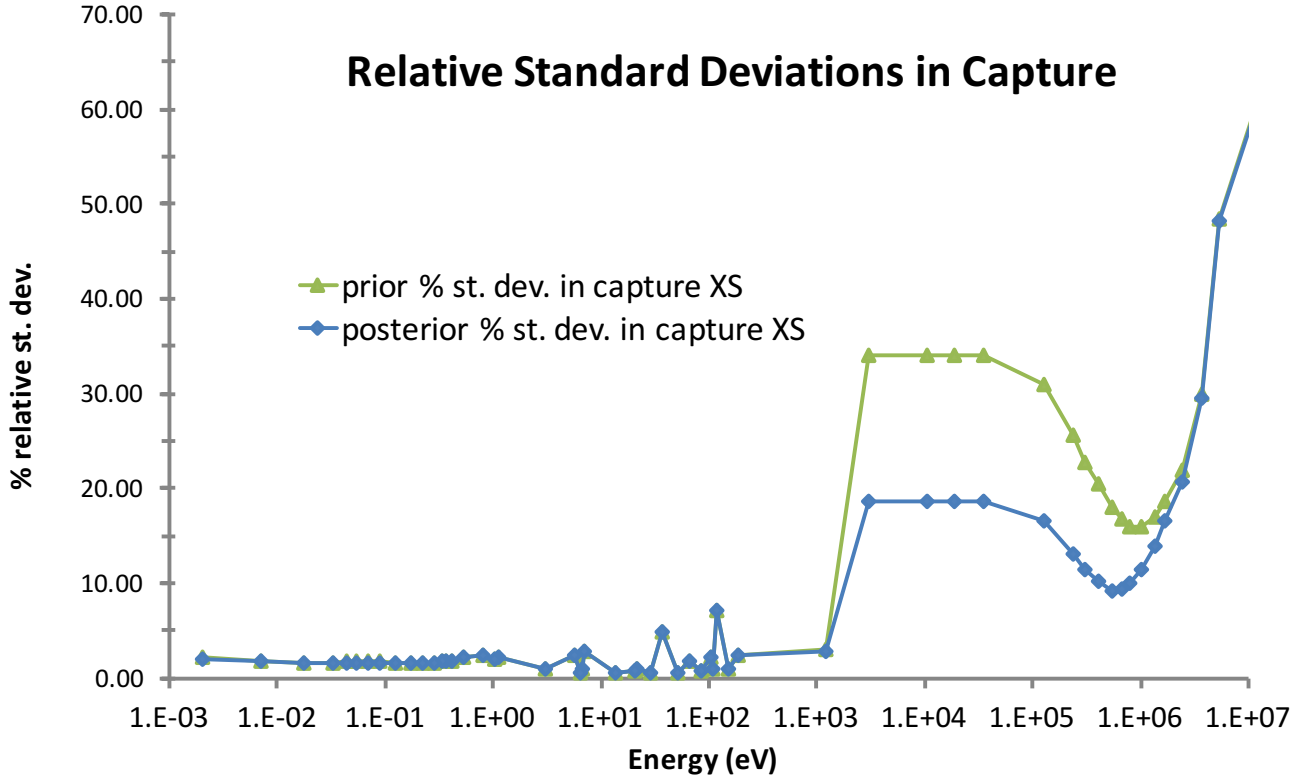
Data Contributions to k_{eff} Total Uncertainty for HST 001-001

Prior k_{eff} Uncertainty (% dk/k)	Posterior k_{eff} Uncertainty (% dk/k)	Change in k_{eff} Uncertainty (%dk/k)
1.228	0.686	-0.828

dk/k% Data	Prior Contribution to (dk/k %)	Posterior Contribution to (dk/k%)	Delta Contribution to (dk/k%)
u235 chi	1.078	0.435	-0.643
u235 nubar	0.376	0.312	-0.064
u235 capture	0.198	0.186	-0.013

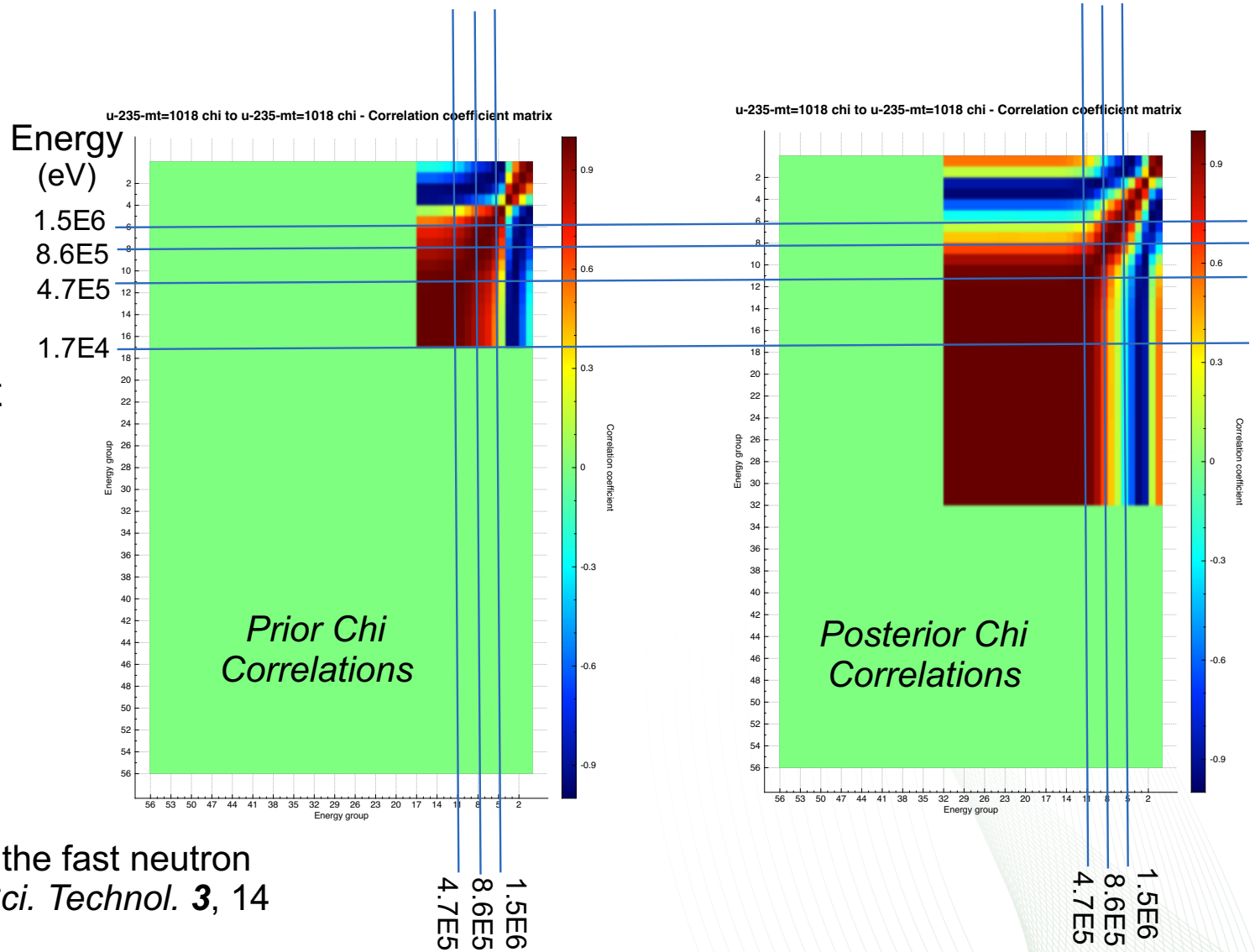
Changes in Nuclear Data Uncertainties





GLLS Changes in Correlation Matrices

- GLLS consolidation affects correlation matrices
- TSURFER code does not add NEW correlations in GLLS adjustment
  - recent work has suggested that new correlations between chi, nubar, and fission can impact uncertainties(1)
- Can omitted correlations be partially responsible for excessive uncertainties?



(1) D. Rochman, et a, "Correlation of υ, σ, χ in the fast neutron range via integral information," *EPJ Nuclear Sci. Technol.* ***3***, 14 (2017)

Conclusions

- ENDF/B covariance data are not consistent with mean values
  - Observed variation in C/E for HSTs is much less than predicted by ENDF cov
- Data adjustment causes small changes in calculated C/Es for HEU benchmarks, but large changes in calculated benchmark uncertainties
- GLLS procedure can make data uncertainties more consistent with mean values
  - largest effect is reduction in standard deviation for U235 chi
  - standard deviation in U235 capture reduced over range 2 KeV – 1 MeV
  - correlations and cross correlations will also be affected
  - Introduction of additional correlations between chi, nubar and fission may be important (not considered in this work)
- Using *prior* ENDF XSs with *posterior* covariances gives more consistent results