

# Validation results of ENDF/B.VIII.1 in GND 2.0 format

Nuclear Data Week  
CSEWG –Validation  
November 5, 2024

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# ENDF/B-VIII.1 and -VIII.0 libraries

- processed in GNDS2.0 format using FUDGE
- Room temperature,  $T = 293.6\text{K}$
- Continuous Energy cross-sections

	ENDF/B-VIII.0	ENDF/B-VIII.1
Isotopes	557	557
Metastables	22	23
TNSL	25	97
URR probability tables	327 (10 m1)	351 (12 m1)
FUDGE version	6.2	6.7.0

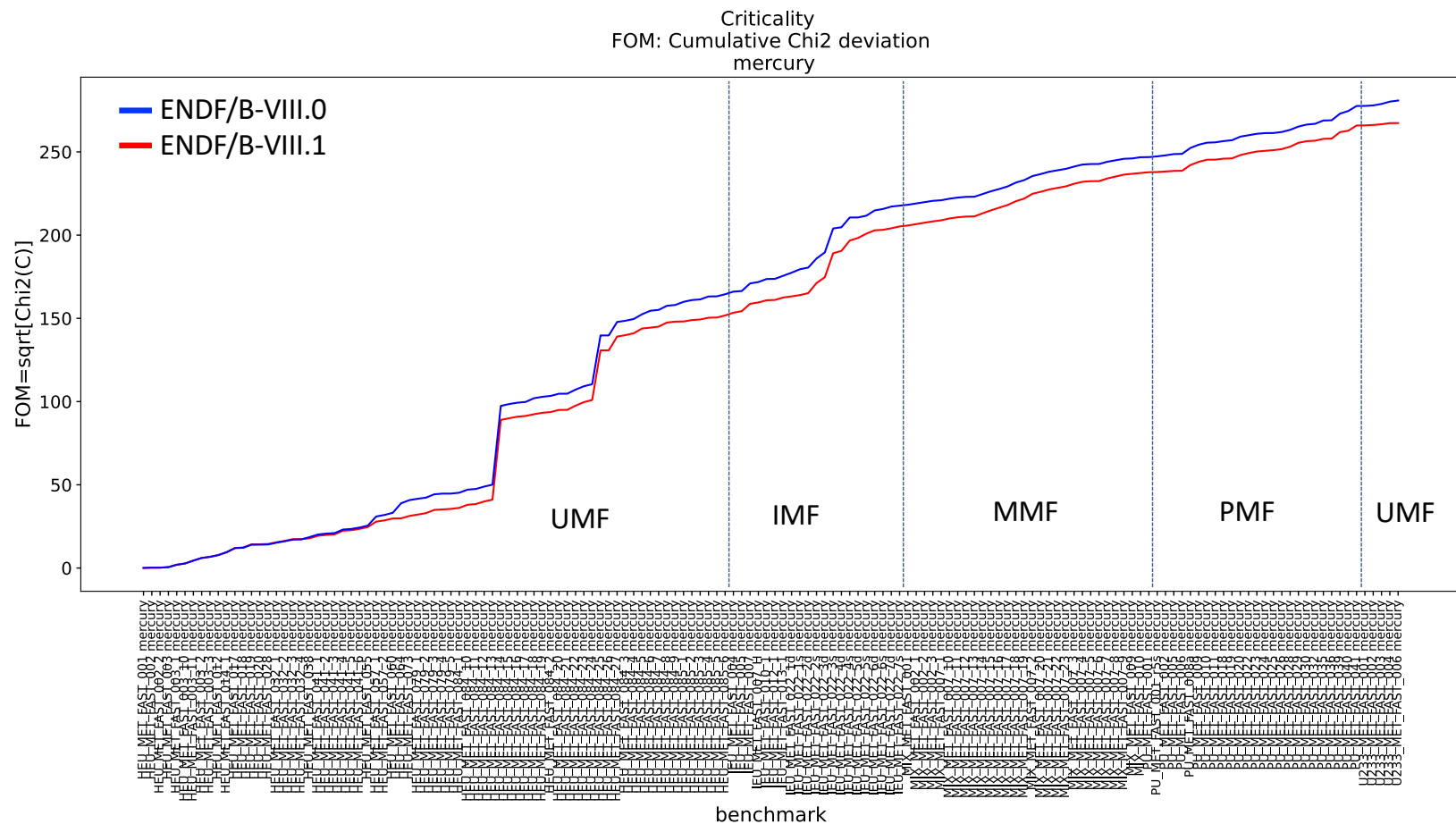
# Validation with Metis suite

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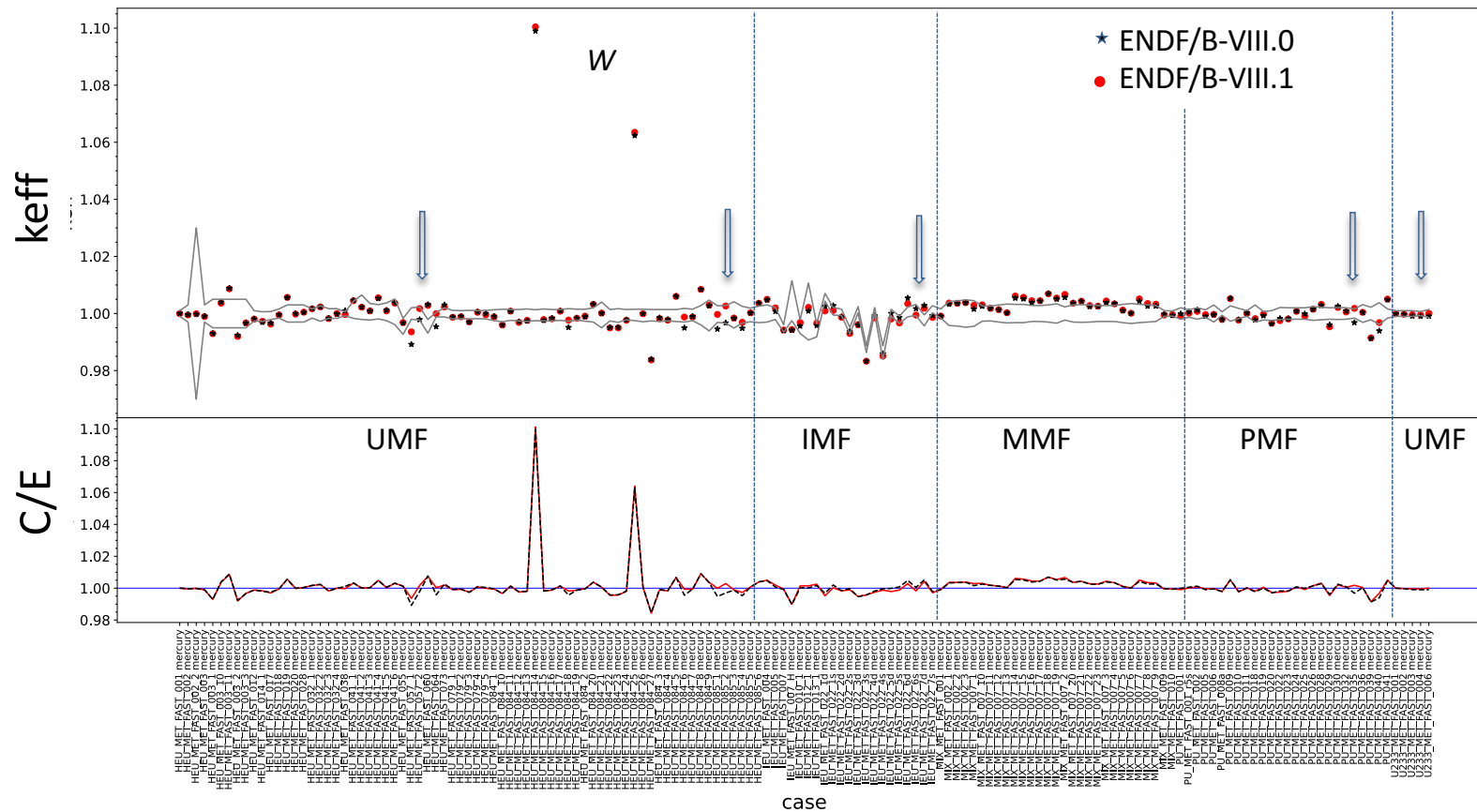
- Cases:
  - 158 Fast Critical Assemblies
  - Fission ratios, and reaction ratios
  - 16 pulsed spheres
  
- Mercury Monte Carlo transport code
  - Version: 5.42.0
  - GIDI+: 3.31.0

# ENDF/B-VIII.1 $\chi^2$ for criticality benchmarks is improved

- Number of cases: 158

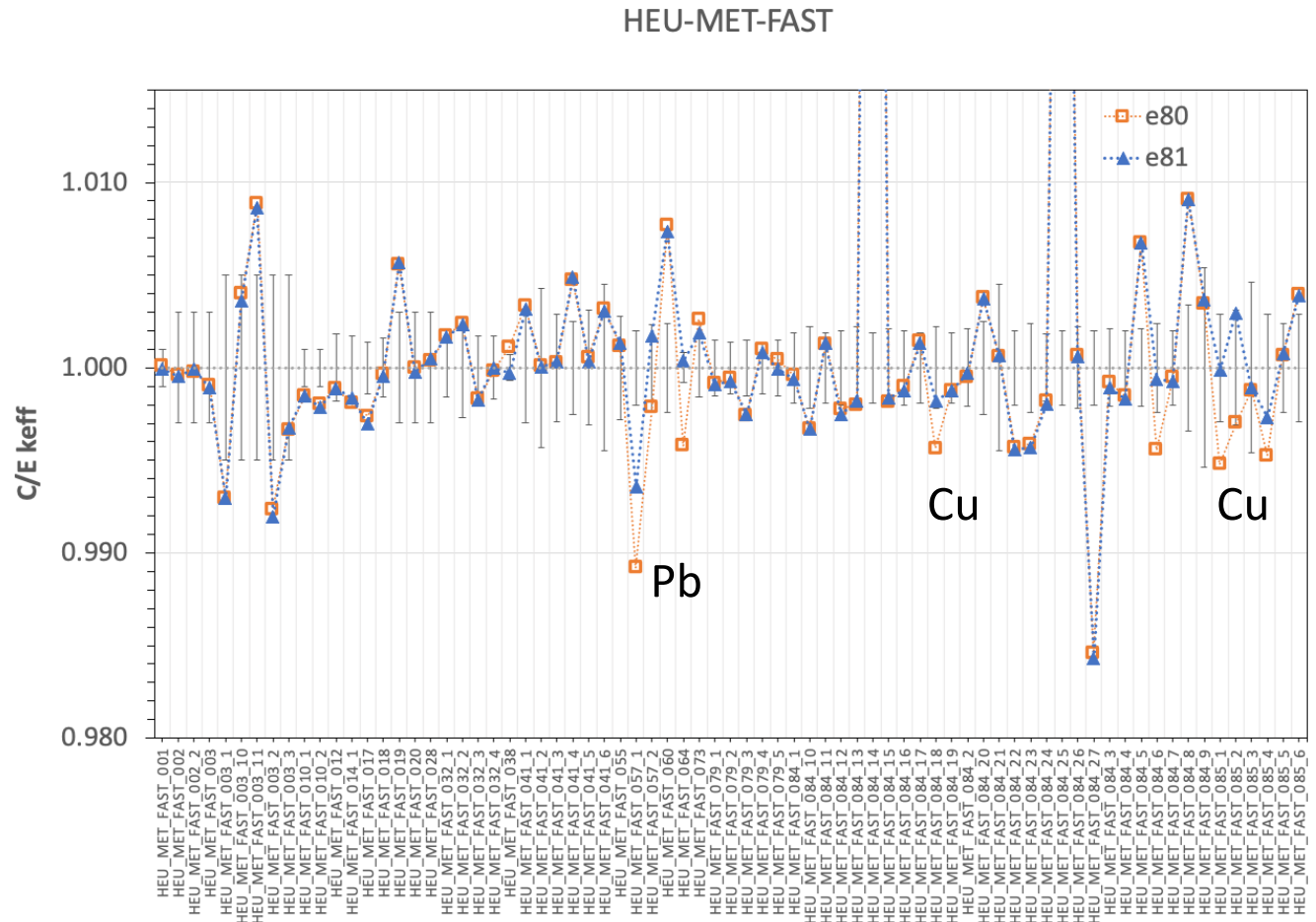


# Criticality: C and $C_{e81}$



# Criticality by core: HEU

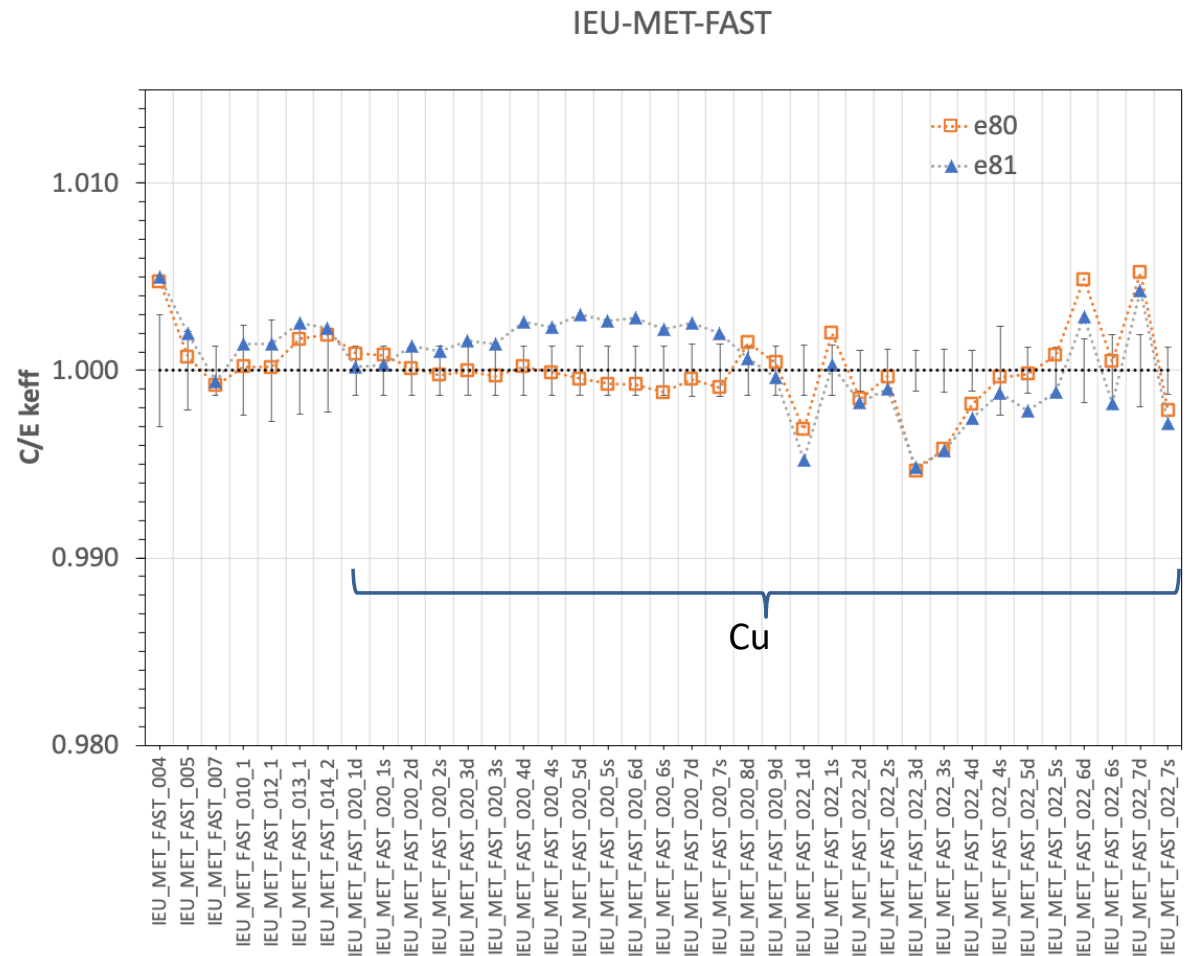
- Overall, small changes from e80 to e81
- Improvements for benchmarks with Cu, and Pb reflectors.





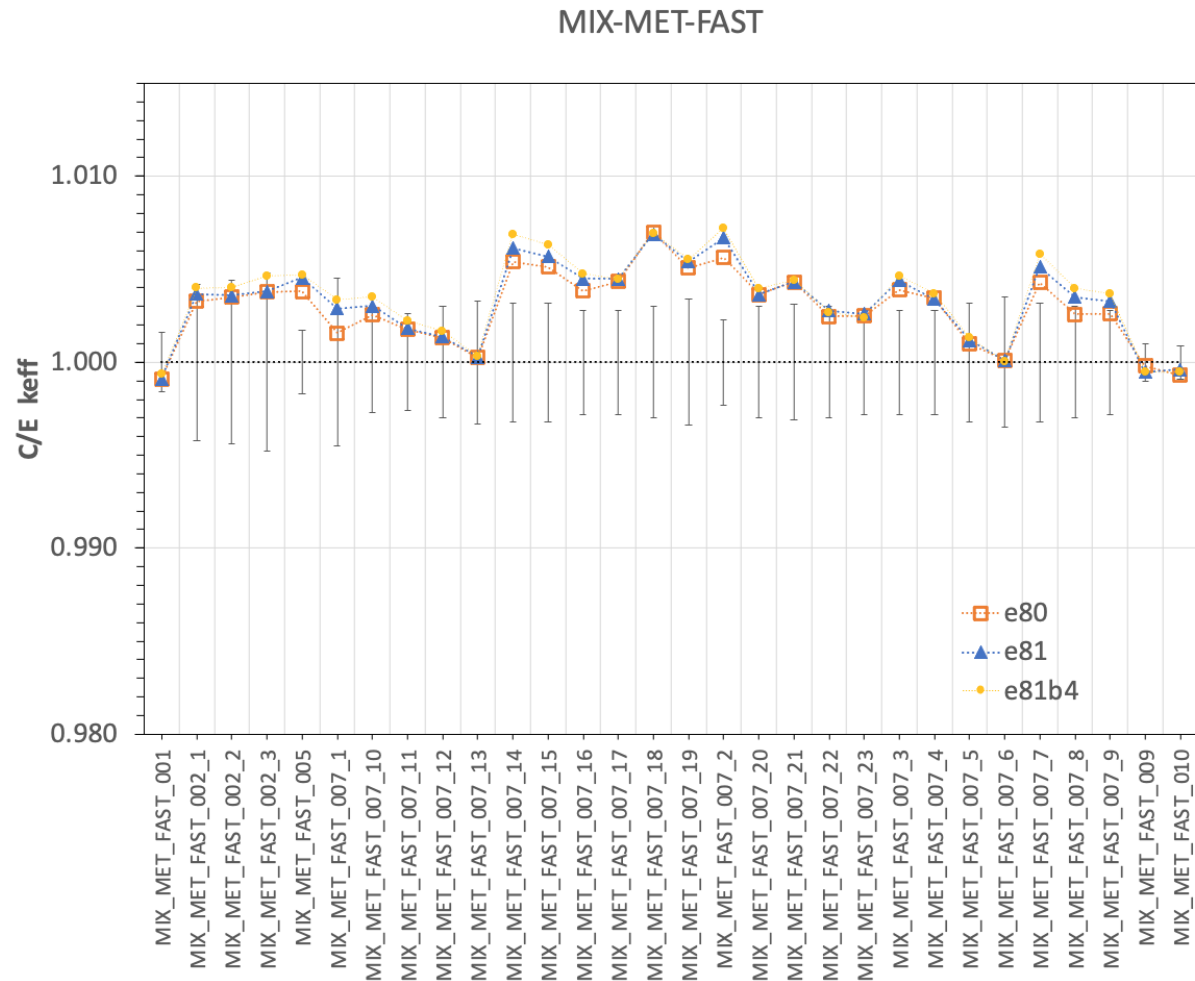
# Criticality by core: IEU

- IMF20, IMF22 are Cu reflected benchmarks
- e81 results higher than e80 for cases other than IMF20-1 and IMF22 cases



# Criticality by core: Pu/U

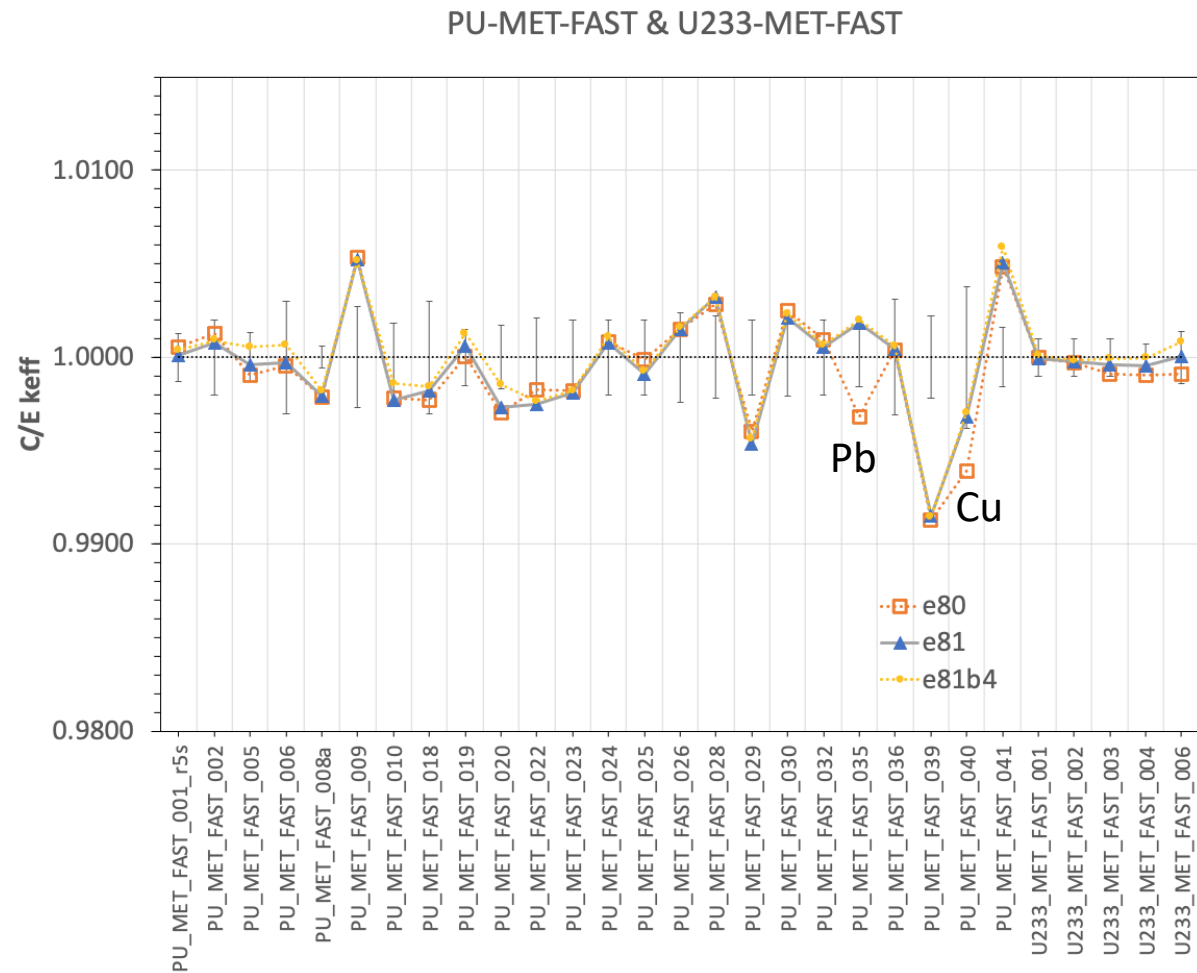
- Lower than beta4
- e81 slightly higher than e80 for MMF7 cases (Be reflected)





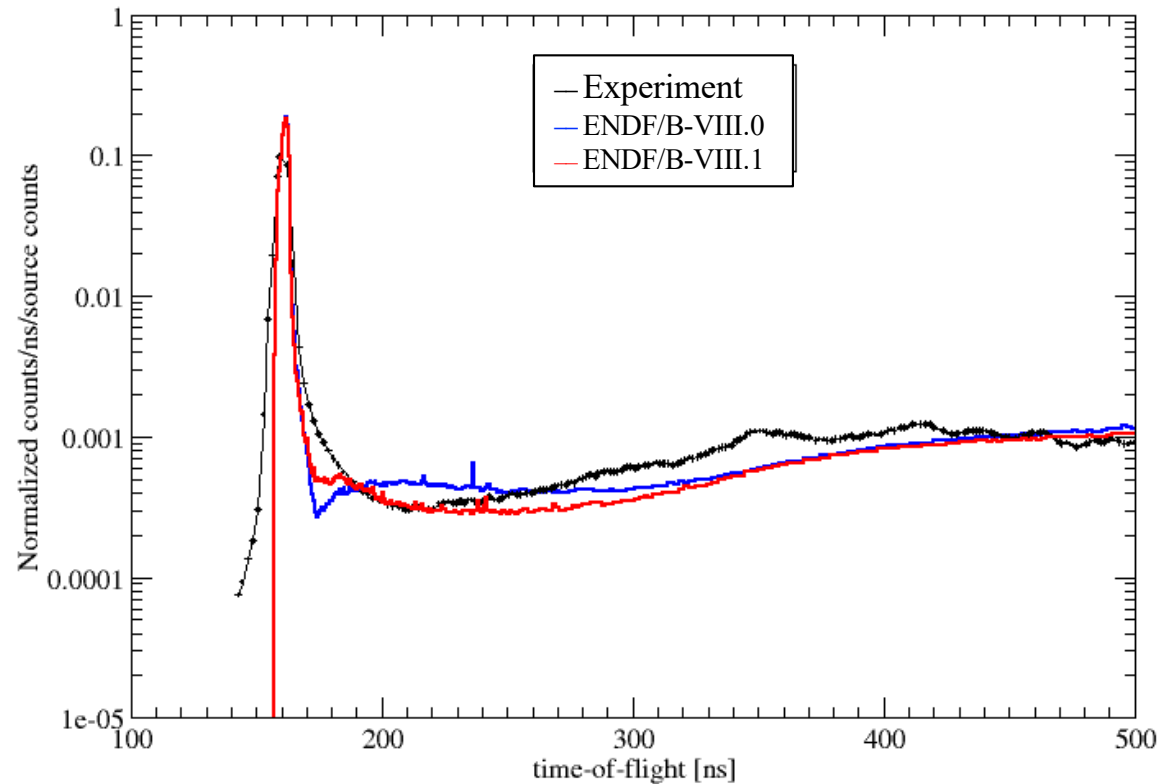
# Criticality by core: Pu, U-233

- PMF: results between e80 and beta4; generally closer to e80. Good agreement for Jezebel.
- UMF: e81 U-233 evaluation seems to have reverted to beta3 (updated resonance region, prompt nu<sub>bar</sub> and PFNS).



# LLNL pulsed sphere: Ta

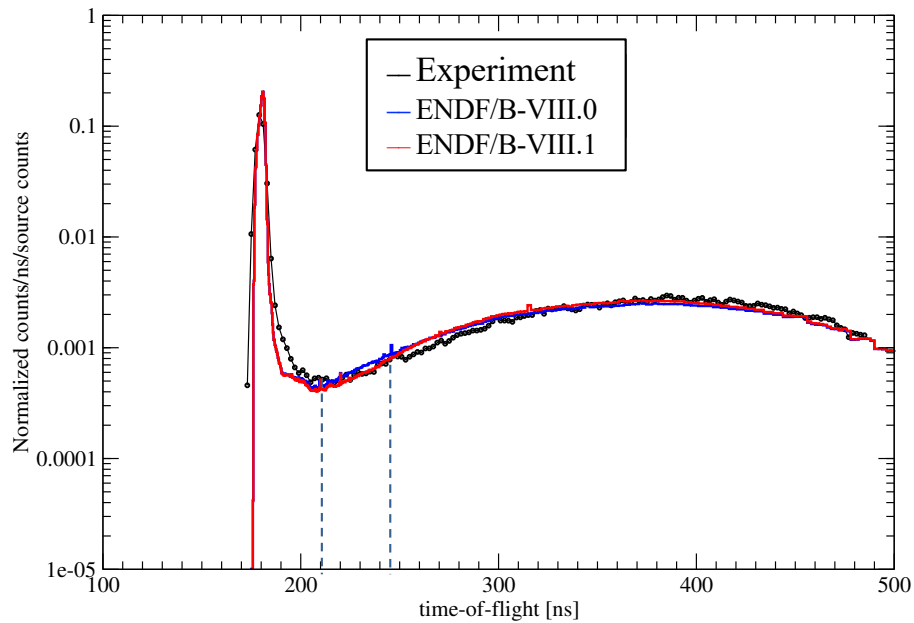
Ta



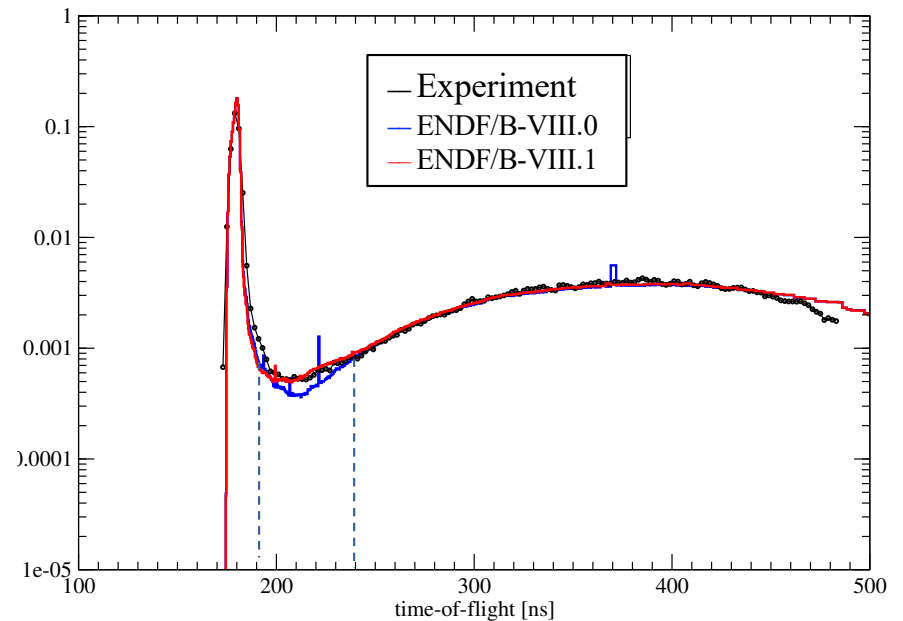
Ta : improved TOF spectrum between 180-210 ns, underestimated at lower energies.  
No changes between e80 and e81 for Al, Au, C, H<sub>2</sub>O, Fe, N<sub>2</sub>, Si, Ta, Teflon, Ti, <sup>232</sup>Th, <sup>238</sup>U, W

# LLNL pulsed spheres: Pu239 and U235

$^{235}\text{U}$



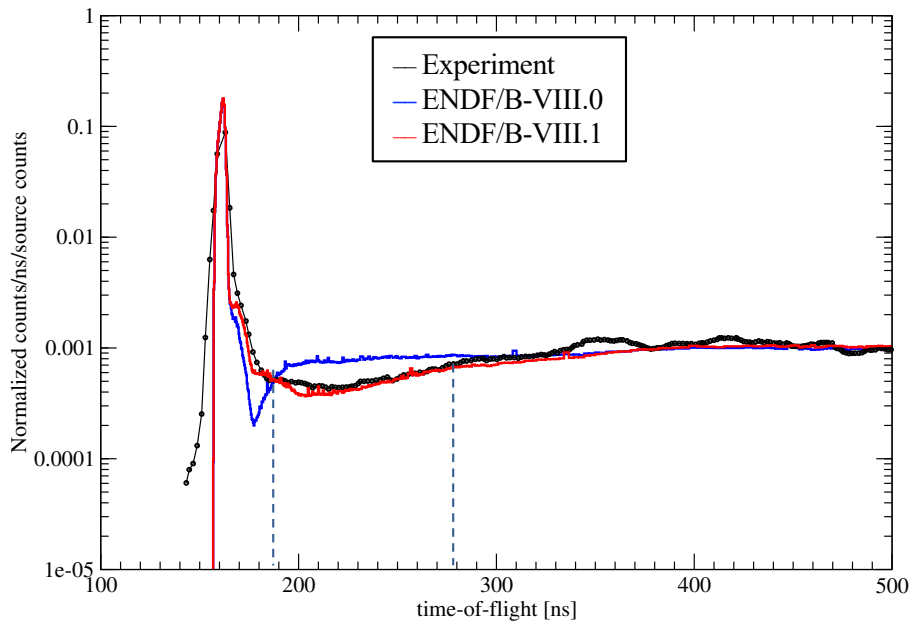
$^{239}\text{Pu}$



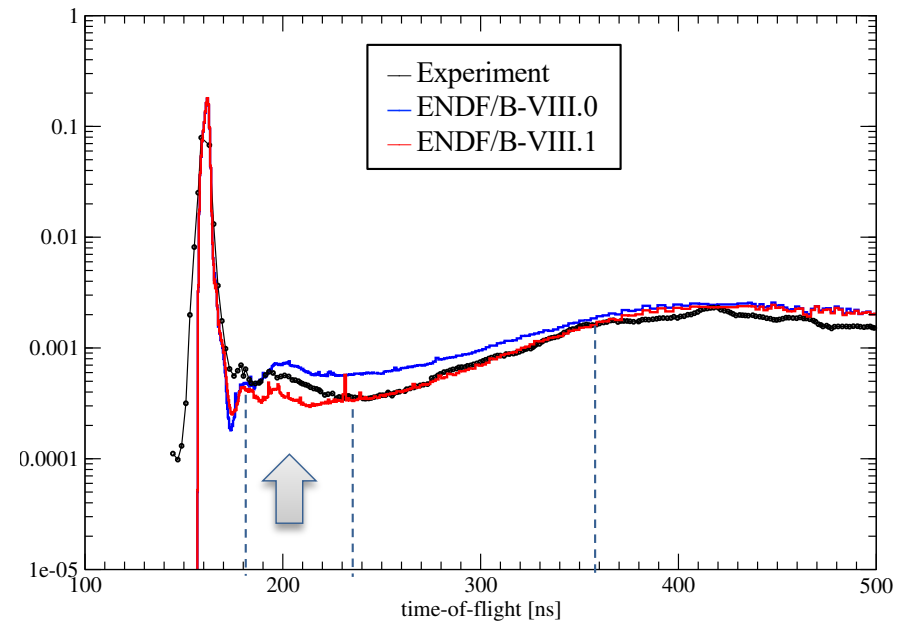
The Pu239 spectrum simulated with e81 shows improved agreement with experiment in the 190-240ns. Slight improvement for U235.

# LLNL pulsed spheres: Cu and Pb

Cu



Pb



Cu: improved agreement with experiment compared to e80's.

Pb: improved agreement with experiment compared to e80's; the neutron count between 180-190 ns is lower than for e81b3 and the 'dip' observed for e81b3 between 190-215 ns is now partially filled.

# Fission Ratios: comparison to e80

- Mercury/GNDS – MCNP6.2/ACE
- Reaction rates are normalized by  $^{235}\text{U}(n,f)$

Benchmark	Reaction Ratio	238U(n,f)	237Np(n,f)	233U(n,f)	239Pu(n,f)
Godiva	Mercury e81	0.1581	0.8307	1.5794	1.3830
	Mercury e80	0.1583	0.8315	1.5796	1.3846
	MCNP e80 *	0.1583	0.8318	1.5793	1.3846
	<i>Mercury e81/e80</i>	<i>0.9990</i>	<i>0.9990</i>	<i>0.9999</i>	<i>0.9988</i>
Jezebel	Mercury e81	0.2109	0.9714	1.5663	1.4244
	Mercury e80	0.2120	0.9768	1.5661	1.4271
	MCNP e80 *	0.2121	0.9770	1.5660	1.4273
	<i>Mercury e81/e80</i>	<i>0.9947</i>	<i>0.9945</i>	<i>1.0001</i>	<i>0.9981</i>
Flatop25	Mercury e81	0.1447	0.7719	1.5779	1.3603
	Mercury e80	0.1451	0.7731	1.5778	1.3620
	MCNP e80 *	0.1451	0.7735	1.5664	1.3622
	<i>Mercury e81/e80</i>	<i>0.9976</i>	<i>0.9985</i>	<i>1.0000</i>	<i>0.9987</i>

\* Brown et al. NDS 148 (2018)

# Fission Ratios: $C_{e81}/E$

Assembly	Quantity	U238f/U235f	Np237f/U235f	U233f/U235f	Pu239f/U235f
Godiva (HMF001)	Calc	0.1581	0.83097	1.5794	1.3830
	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
	<b>Calc/Exp</b>	<b>0.9623</b>	<b>0.9755</b>	<b>0.9933</b>	<b>0.9772</b>
Jezebel (PMF001)	Calc	0.2109	0.9714	1.5663	1.424
	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
	<b>Calc/Exp</b>	<b>0.9887</b>	<b>0.9877</b>	<b>0.9926</b>	<b>0.9750</b>
Jezebel-23 (UMF001)	Calc	0.2112	0.9842		
	Exp-B	0.2131±0.0026	0.997±0.015		
	Exp-A	0.2131±0.0023	0.977±0.016		
	<b>Calc/Exp</b>	<b>0.9912</b>	<b>0.9872</b>		
Flatop-25 (HMF028)	Calc	0.1447	0.7719	1.5779	1.3603
	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
	<b>Calc/Exp</b>	<b>0.9699</b>	<b>0.9892</b>	<b>0.9813</b>	<b>0.9824</b>
Flatop-Pu (PMF006)	Calc	0.1779	0.8508		
	Exp-B	0.1799±0.002	0.8561±0.012		
	Exp-A	0.1800±0.003	0.84±0.01		
	<b>Calc/Exp</b>	<b>0.9889</b>	<b>0.9938</b>		
Flatop-23 (UMF006)	Calc	0.1872	0.8992		
	Exp-B	0.1916±0.0021	0.9103±0.013		
	Exp-A	0.1910±0.003	0.8900±0.01		
	<b>Calc/Exp</b>	<b>0.9771</b>	<b>0.9878</b>		



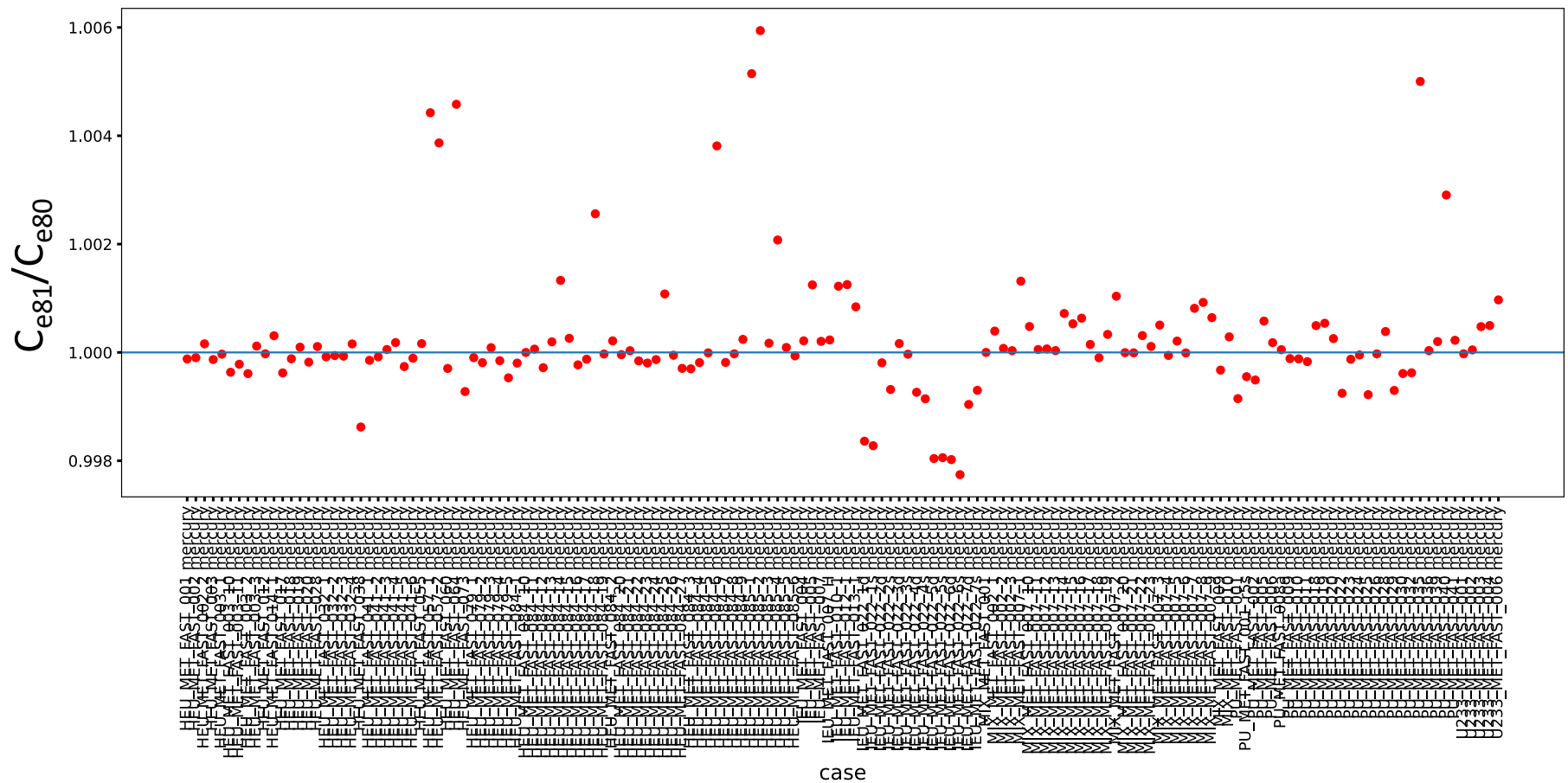
# Summary

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- Simulations of fast critical assemblies and LLNL pulsed spheres
- Cumulative Chi2 plot of criticality benchmarks indicates improvements from ENDF/B-VIII.0 and ENDF/B-VIII.1
- Small changes compared to ENDF/B-VIII.1 beta4
- Dominated by changes to Cu and Pb evaluations
- U233 evaluation = ENDF/B-VIII.1 beta3

# Criticality: comparison $C_{e81}/C_{e80}$

Criticality  
keff(test1) / keff(test2) results  
test1 = ../run\_inputs/e81\_final\_20241014/mercury/Criticality  
test2 = ../run\_inputs/e80\_URR\_TNSL\_20241014/mercury/Criticality





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