

WPEC Subgroup 40 (CIELO)
May 2015

U235 Items

C. R. Lubitz

#1 Agree on one or more ***defined collections*** of integral benchmarks

- Agreement between calculated eigenvalues and the integral benchmarks is an objective measure of their ***utility*** (not accuracy).
- That agreement ***and particularly the trends*** with leakage and absorption, depend on what benchmarks we compare to, so we all need to be using the same collections.

#2 Require that all changes to existing cross sections, not only U235, be accompanied by a ***trend analysis*** of the ***absorption rates*** and ***leakage***.

- Why? Because It's ***easy*** to fix problems with the overall reactivity, $\langle K_{eff} \rangle$. The simplest is to replace a "high-reactivity" isotopic cross section set with a "lower-reactivity" version (or vice versa).
- Unfortunately, it is ***difficult*** to do that without introducing ***trends***.

#3-1 Why are ENDF/B-VII.1 U235 and U238 so hard to modify without introducing trends?

- ***An hypothesis:*** ENDF71 U235 and U238 are not "correct", but after 8 years of work at KAPL, ORNL, LANL, CEA, Harwell, SG18, and SG22, they correctly calculate the results of a large number of experiments and agree with the low-energy thermal cross sections and resonance integrals.
- This means that they are ***internally consistent*** in a way that makes them agree with these different quantities.

#3-2 Why are ENDF/B-VII.1 U235 and U238 so hard to modify without introducing trends?

- That consistency is **relative** to a specific set of other materials and a specific set of benchmarks. Significant changes to either of those or to the U5 and U8 themselves will usually **degrade** their performance.
- Trends with leakage and absorption will result in a departure of $\langle K_{eff} \rangle$ C/E from 1.0.
- Examples are the Trkov G6PFNS and the new O16 files, but there are other mods being worked on whose trends also need to be examined.

#4 Recommendation

- It seems reasonable to require that **every** isotopic evaluation in CIELO be trend-free before it is considered as a candidate for the "mix and match" effort to keep the benchmark $\langle K_{eff} \rangle$ C/E equal to 1.0.
- We should not rely on "canceling trends".

#5-1 Kahler's recent leakage trends

- ENDF71 $k = 1.0007(32) - 0.0010(85)*ATLF$
- K_{eff} is close to 1.0 and there is a negligible trend with leakage.
- That did not "just happen".
- It took two years to make ENDF/B-VI.3 U235; four years in SG18 to make ENDF/B-VI.5 U235; and two years in SG22 to make ENDF/B-VII.0 U238.

#5-2 Kahler's recent leakage trends

- E71+G6PFNS $k = 1.0010 + \mathbf{0.0073} * \text{ATLF}$
- Softening the spectrum to which E71 U235 was adjusted *degrades the adjustment*.
- We will need to remove that trend.
- E71+G6PFNS+Hale O16 $k = 1.0004 + \mathbf{0.0051} * \text{ATLF}$
- "Pairing" the "up-trend" U235 with the "down-trend" Hale O16 looks attractive, but is not. They need to be individually trend-free.

#6 Removing trends

- There are two ways to make U235 trend-free again.
- The standard way is to find experimental or theoretical support for altered reaction cross sections. E.g., Trkov has suggested a new inelastic cross section.
- The other way is through targeted adjustment, with or without sensitivities. The rationale for that is that the hypothesized ***internal consistency*** of ENDF71 U235 is robust enough to withstand a collection of small tweaks. If true, it will be much easier than the standard method.

Thank you
We are very far from

THE END

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Agree on one or more *defined collections* of
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- Agreement between calculated eigenvalues and integral benchmarks depends on the benchmarks we compare to so we should all use the *same* collections.

Include a ***trend analysis*** of the ***absorption rates*** and ***leakage*** with proposed changes to existing cross sections.

- The isotopic absorption rates tell us if the isotope itself is trend-free.
- The leakage trend tells us how well the unknown errors in the data set have fortuitously canceled and is sensitive to the angular distributions..

Thank you
We are very far from

THE END