

Covariance Testing Progress for ENDF/B-VIII.1 β 1 at ORNL

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Outline

- Summary of results presented for $\beta 1$ at mini-CSEWG
- Detailed results for HMF-001 and PMF-001

Data-induced uncertainty in VALID benchmarks

- Historically a check ORNL has used to compare predicted variability with observed variability from benchmarks
- TSUNAMI-IP propagates covariance data with sensitivities from benchmarks
- The uncertainty is determined by reaction-nuclide pair and summed to determine the total data-induced uncertainty in k_{eff}
- Examination of results highlights potential concerns with covariance data

Results by benchmark category

Category	Number of Cases	Avg C/E (CE_V8.1)	Avg Exp. Unc. (pcm)	St. Dev. Of C/Es (pcm)	Avg 1 σ XS Unc (pcm)		% of Cases Within	
					E8+SCALE	E8.1+SCALE	Exp. Unc. Band	E8.1+SCALE XS Band
HMF	50	1.00002	193	467	979	950	34.0	96.0
HST	52	0.99900	494	615	652	792	75.0	96.2
IMF	13	1.00132	269	362	1027	1003	46.2	100
LCT	140	0.99874	195	162	603	737	56.4	100
LST	19	0.99920	318	283	824	944	57.9	100
MCT	49	0.99244	400	313	973	758	18.4	51.0
MST	10	0.99177	452	384	1323	1019	0	50.0
PMF	12	0.99902	207	133	1022	1038	66.7	100
PST	81	0.99927	497	429	1344	937	76.5	92.6

It appears that the covariance changes are generally having much larger impacts on thermal systems than on fast systems.

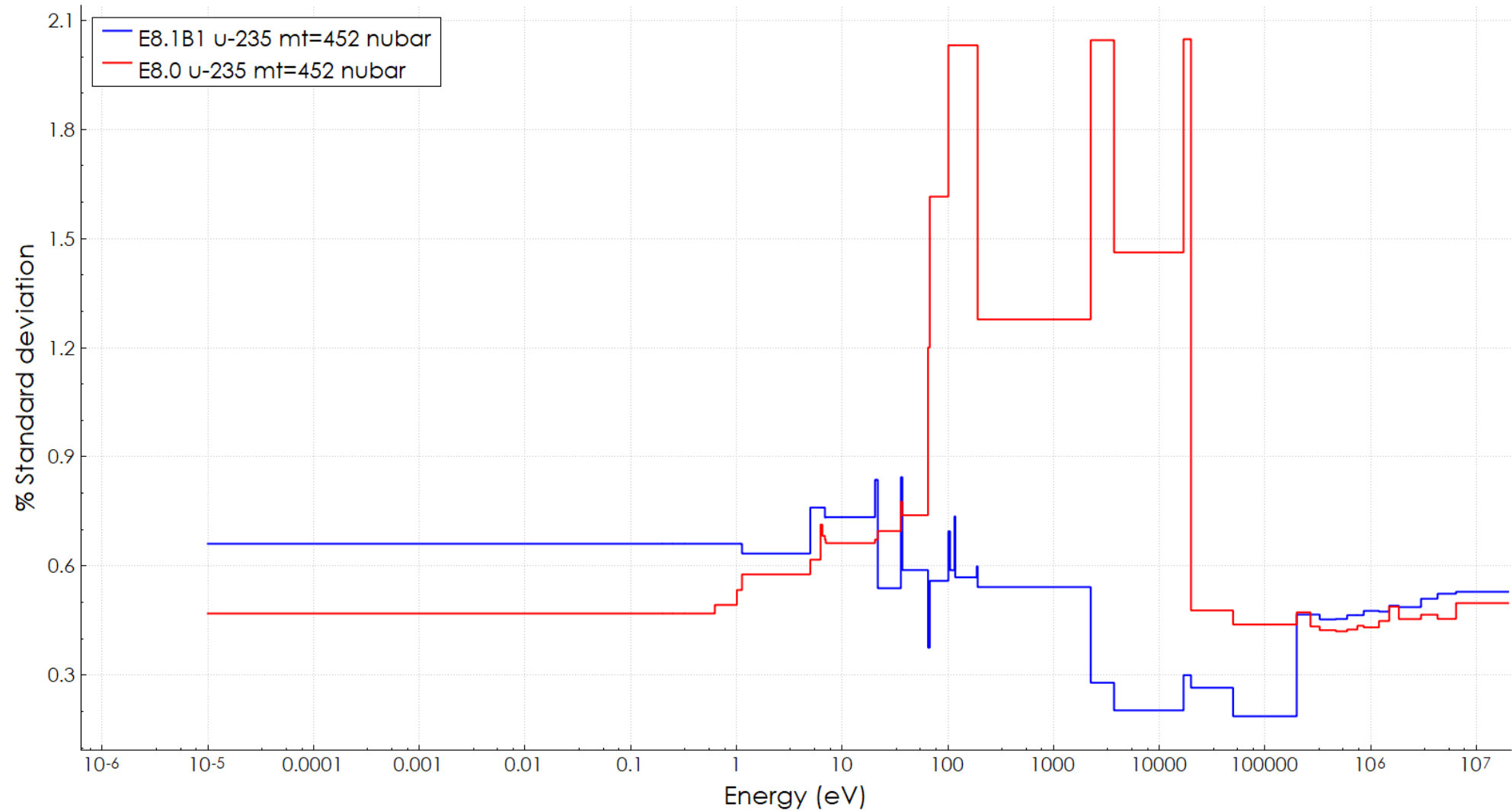
Small changes...

- HMF systems show small differences in general: ~3%
 - HMF systems reflected with DU appear to have significant reductions in ^{235}U nubar uncertainty (~400 pcm in E8.0 → ~225 pcm in E8.1)
- IMF system uncertainties ~2% lower with ENDF/B-VIII.1 β 1
- PMF systems a little less than 2% higher on average

Big uranium changes

- HST, LCT and LST systems see ~15-20% increases in uncertainty
- Directly attributable to ~40% increase in nubar contribution to uncertainty in **thermal** uranium systems
 - ORNL still disagrees with the ^1H covariance introduced in ENDF/B-VIII.0 and its associated significant increase in data-induced uncertainty
 - Neutron scatter off a proton has measured uncertainty more similar to the older data, references provided by Goran in the past
- Plot on next slide shows comparison of ENDF/B-VIII.0 and ENDF/B-VIII.1 β 1 nubar

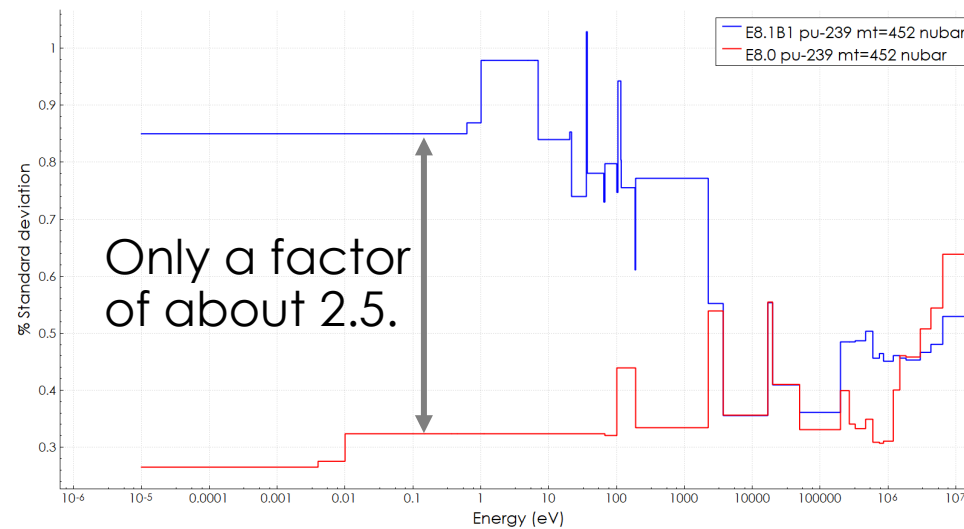
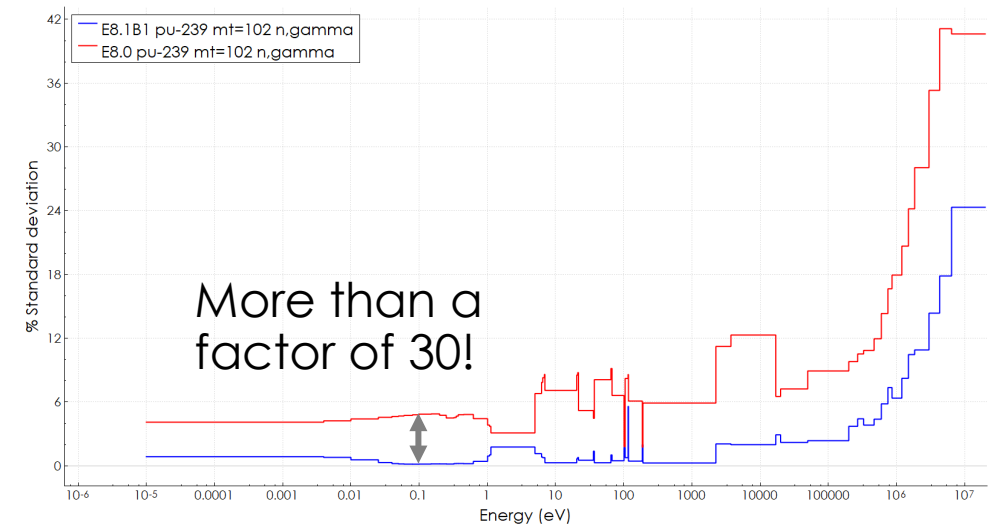
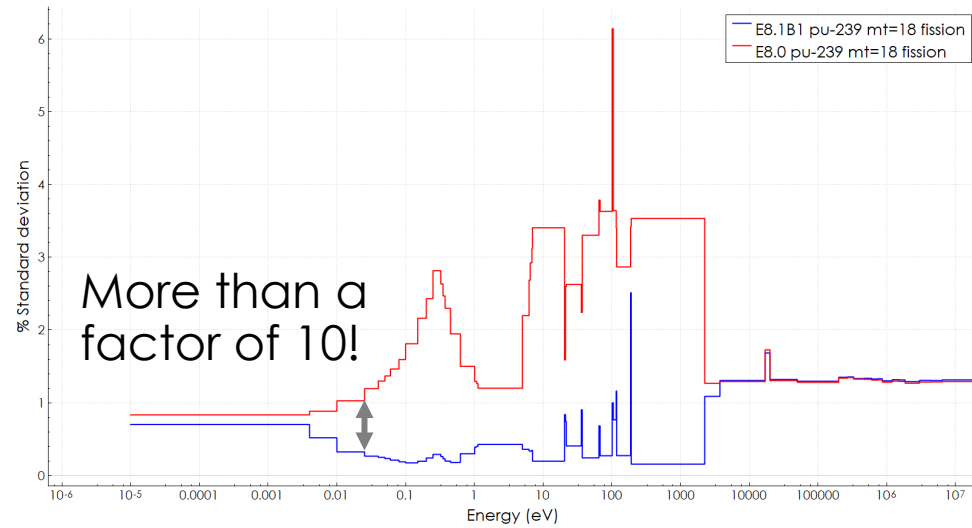
Comparison of ^{235}U nubar uncertainty data



Big Pu changes

- MST, MCT, and PST systems see ~20-30% decreases in uncertainty
- All the ^{239}Pu covariance data is totally different
 - n,gamma (leading contributor in E8.0) down by **95%**
 - Nubar uncertainty up by 167%
 - Chi down by 80%
 - Fission down by >85%

^{239}Pu fission, nubar, and n,gamma uncertainties



Questions on VALID results?



Detailed results for HMF-001 (“Godiva” simple sphere)

	ENDF/B-VIII.0 uncertainty (pcm)	ENDF/B-VIII.1β1 uncertainty (pcm)
²³⁵ U Fission	787	787
²³⁵ U Nubar	399	382
²³⁵ U Chi	33	33
²³⁵ U Elastic [†]	224	224
²³⁵ U Inelastic	239	239
²³⁵ U Capture	277	277
²³⁵ U Sum	982	975
Exp. Uncertainty	100	100
C-E	14	0

[†]Accounting for cross correlation with fission

Detailed results for PMF-001S (Jezebel simple sphere)

	ENDF/B-VIII.0 uncertainty (pcm)	ENDF/B-VIII.1β1 uncertainty (pcm)
²³⁹ Pu Fission	877	920
²³⁹ Pu Nubar	317	416
²³⁹ Pu Chi	179	37
²³⁹ Pu Elastic	484	360
²³⁹ Pu Inelastic	-119*	165
²³⁹ Pu Capture	64	19
Sum	1061	1085
Exp. uncertainty	130	130
C-E	-28	-116

- * Cross correlation between elastic and inelastic is larger than inelastic with itself
- Resulting total scattering uncertainty is 469 pcm in ENDF/B-VIII.0 and 396 pcm with ENDF/B-VIII.1β1

Conclusions

- Data-induced uncertainty significantly increased for thermal ^{235}U -fueled systems
- Dramatic changes in ^{239}Pu covariance changes for thermal systems are worrying
 - Were these the changes that were intended?
- Impact of changes on HMF-001 and PMF-001 is small

Acknowledgment

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Questions?

