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# Comparison of adjustment trends with the Cielo evaluation

NEA Nuclear Data Week, WPEC/SG-39

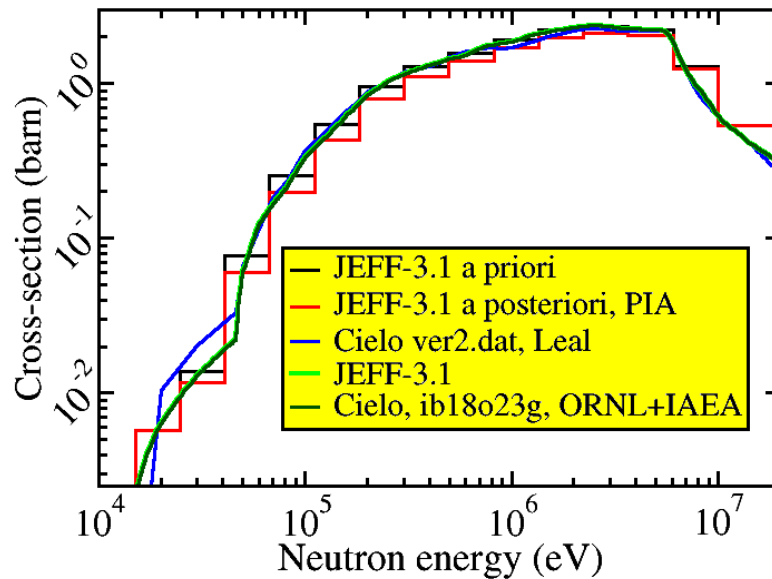
## This study:

- Data assimilation: 4 configurations + 14 integral experiments.
- 10 nuclides considered in adjustment:  
 $^{16}\text{O}$ ,  $^{23}\text{Na}$ ,  $^{52}\text{Cr}$ ,  $^{56}\text{Fe}$ ,  $^{58}\text{Ni}$ ,  $^{235}\text{U}$ ,  $^{238}\text{U}$ ,  $^{239}\text{Pu}$ ,  $^{240}\text{Pu}$ ,  $^{241}\text{Pu}$ .
- 33 group JEFF-3.1 a priori cross-sections (ECCO: ERANOS-2.2-N)  
+  
33 group a priori COMMARA-2.0 based variance/covariance data.

| Configuration | Integral parameters                                                               |                     |
|---------------|-----------------------------------------------------------------------------------|---------------------|
| GODIVA        | $F28/F25, F49/F25, F37/F25$                                                       | } At core<br>center |
| JEZEBEL-Pu239 | $F28/F25, F49/F25, F37/F25$                                                       |                     |
| ZPR6-7        | $F28/F25, F49/F25, C28/F25$                                                       |                     |
| ZPPR9         | $F28/F25, F49/F25, C28/F25,$<br>Na Void -Step 3, -Step 5: coolant density effects |                     |

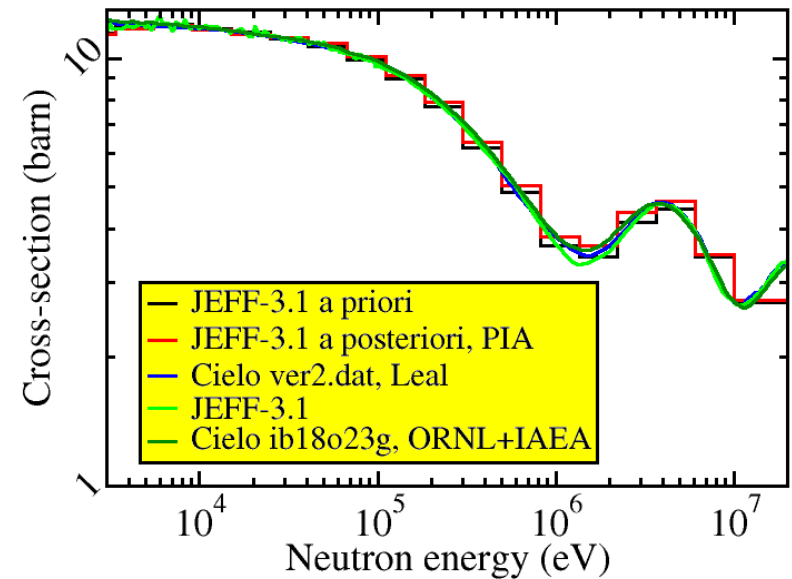
- PIA sequence, steps according to table:  
 GODIVA spectral indices → ZPPR9 coolant density effects →  
 ZPPR9 spectral indices → ZPR6-7 spectral indices →  
 JEZEBEL-Pu239 spectral indices.
- Asymptotic GLLS methodology.

U235 (n,inelastic) adjustment



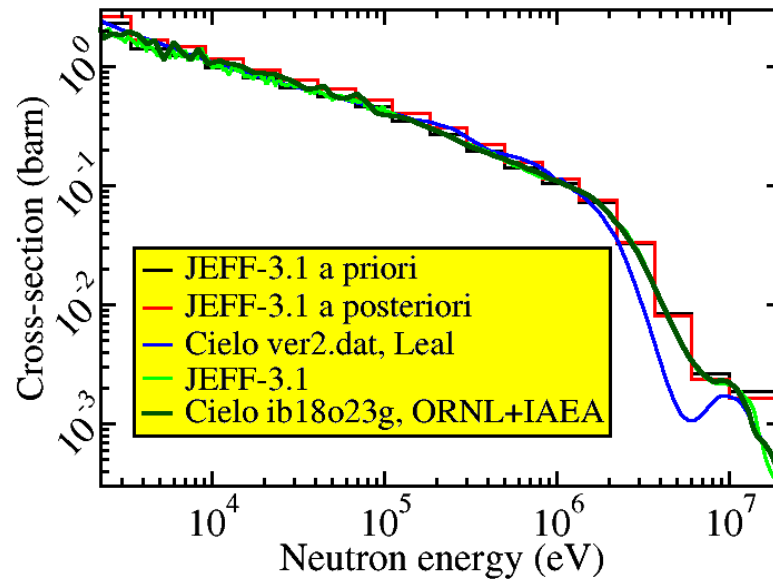
The adjustment reproduces the data from Cielo ver2.dat, Leal around 1MeV.

U235 (n,elastic) adjustment



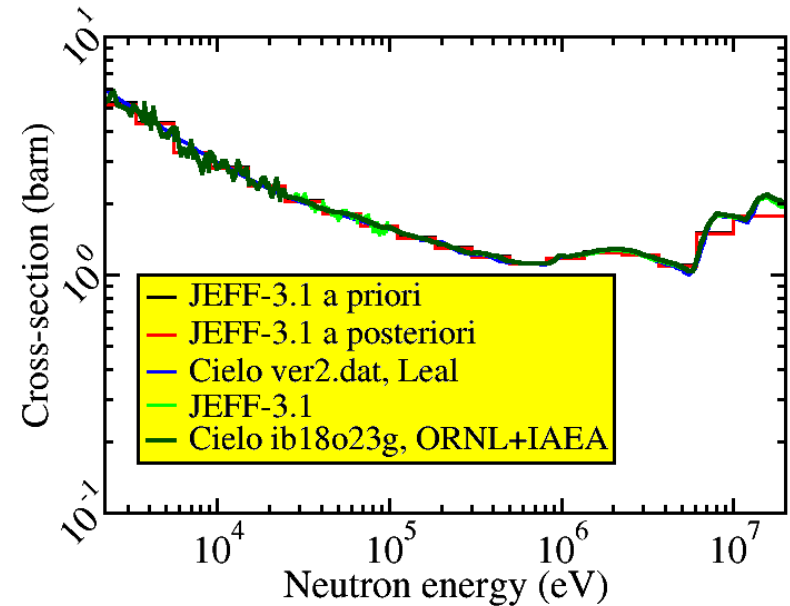
The adjustment reproduces the data from Cielo which is higher than JEFF-3.1 from 100keV to a few MeV.

U235 (n,capture) adjustment



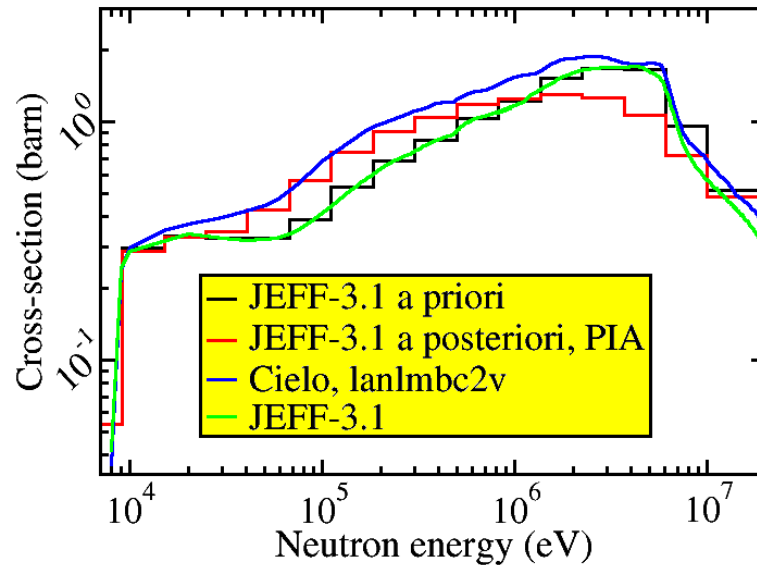
- The adjustment trend between 100keV and 1MeV is consistent with the difference between Cielo ver2.dat, Leal and JEFF-3.1.

U235 (n,fission) adjustment

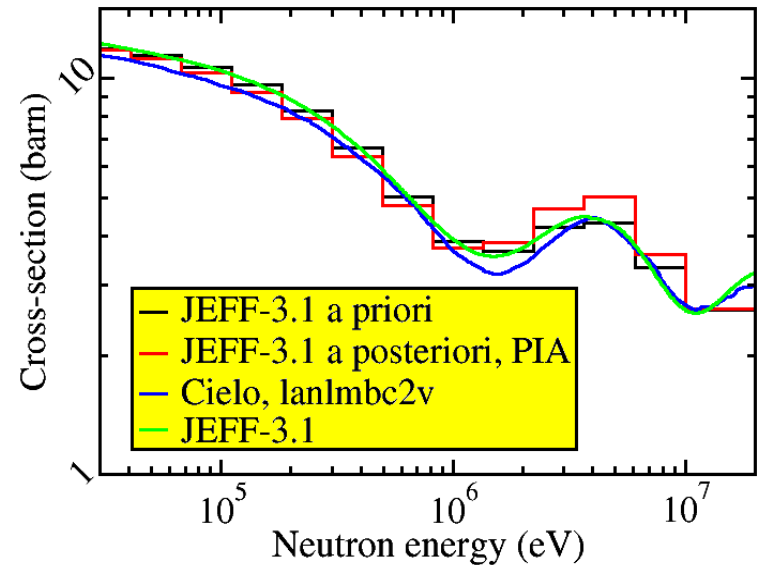


- A just small adjustment of this cross-section seems consistent with the fact that Cielo and JEFF-3.1 look similar.

Pu239 (n,inelastic) adjustment

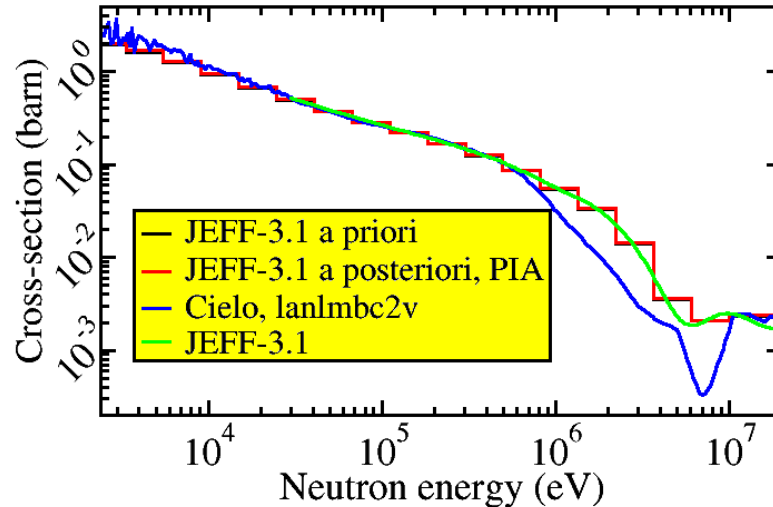


Pu239 (n,elastic) adjustment

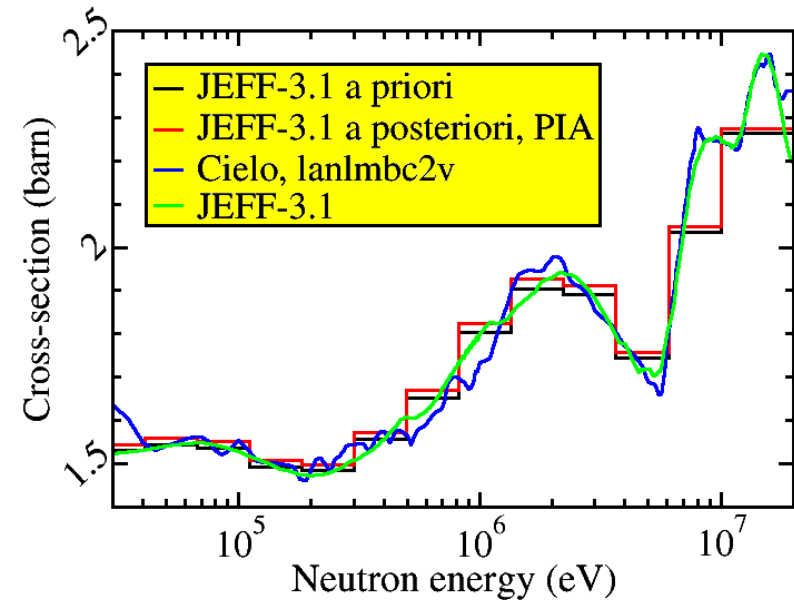


- The adjustment tends reproducing Cielo for  $E < 1\text{MeV}$ .
- Fission spectrum adjustment likely needed for higher energies.

Pu239 (n,capture) adjustment



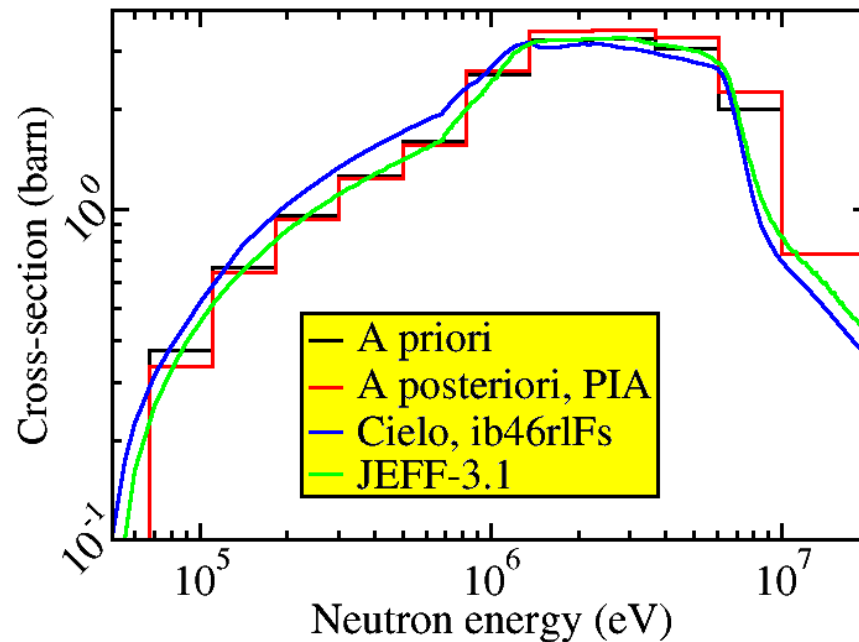
Pu239 (n,fission) adjustment



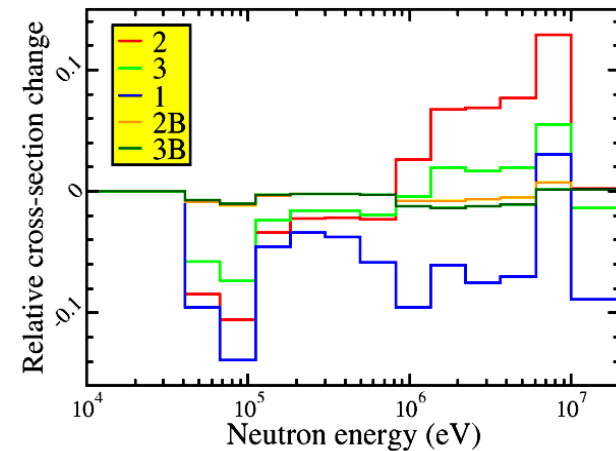
- The adjustment is too weak as regards the difference between Cielo and JEFF-3.1.
- Additional integral parameters needed.
- The adjustment trend is mostly consistent with the difference between Cielo and JEFF-3.1.

Example for  $^{238}\text{U}$ 

## U238 (n,inelastic) adjustment



## U238 (n,inelastic) adjustment



PIA sequence  
dependency

- The current adjustment for this isotope judged unreliable does consistently not reproduce Cielo.

- Fast reactor, one-zone core:  $\text{PuO}_2\text{-UO}_2$  fuel reflected by depleted U.
  - SNEAK 7A: 26.6%  $\text{PuO}_2$  in  $\text{PuO}_2\text{-UO}_2$ , 8% Pu240, + graphite platelets.
  - SNEAK 7B: graphite replaced by natural  $\text{UO}_2$ , less Pu, 13% in U + Pu  
→ spectrum hardening.

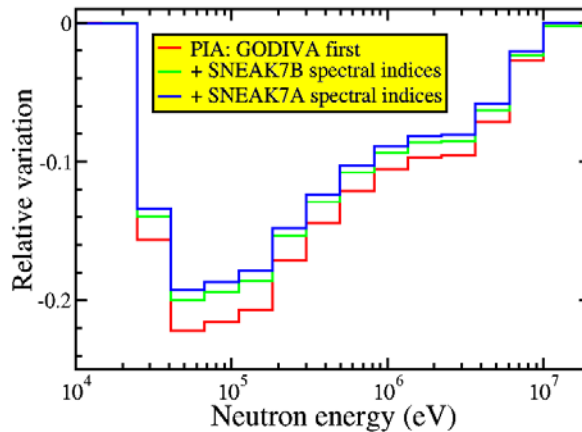
| Configuration | Integral parameters, core center |
|---------------|----------------------------------|
| SNEAK 7A, 7B  | <i>F28/F25, F49/F25, C28/F25</i> |

PIA sequence:

GODIVA spectral indices → ZPPR9 coolant density effects →  
 ZPPR9 spectral indices → ZPR6-7 spectral indices →  
 JEZEBEL-Pu239 spectral indices →  
 SNEAK 7B spectral indices → SNEAK 7A spectral indices.

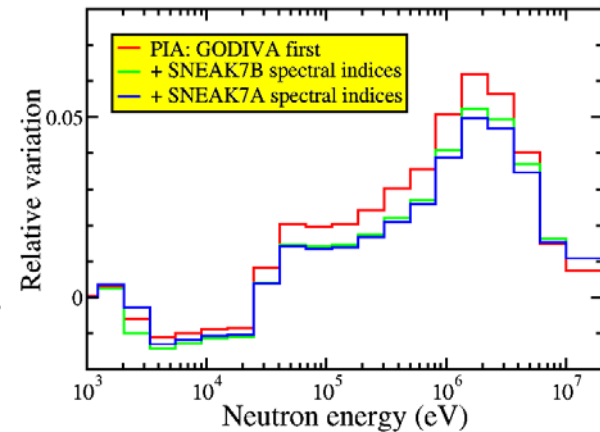
# $^{235}\text{U}$ : Relative xs variations as regards a priori values

U235 (n,inelastic) adjustment

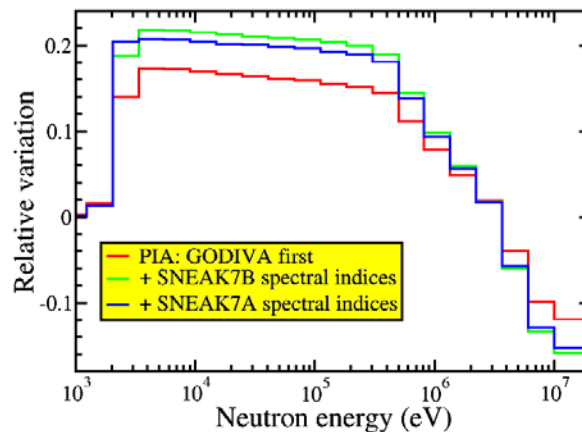


SNEAK 7A:  
largely  
redundant  
for  
adjustment.

U235 (n,elastic) adjustment

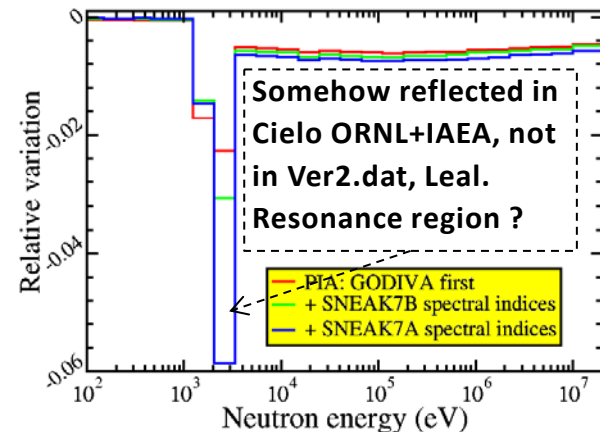


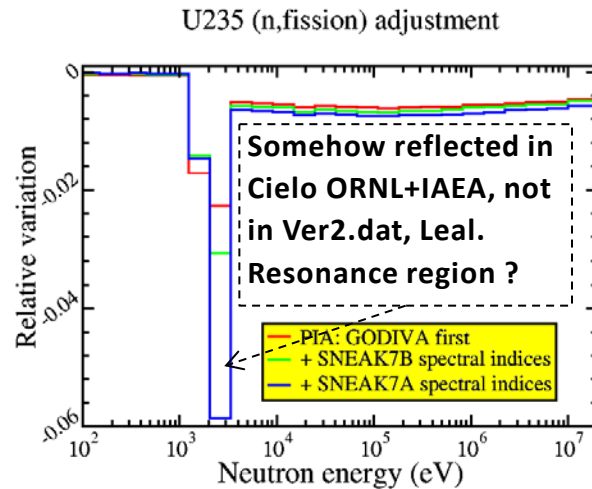
U235 (n,capture) adjustment



Capture xs  
trend  
stronger,  
SNEAK 7B.

U235 (n,fission) adjustment



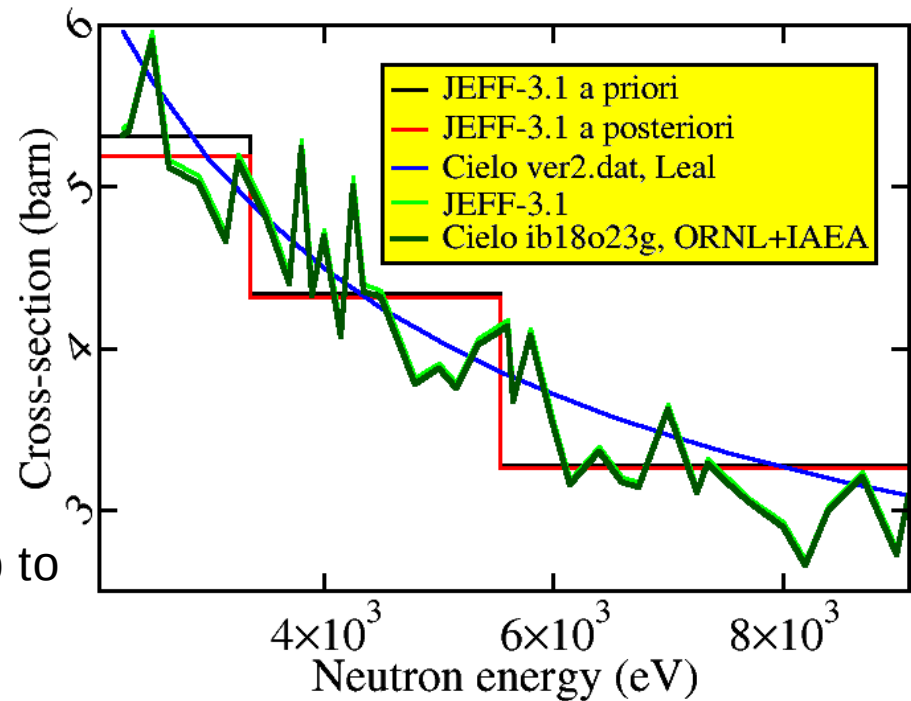


Resolved resonance region up to 2.25keV.

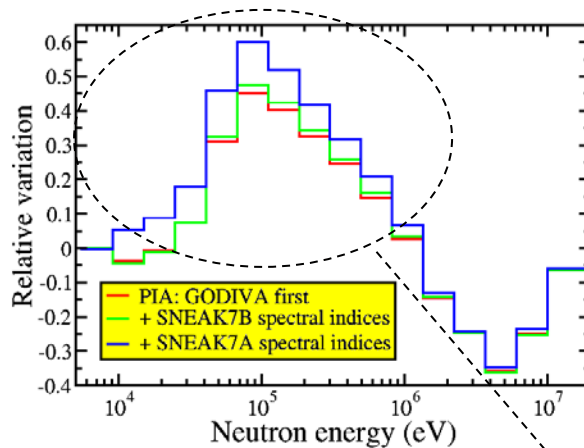
UR:

- Ver2.dat, Leal: 2.25 – 46.2keV.
- JEFF-3.1, ORNL+IAEA:  
2.25 – 25keV.

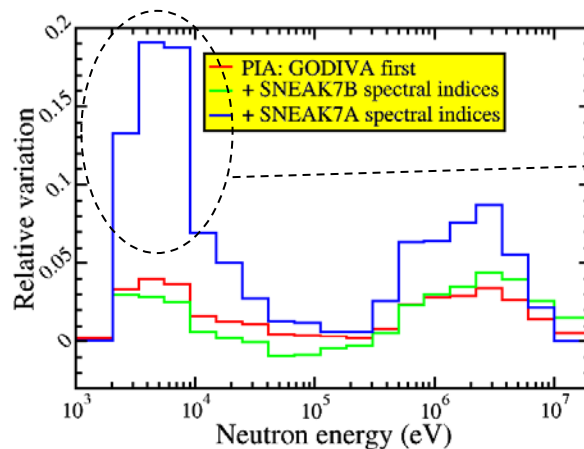
## U235 (n,fission) adjustment



Pu239 (n,inelastic) adjustment



Pu239 (n,capture) adjustment

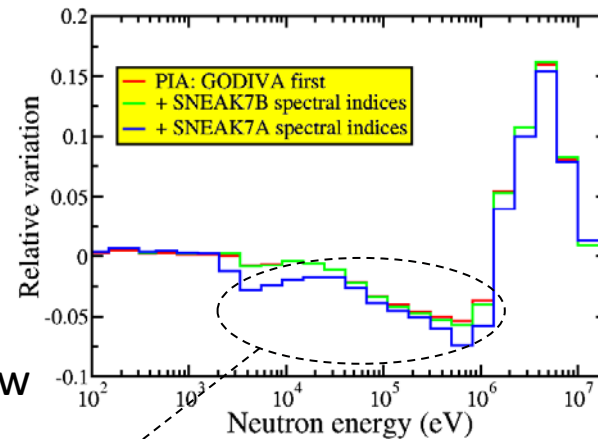


Scattering

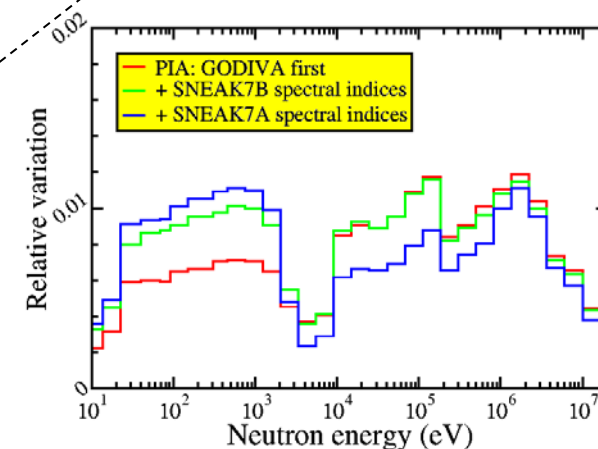
+

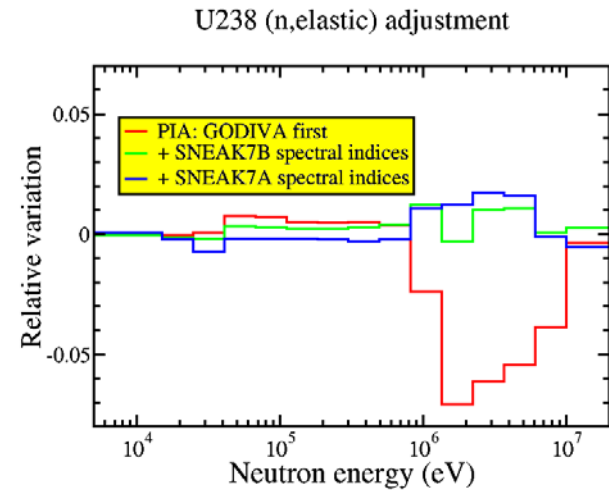
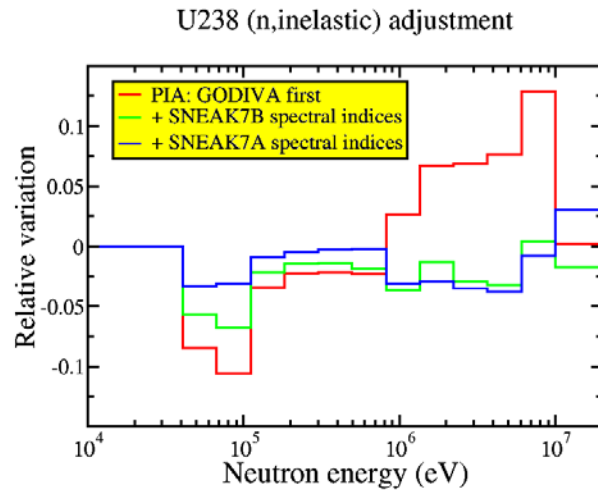
capture xs  
trends below  
10keVenhanced,  
SNEAK 7A:Bring these  
xs further  
closer to  
Cielo.

Pu239 (n,elastic) adjustment



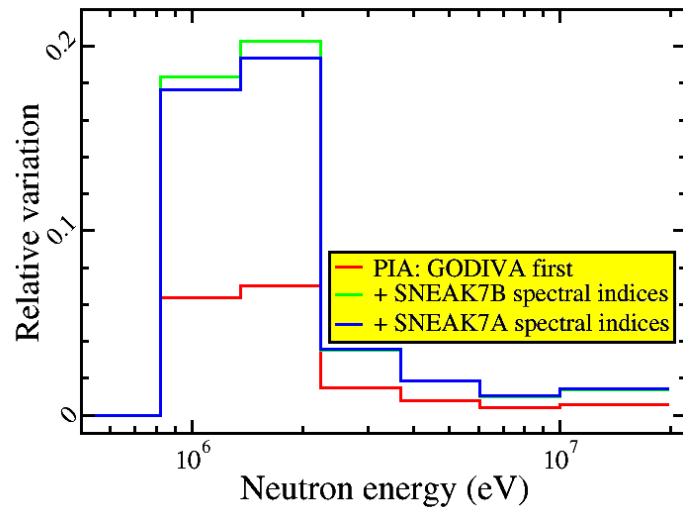
Pu239 (n,fission) adjustment



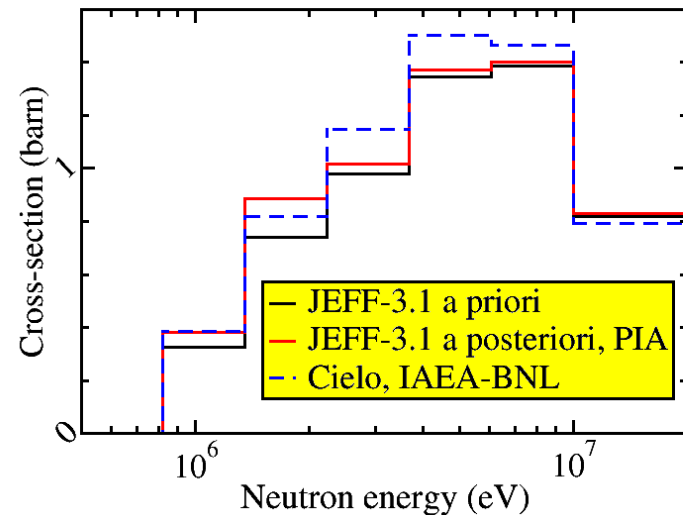


- Despite non reliable adjustment: final result almost no adjustment, SNEAK 7A spectral indices assimilation more or less redundant.

Fe56 (n,inelastic) adjustment



Fe56 (n,inelastic) adjustment



- Right Figure: Cielo processed into multi-group data, NJOY.
- Adjustment of inelastic scattering with respect to JEFF-3.1 (consistent): Predicts cross-section increase  $\rightarrow$  rather consistent with Cielo. Additional experiments may be useful to fill the remaining gap.

- Reaction rate traverses: their assimilation does not modify these results: a priori  $C/E_s$  already more or less within the experimental error.
- Central reactivity worth, assimilation inconsistent: Strong increase of several COMMARA-2.0 standard deviations of the fast capture cross-section of Oxygen,  $(n,\alpha)$  reaction: likely the unwished result of additional model uncertainties not accounted for e.g.  $\beta_{\text{eff}}$ .