

JEFF



ec.europa.eu/jrc



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Joint Research Centre

the European Commission's
in-house science service

On the way to JEFF-3.3

Expected release: end of 2016

Current situation: JEFF-3.3T1 (test file)

- New major actinides CEA
- Largely increased number of files with covariance
- Replacement of many legacy files
- March 2016, 559 nuclides
- O16, Cu ENDF/BVII.1, 300 TENDL-2015, Pb, Bi, Cr-52

March-April

- Verification and processing
- Benchmarking

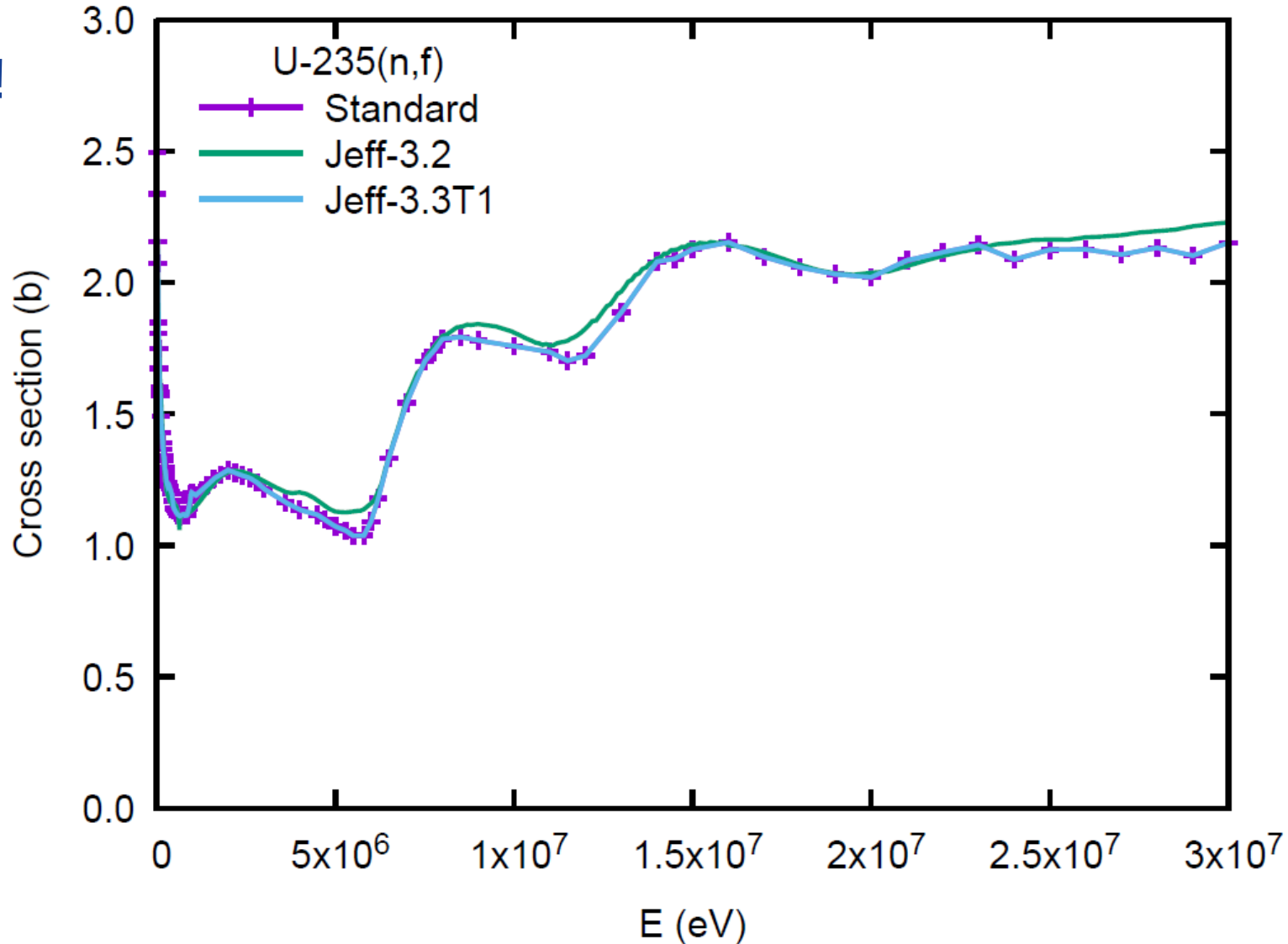
June 2016

- JEFF-3.3T2
- FY, DD

CEA Actinides

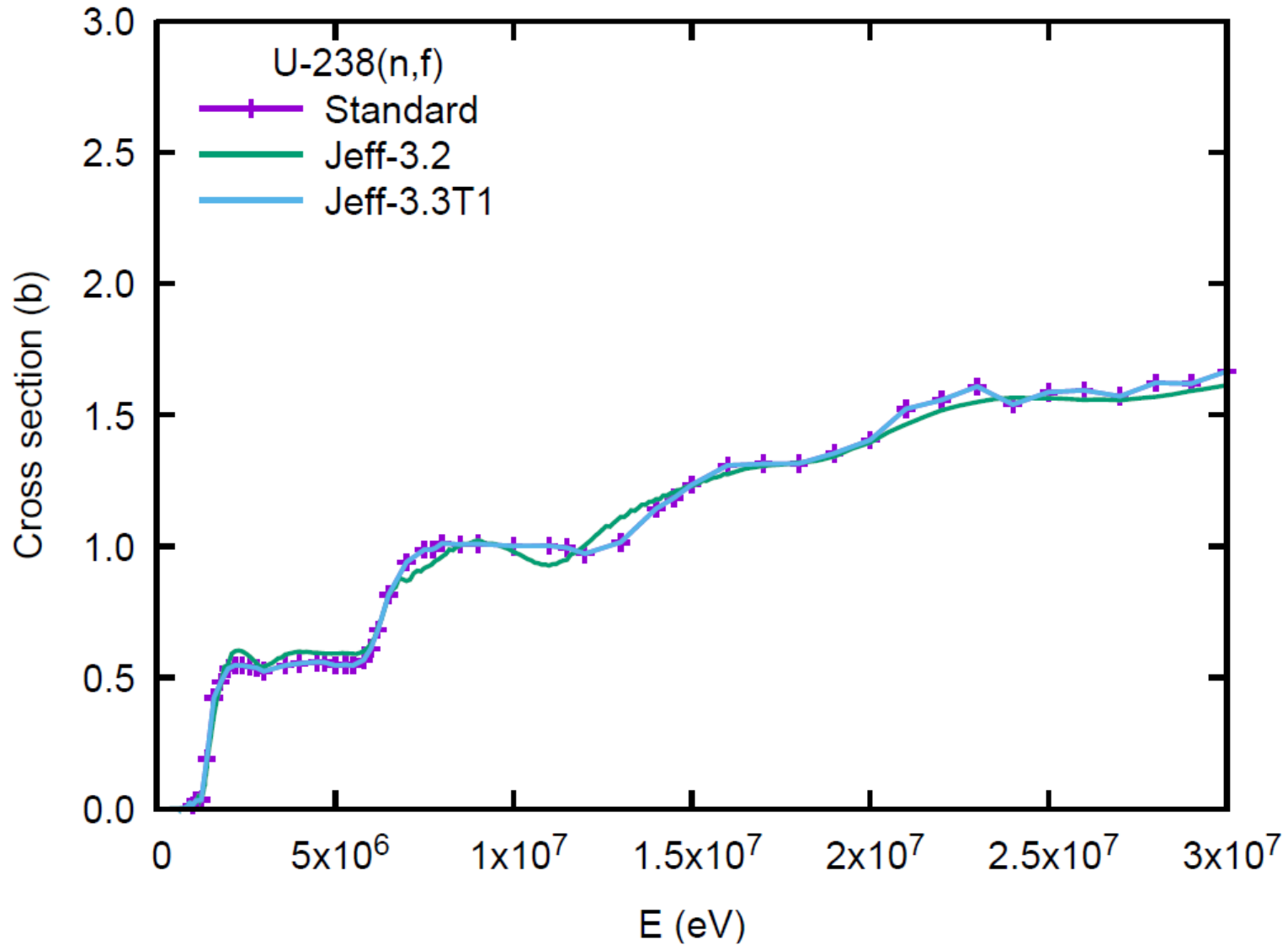
Fission standards

Adopted!
U-235

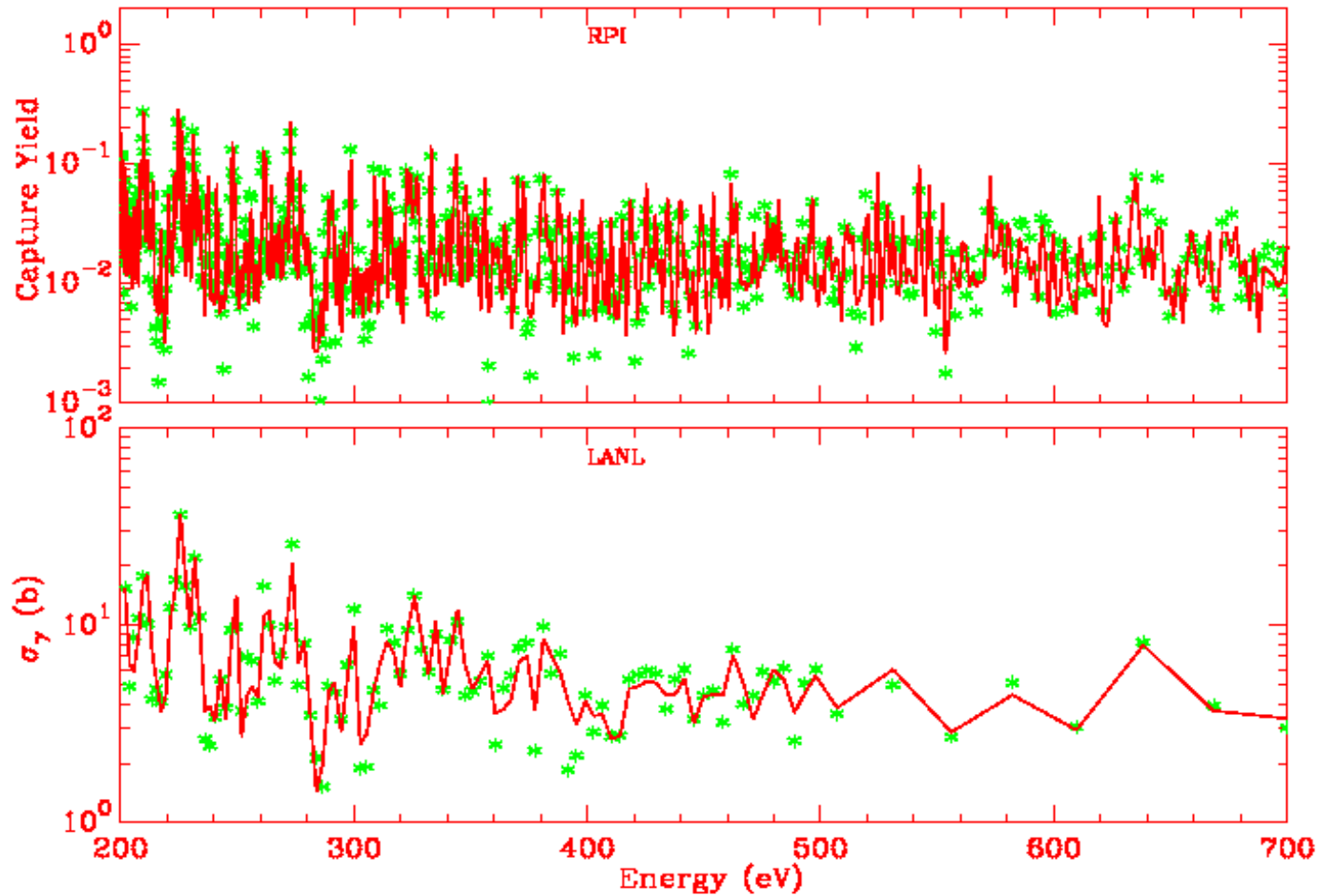


Fission standards

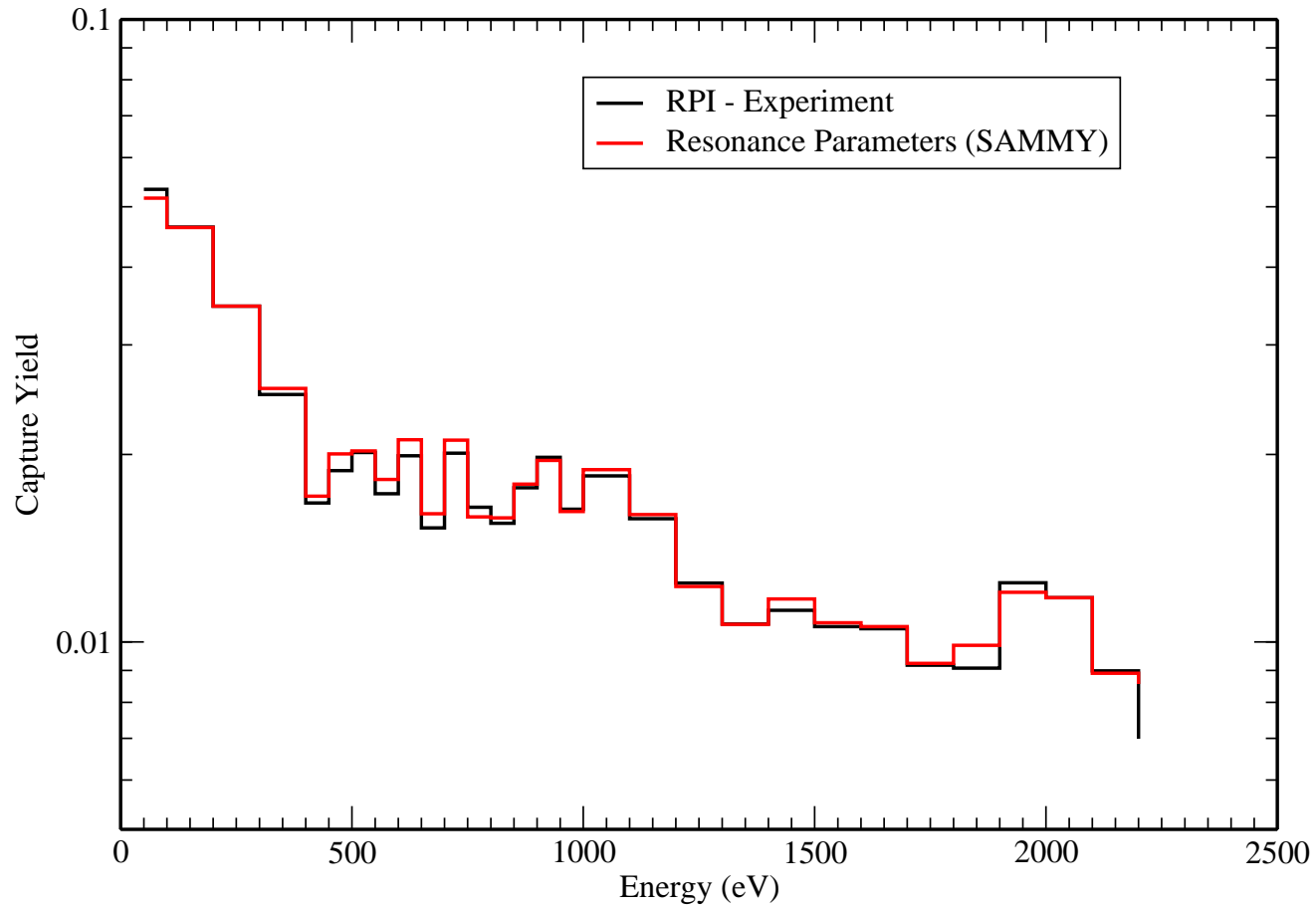
Adopted!
U-238



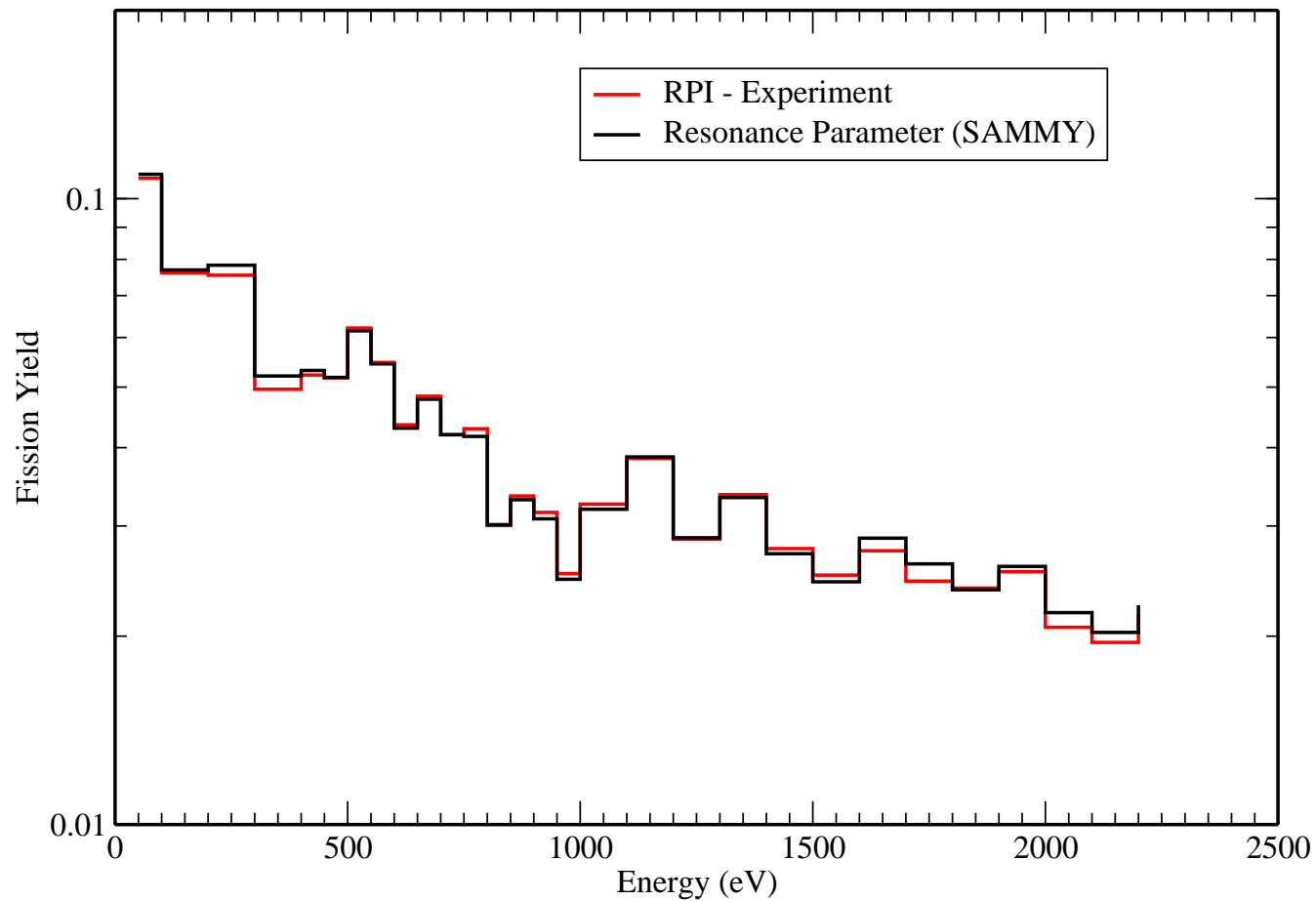
RPI and LANL Capture Data



Fit of the RPI Capture Data



Fit of the RPI Fission data



^{235}U Thermal Values

| Quantity | Standard | B7 (barns) | JEFF3.2 (barns) | JENDL4 (barns) | IRSN (barns) |
|-------------------------|---------------------|---------------|--------------------|-------------------|-----------------|
| σ_f (barns) | 584.380 ± 1.030 | 584.897 | 584.897 | 584.897 | 584.417 |
| σ_γ (barns) | 99.304 ± 0.725 | 98.665 | 98.665 | 98.665 | 99.231 |
| σ_s (barns) | 14.087 ± 0.219 | 15.115 | 15.115 | 15.115 | 14.086 |

²³⁵U Average Fission integral

| ΔE (eV) | Standard (barns) | B7 (barns) | JEFF3.2 (barns) | JENDL4 (barns) | IRSN (barns) |
|--------------------|---------------------|---------------|--------------------|-------------------|-----------------|
| 100 - 200 | 21.17 (11) | 20.33 | 20.33 | 20.29 | 20.81 |
| 200 - 300 | 20.69 (11) | 20.62 | 20.62 | 20.66 | 21.04 |
| 300 - 400 | 13.13 (7) | 12.81 | 12.81 | 12.81 | 13.22 |
| 400 - 500 | 13.78 (8) | 13.33 | 13.33 | 13.31 | 13.51 |
| 500 - 600 | 15.17 (9) | 14.89 | 14.89 | 14.73 | 15.21 |
| 600 - 700 | 11.51 (7) | 11.26 | 11.26 | 11.13 | 11.52 |
| 700 - 800 | 11.10 (6) | 10.89 | 10.89 | 11.06 | 11.11 |
| 800 - 900 | 8.21 (48) | 7.98 | 7.98 | 7.93 | 8.12 |
| 900 - 1000 | 7.50 (44) | 7.25 | 7.25 | 7.46 | 7.39 |
| 1000 - 2000 | 7.30 (40) | 7.14 | 7.14 | 7.10 | 7.29 |

$$\langle \sigma_f \rangle = \frac{1}{E_f - E_i} \int_{E_i}^{E_f} \sigma_f(E) dE$$

Completely new evaluations

- New FILES 2,
- Calculations done with the TALYS code¹,
- New softer prompt fission neutron spectra, with new prompt neutron multiplicity,
- New OMP parameters :
 - New elastic and inelastic cross sections,
 - → New (n,γ) cross sections,
 - ...,
- Fission cross sections from Standards, but close to the BRC model calculation,
- Covariances (FILE 33).

1. TALYS 1.6 developed by A.J. Koning et al.

^{235}U , ^{238}U and ^{239}Pu : what's new

^{235}U

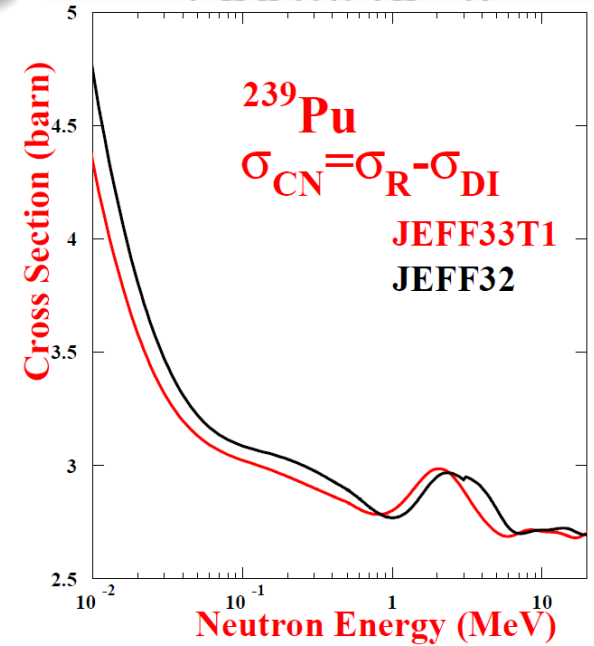
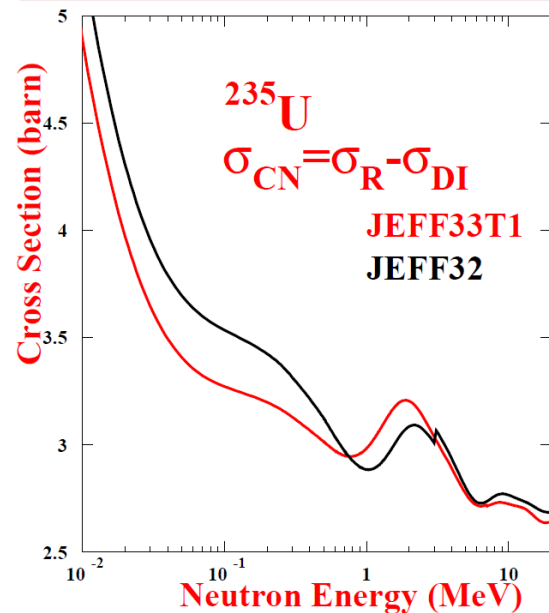
- Fission spectra,
- Multiplicity,
- OMP parameters,
- Fission standards,
- FILES 2,
- Covariances (T6¹).

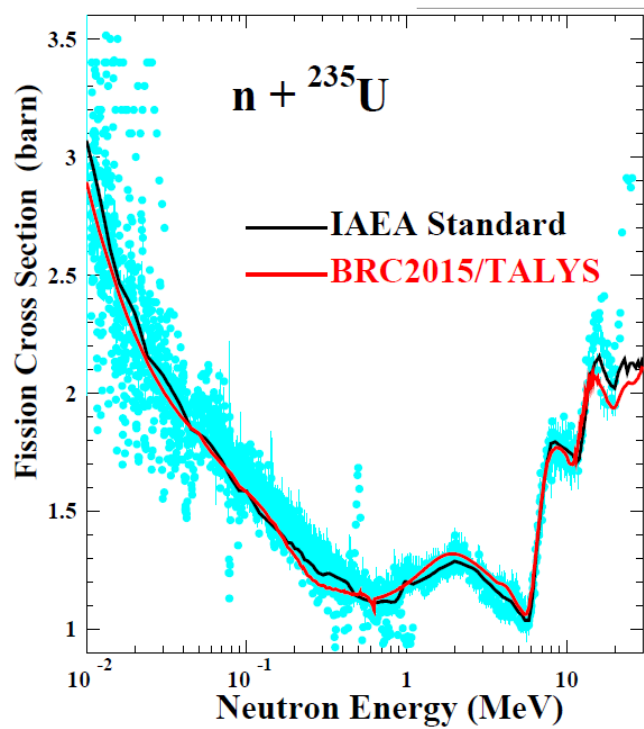
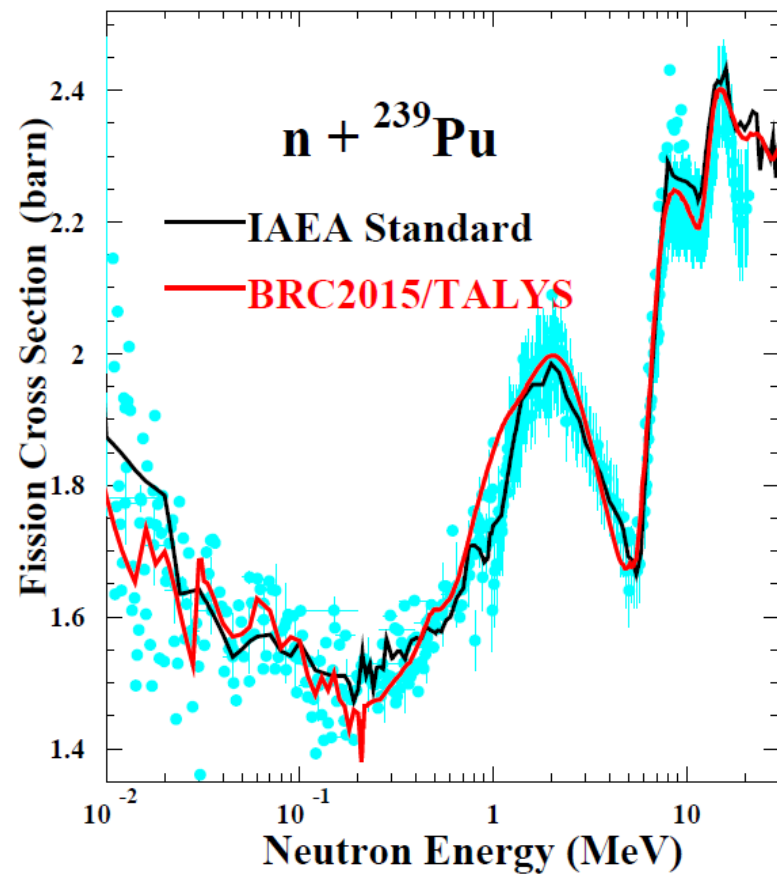
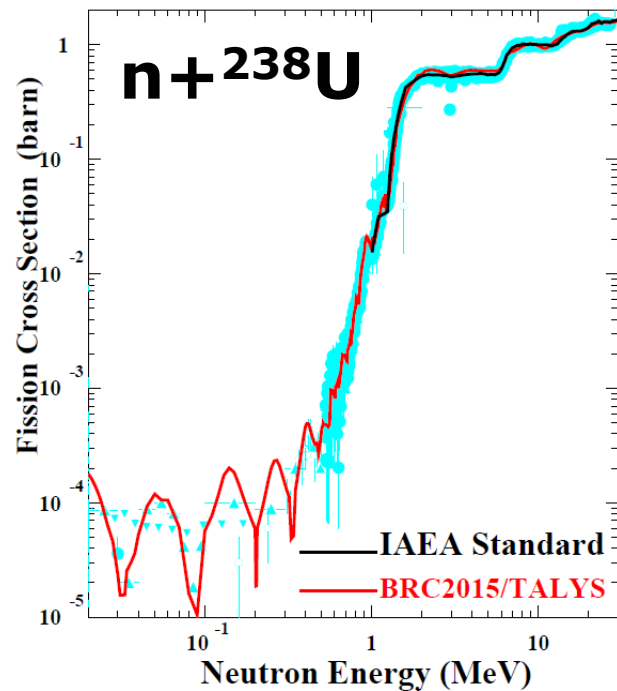
^{238}U

- Fission spectra,
- Multiplicity,
- OMP parameters,
- Fission standards,
- Covariances (COMAC²).

^{239}Pu

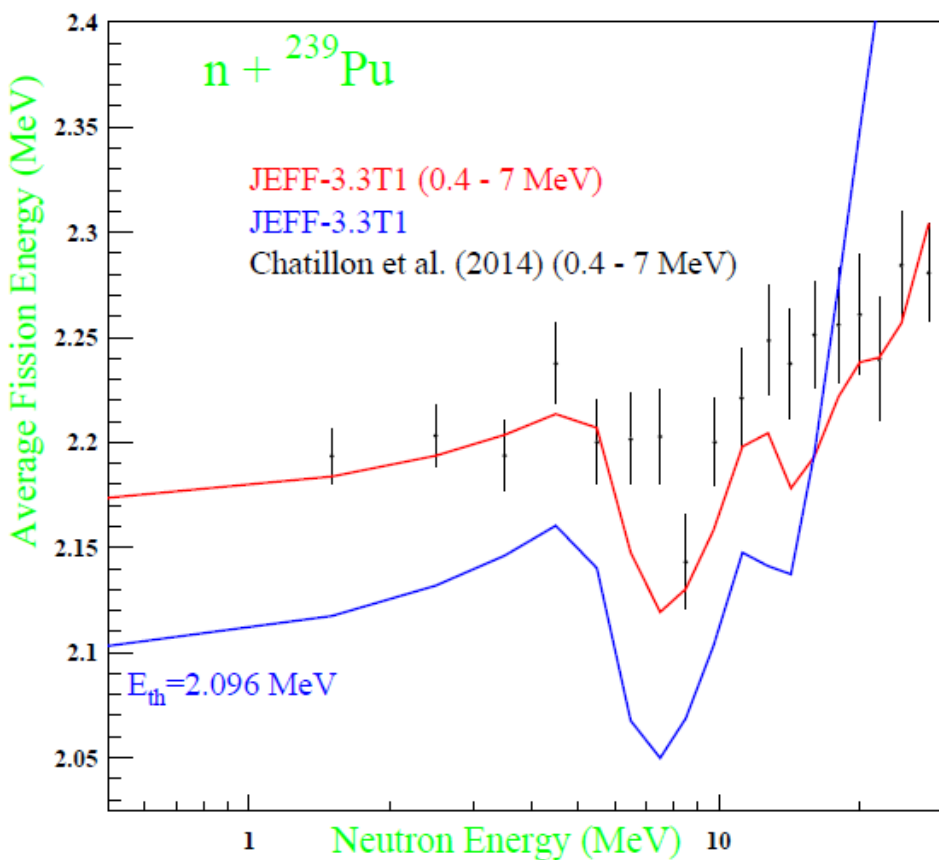
- Fission spectra,
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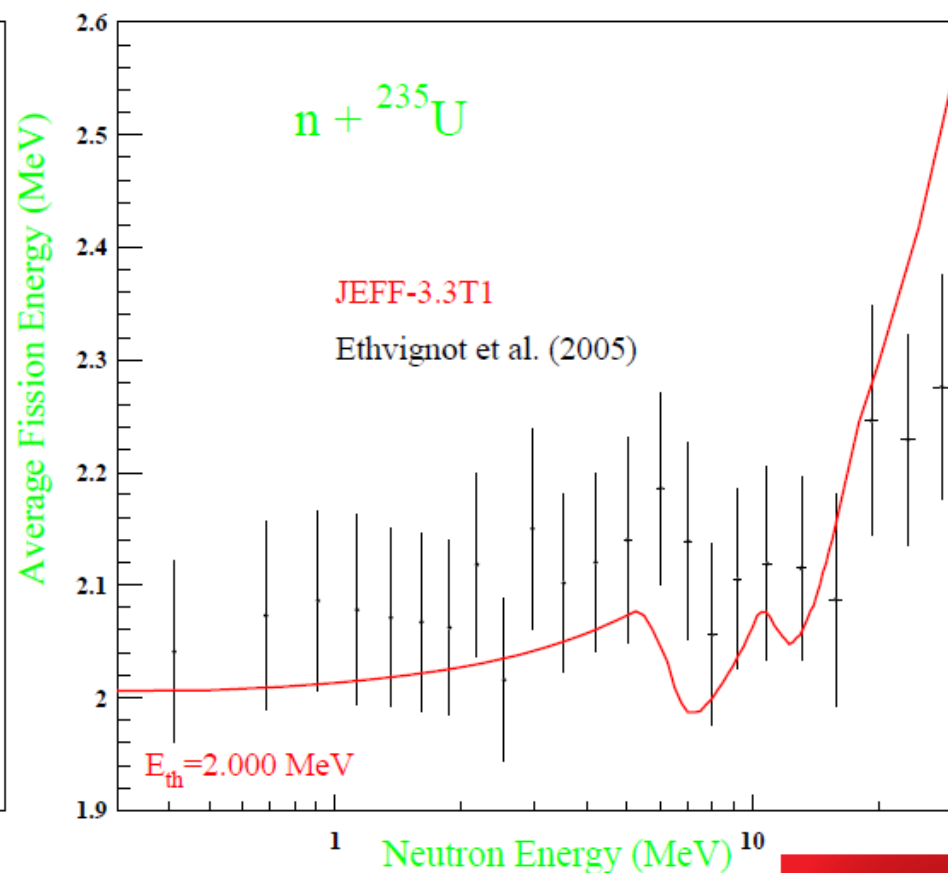


^{239}Pu and ^{235}U : average fission energy

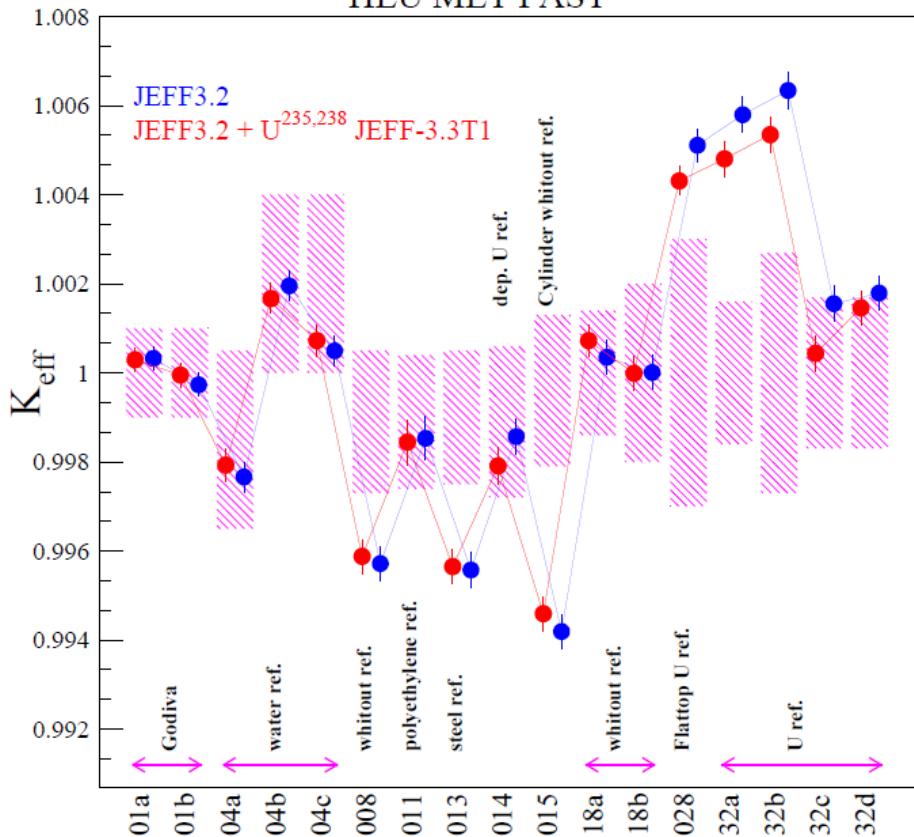
^{239}Pu



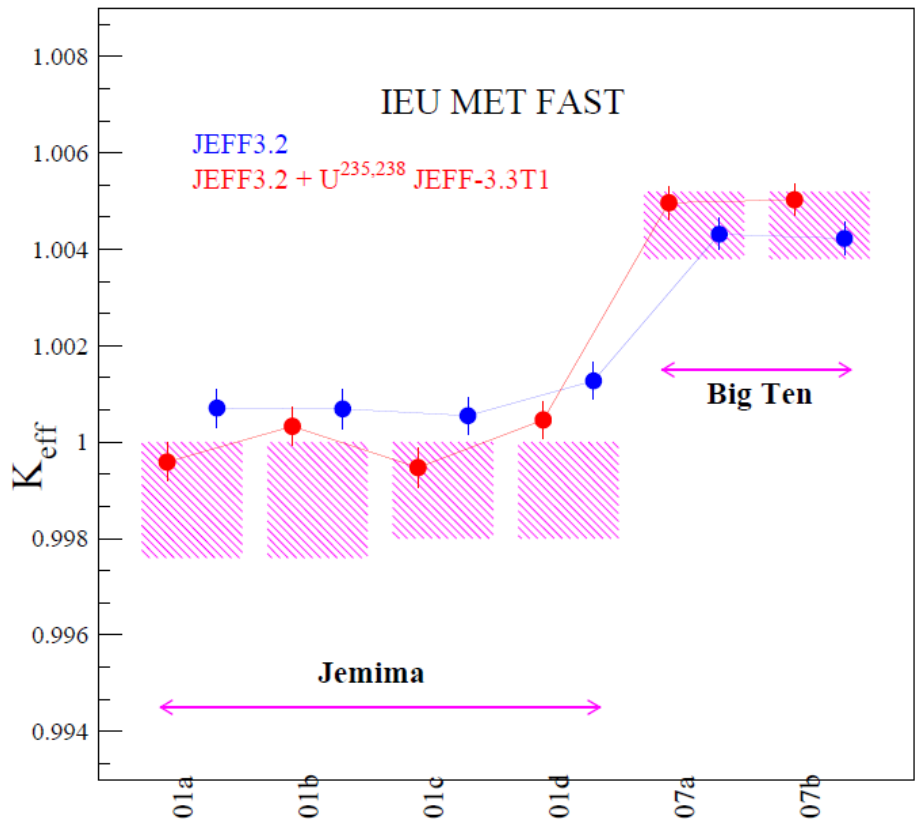
^{235}U



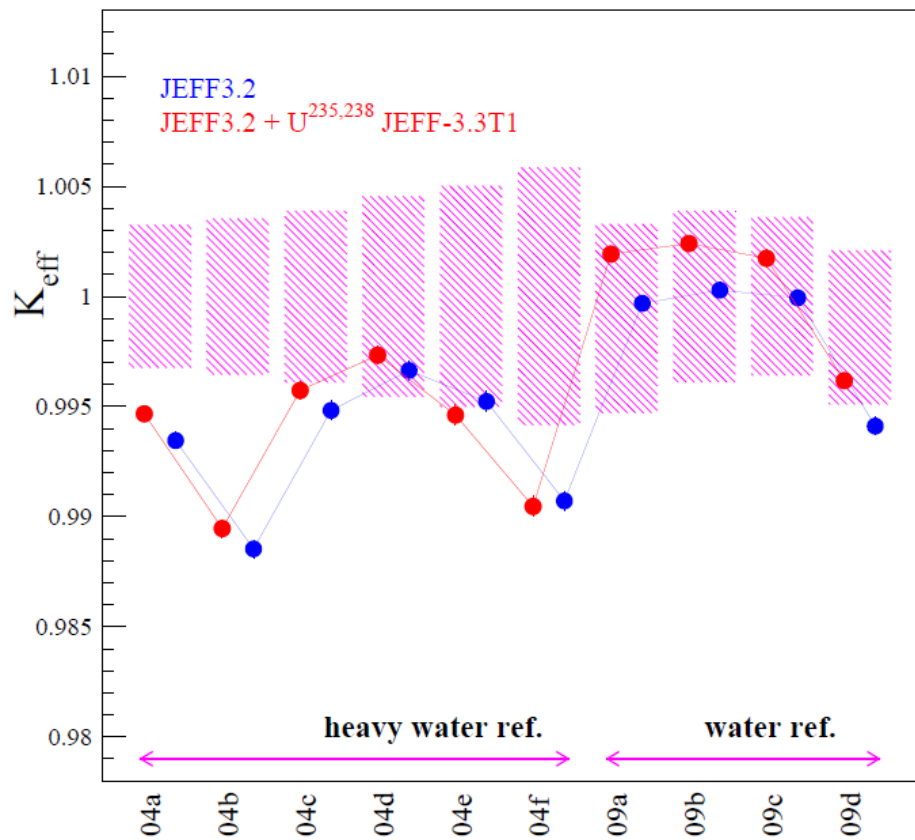
HEU MET FAST



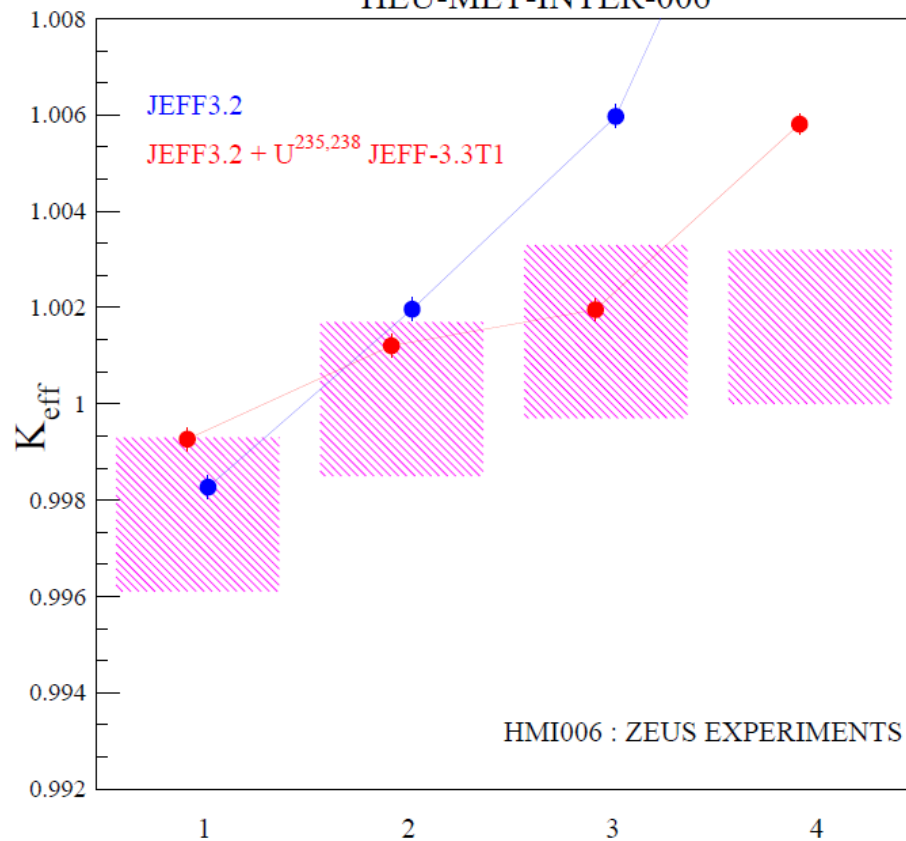
IEU MET FAST



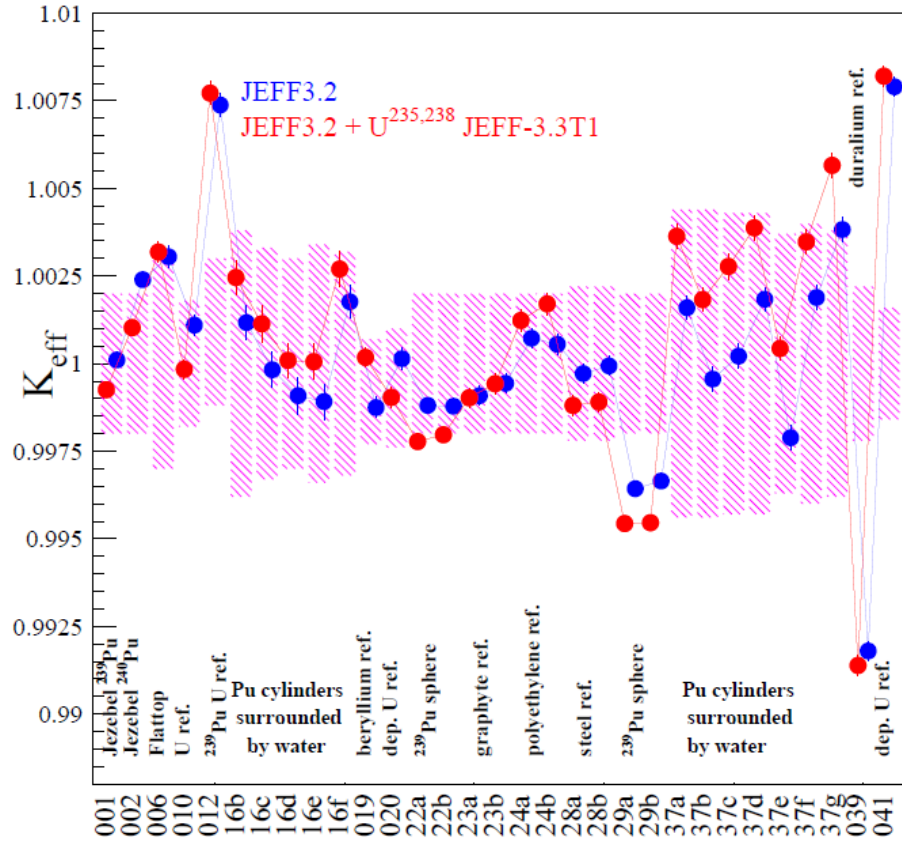
HEU SOL THERM



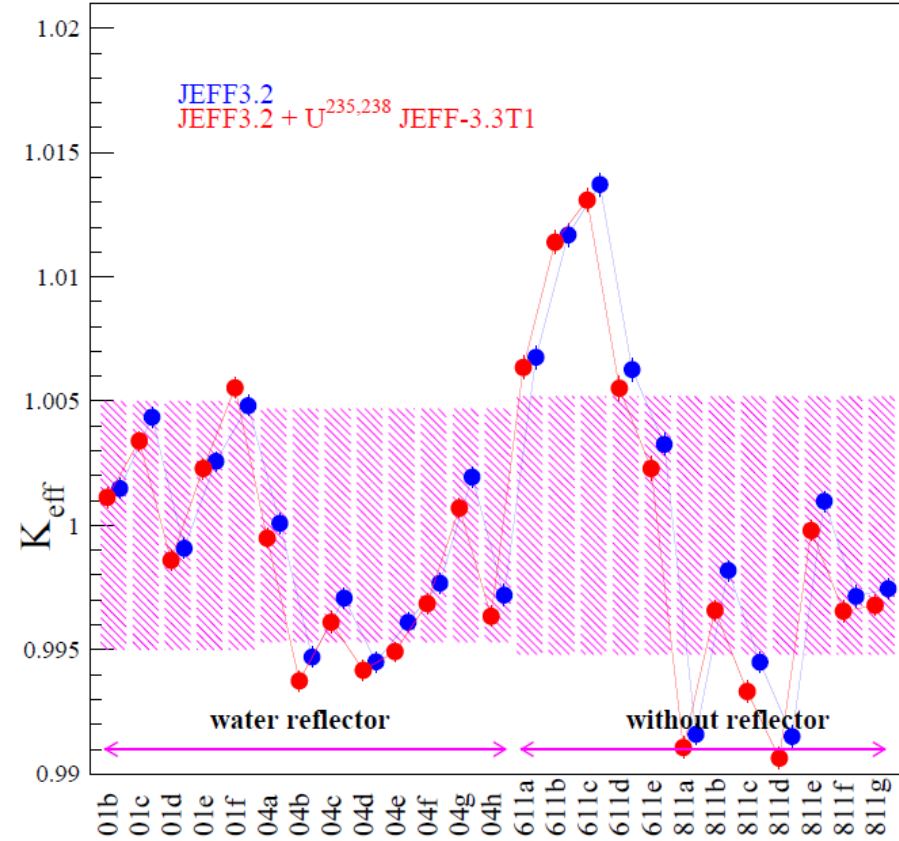
HEU-MET-INTER-006



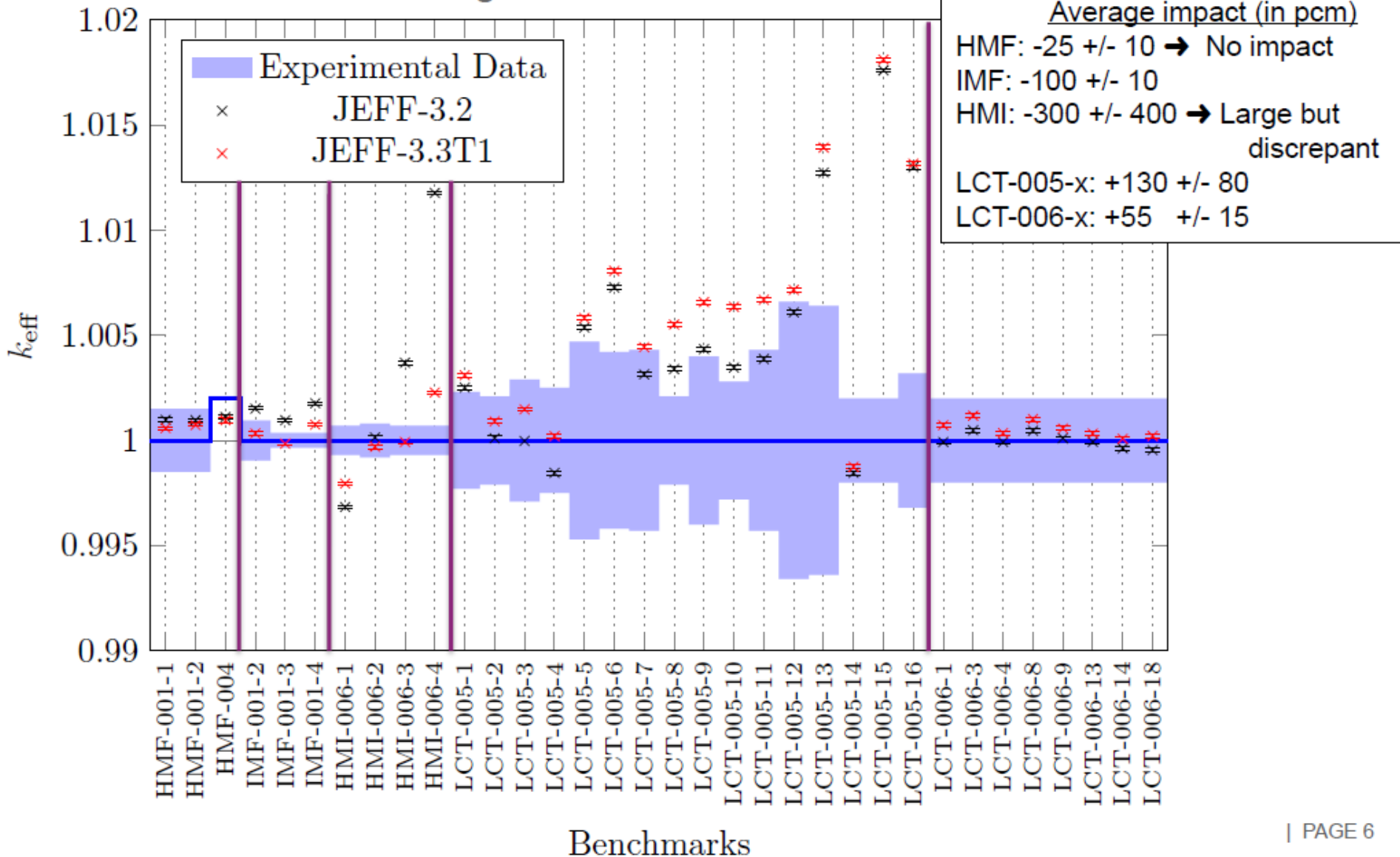
PU MET FAST



PU SOL THERM

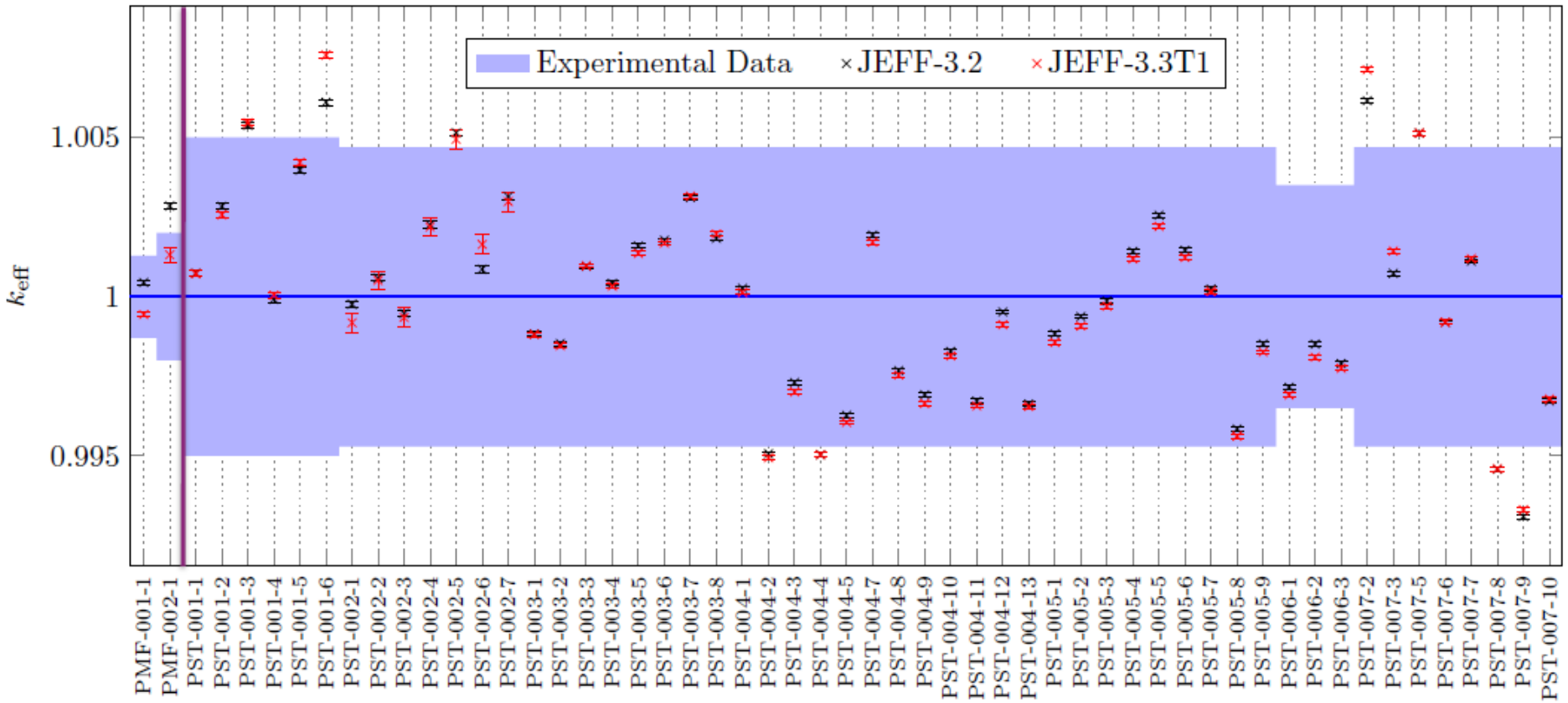


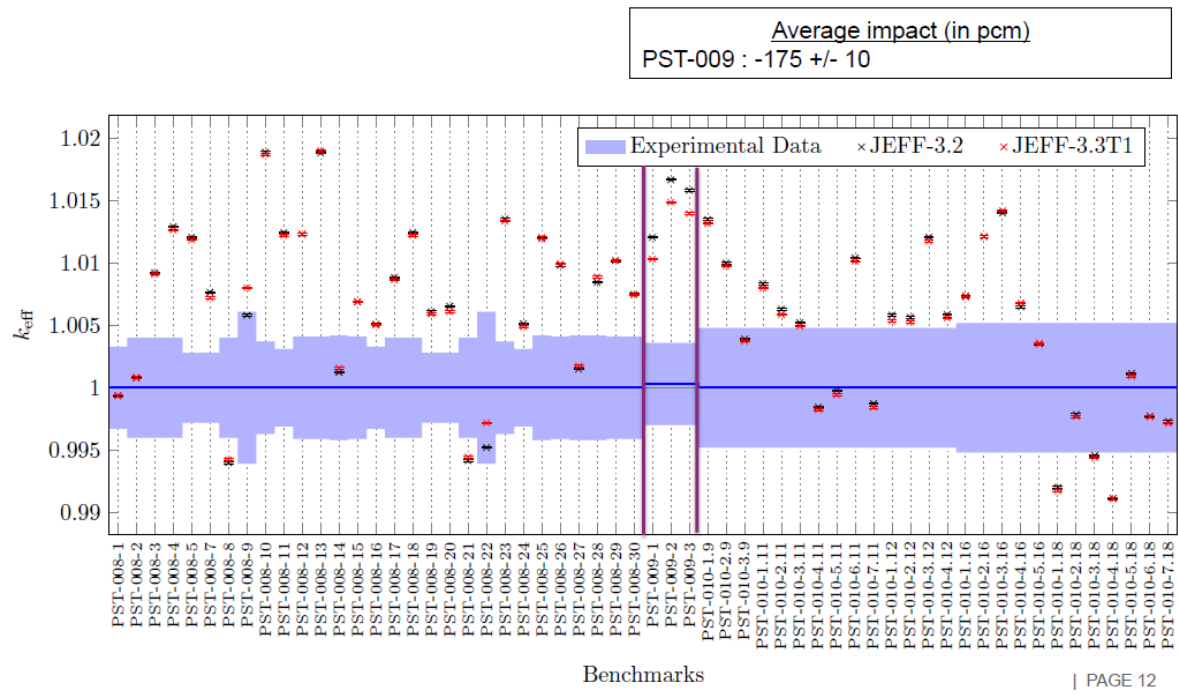
■ ICSBEP benchmarking : Uranium series overview



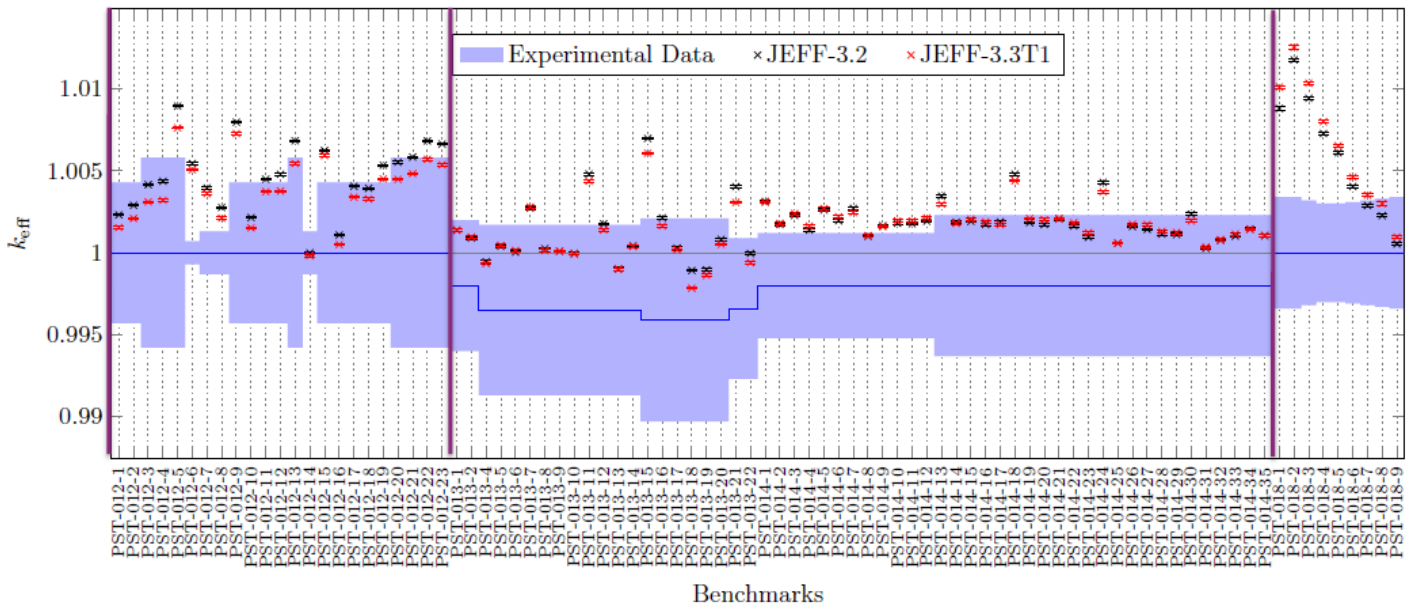
■ **ICSBEP benchmarking** : Plutonium series

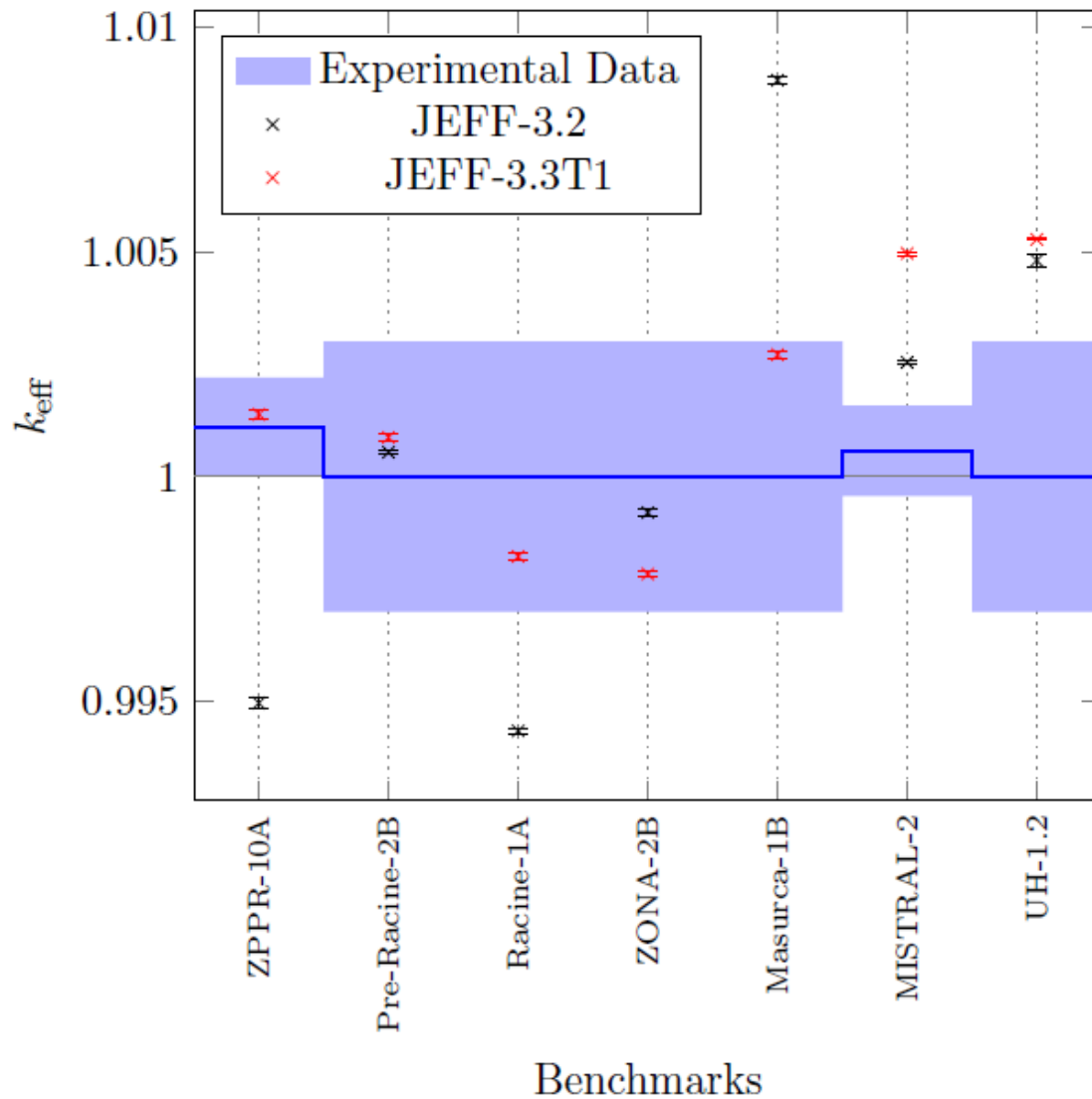
Average impact (in pcm)
 PMF: -135 +/- 20
 PST-001 to 007: almost no impact, except few case





Average impact (in pcm)
PST-012 : - 80 +/- 33
PST-018 : +70 +/- 25

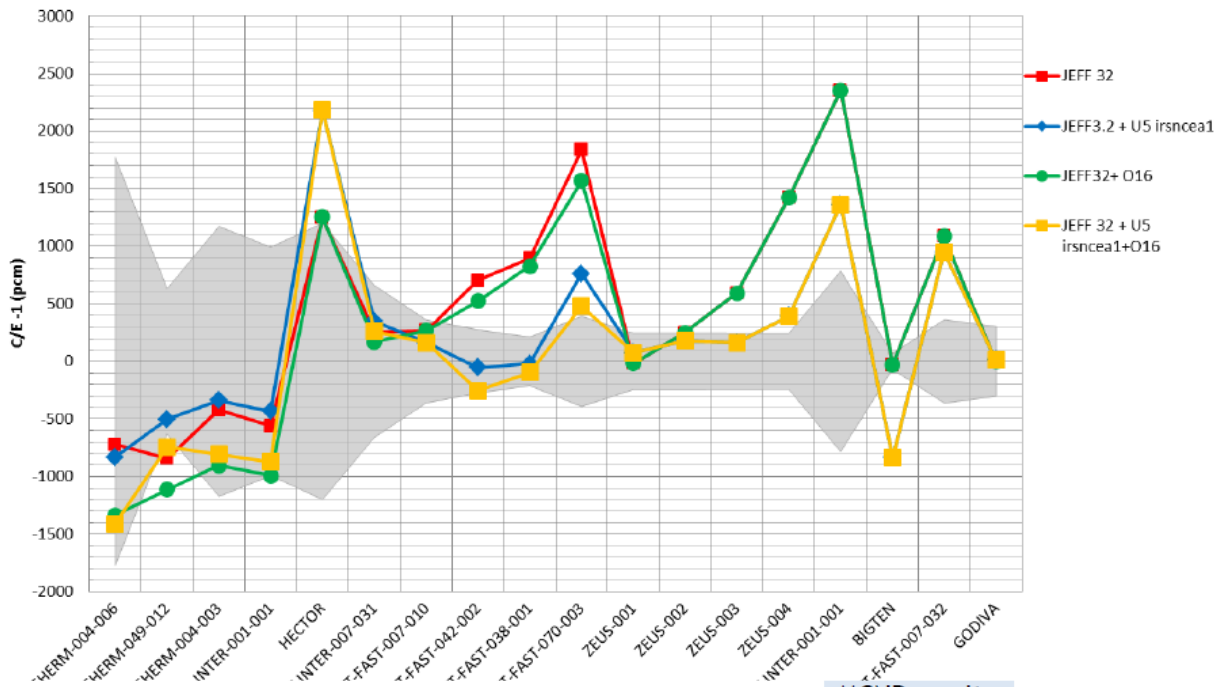




| Experiment | $\Delta\rho(\text{JEFF33T1-JEFF32})$ [pcm] |
|---------------|--|
| ZPPR-10A | +644 |
| Pre-Racine-2B | +33 |
| Racine-1A | +391 |
| ZONA-2B | -137 |
| Masurca-1B | -603 |
| Mistral-2 | +240 |
| UH1.2 | +51 |

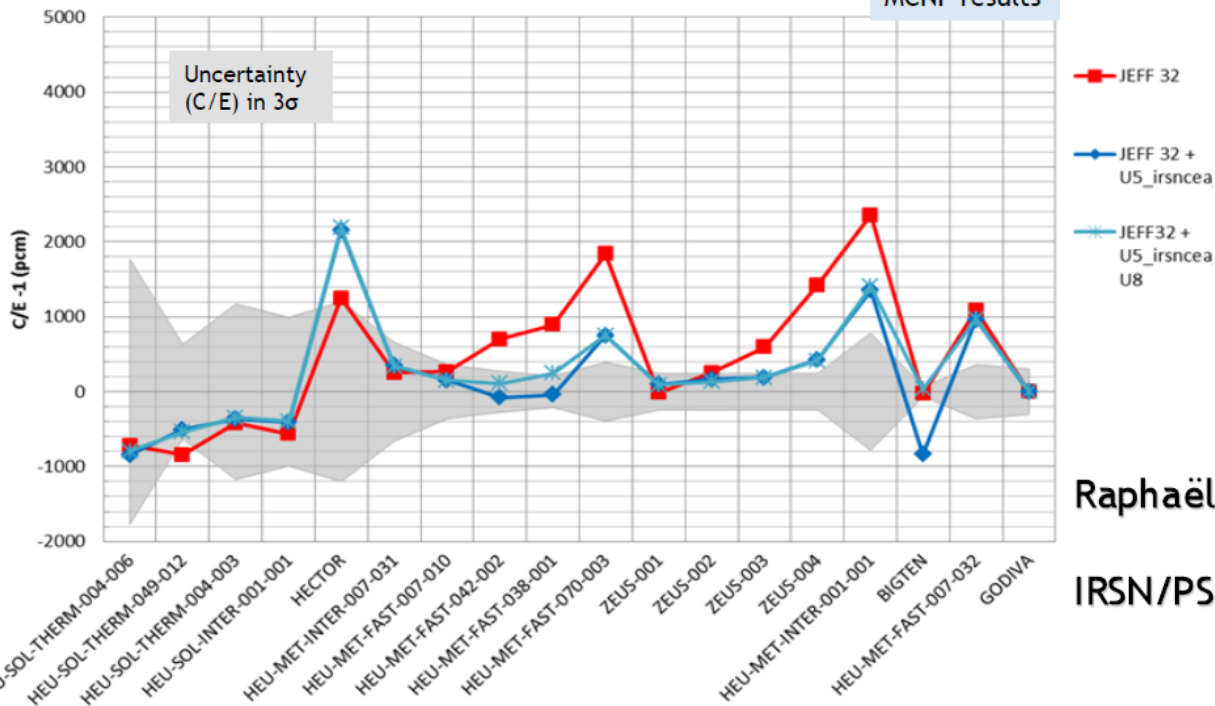
- UH1.2 : small positive effect consistent with LCT-005
- Masurca-1B negative effect (cf. IMF and HMF)
- For fast Pu-reactors, the trend is to an increase of reactivity except for ZONA-2B (no fertile blanket)
- MISTRA-2 : positive impact to be analyzed (\neq PST)

U5+U8



MCNP results

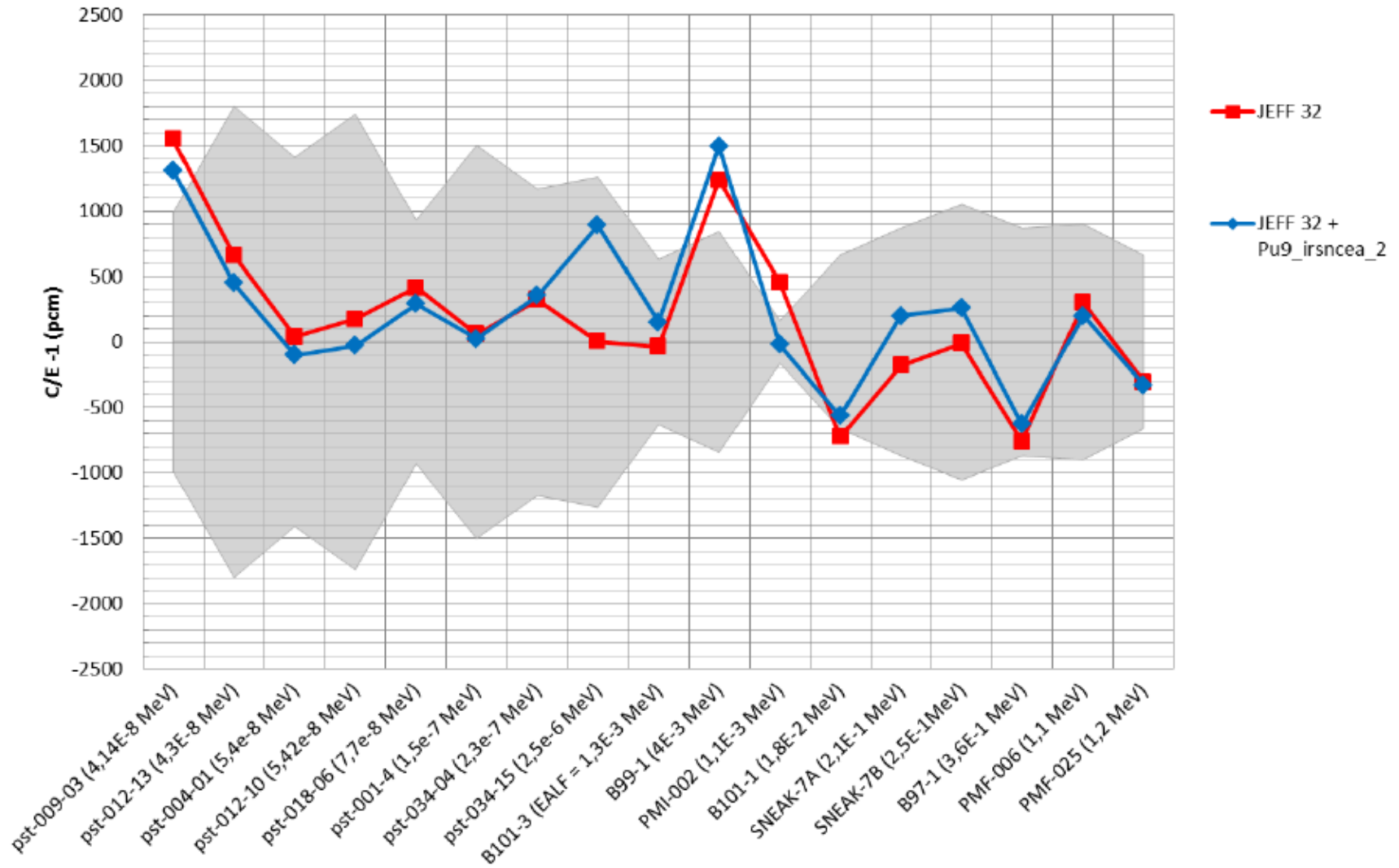
U5+O16

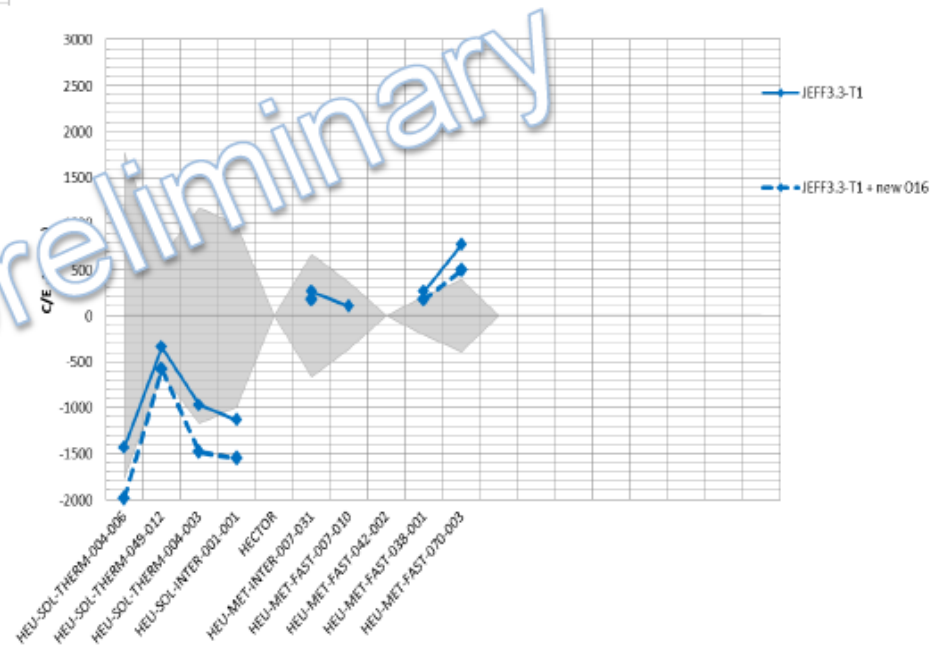
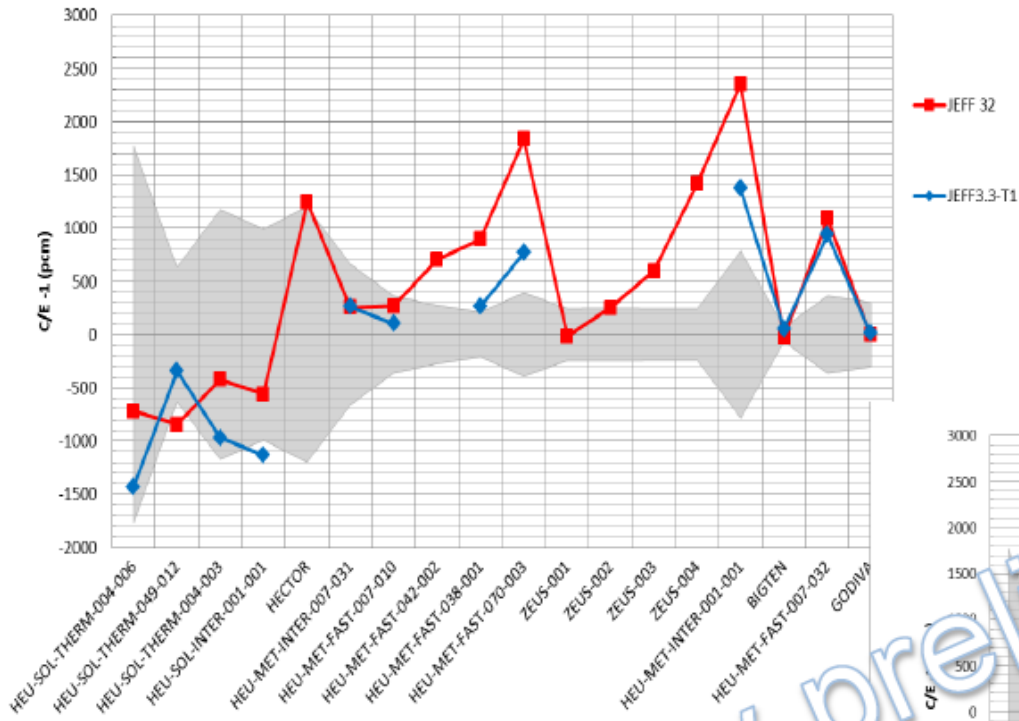


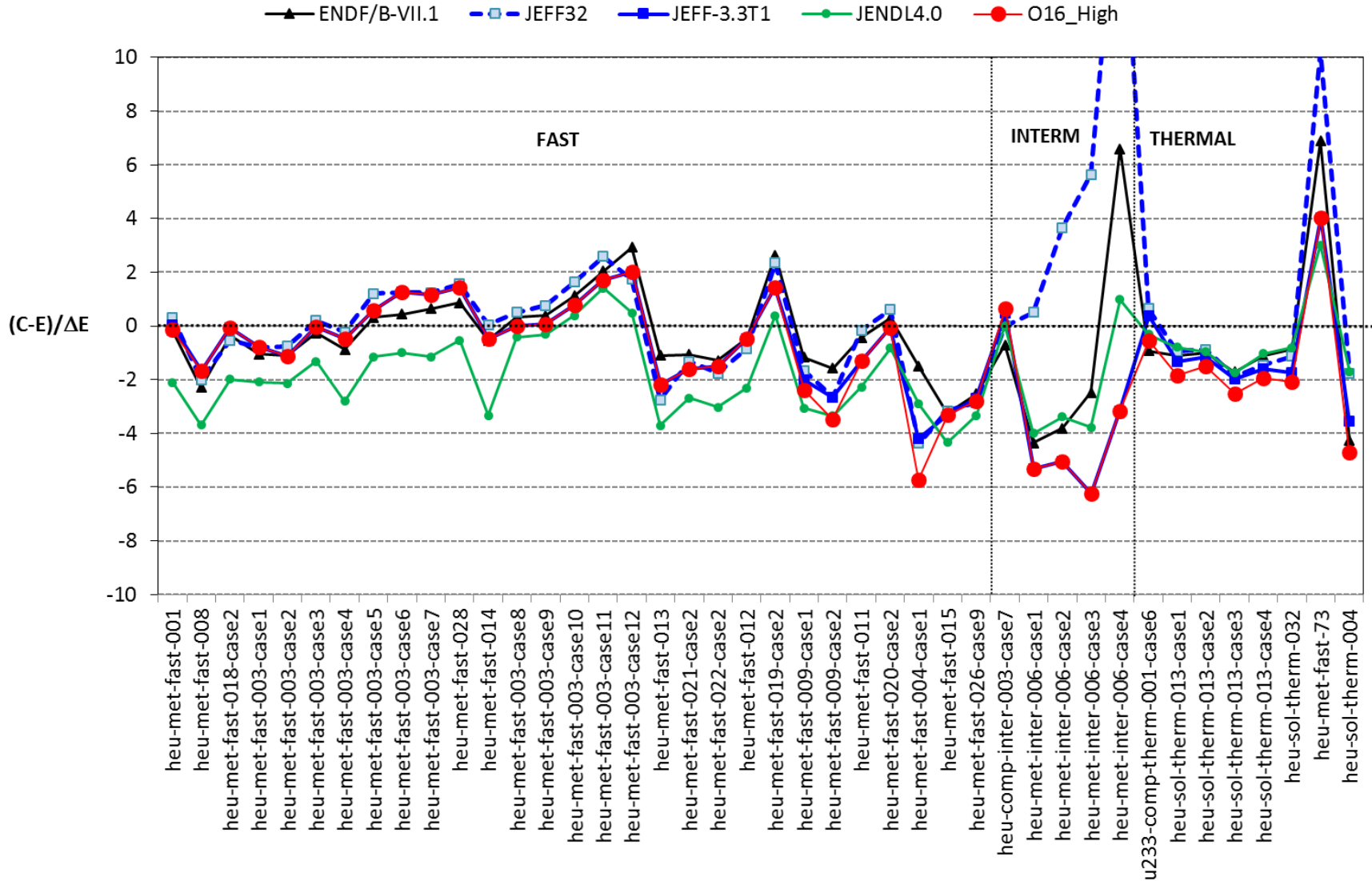
Raphaëlle Ichou (with L.Leal and W.Haack)

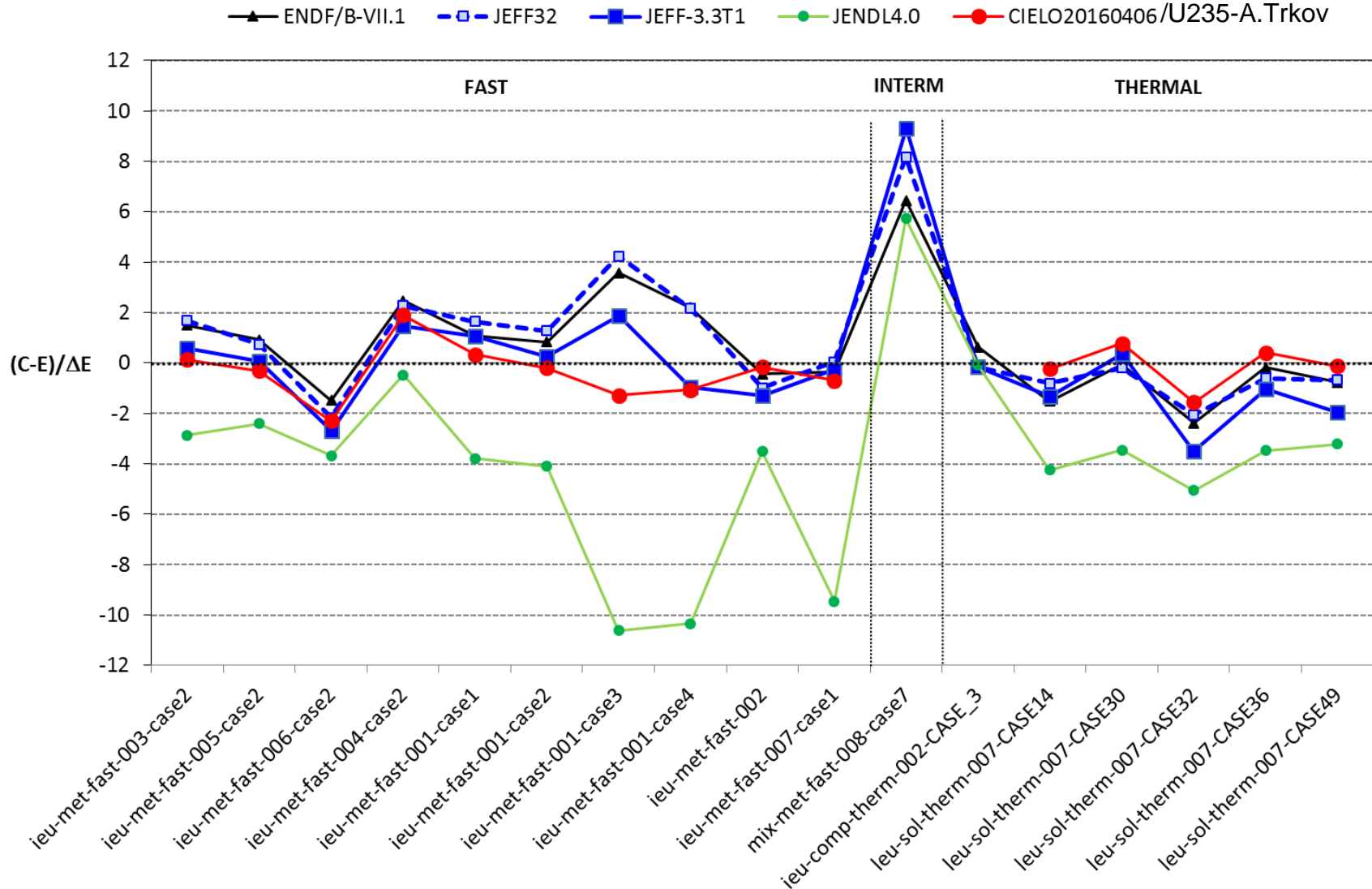
IRSN/PSN-EXP/SNC/LNR

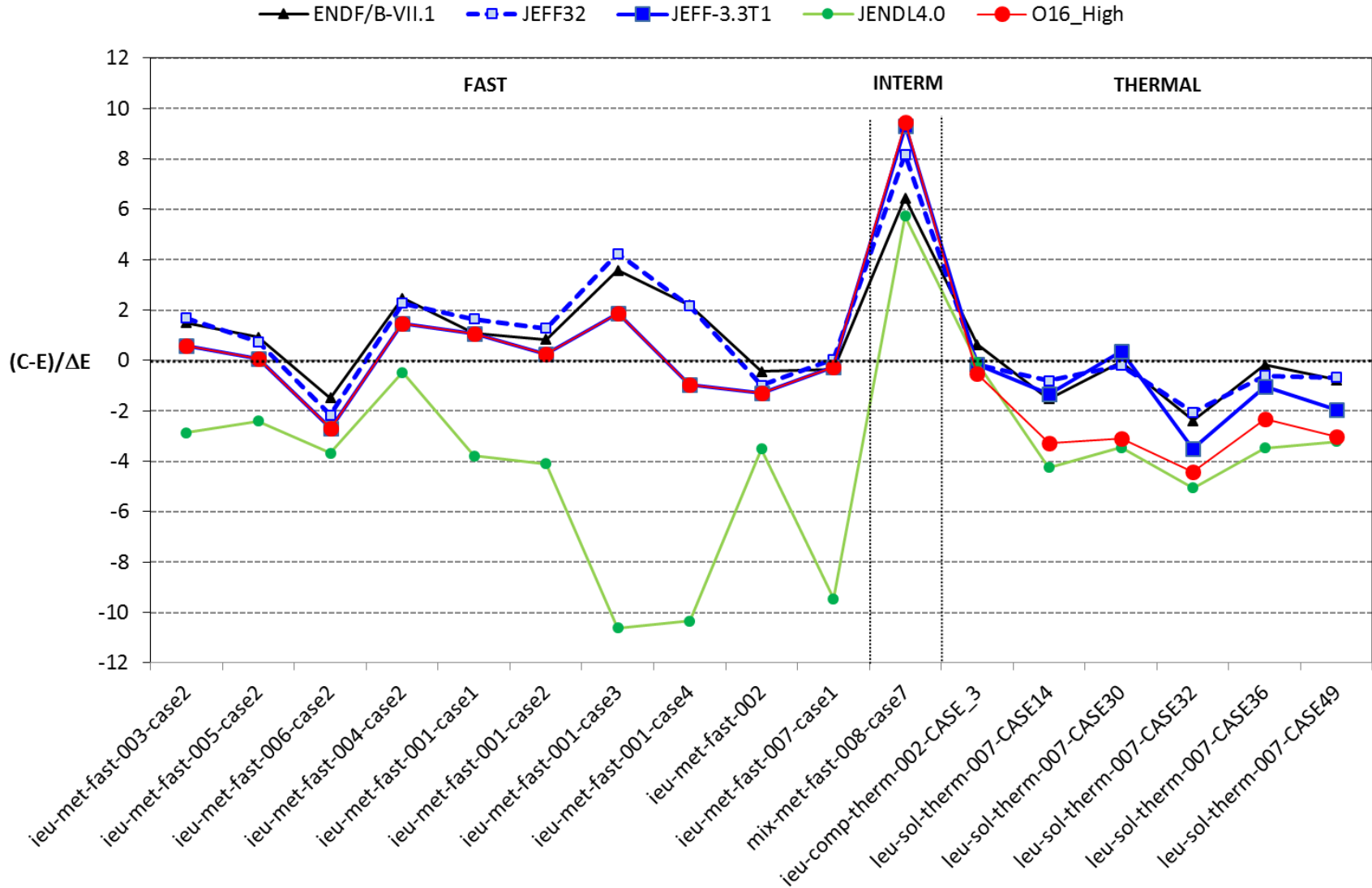
C/E results with new ^{239}Pu -irsn-cea (JEFF32)



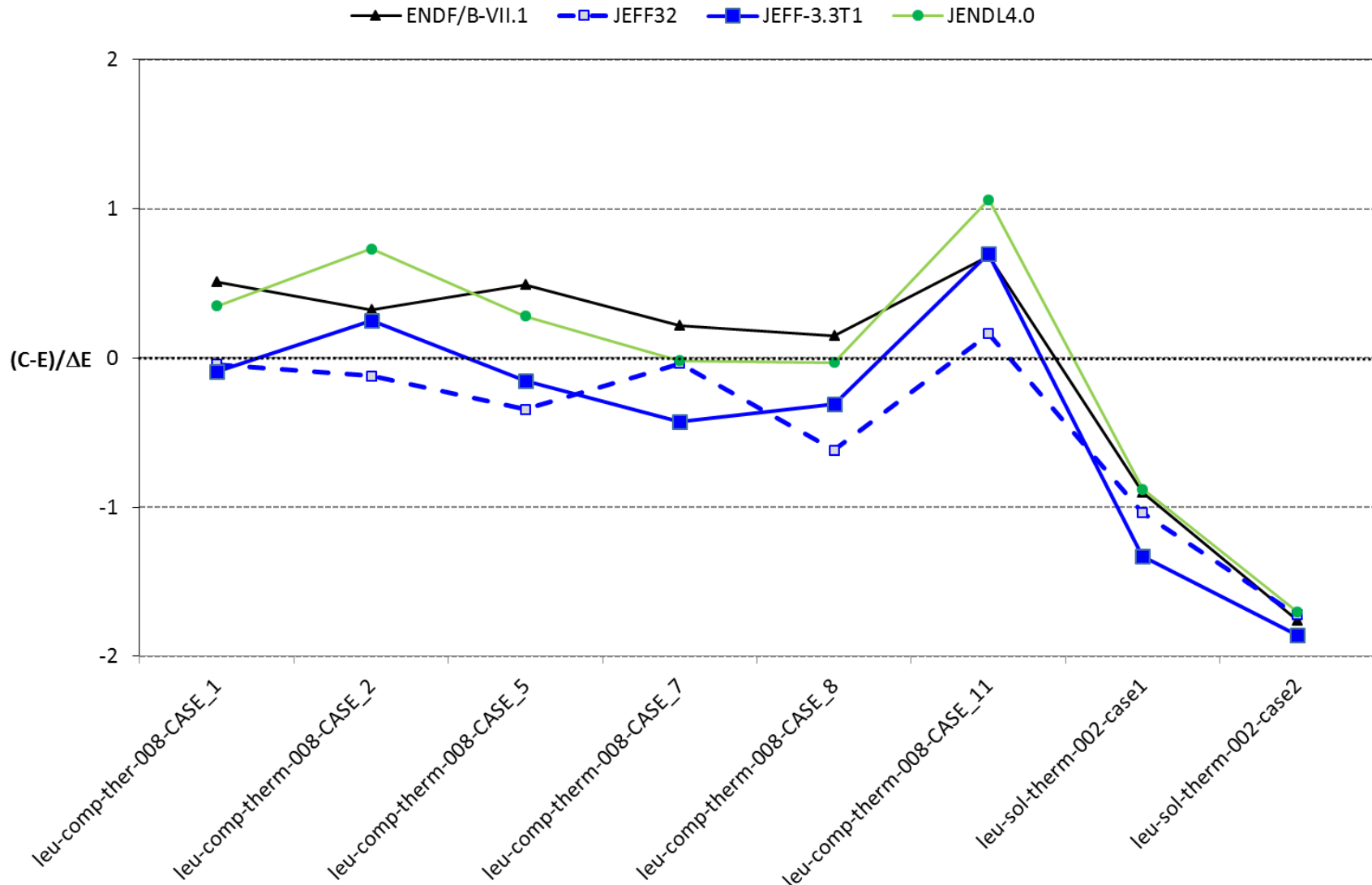




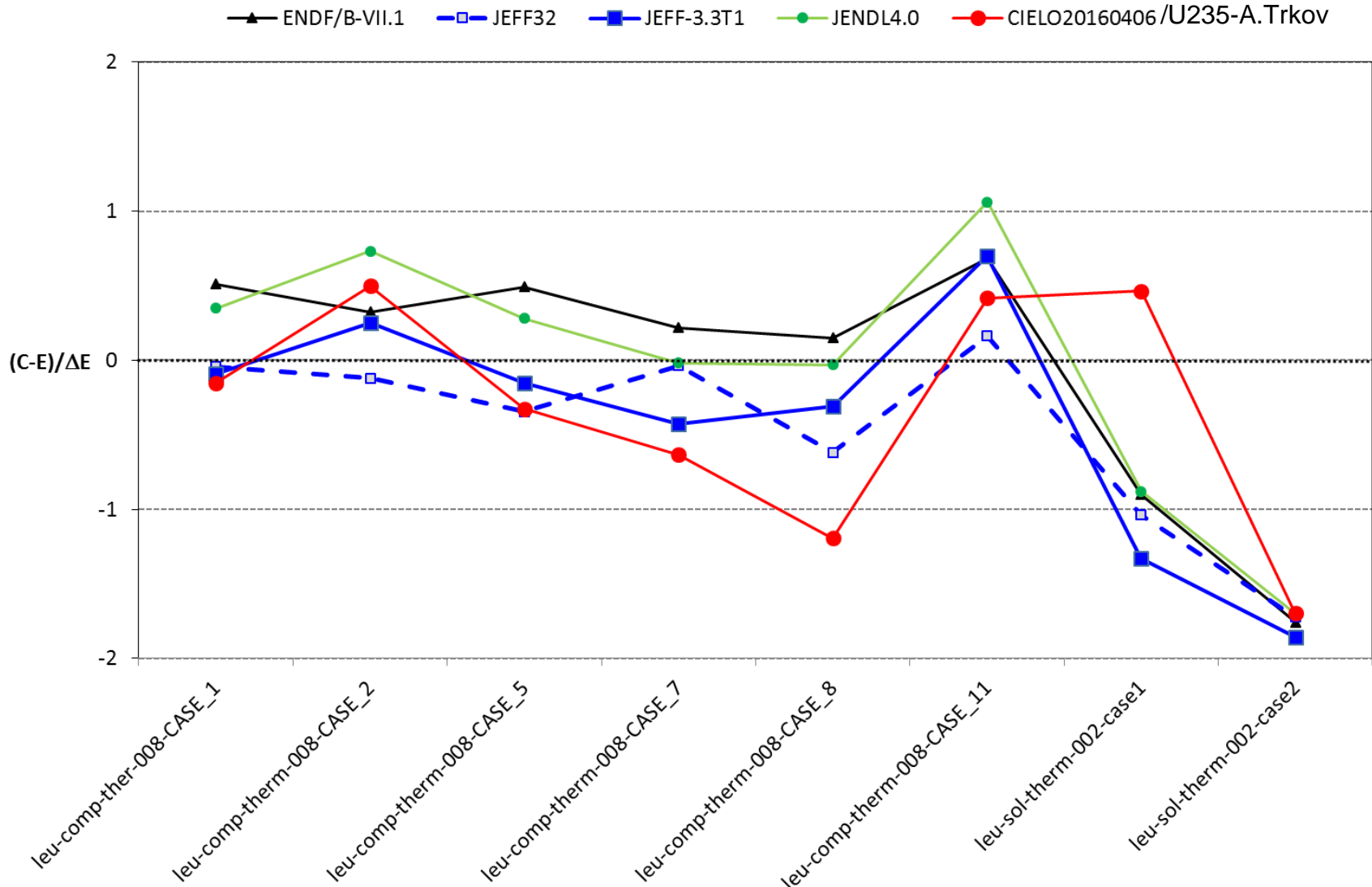


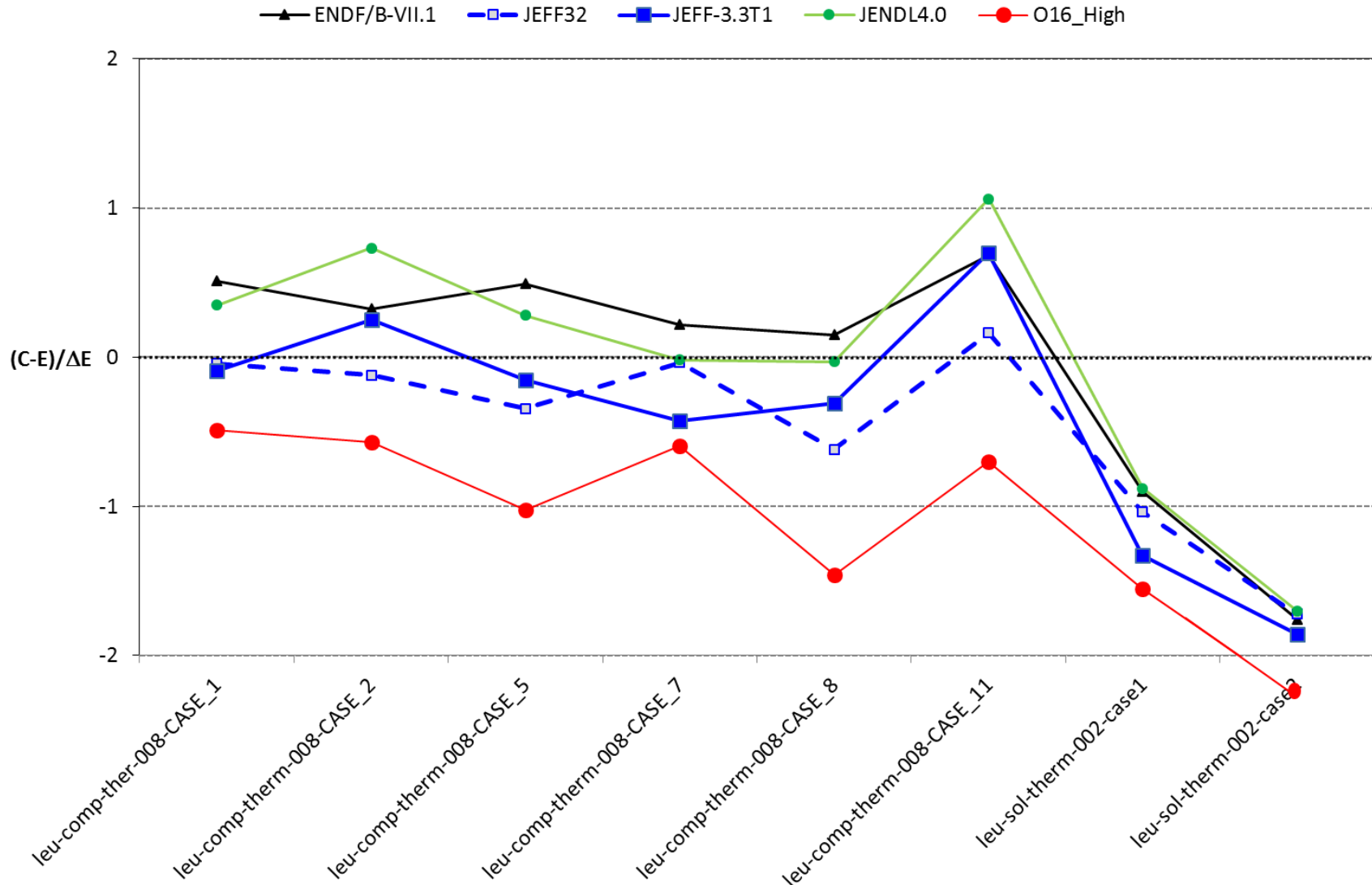


LEU



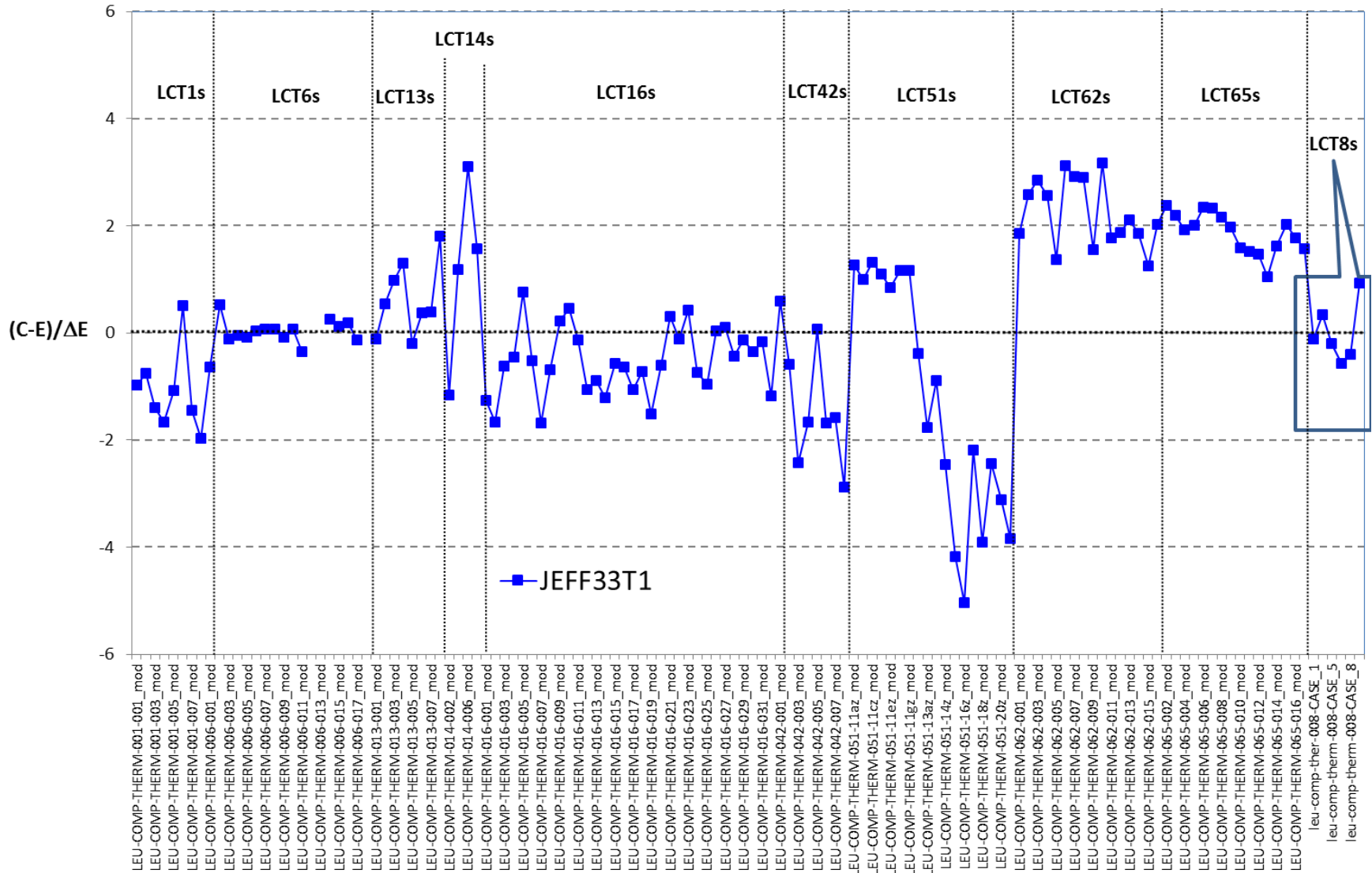
LEU





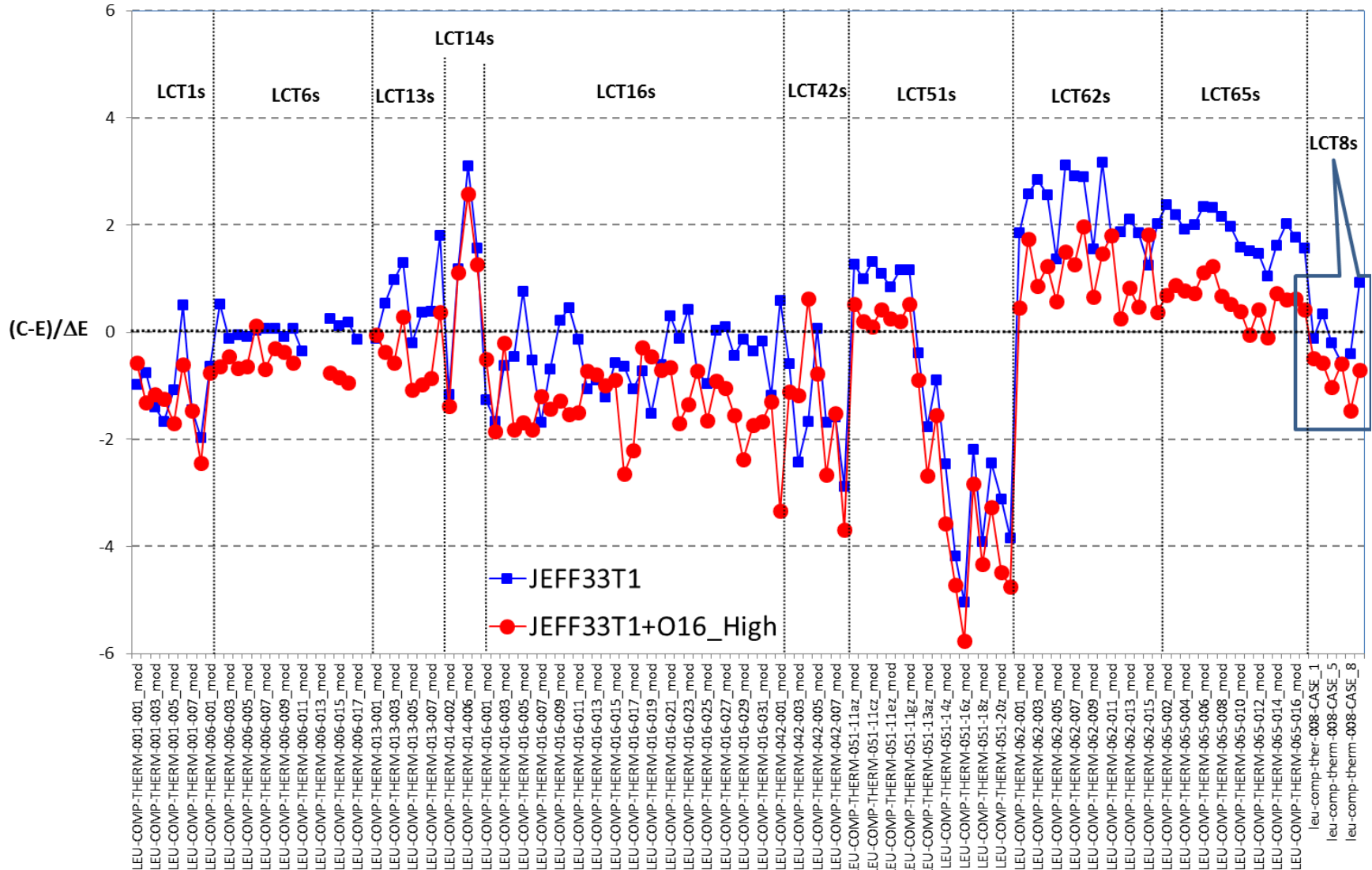
More thermal results ...

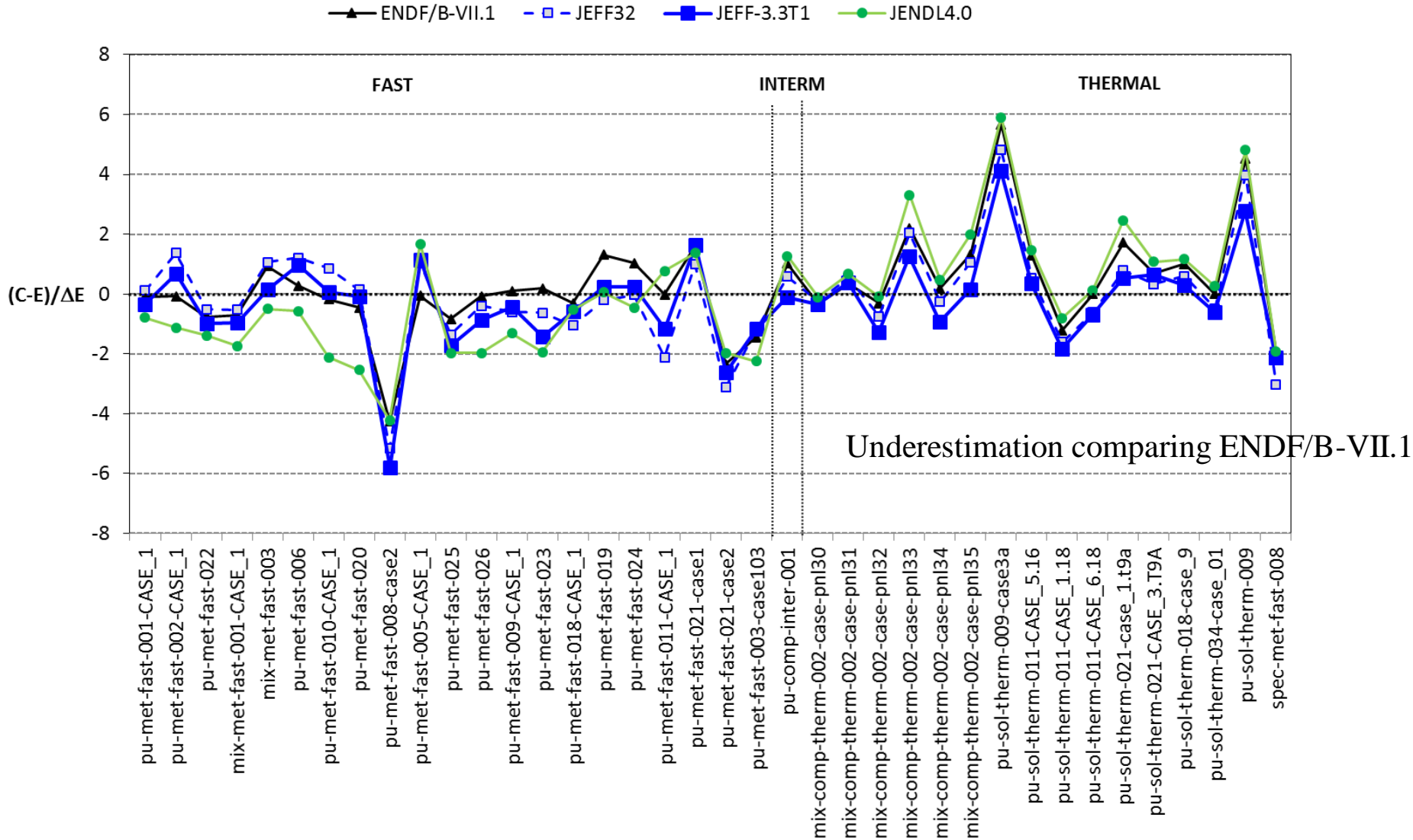
LEU



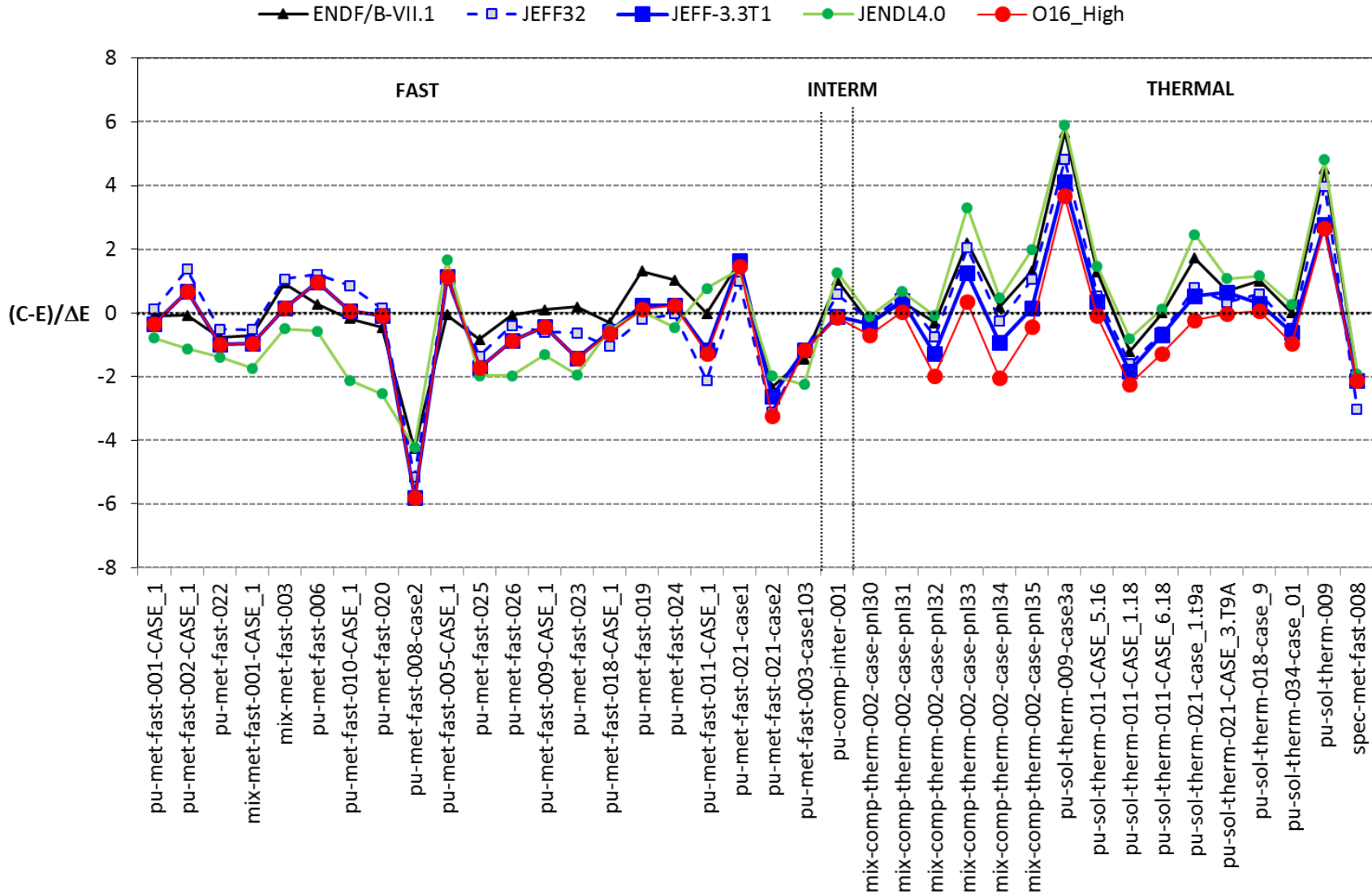
More thermal results ...

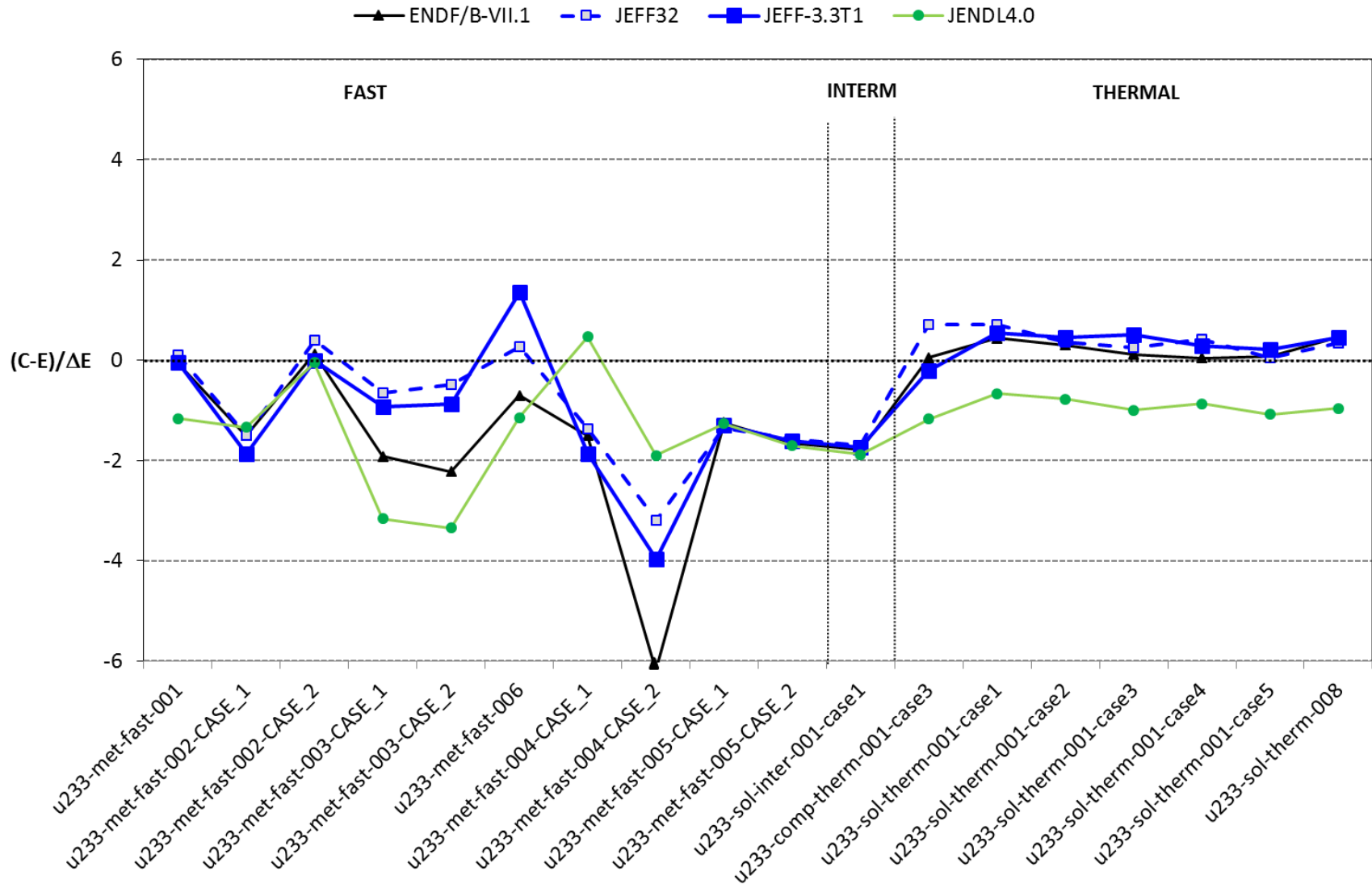
LEU

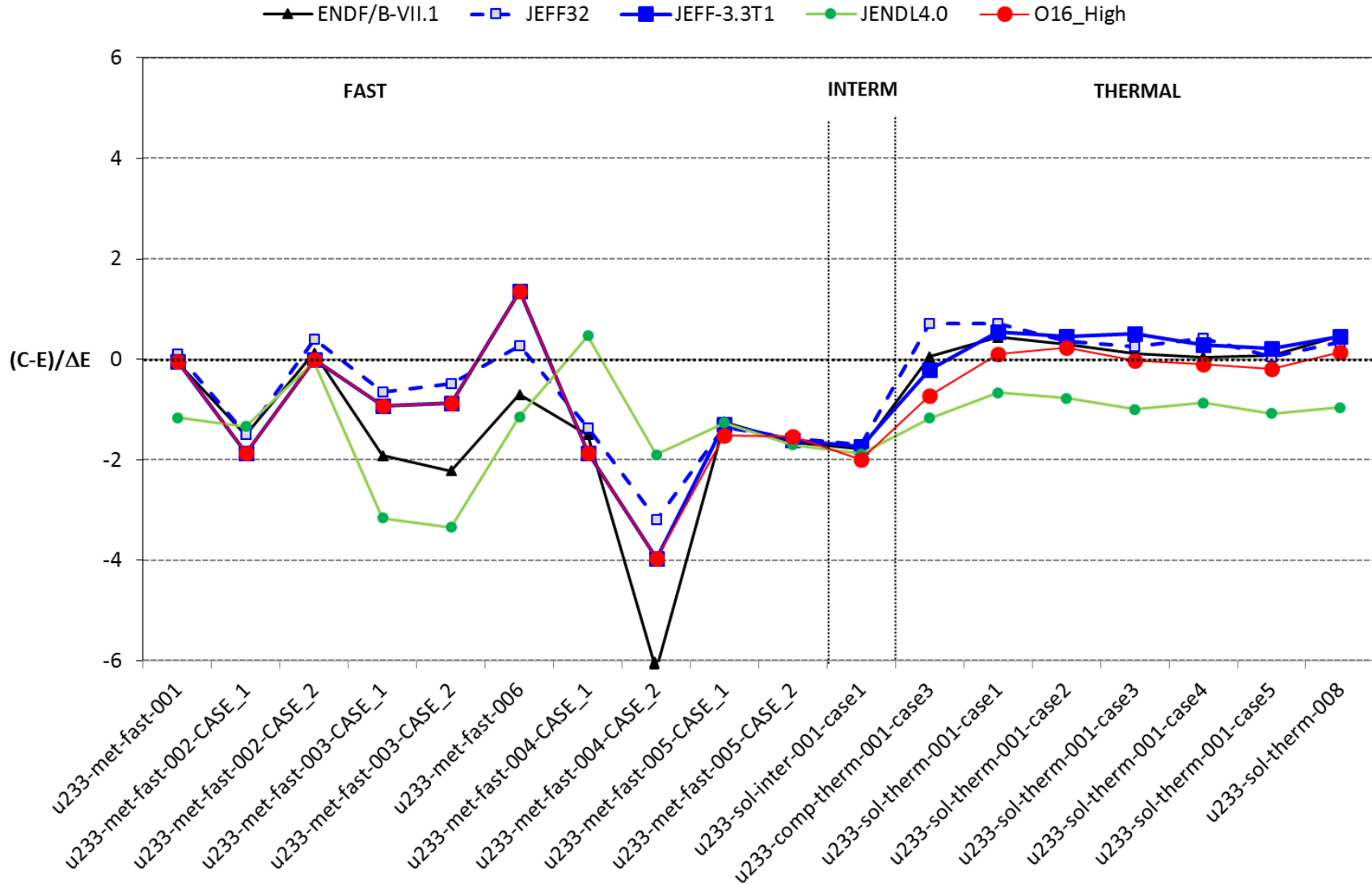




PU







Completely new evaluations

- New FILE 2,
- New softer prompt fission neutron spectra, with new prompt neutron multiplicity,
- New OMP parameters,
- New elastic and inelastic cross sections,
- Fission cross section from IAEA standards, but close to the BRC model calculations.
- Covariances (COMAC or T6).

Benchmarks

^{239}Pu benchmarks and $^{235,238}\text{U}$ benchmarks : results obtained with JEFF-3.3T1 are at least as good as with JEFF-3.2.

What to expect from an evaluated file?

Perspective of the user

- Best available knowledge of nuclear data for his application
 - Can be from models or from experiment
 - Evaluators' task to judge which should prevail!
- A mix of contributing sources is inevitable
 - Whether model or experiment
 - Which model
 - Energy ranges
- We must master assembling files from different sources
 - Difficult (I messed up Cr-52 in 3.3T0 'automatically')
 - Absolutely necessary or we destroy precious efforts!
 - Automation is the future, but must mature further.
- Checking is absolutely essential
 - Not nearly as automated yet.
 - Coarse comparison plots are dangerous
 - Human intervention still proves indispensable

JEFF for MYRRHA?

Comments for fast range, total cross section

CHANDA assessment: JENDL-4.0 better

See Stefan Kopecky for resonance range

JEFF-3.3T1 =
TENDL2015 +
INL-modifications
Plompen

Bi-209

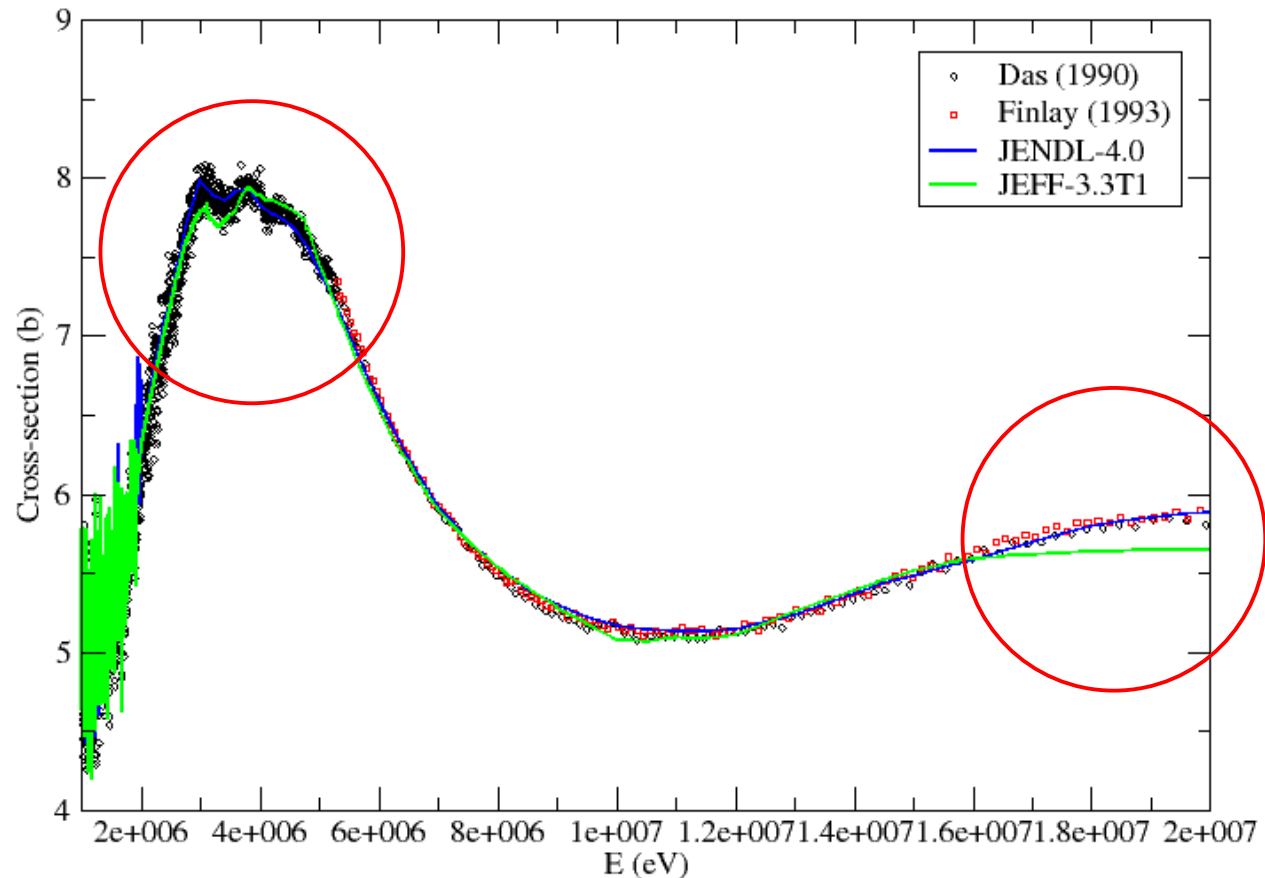


Fig. Pablo Romojaro, CHANDA WP-10

JEFF for MYRRHA?

Comments for fast range, total cross section

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JEFF-3.3T1 =
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Plompen

Pb-208

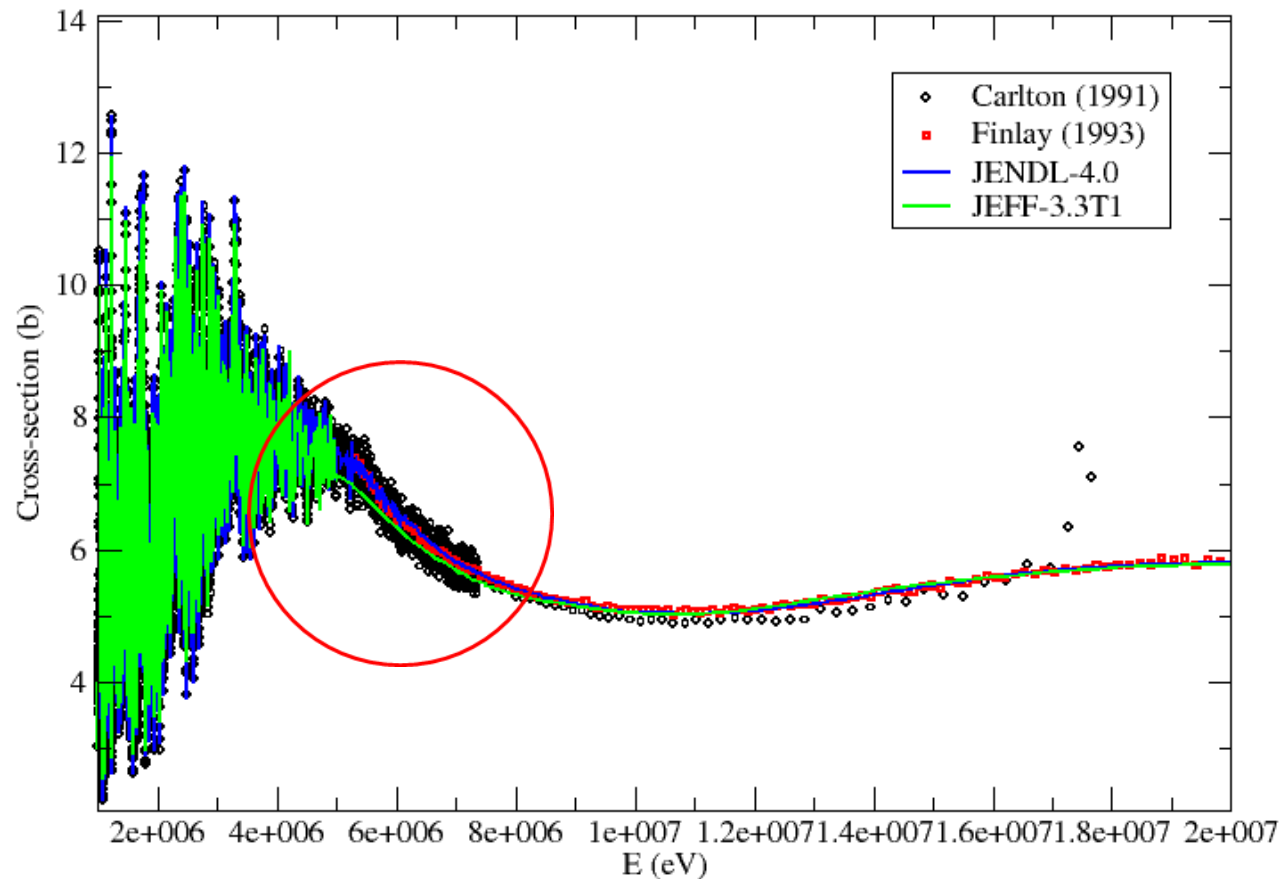


Fig. Pablo Romojaro, CHANDA WP-10

JEFF for MYRRHA?

Comments for fast range, total cross section

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Same as JENDL-4

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for resonance range

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Plompen

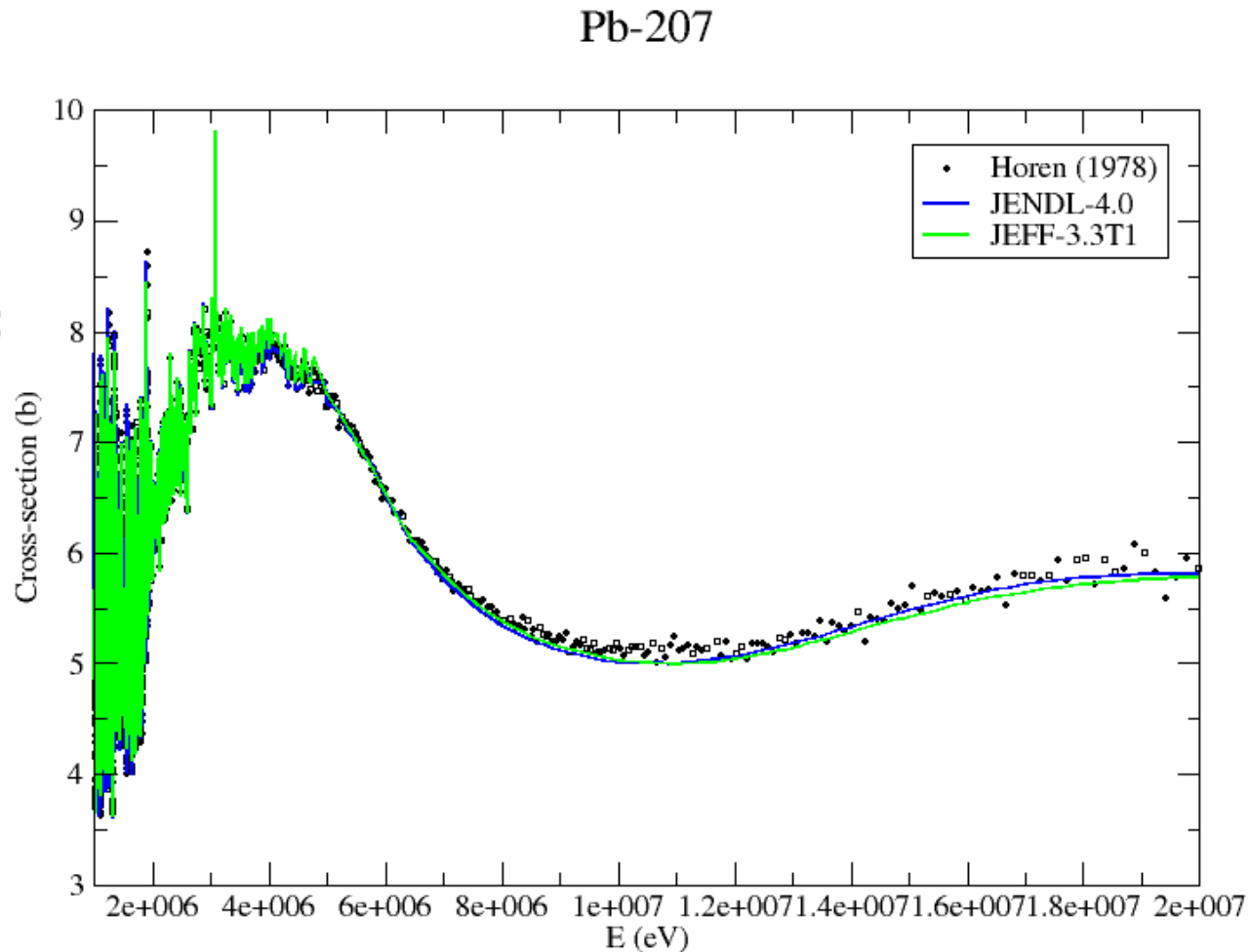


Fig. Pablo Romojaro, CHANDA WP-10

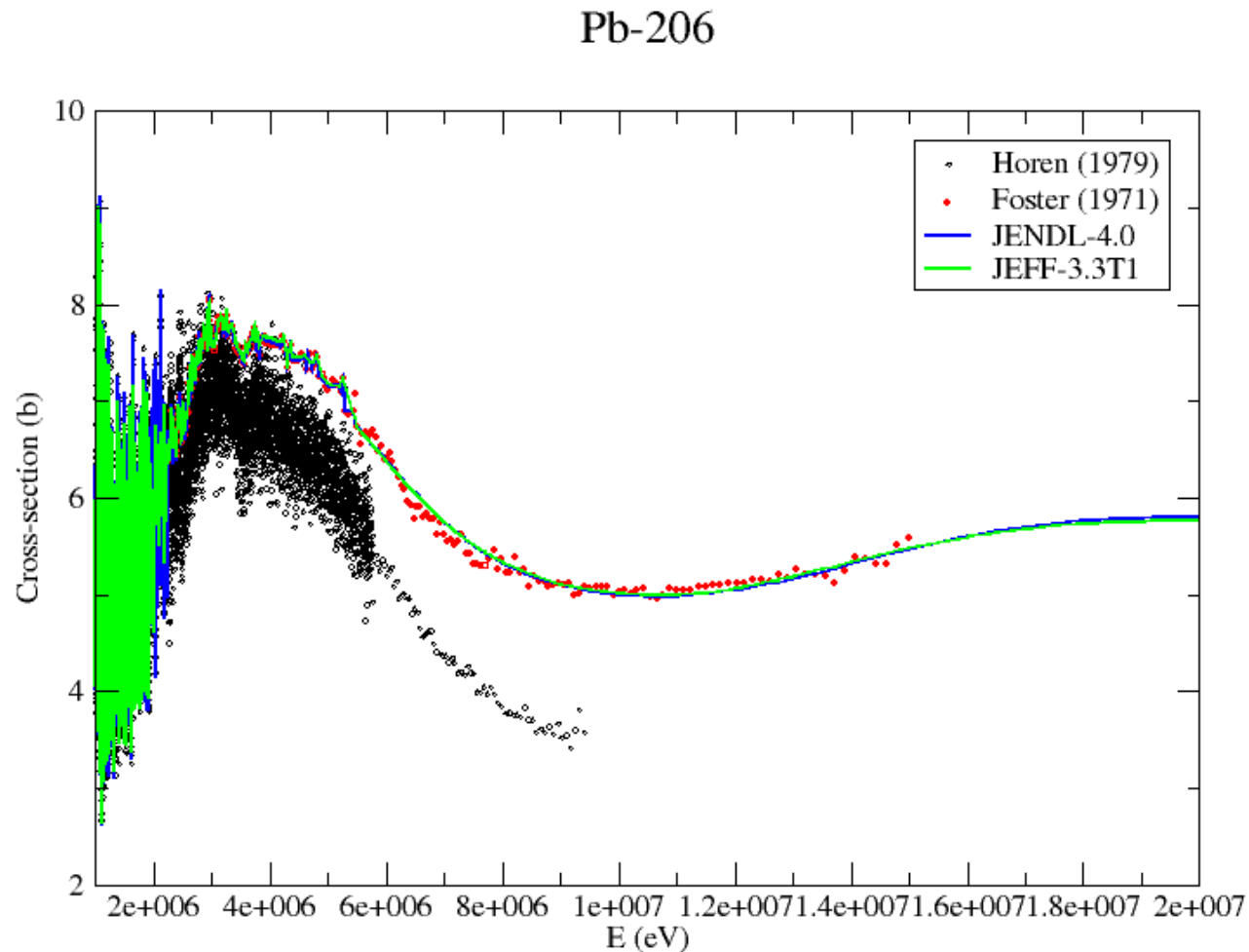
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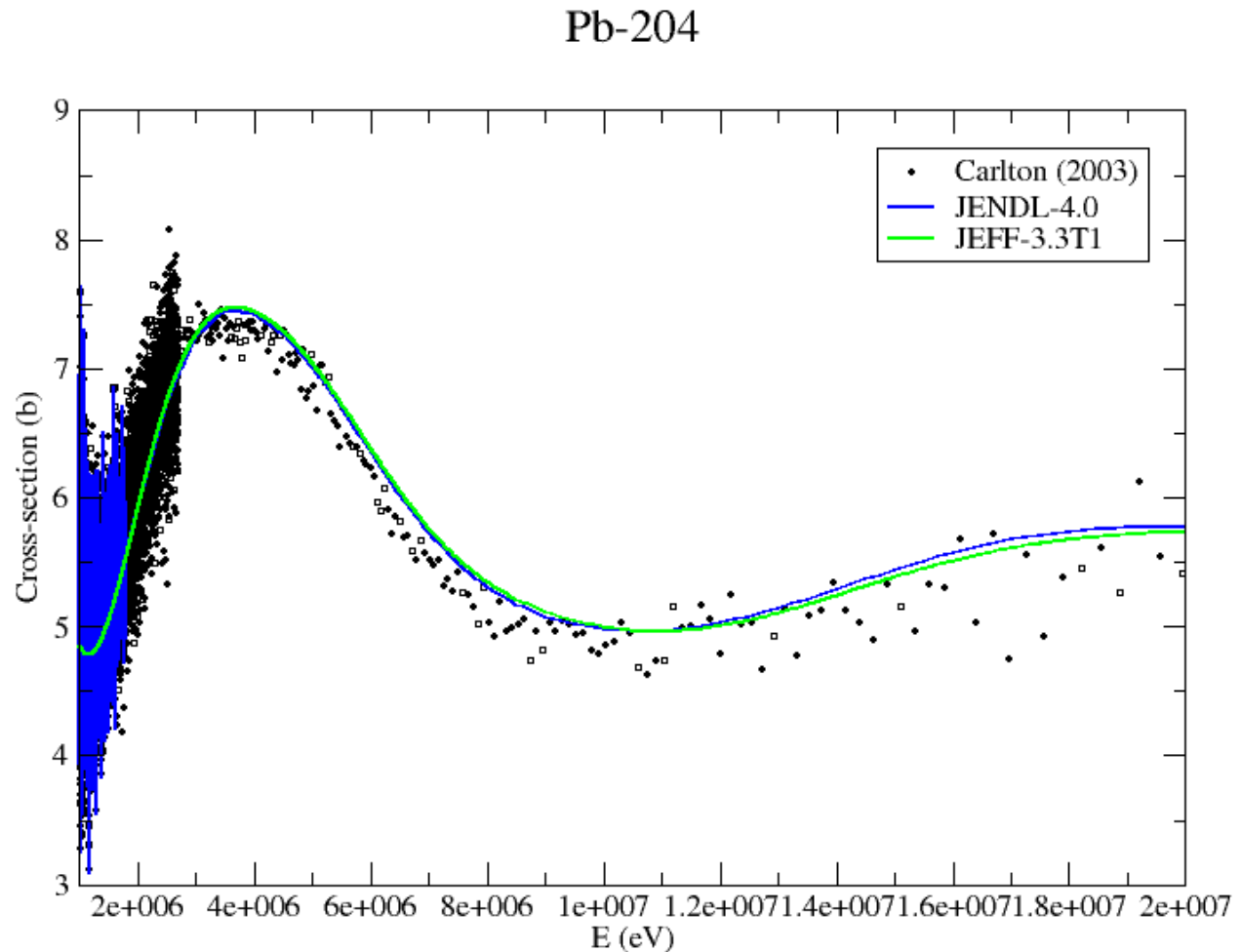


Fig. Pablo Romojaro, CHANDA WP-10

Summary

- *Test file out since 1 March 2016 (JEFF-3.3T1)*
 - Many changes*
 - New U-235 and U-238 files*
 - 'Legacy-files' replaced*
- *Processing since 1 March 2016*
 - Eastern*
 - Feedback and exchange of inputs (see later)*
- *Benchmarking*
 - With and without final agreed processing*
- *Status to become clear in the coming days*
- *JEFF-3.3T2 contents to crystalize from discussions*