

Tests results of ENDF/B.VIII.1.β2 in GND format

CSEWG 2023

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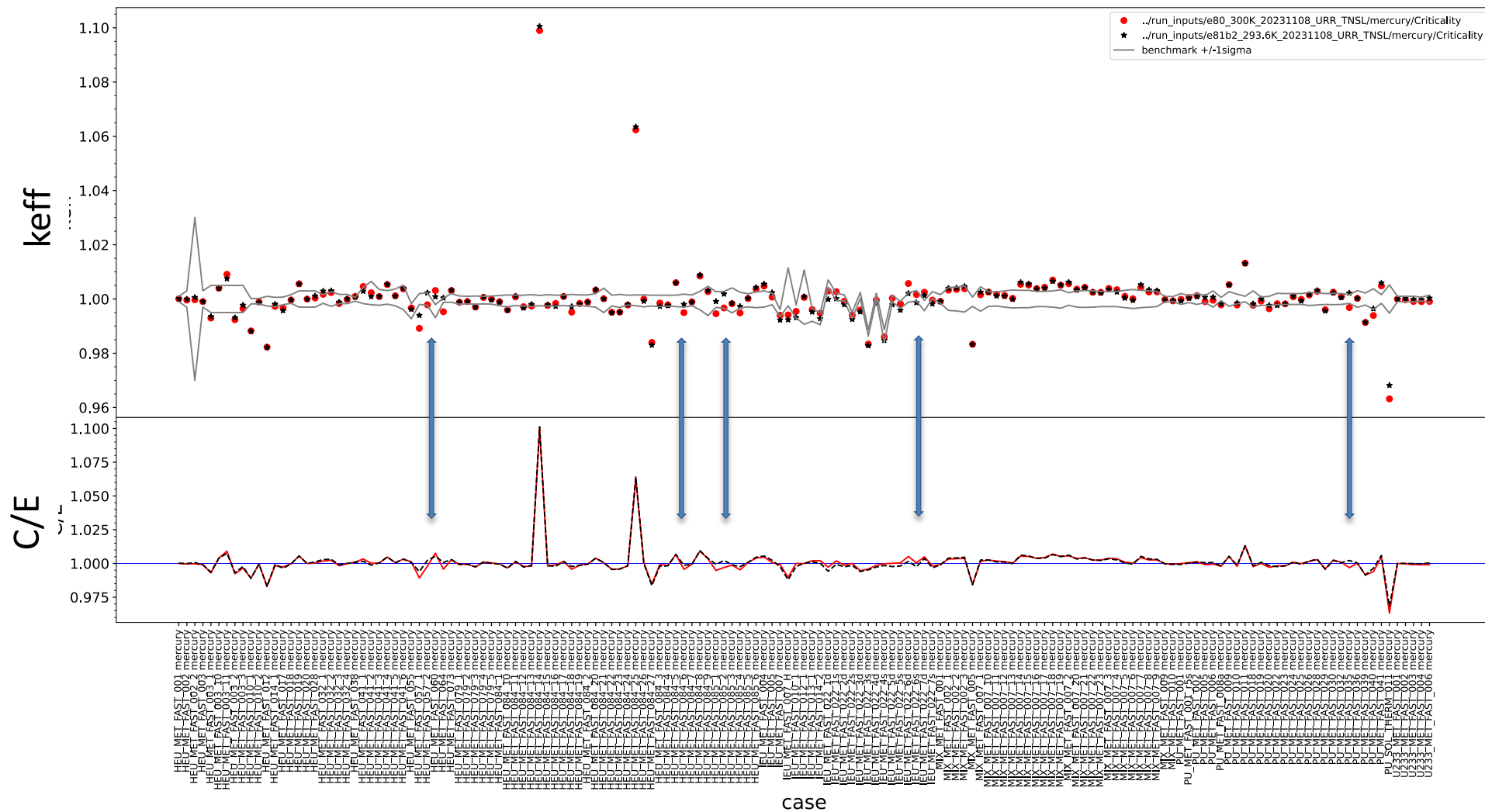


The ENDF/B-VIII.x evaluations were processed with FUDGE 6.1.0 in GNDS 2.0 format

- Beta 2: 557 isotopes
- URR Probability Tables except for
 - ENDF/B-VIII.0 timeout: 17; fail: Sn112, Pt192 T=300.0K
 - ENDF/B-VIII.1.beta1, long processing time Pa231, Pa 233, Eu; no fail T=293.6K
 - ENDF/B-VIII.1.beta2 T=293.6K
- TNSL processed, 25/88 TNSL files accessed by Mercury,
 - cases with H2O,D2O,CH2, Be, BeO
- Metis: 147 Fast Critical Assemblies/ 73 Thermal
- Mercury MC transport code
 - Version: 5.36.1
 - GIDI+: 3.27.9

Criticality: comparison to ENDF/B-VIII.0

$C_{e81beta2}$ and C_{e80}



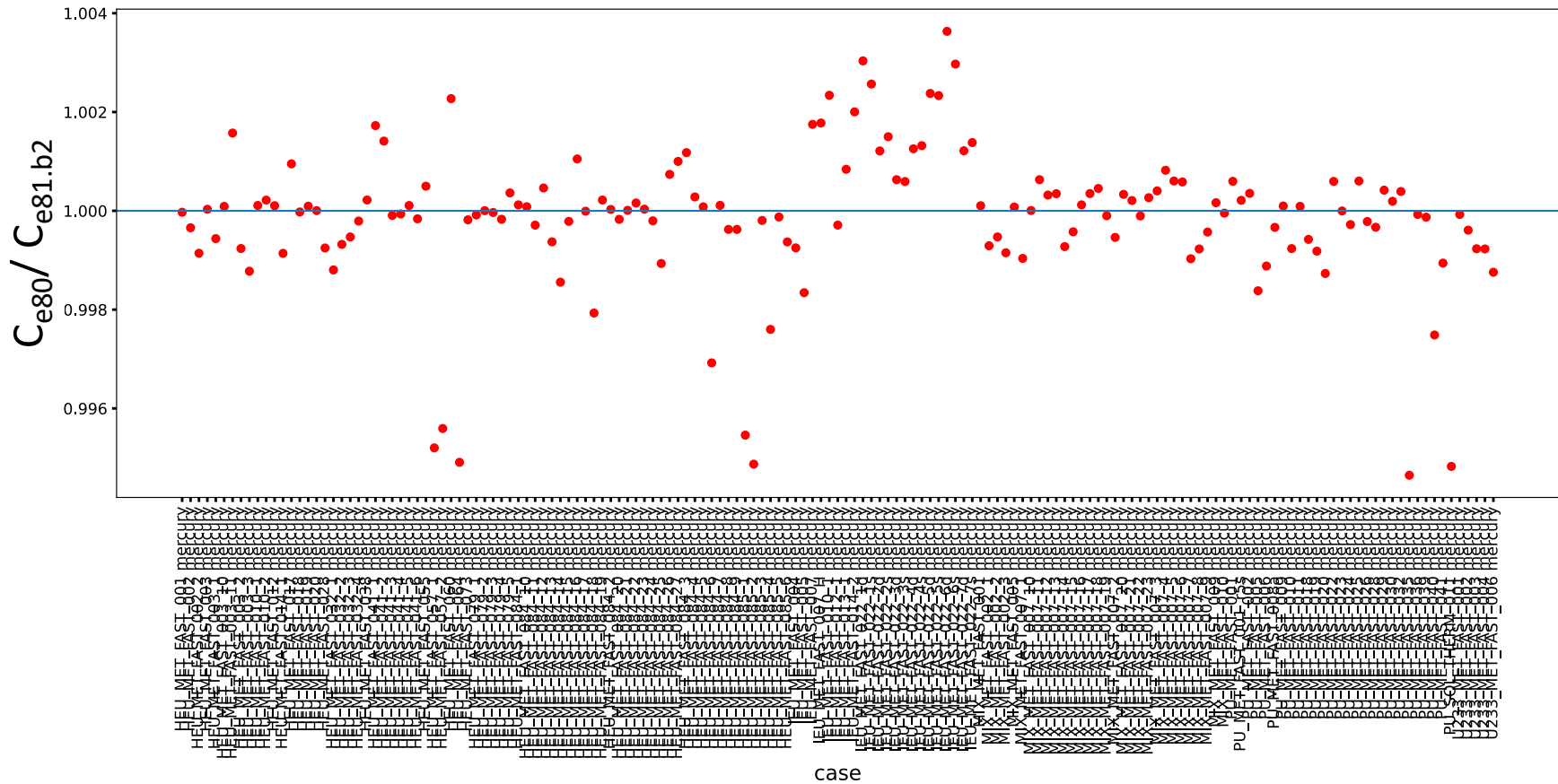
Criticality: comparison to ENDF/B-VIII.0

$$C_{e80}/C_{e81.beta2}$$

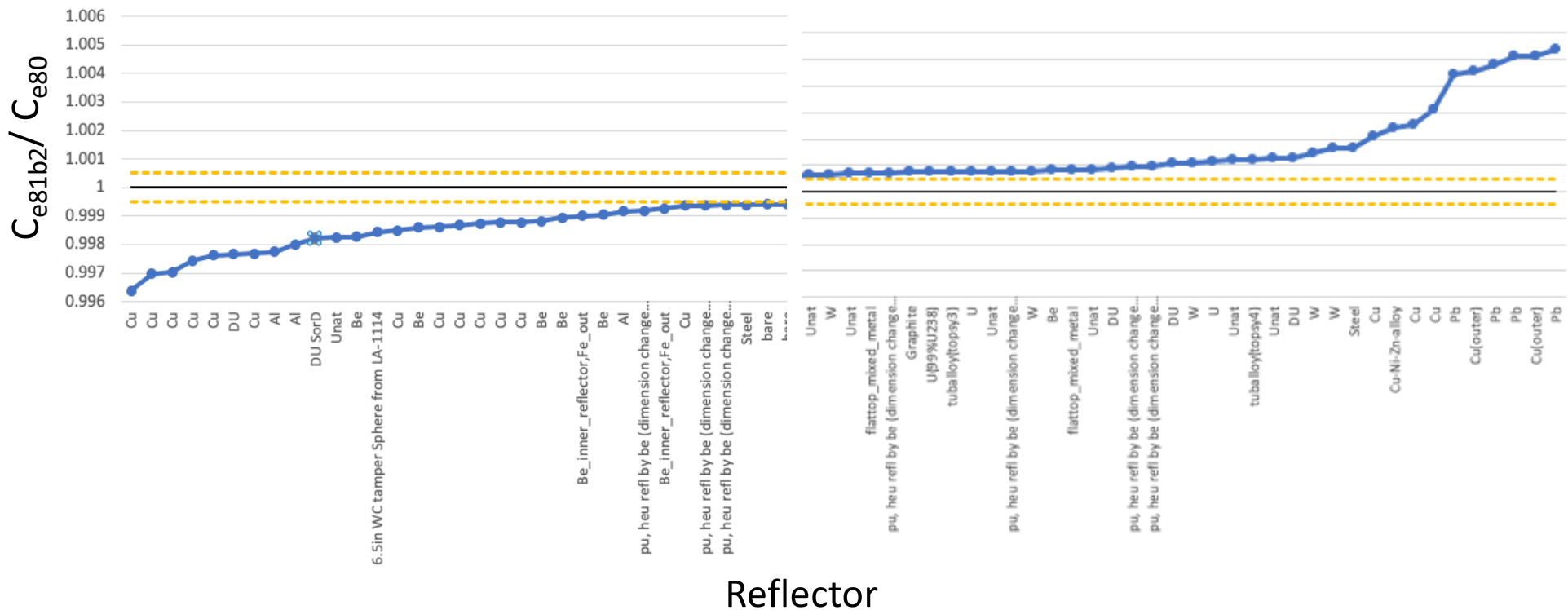
Criticality

keff(test1) / keff(test2) results

test1 = ../run_inputs/e80_300K_20231108_URR_TNSL/mercury/Criticality
test2 = ../run_inputs/e81b2_293.6K_20231108_URR_TNSL/mercury/Criticality

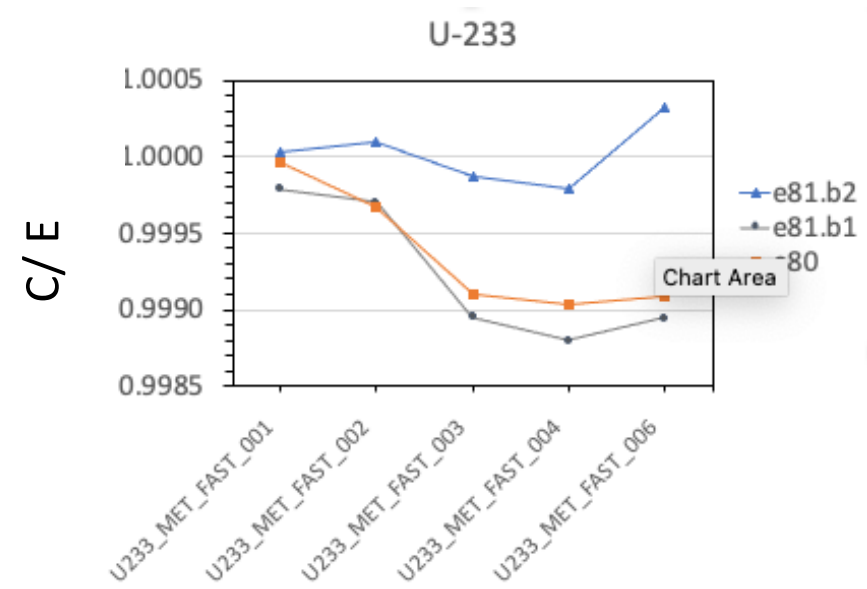
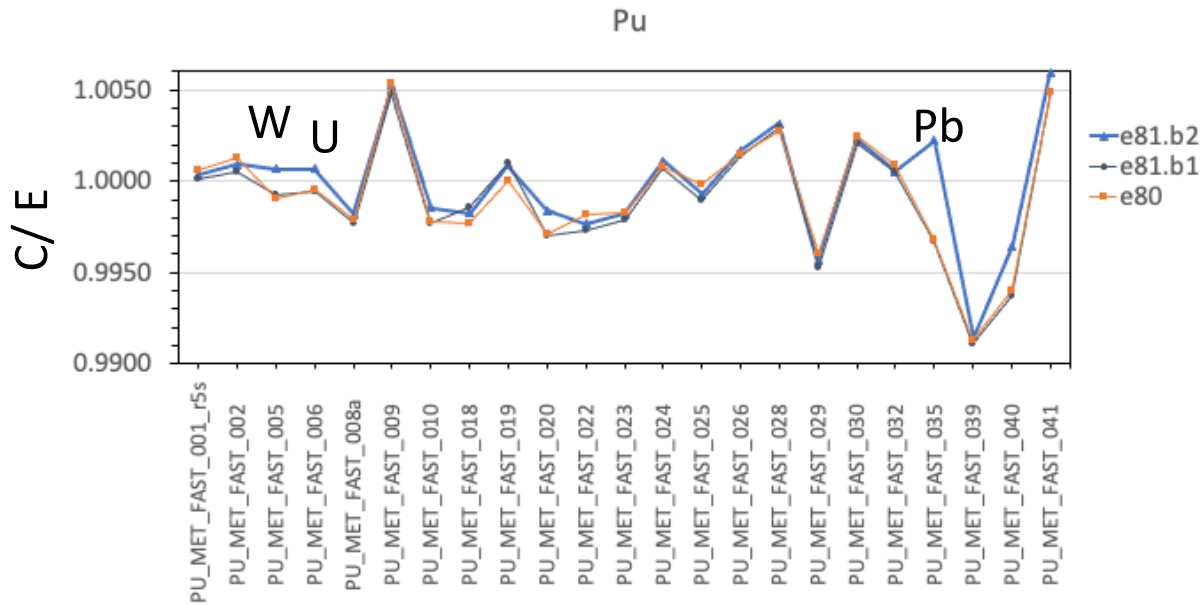


Now, Criticality: C_{e81b2}/C_{e80}



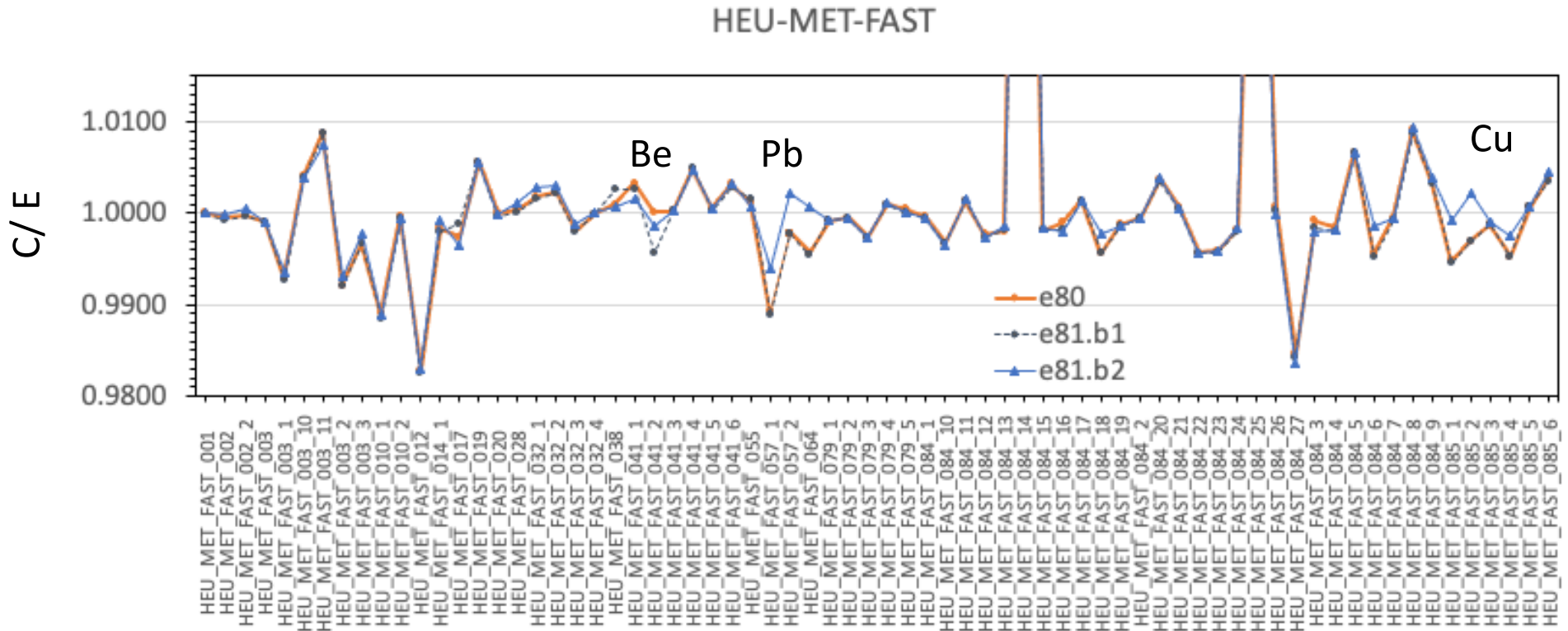
Cases with IMF22(Cu) reflectors and Pb show largest differences; Al, Du and U nat & W

C/E Criticality: PU, U233



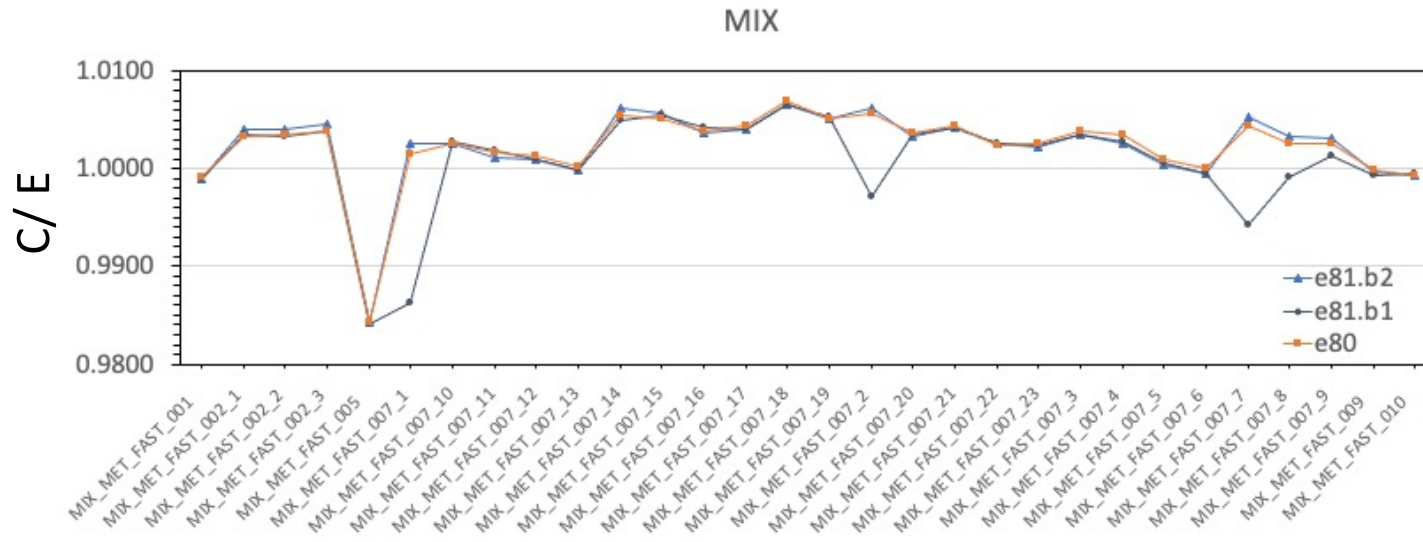
Jezebel rev 5 simplified excellent agreement, PMF good agreement
UMF overall improvement

C/E Criticality: PU, HEU, U233



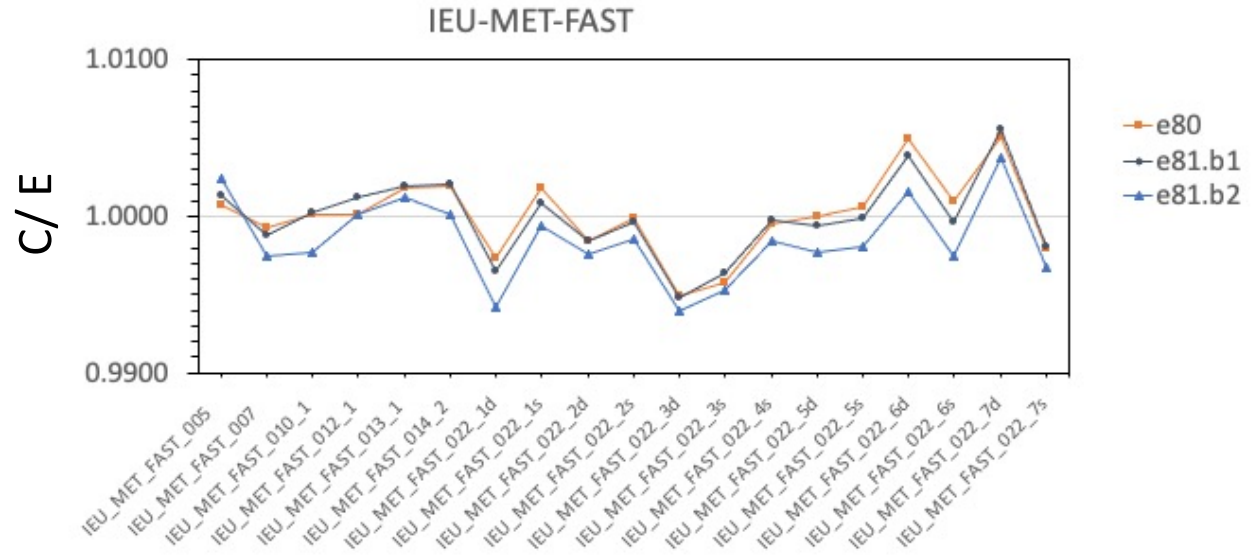
HMF improvements seem to be driven by changes to Cu, Pb, Be

C/E Criticality: MIX, IEU

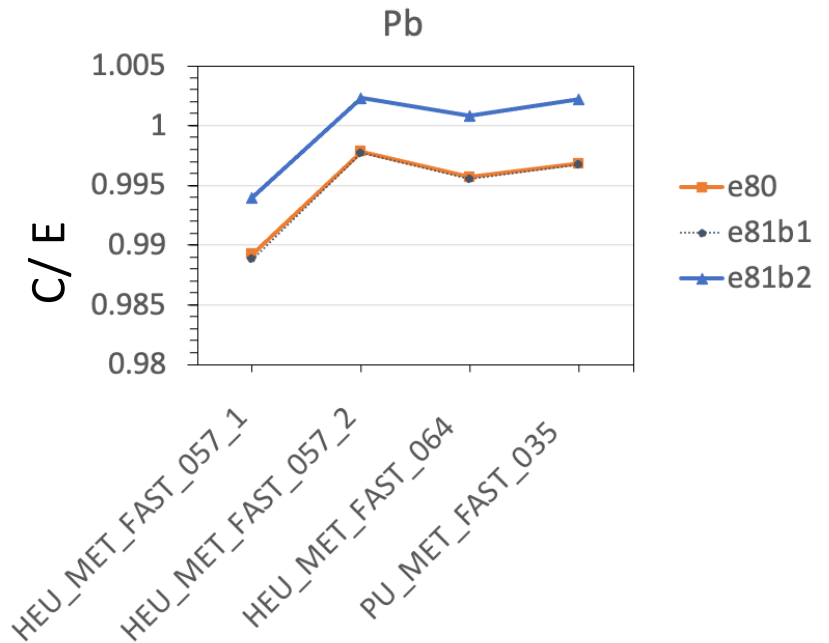
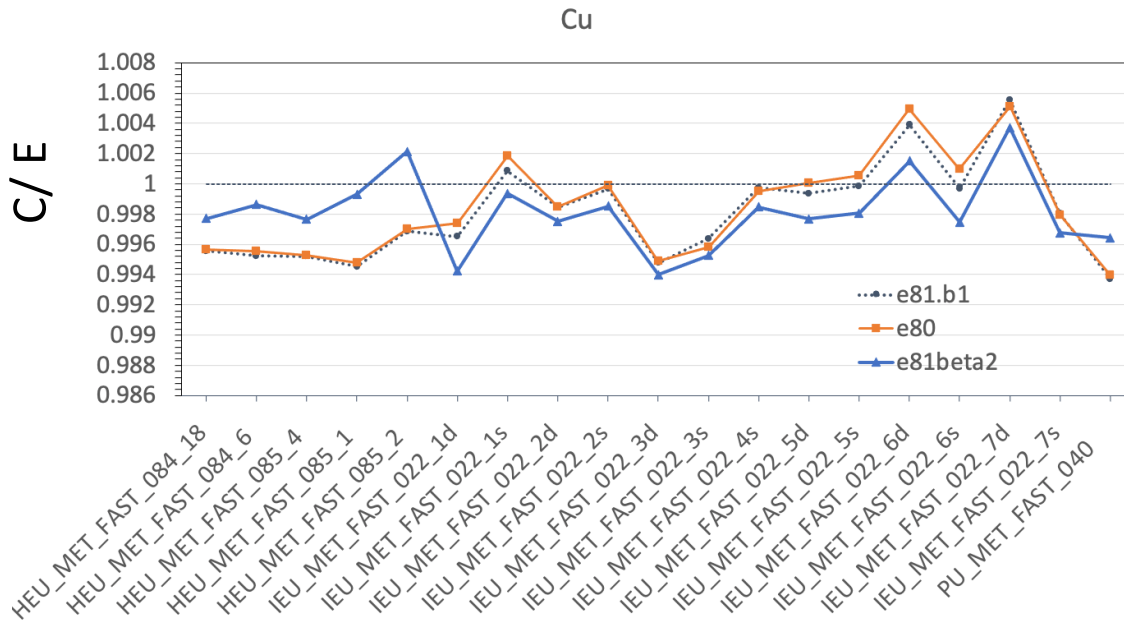


E81.b1 low k_{eff} :Be

IMF overall decrease in k_{eff} , overall poorer agreement when including IMF022 (Cu)

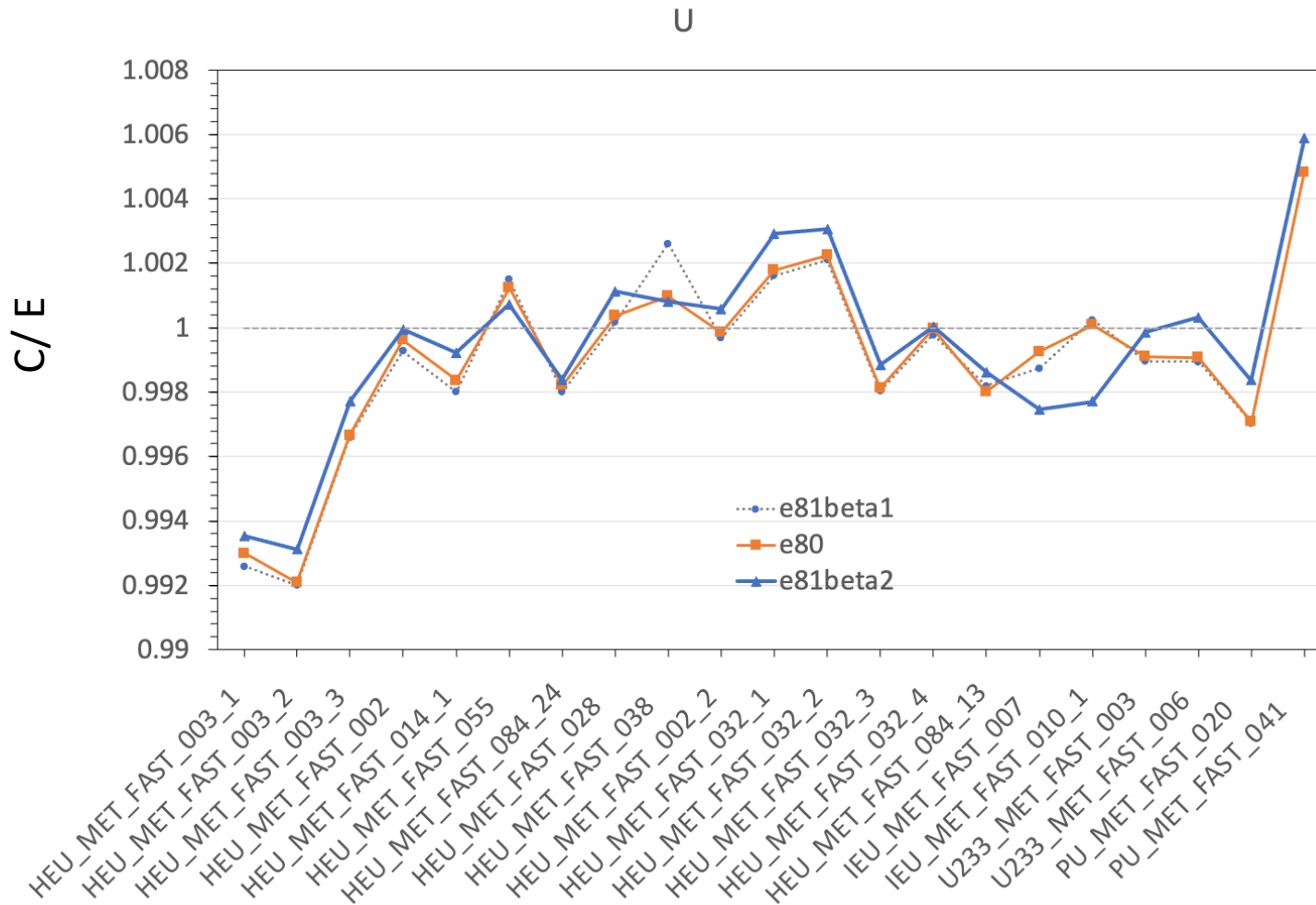


Reflector: Cu, Pb

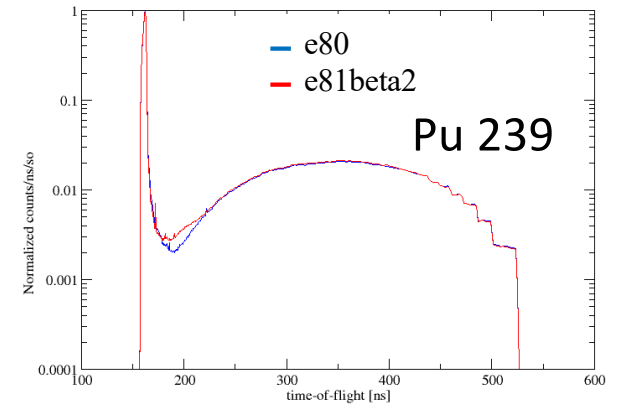
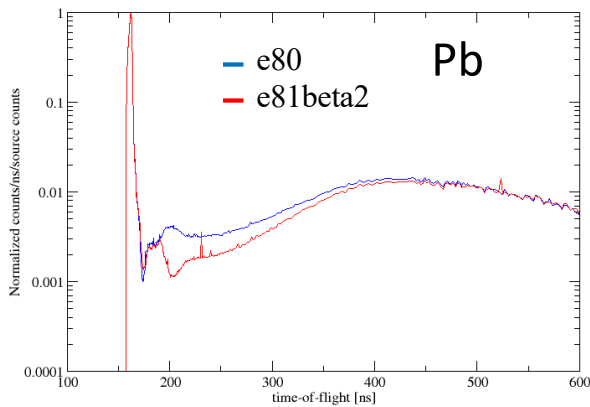
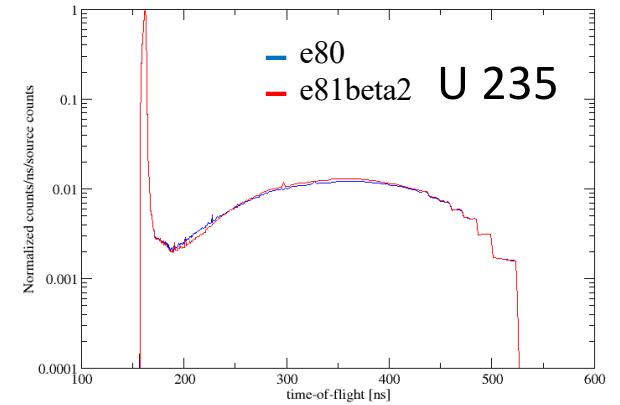
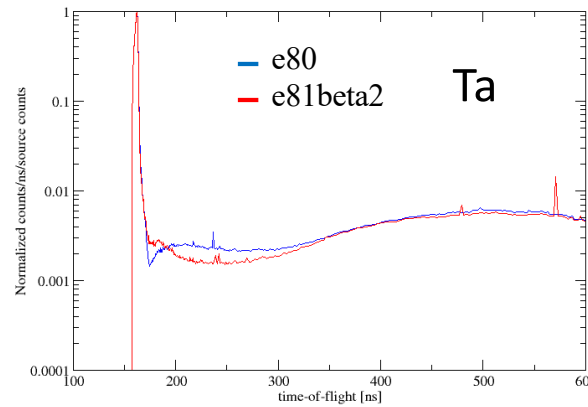
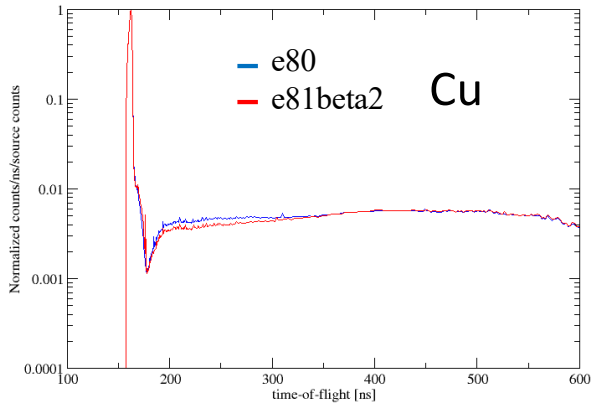


Cu: HMF better agreement while for IMF agreement is worse
 Pb: C/E improved

Reflector: U, DU, tuballoy

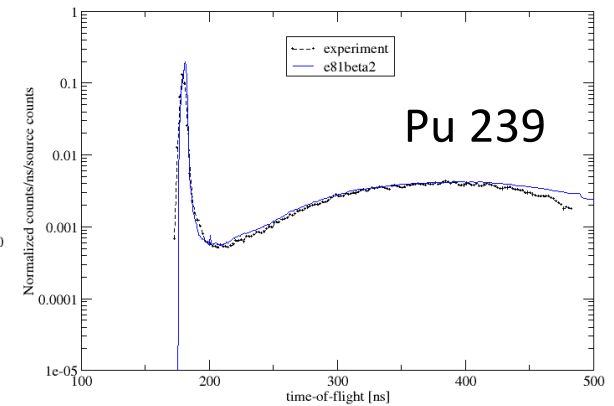
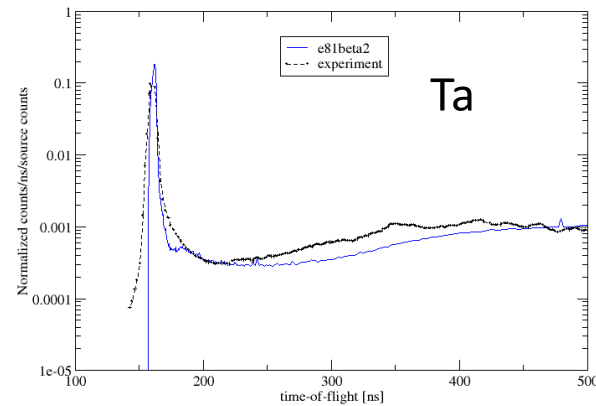
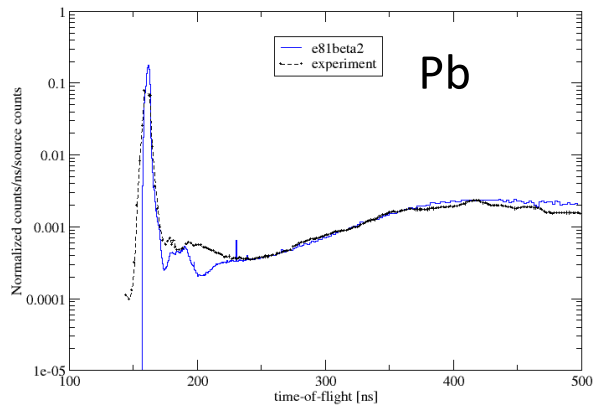
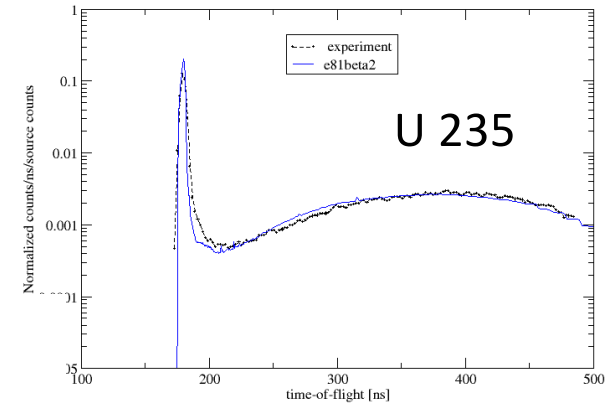
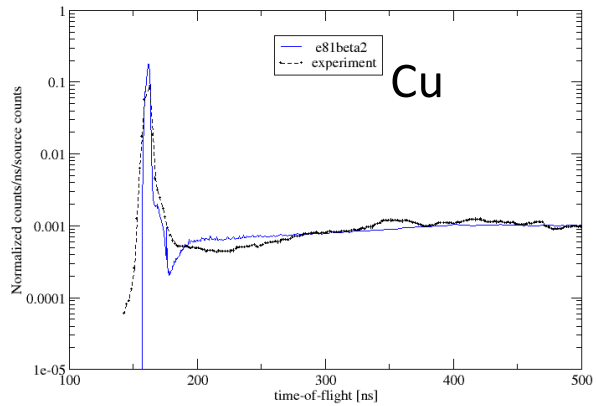


LLNL pulsed spheres



Pb, Ta, Pu239 show spectral changes, smaller effect seen for Cu and U235

LLNL pulsed spheres



Pu239 improved; U235 and Cu similar; Ta local improvement; Pb should be reviewed

Fission Ratios: comparison to e80

- Mercury/GNDS – MCNP6.2/ACE * Brown et al. NDS 148 (2018)
- Reaction rates are normalized by $^{235}\text{U}(n,f)$

Benchmark	Reaction Ratio	$^{238}\text{U}(n,f)$	$^{237}\text{Np}(n,f)$	$^{233}\text{U}(n,f)$	$^{239}\text{Pu}(n,f)$
Godiva	Mercury e81b2	0.1580	0.8301	1.5795	1.3831
	Mercury e80	0.1583	0.8315	1.5796	1.3846
	MCNP e80 *	0.1583	0.8318	1.5793	1.3846
	Mercury e81b2/e80	0.9980	0.9983	0.9999	0.9989
Jezebel	Mercury e81b2	0.2108	0.9711	1.5661	1.4246
	Mercury e80	0.2107	0.9768	1.5661	1.4271
	MCNP e80 *	0.2121	0.9770	1.5660	1.4273
	Mercury e81b2/e80	1.0005	0.9942	1.0000	0.9982
Flatop25	Mercury e81b2	0.1448	0.7726	1.5779	1.3607
	Mercury e80	0.1451	0.7732	1.5779	1.3621
	MCNP e80 *	0.1451	0.7735	1.5664	1.3622
	Mercury e81b2/e80	0.9979	0.9992	1.0000	0.9990

Fission Ratios: C_{e81b2}/E

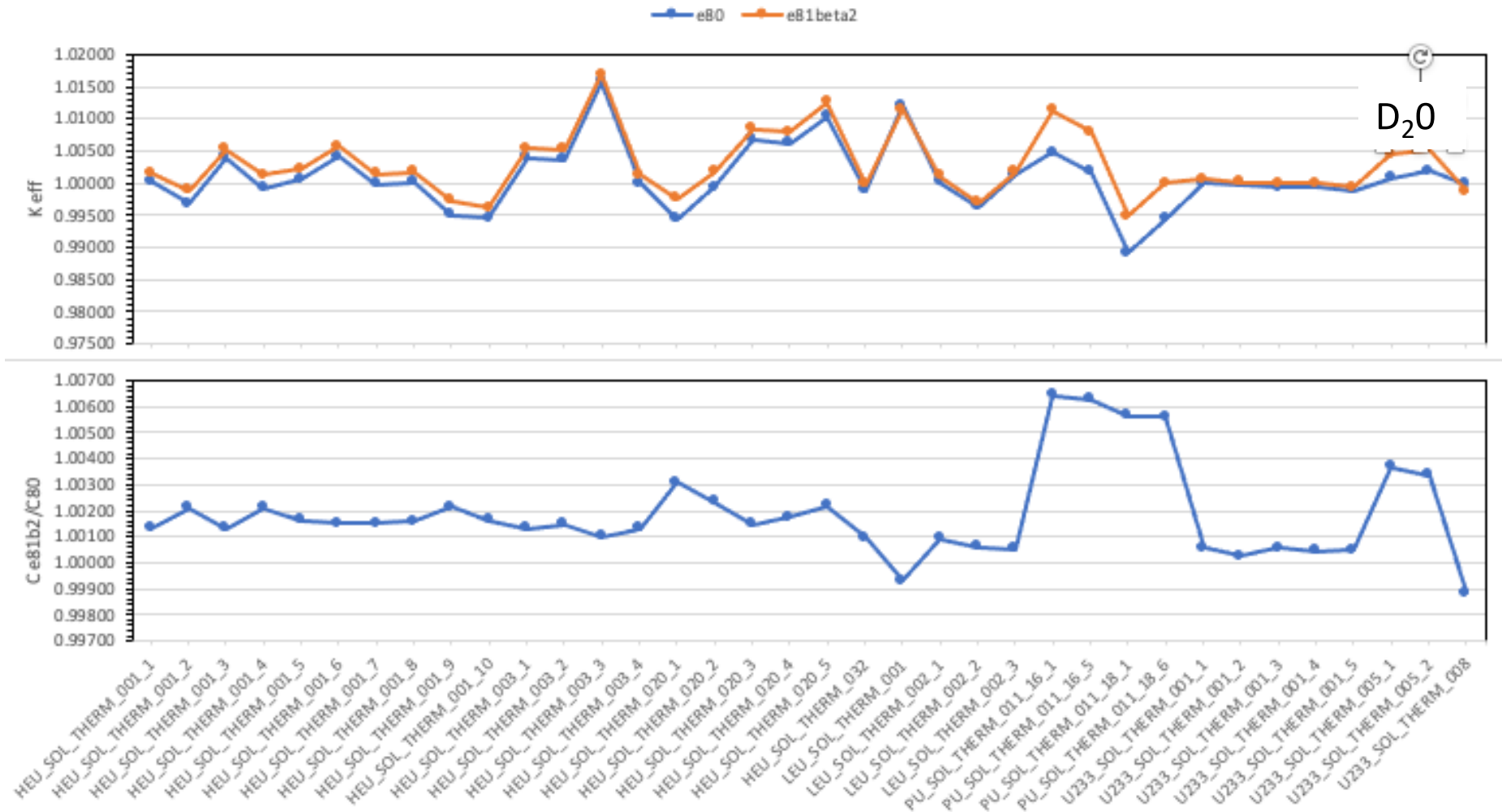
Assembly	Quantity	U238f/U235f	Np237f/U235f	U233f/U235f	Pu239f/U235f
Godiva (HMF001)	Calc	0.1580	0.8301	1.5795	1.3831
	Exp-B	0.1643±0.0018	0.8516±0.012	*	1.4152±0.014
	Exp-A	0.1642±0.0018	0.8370±0.013	1.5900±0.03	1.4020±0.025
	Calc/Exp	0.9614	0.9748	0.9934	0.9773
Jezebel (PMF001)	Calc	0.2108	0.9711	1.5661	1.4246
	Exp-B	0.2133±0.0023	0.9835±0.014	*	1.4609±0.013
	Exp-A	0.2137±0.0023	0.9620±0.016	1.578±0.027	1.448±0.029
	Calc/Exp	0.9883	0.9874	0.9925	0.9752
Jezebel-23 (UMF001)	Calc	0.2114	0.9851		
	Exp-B	0.2131±0.0026	0.997±0.015		
	Exp-A	0.2131±0.0023	0.977±0.016		
	Calc/Exp	0.9922	0.9881		
Flatop-25 (HMF028)	Calc	0.1448	0.7726	1.5779	1.3607
	Exp-B	0.1492±0.0016	0.7804±0.01	1.608±0.003	1.3847±0.012
	Exp-A	0.1490±0.002	0.7600±0.01	1.600±0.003	1.3700±0.02
	Calc/Exp	0.9705	0.9900	0.9813	0.9827
Flatop-Pu (PMF006)	Calc	0.1778	0.8503		
	Exp-B	0.1799±0.002	0.8561±0.012		
	Exp-A	0.1800±0.003	0.84±0.01		
	Calc/Exp	0.9881	0.9933		
Flatop-23 (UMF006)	Calc	0.1873	0.8994		
	Exp-B	0.1916±0.0021	0.9103±0.013		
	Exp-A	0.1910±0.003	0.8900±0.01		
	Calc/Exp	0.9776	0.9880		

Summary

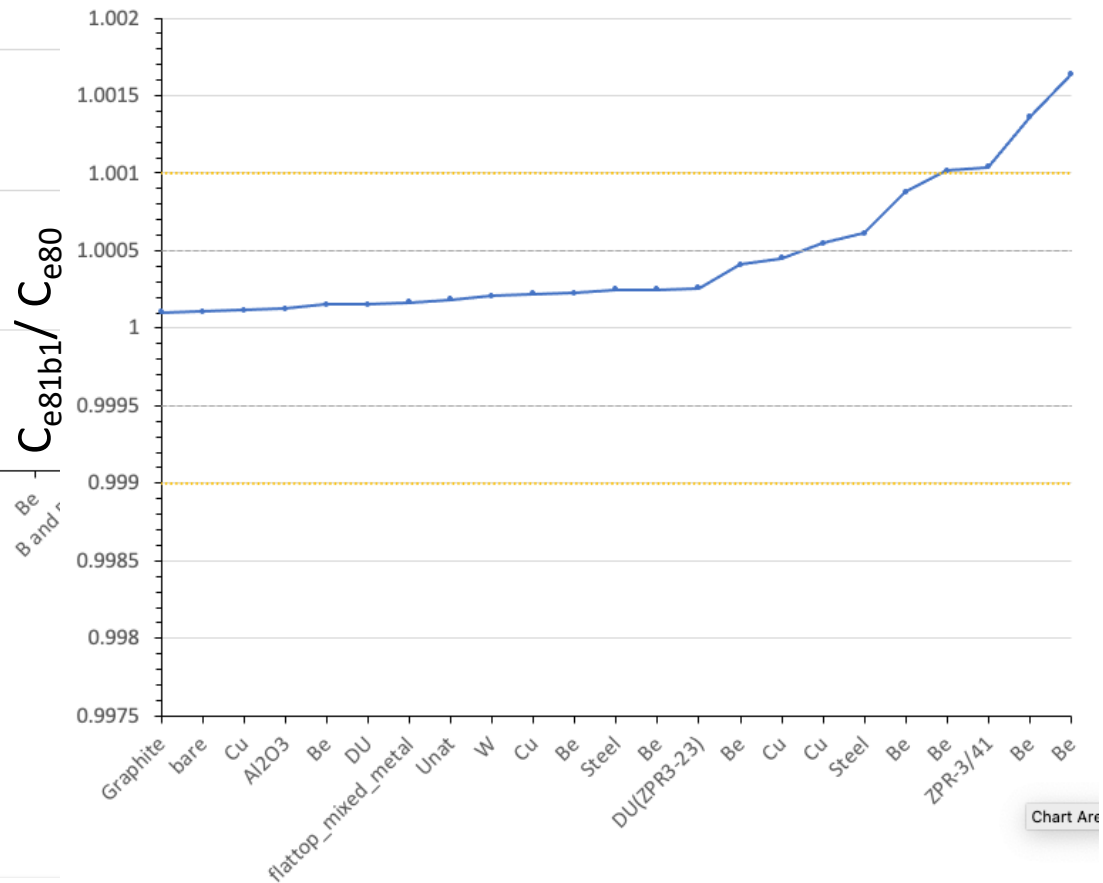
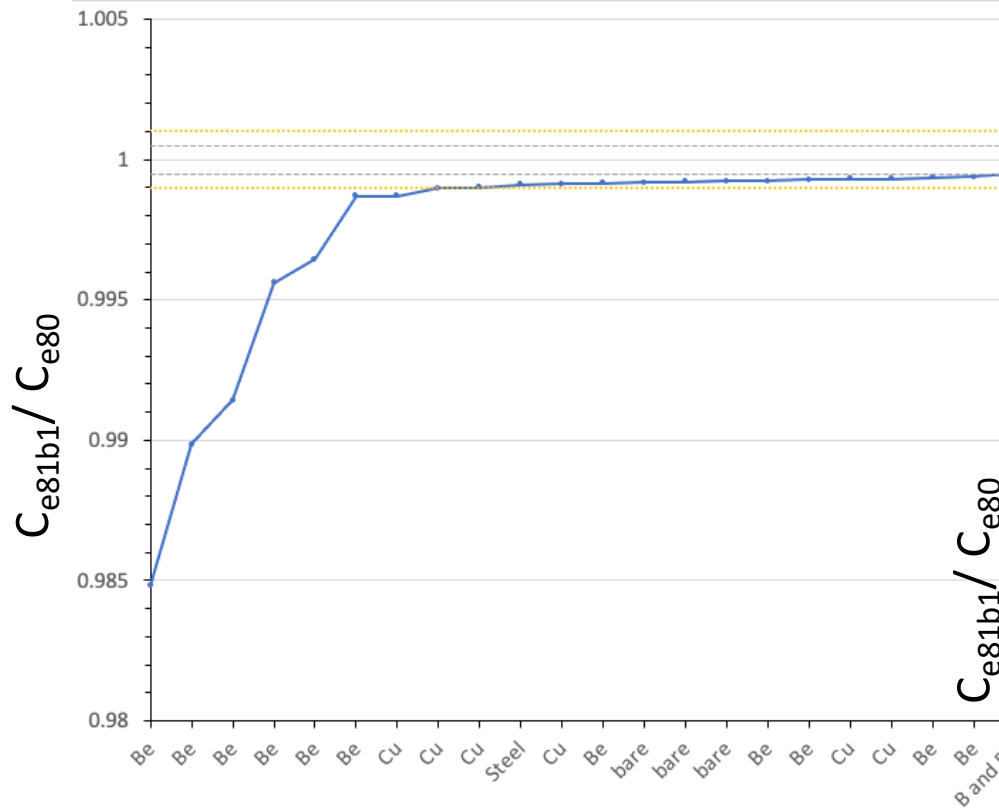
- C/E of U233-MET-FAST benchmarks were improved when using ENDF/B-VIII.1 beta2 compared to VIII.0 and VIII.1beta1
- C/E of HEU and PU-MET-FAST did not show major changes using ENDF/B-VIII.1 beta2
- C/E of IEU-MET-FAST benchmarks are lower and worse than those simulated with VIII.0 and VIII.1beta1
- Changes seen were driven by reflector, mostly Pb, Cu and Be
 - Be ENDF/B-VIII.1 beta2 results are improved compared to ENDF/B-VIII.1 beta1
 - Cu ENDF/B-VIII.1 beta2 results are improved for HEU-MET-FAST cases, not for IEU-MET-FAST but unlikely to be related to the Cu evaluations
 - Pb ENDF/B-VIII.1 beta2 results are improved for 4 cases, the Pulsed sphere spectrum shows odd features.

Backup

Thermal assemblies



Then, Criticality: C_{e81b1}/C_{e80}



Cases with MMF7(Be) & IMF22(Cu) reflectors show largest differences; 2 steel reflected & 3 bare Pu assemblies (PMF2, 22, 29)

Then: Beta 1 Fission Ratios

- Mercury/GNDS – MCNP6.2/ACE * Brown et al. NDS 148 (2018)
- Reaction rates are normalized by $^{235}\text{U}(n,f)$

Benchmark	Reaction Ratio	$^{238}\text{U}(n,f)$	$^{237}\text{Np}(n,f)$	$^{233}\text{U}(n,f)$	$^{239}\text{Pu}(n,f)$
Godiva	Mercury e81b1	0.1580	0.8301	1.5795	1.3830
	Mercury e80	0.1583	0.8315	1.5796	1.3846
	MCNP e80 *	0.1583	0.8318	1.5793	1.3846
	Mercury e81b1/e80	0.9981	0.9983	0.9999	0.9988
Jezebel	Mercury e81b1	0.2110	0.9719	1.5662	1.4246
	Mercury e80	0.2107	0.9768	1.5661	1.4271
	MCNP e80 *	0.2121	0.9770	1.5660	1.4273
	Mercury e81b1/e80	1.0013	0.9949	1.0001	0.9982
Flatop25	Mercury e81b1	0.1447	0.7728	1.5779	1.3608
	Mercury e80	0.1451	0.7732	1.5779	1.3621
	MCNP e80 *	0.1451	0.7735	1.5664	1.3622
	Mercury e81b1/e80	0.9972	0.9995	1.0000	0.9990

TNSL files available to Mercury

- <alias id="1401" pid="HinC5O2H8"/>
- <alias id="1501" pid="HinYH2"/>
- <alias id="1701" pid="HinZrH"/>
- <alias id="1801" pid="HinH2O"/> 6 std 32tnsl ///cog 231/190
- <alias id="1901" pid="HinCH2"/> 5 tns1 80/190
- <alias id="1902" pid="DinD2O"/> 5 tns1
- <alias id="4809" pid="Be-metal"/> 56
- <alias id="4909" pid="BeinBeO"/> 2
- <alias id="6512" pid="benzene"/>
- <alias id="6712" pid="CinSiC"/>
- <alias id="6612" pid="reactor-graphite-30P"/>
- <alias id="6812" pid="reactor-graphite-10P"/>
- <alias id="6912" pid="crystalline-graphite"/>
- <alias id="7914" pid="NinUN"/>
- <alias id="8716" pid="OinD2O"/>
- <alias id="8816" pid="OinUO2"/>
- <alias id="8916" pid="OinBeO"/>
- <alias id="13927" pid="tnsl-Al27"/>
- <alias id="26956" pid="tnsl-Fe56"/>
- <alias id="14728" pid="SiinSiC"/>
- <alias id="14928" pid="SiO2-alpha"/>
- <alias id="39989" pid="YinYH2"/>
- <alias id="40900" pid="ZrinZrH"/>
- <alias id="92838" pid="UinUN"/>
- <alias id="92938" pid="UinUO2"/>



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