ENDF/B-VIII-beta Data Testing at ORNL

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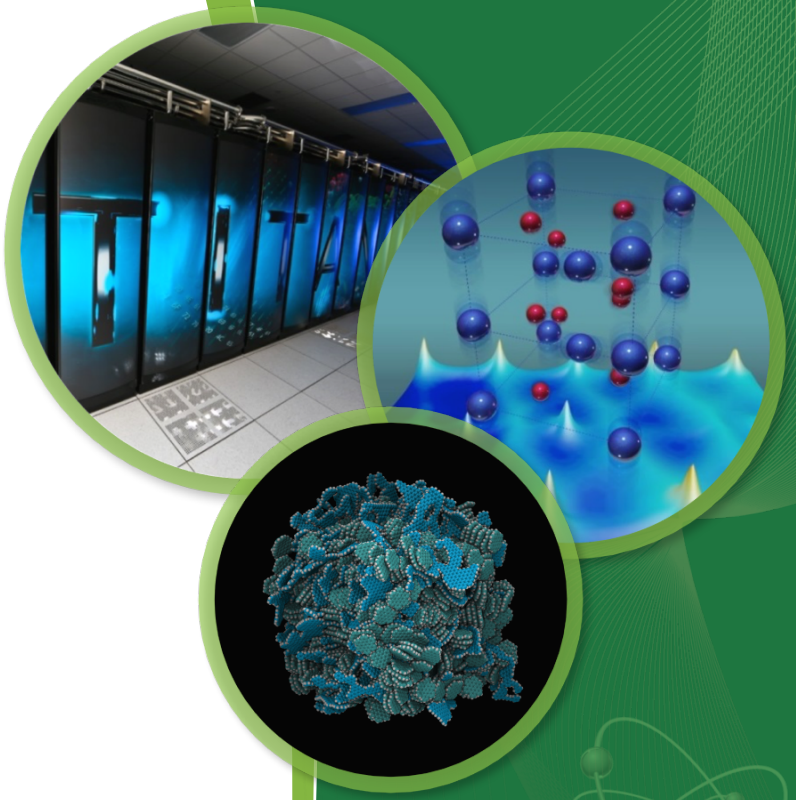

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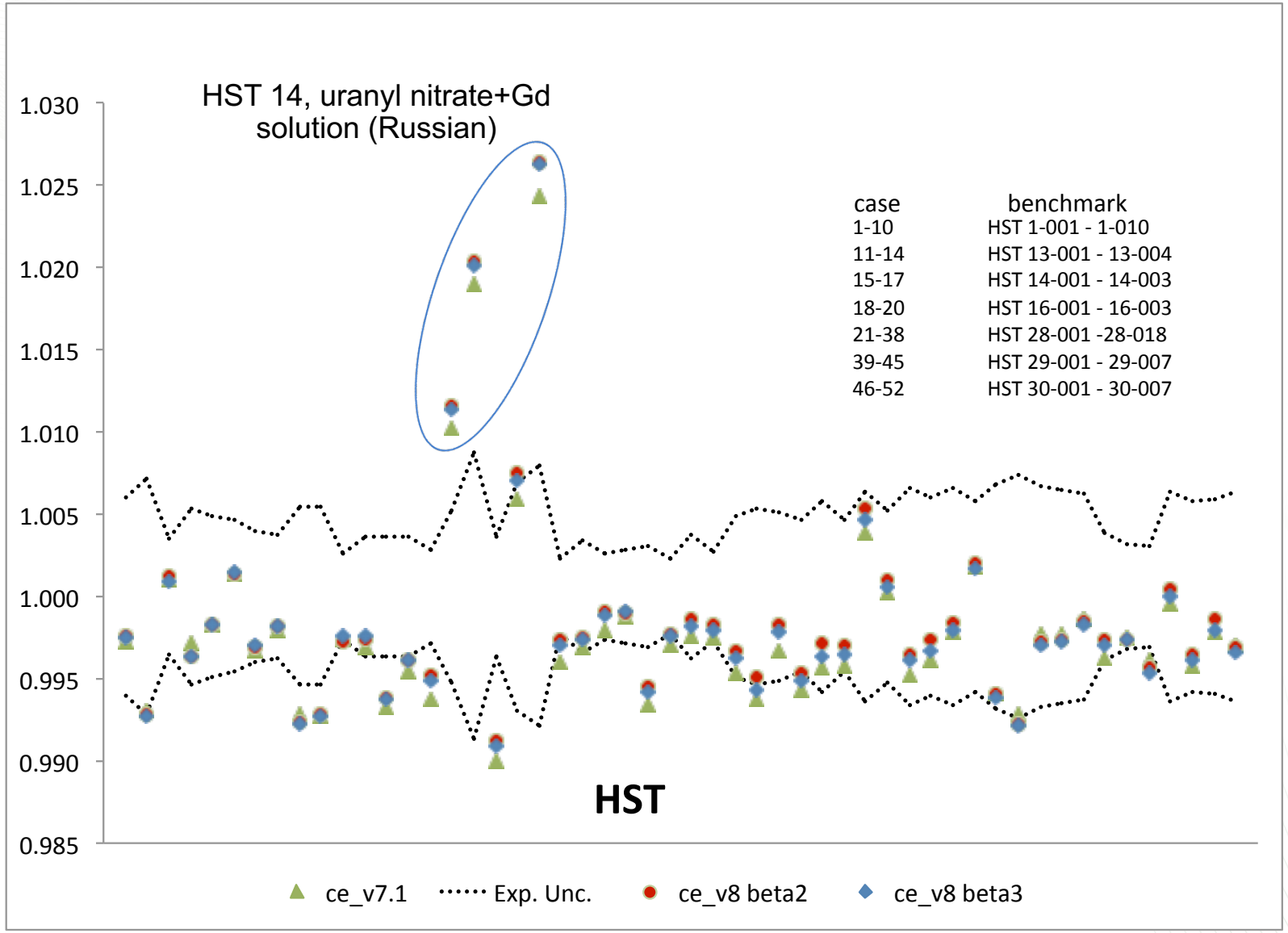
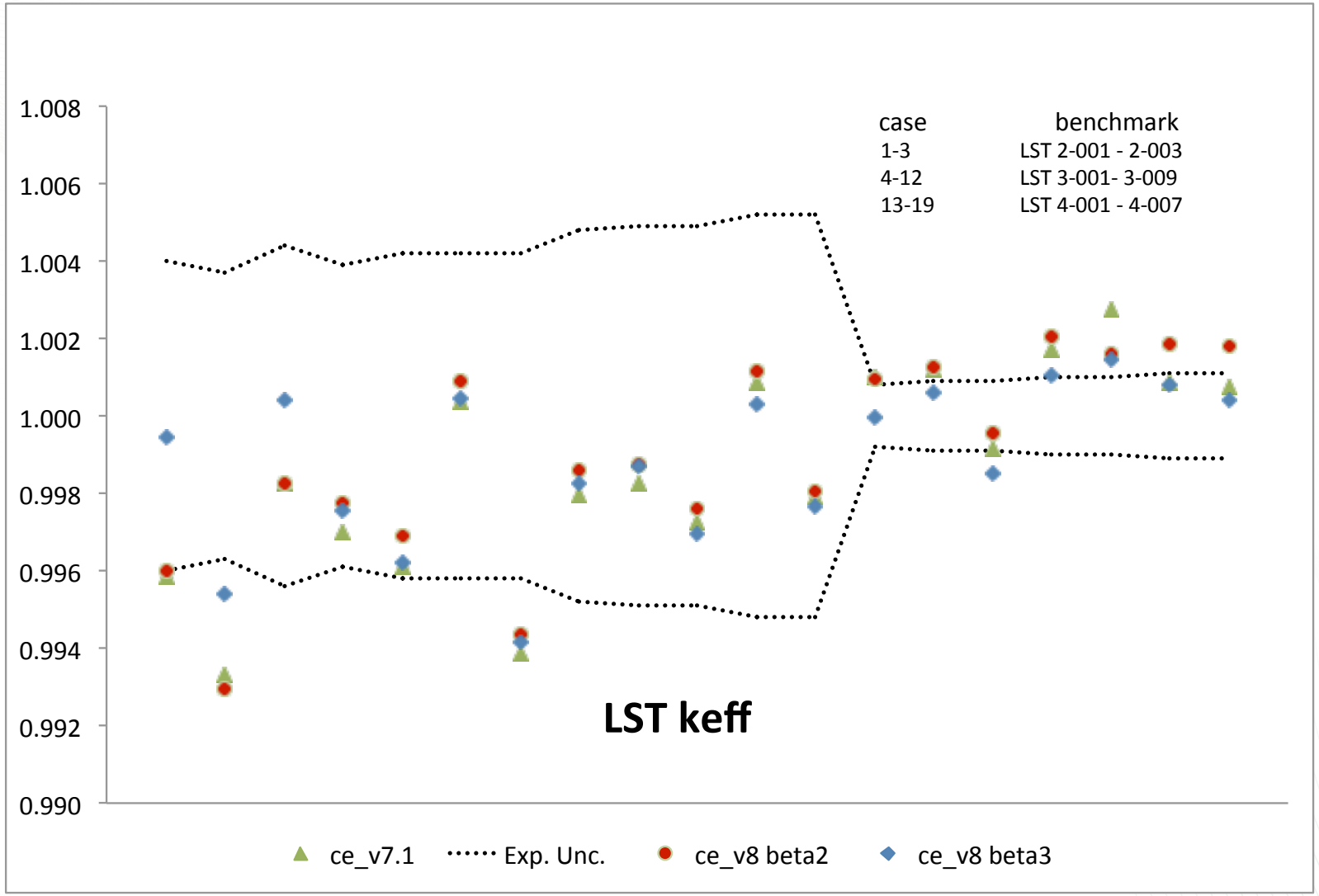
Summary of Methods

- AMPX processing system was used to process continuous energy (CE) and multigroup (MG) libraries from ENDF/B-VIII beta2 and beta3 files
- Critical benchmark calculations were performed with CE-KENO from SCALE-6.2.1
- Benchmark cases taken from ORNL's Valid Suite of inputs for selected criticals in ICSBEP Handbook
  - 52 HEU solutions, thermal (HST)
  - 19 LEU solutions, thermal (LST)
  - 81 Pu solutions, thermal (PST)
  - 72 LEU lattices, thermal (LCT)
  - 49 Mixed U-Pu, thermal lattices (MCT)
  - 11 IEU metal, fast (IMF)
  - 23 HEU metal, fast (HMF)
  - 10 Pu metal, fast (PMF)

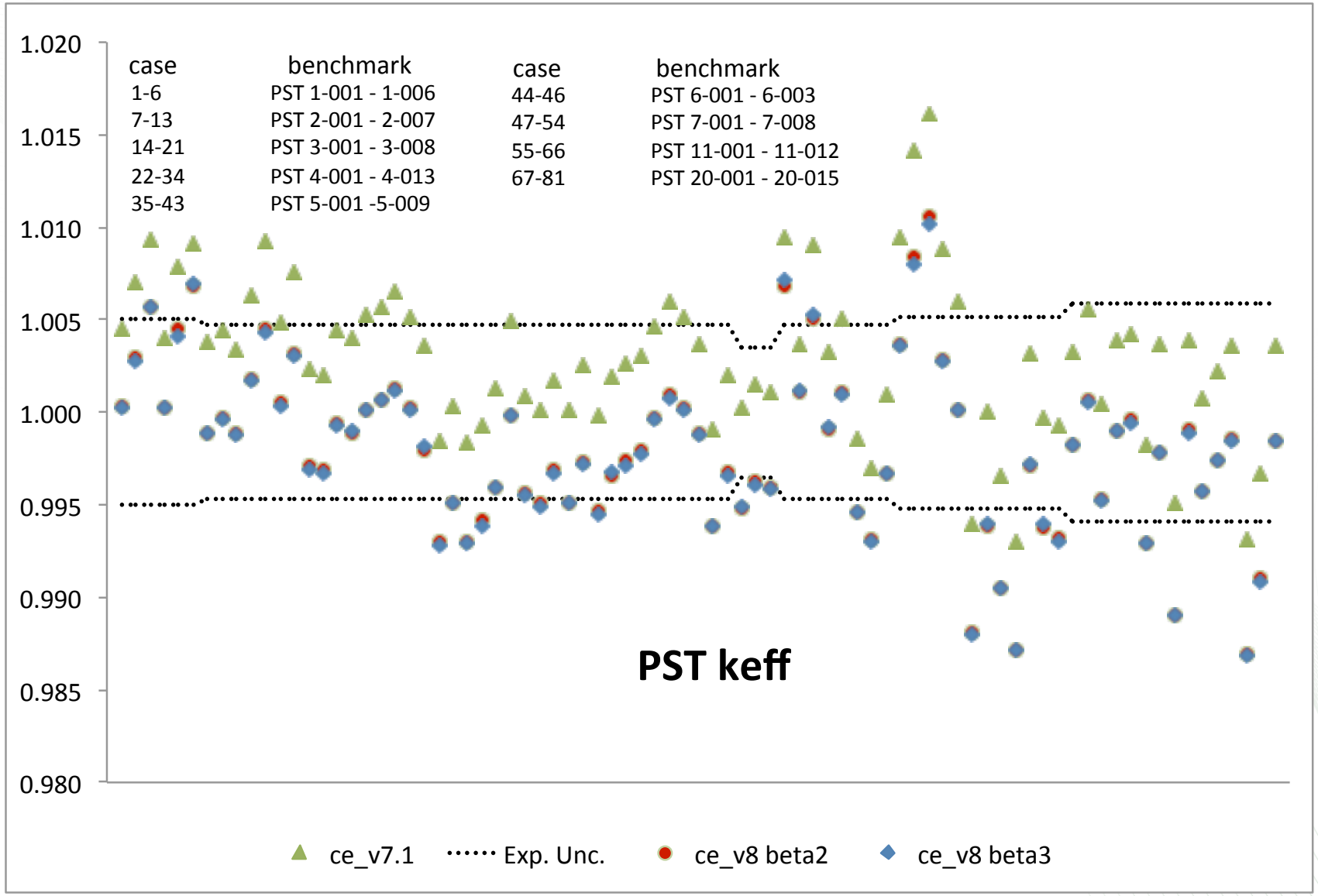
Results for Thermal HEU Solutions



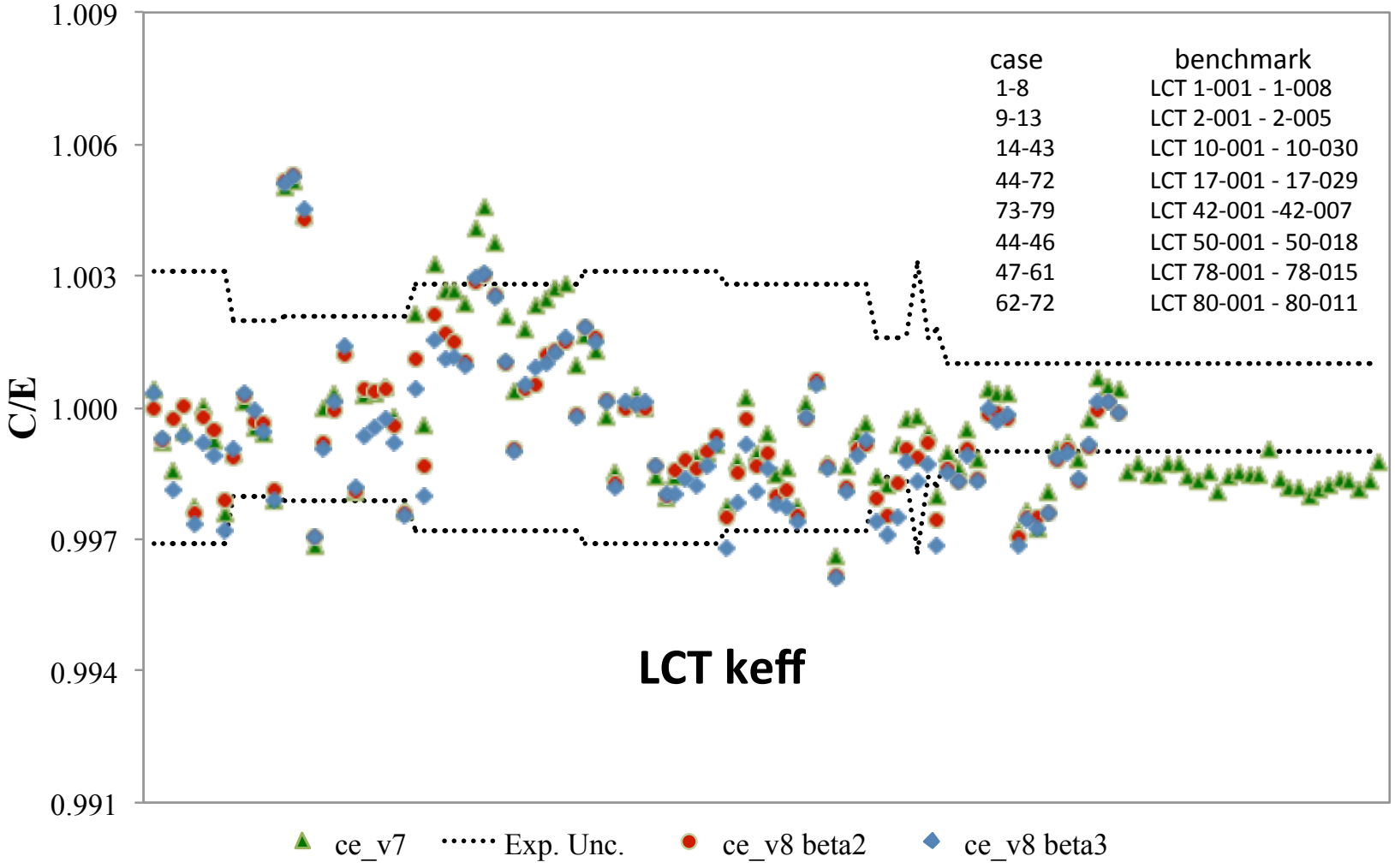
Results for Thermal LEU Solutions



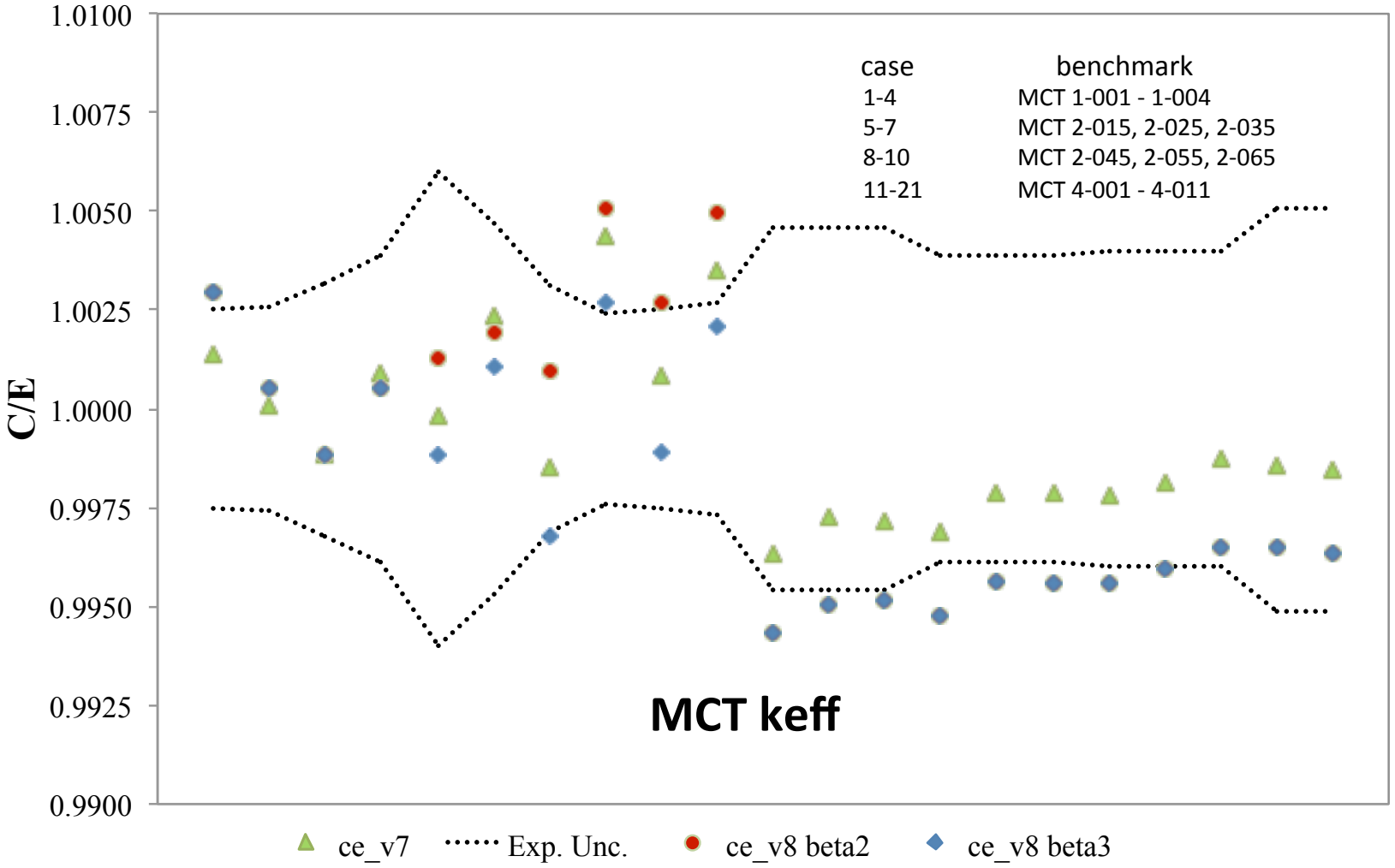
Results for Thermal Pu Solutions



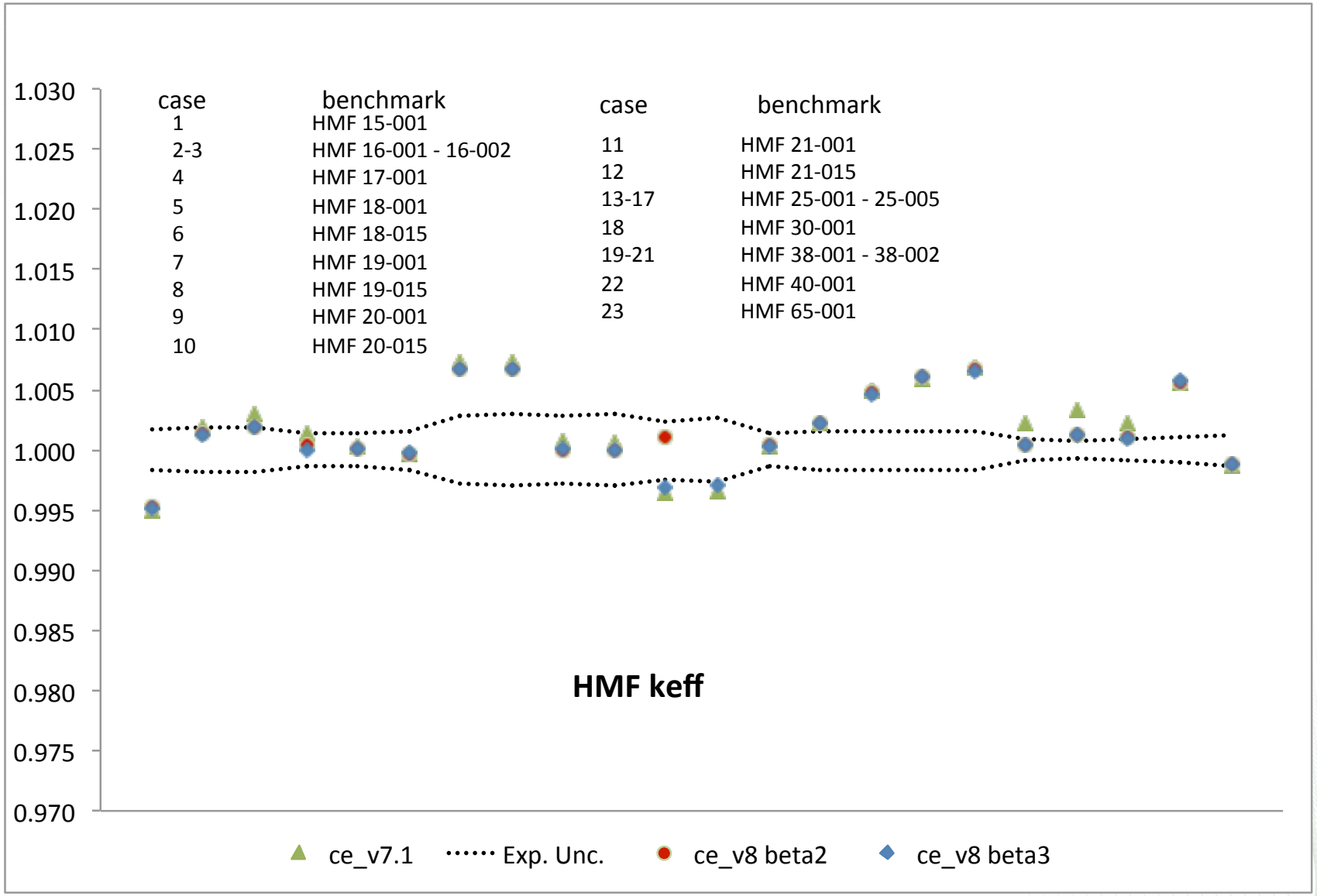
Results for Thermal LEU Lattices



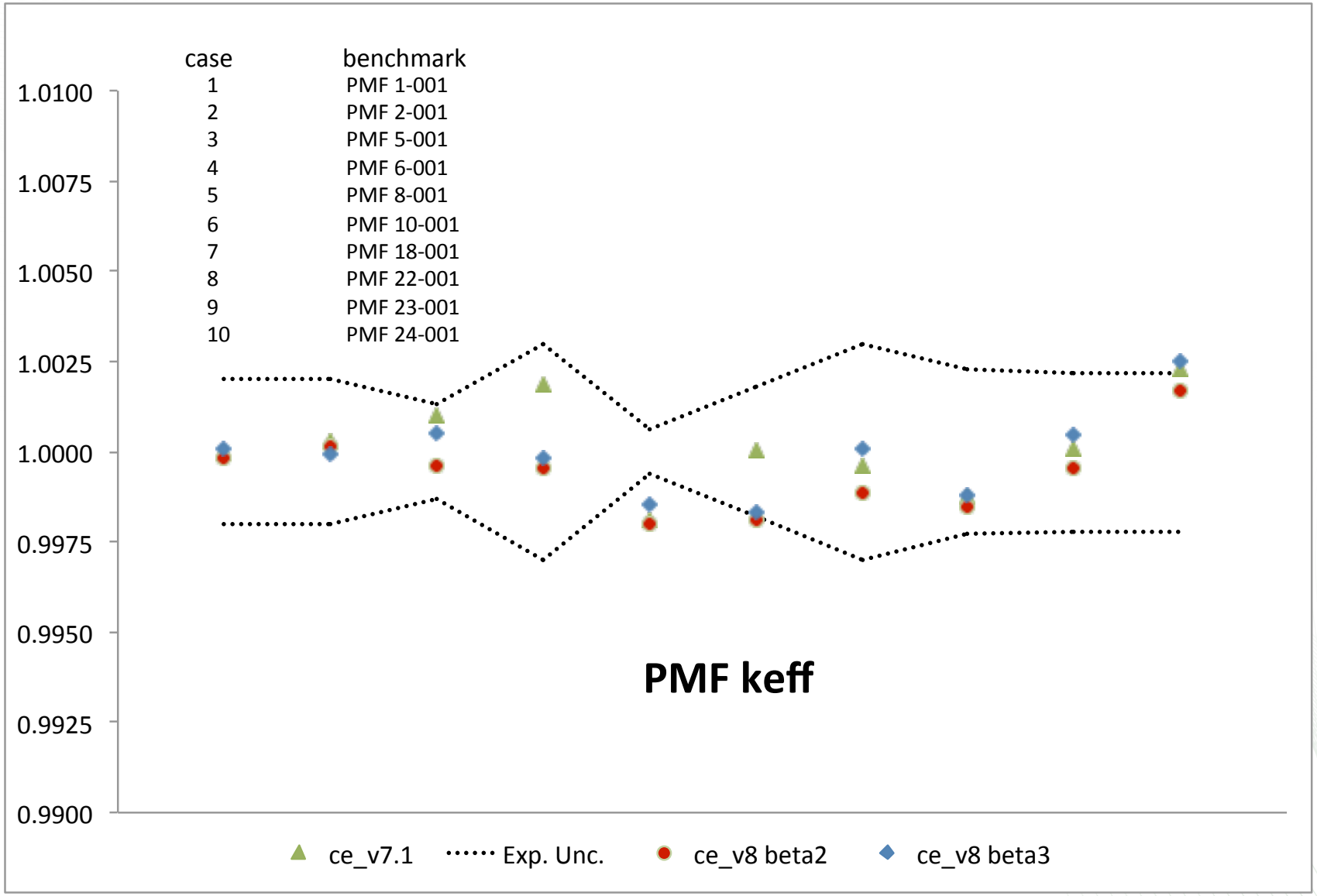
Results for Thermal U-Pu Lattices



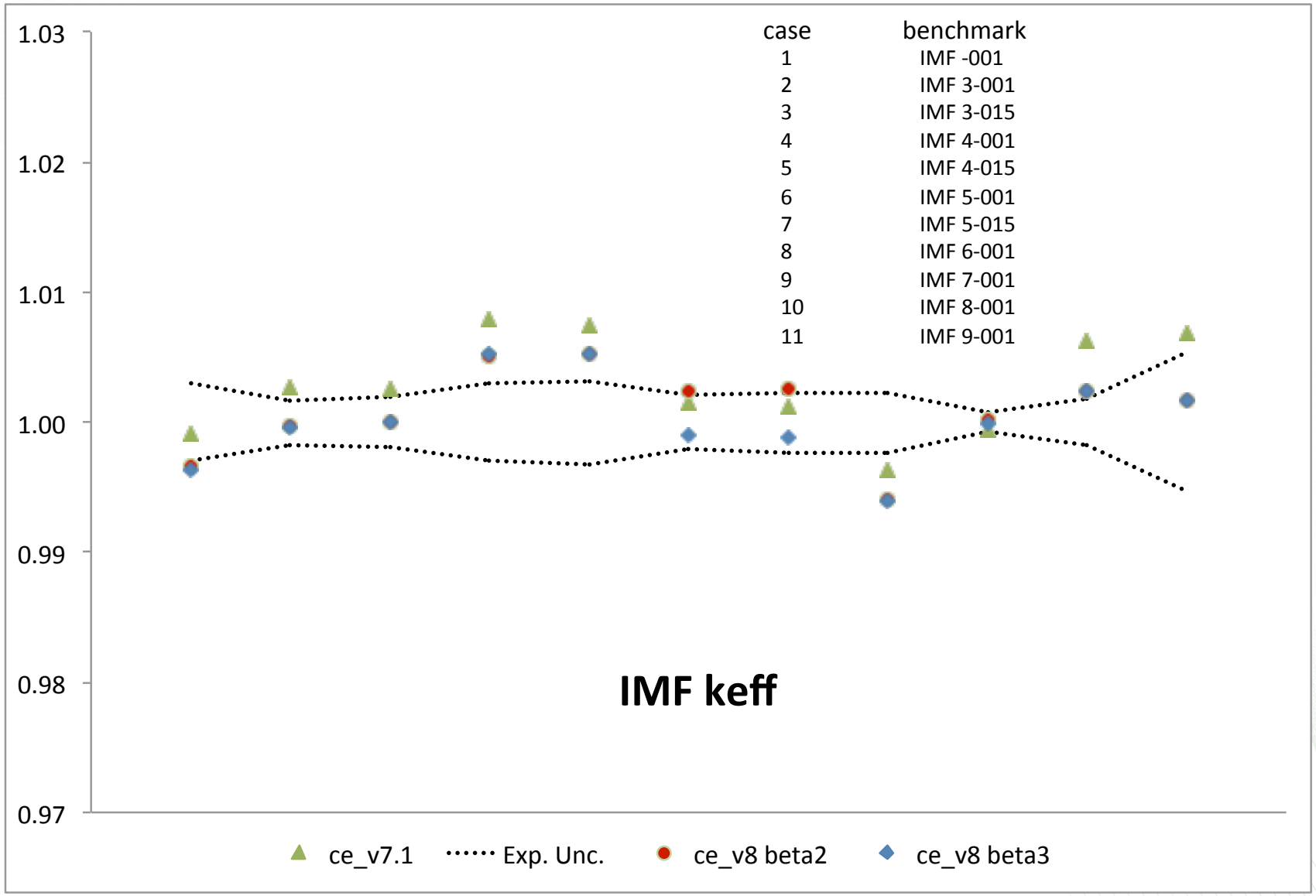
Results for Fast HEU Metal Systems



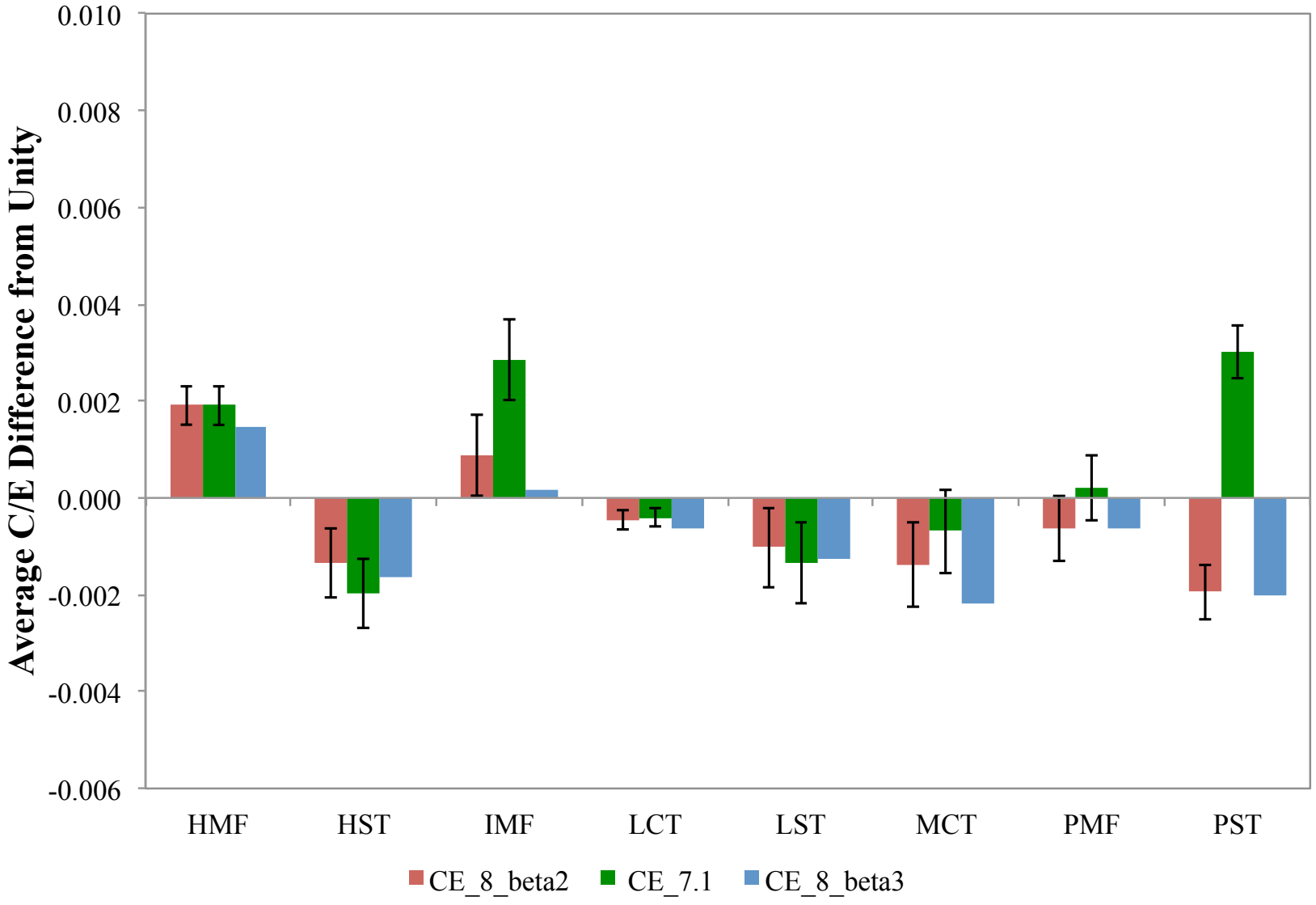
Results for Fast Pu Metal Systems



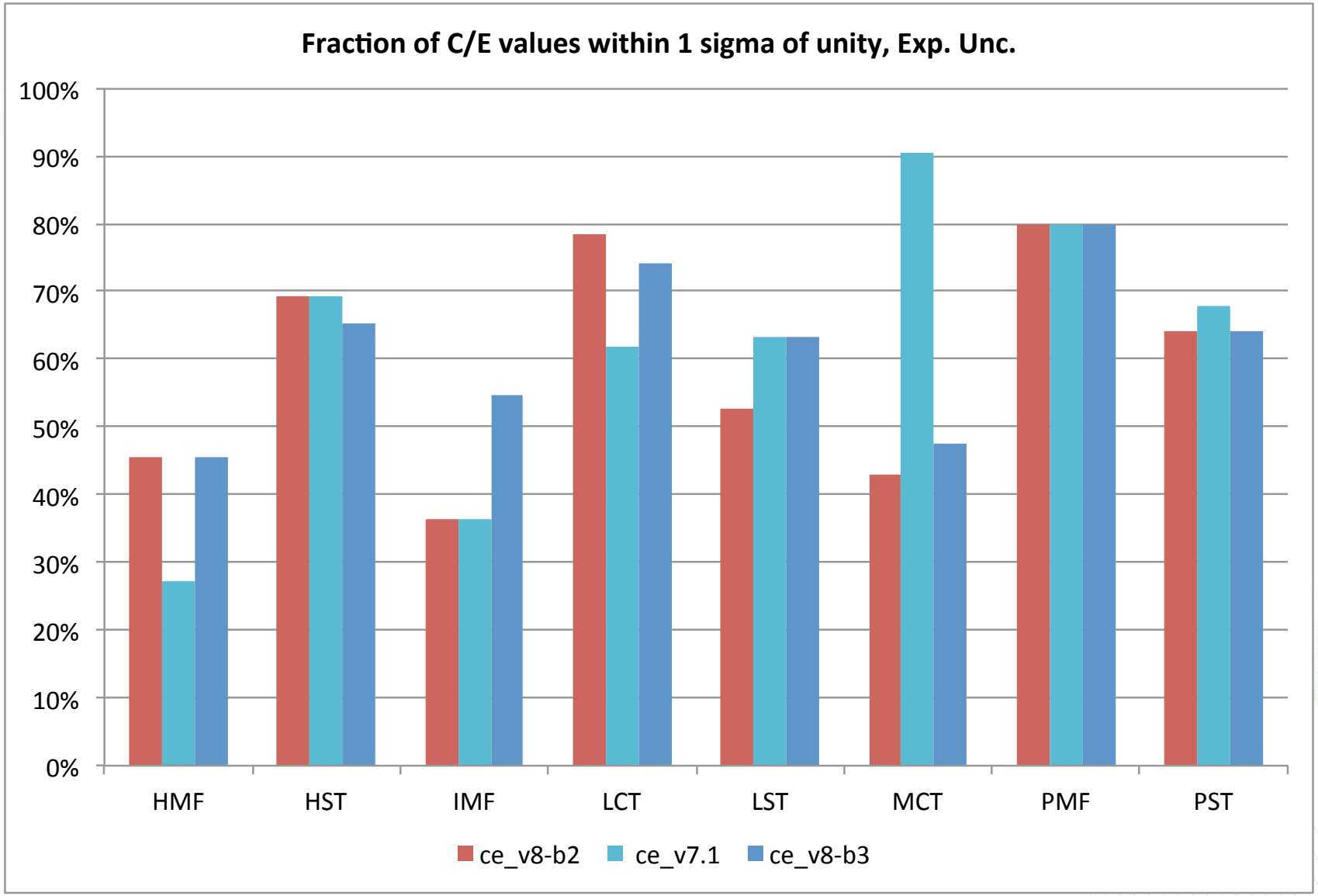
Results for Fast IEU Systems



Average over all experiments for benchmark type



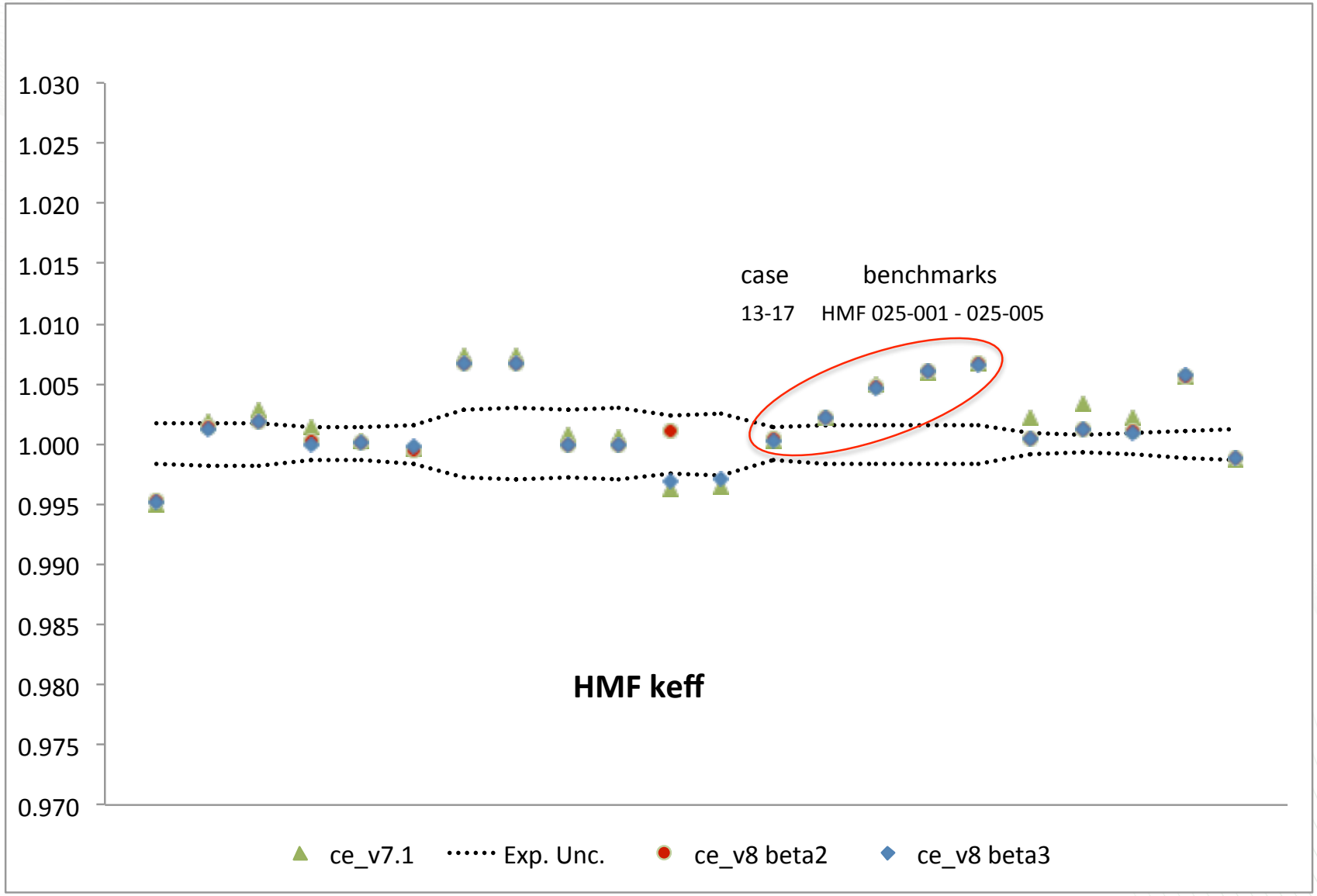
% of Results Within Experimental Std. Dev.



SUMMARY of CHANGES FROM VII.1 to VIII-beta

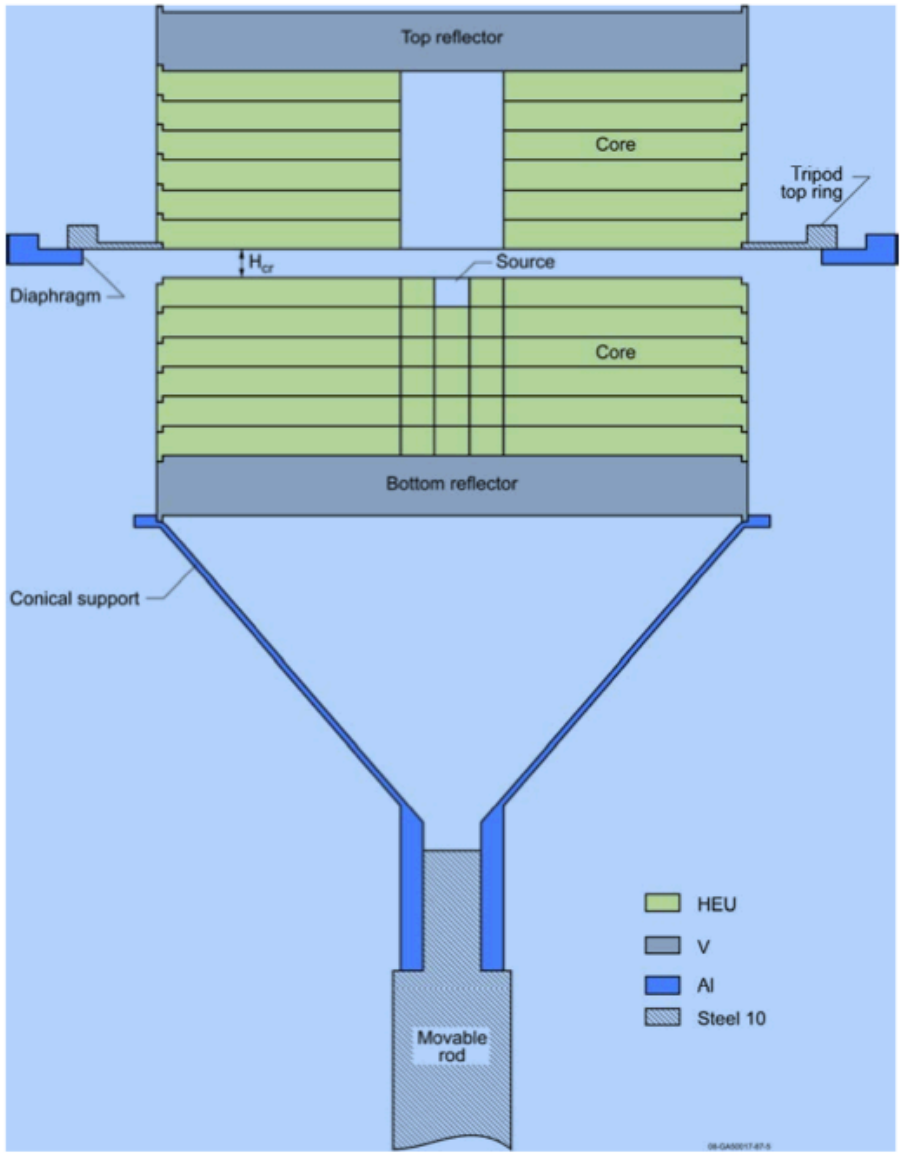
- Slight improvement for HST
  - k_{eff} is typically low by 200-500 pcm; 70% of cases are in exp. uncertainty
- Slight improvement for LEU lattices,
  - Nearly 80% of beta3 C/E's within experiment uncertainty
- Little change for HMF cases
  - Several cases remain ~500 pcm high
- VIII-beta Pu data is less reactive VII.1
  - Reduces high k_{eff} for some PST criticals; but makes others too low
  - k_{eff} for U-Pu thermal lattices are lower and worse
  - Average PMF k_{eff} reduced slightly; agreement within +/- 250 pcm of experiment
- IMF cases are improved; beta3 is better than beta2

Trending of HMF-025 Criticals



Description of HMF-025 Benchmark Series

- 5 experiments performed in 2007 at FKBN-2 critical facility at Russian Federal Center Institute of Physics
- HEU disks (20 cm OD;1 cm thick) stacked to form two cylindrical core regions
- Vanadium reflectors on top and bottom with thicknesses varied from 1-20 cm
- Criticality achieved by raising lower fuel region
- ICSBEP integral experiment uncertainty ~160 pcm



C/E values versus V Reflector Thickness for HMF-025

CASE	Reflector Thickness (cm)	C/E
HMF-025-001	1.0	0.99903
HMF-025-002	2.0	1.00115
HMF-025-003	4.0	1.00368
HMF-025-004	10.0	1.00548
HMF-025-005	20.0	1.00566

Integrated Sensitivities for HMF-25-001 and 25-005

- keff sensitivity to data:

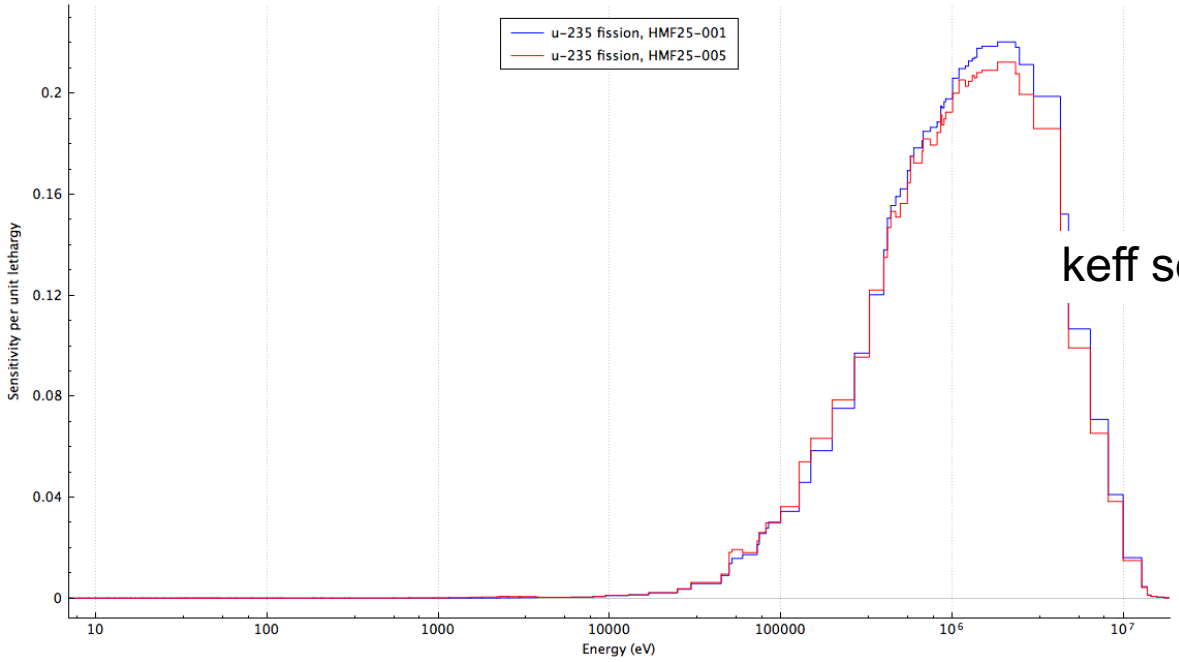
$$S_{\alpha}^{(k)} = \frac{\alpha}{k}\frac{\partial k}{\partial \alpha}$$

- Delta-keff sensitivity to data:

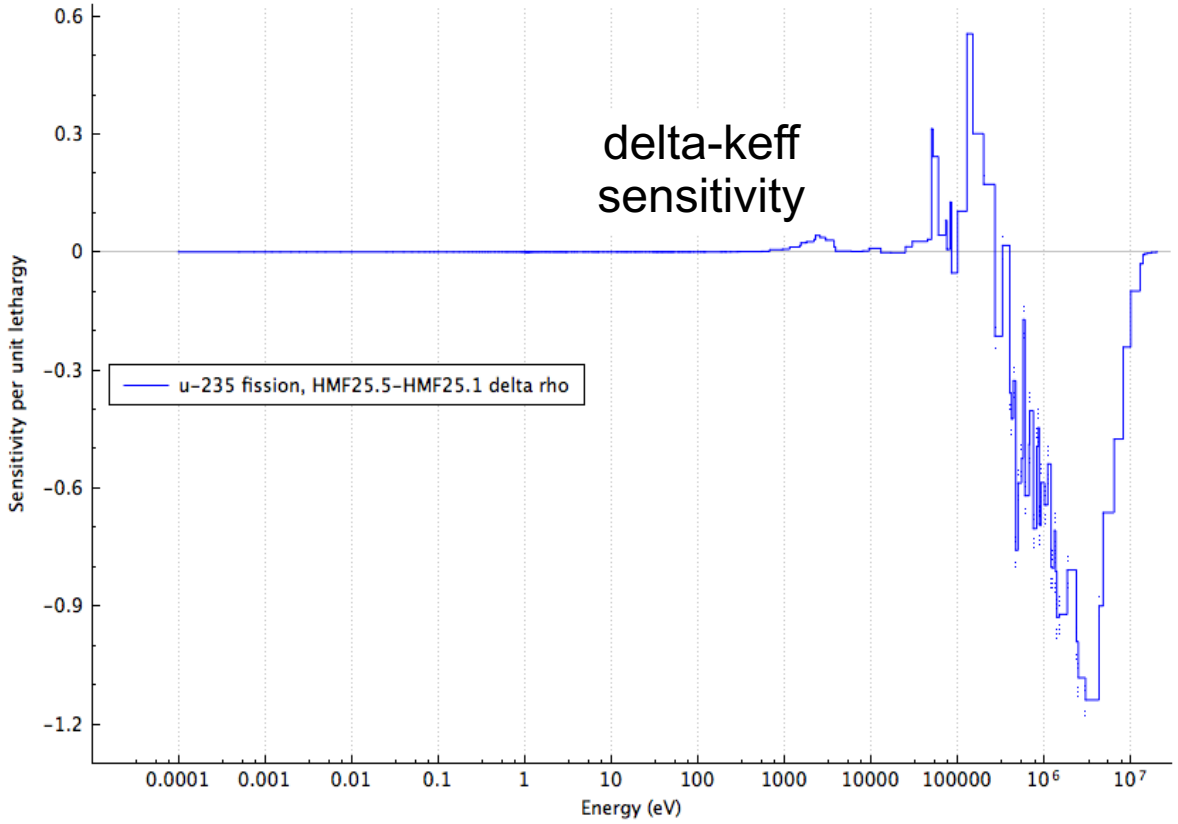
$$S_{\alpha}^{(k_2-k_1)} = \frac{\alpha}{\Delta k}\frac{\partial \Delta k}{\partial \alpha} \rightarrow \frac{k_2}{\Delta k} S_{\alpha}^{(k_2)} - \frac{k_1}{\Delta k} S_{\alpha}^{(k_1)}$$

rank	HMF-025-001 keff		HMF-025-005 keff		delta k	
1	U235 nubar	0.986	U235 nubar	0.986	V total	4.74
2	U235 total	0.770	U235 total	0.734	V (n,n)	3.83
3	U235 (n,f)	0.648	U235 (n,f)	0.631	U235 total	-3.26
4	U235 (n,n)	0.087	V total	0.099	U235 (n,f)	-1.86
5	U235 (n,n’)	0.073	V (n,n)	0.081	V (n,n’)	0.953
6	U235 (n,g)	-0.041	U235 (n,n)	0.077	U235 nubar	-0.95
7	V total	0.035	U235 (n,n’)	0.071	U235 (n,n’)	-0.84

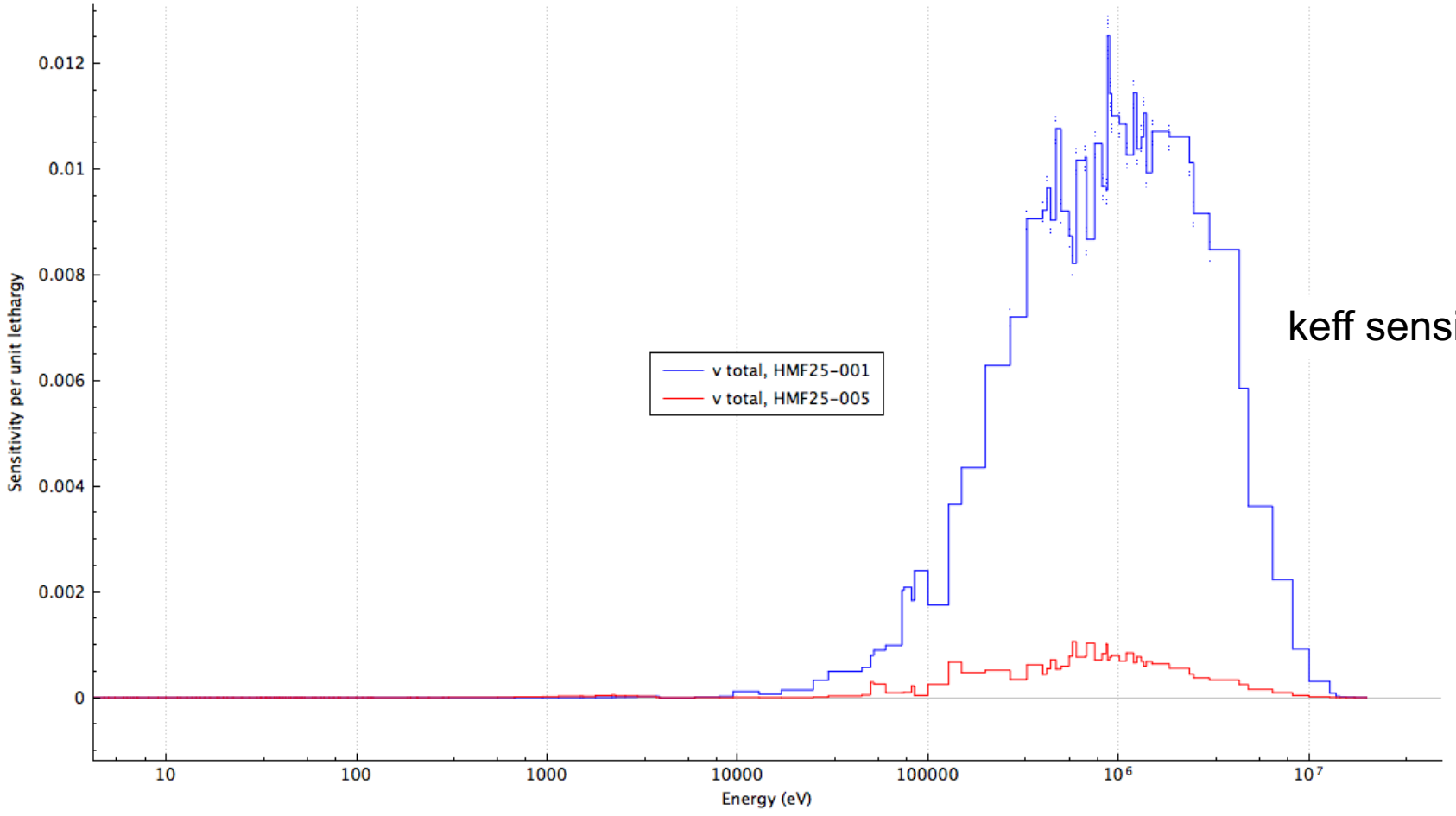
Energy-Dependent Sensitivities for U235 Fission



keff sensitivity



Vanadium Total Cross Section Sensitivities



keff sensitivity