LANL Data Testing

A. C. (Skip) Kahler *et al*

Los Alamos National Laboratory

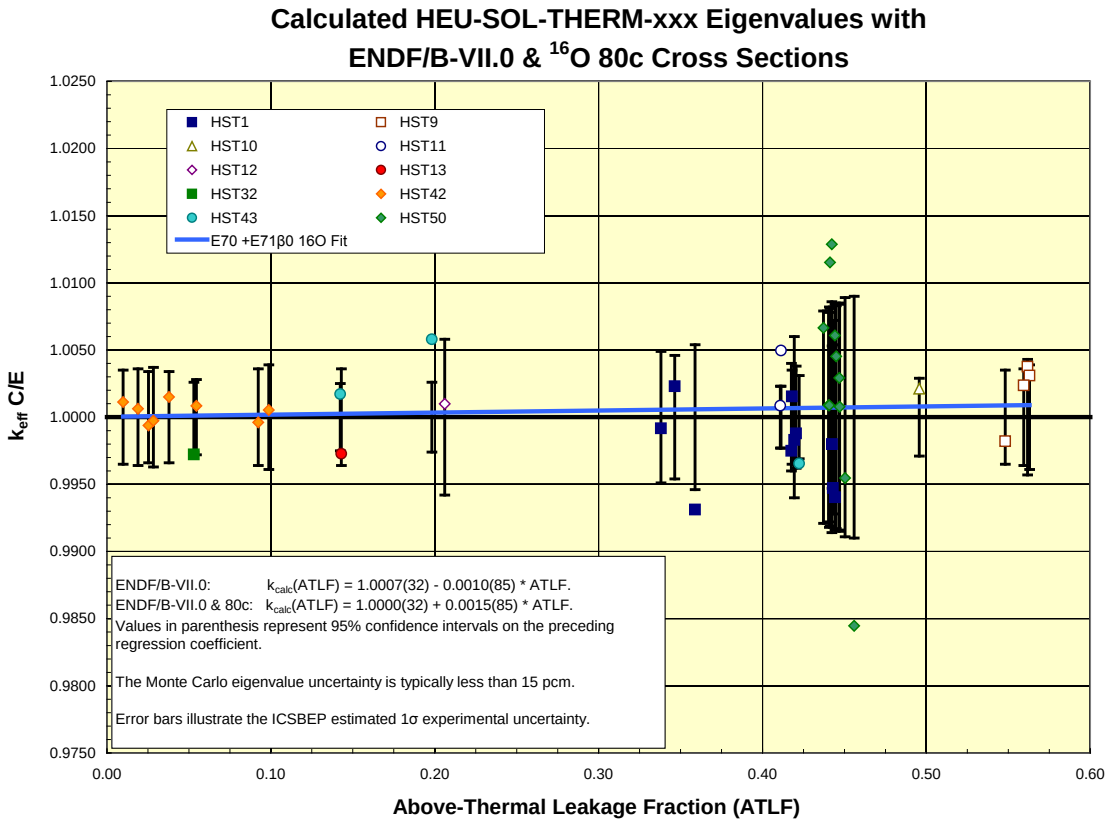
CSEWG Meeting

November 2010

Introduction

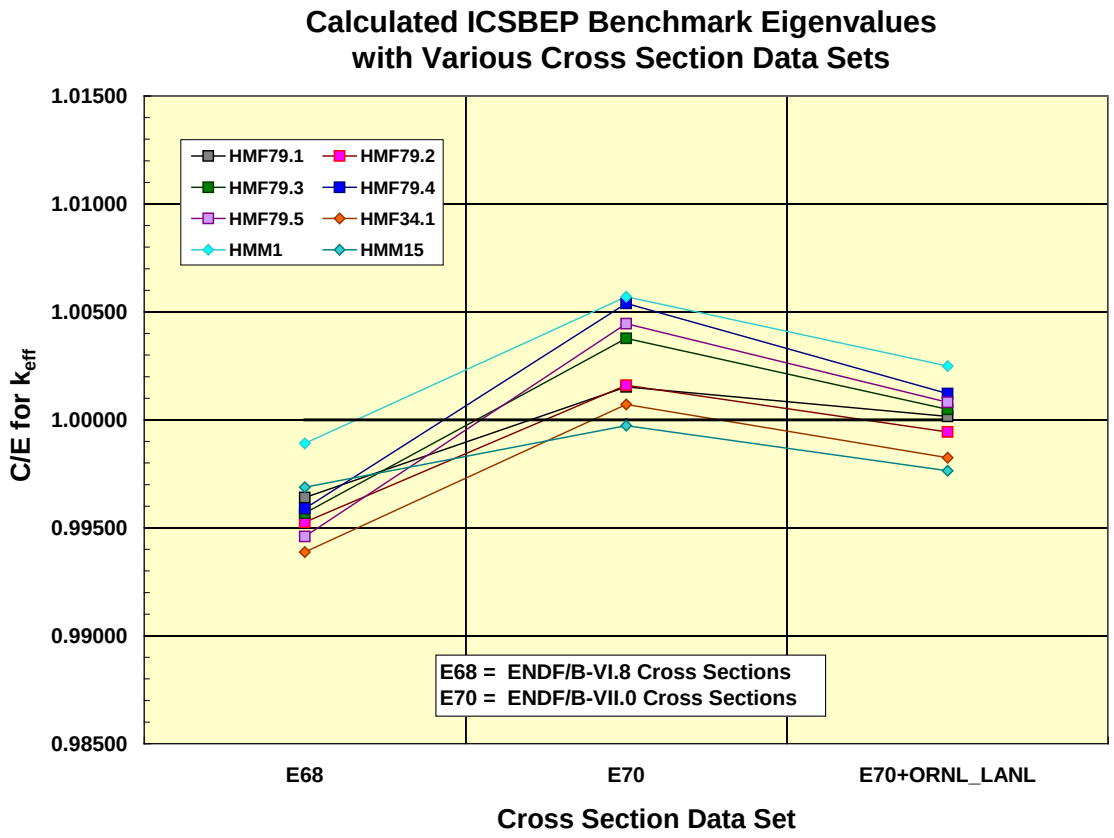
- **ENDF/B-VII.1β0 created last week.**
  - Limited new testing to date
    - ^{16}O (Hale)
    - ^{iso}Ti (ORNL/LANL)
    - ^{iso}W (IAEA; includes ^{180}W)
- **Actinides (^{236,237}U, ^{237}Np, ^{240}Pu, ^{241}Am)**
  - Improved reaction rate ratios observed in various LANL assemblies (Godiva, Flattop, Big-10).
    - See November, 2009 and June, 2010 presentations.

Data Testing: E71β0 ^{16}O



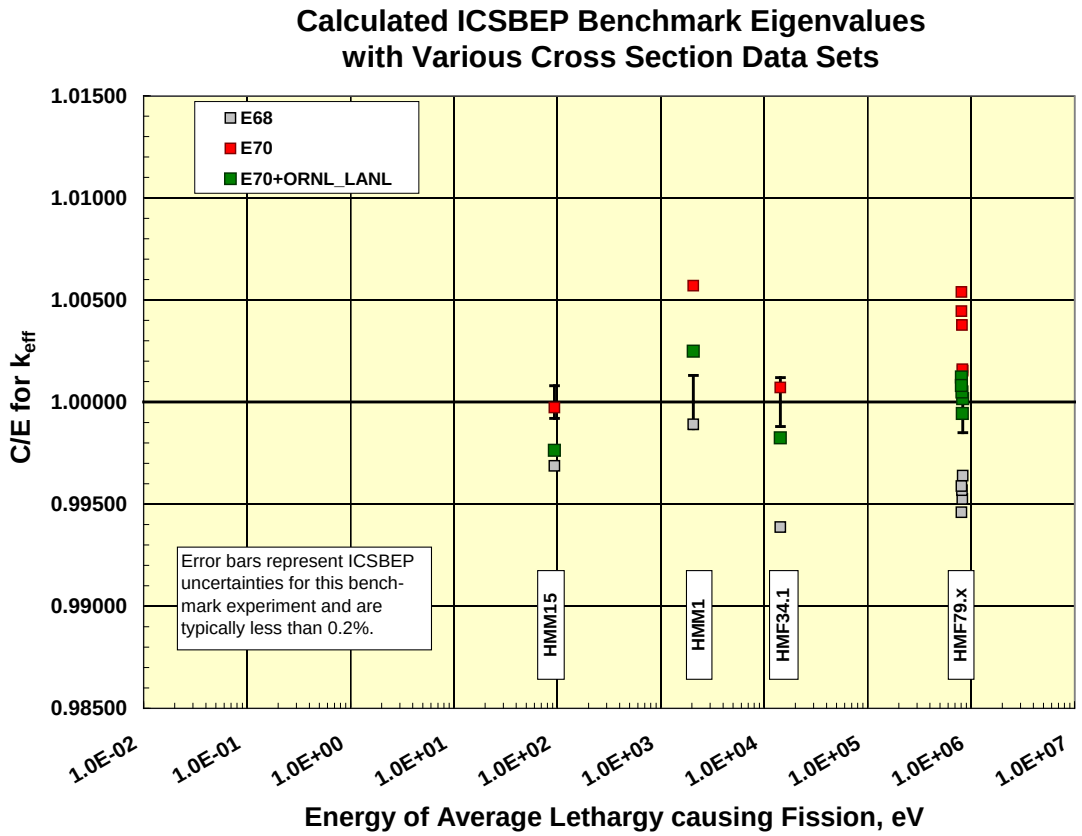
- **Small improvement in regression intercept**
- **Small decrement in regression slope.**
- **Both intercept and slope were, and remain, statistically equal to unity and zero respectively.**

Data Testing: Ti Benchmarks



- **ENDF/B-VII.0 based eigenvalues are less accurate than those obtained with ENDF/B-VI.8.**
- **Revised ORNL/LANL Ti isotopic data sets eliminate much of this deficiency.**

Data Testing: Ti Benchmarks



- **Calculated eigenvalues show no trend with average energy.**

Data Testing: W Benchmarks

- **Isotopic W Evaluations from the IAEA**
  - Not neutronically important, but includes ^{180}W
  - Limited criticality testing to date
    - HMF3.8 to 3.11: 1.9” to 6.5” thick spherical reflector
    - PMF5: 1.85” thick spherical reflector
- **ENDF/B-VII.0 Calculated Eigenvalues are Too High**
  - HMF3.8 3.11 = 1.00841(9), 1.00930(9), 1.01262(9) and 1.01677(9)
  - PMF5 = 1.00923(9)
- **ENDF/B-VII.1β0 Calculated Eigenvalues are ~750 pcm Lower, but the Increasing Trend of k_{calc} with Increased Amounts of W Remains.**
  - HMF3.8 – 3.11 = 1.00124(9), 1.00174(9), 1.00519(9) and 1.00978(9)
  - PMF5 = 1.00068(9)
- **Additional W Benchmarks are now in the ICSBEP Handbook**

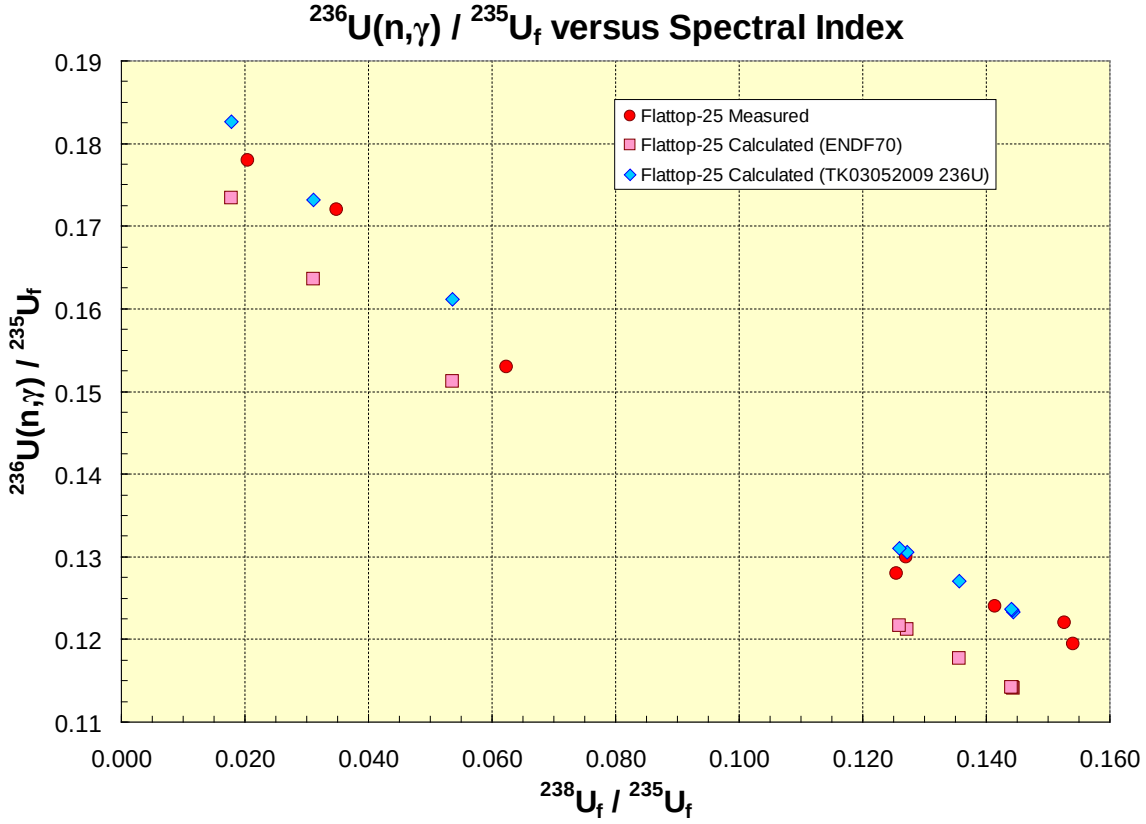
Future Data Testing Work

- **A topic for later this session**

Actinides

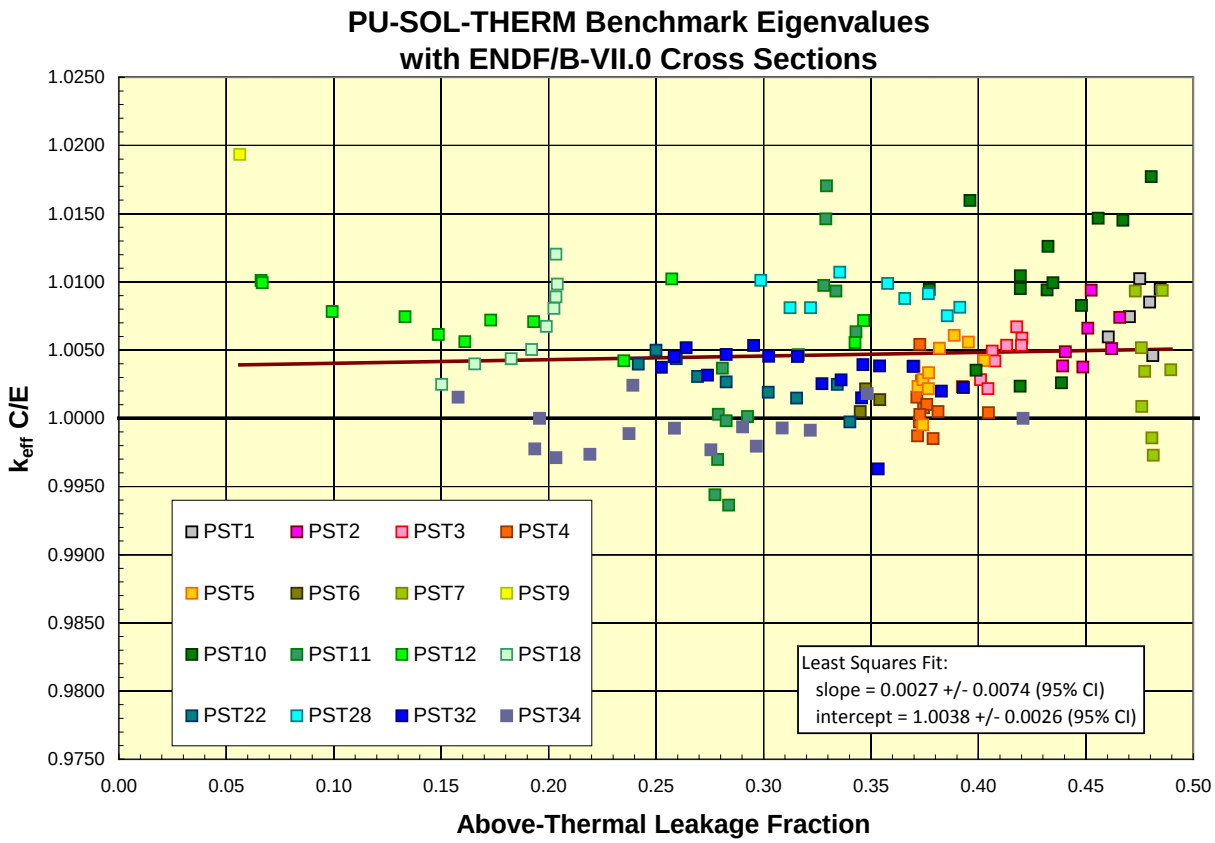
- **^{236,237}U, ^{237}Np, ^{240}Pu, ^{241}Am**
  - Changes to basic data.
    - ^{236}U: increased capture cross section above ~100 keV.
    - ^{237}U: adopt JENDL-3.3 resonance parameters and revise fission cross section below ~1 MeV.
    - ^{237}Np: revisions to (n,2n), particularly near threshold.
      - Good reaction rate agreement with unpublished Big-10 measurements.
    - ^{240}Pu: fission cross section revisions in the tens of keV to low MeV region.
    - ^{241}Am: small changes to fission and capture cross sections below 1 MeV.
  - Nuclear data changes are within the uncertainties in the underlying microscopic data, take advantage of new model calculations and experimental data and/or borrow from more modern evaluations.
  - Changes are also guided by comparison to critical assembly reaction rate ratio measurements.

Actinides



- Calculated ^{236}U capture is biased high with ENDF/B-VII.0
- Revised evaluation from TK has eliminated this bias.

^{239}Pu

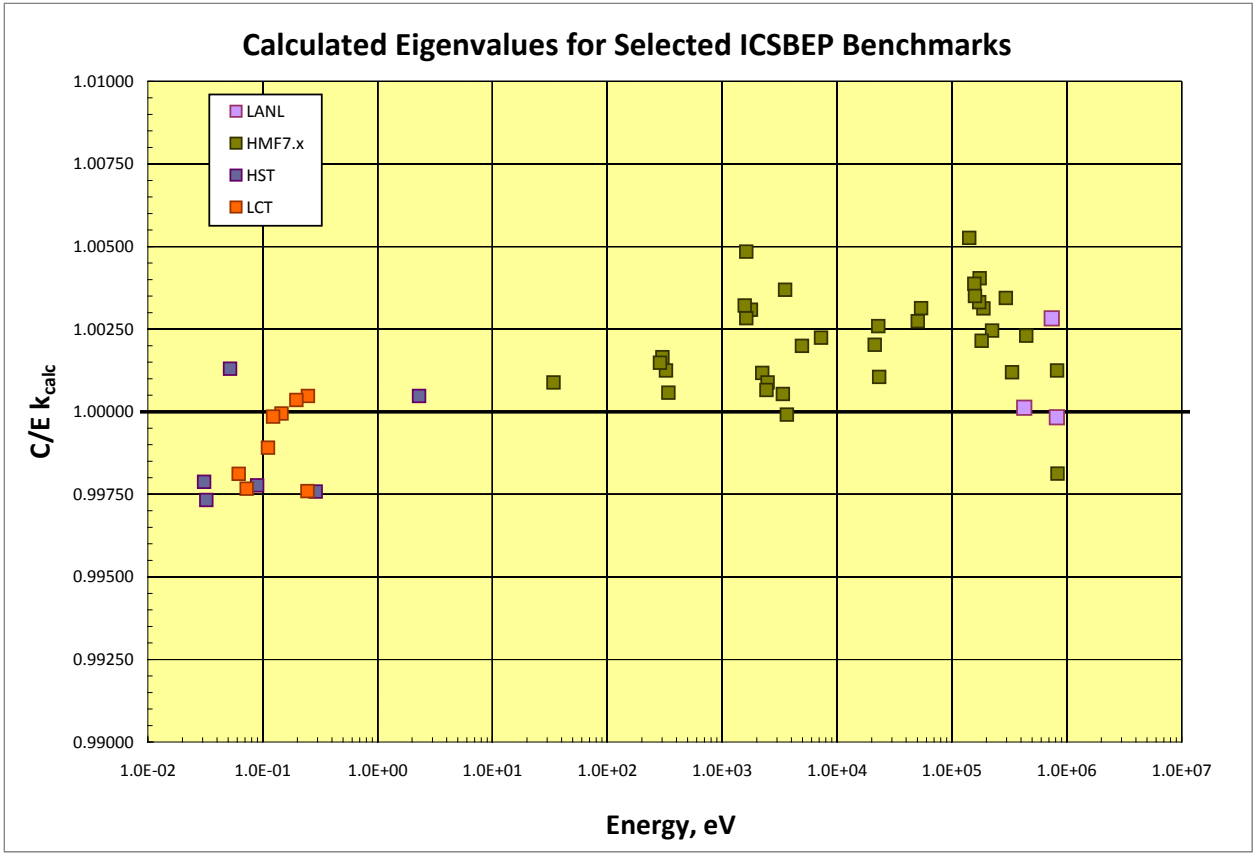


- Calculated ^{239}Pu thermal solution eigenvalues are biased high by ~500 pcm.
- Benchmark suite contains ~150 experimental configurations.
- No obvious trend (vs. ATLF in this figure).

^{239}Pu

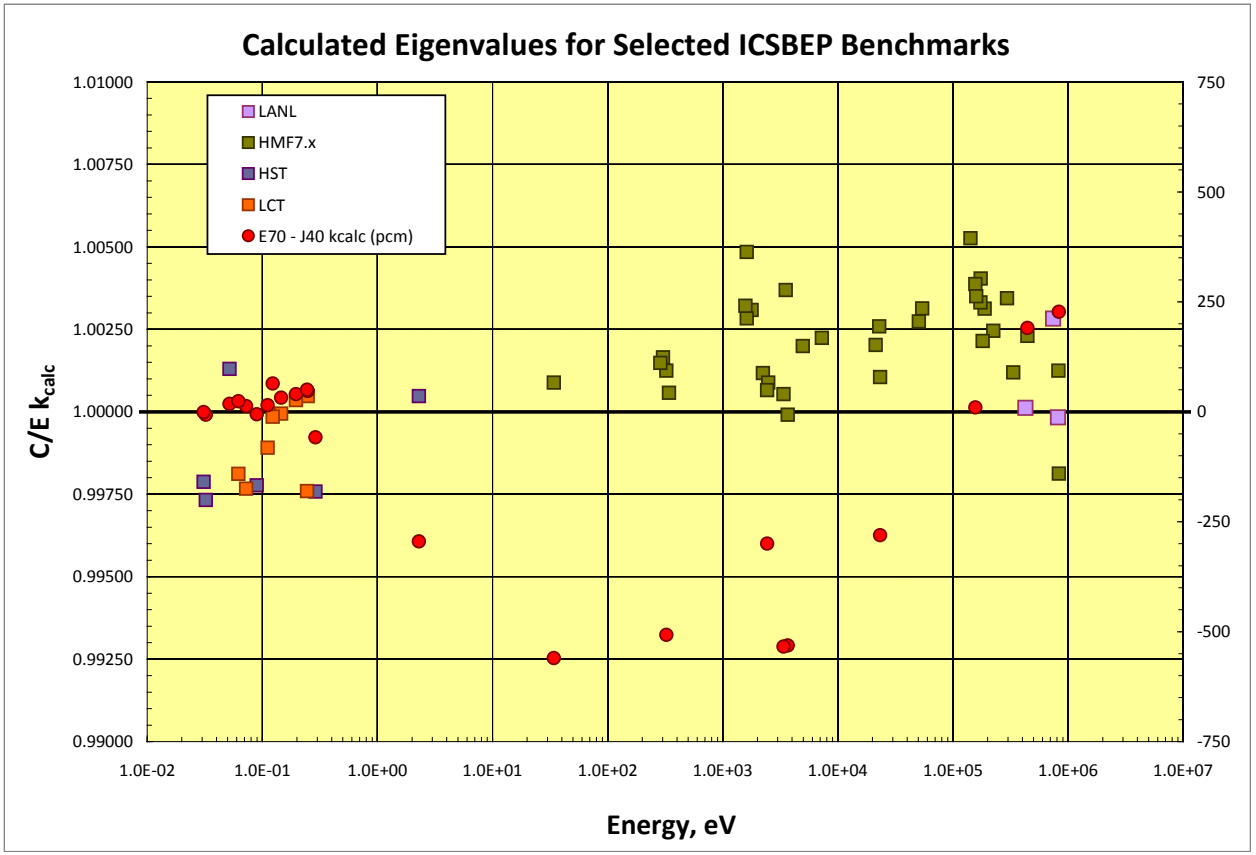
- **Data Testing methodology**
  - Select representative Pu solution benchmarks that span the parameter space
    - Parameters include:
      - Above-Thermal Leakage Fraction (ATLF)
      - Above-Thermal Fission Fraction (ATFF)
      - Atom Percent ^{239}Pu (a/o ^{239}Pu)
      - Grams Pu per liter (g/l)
  - Re-calculate eigenvalues for this subset of benchmarks with revised ^{239}Pu data sets.
    - Potential revisions include
      - Refined resolved resonance parameters (ORNL/Leal)
      - Revised prompt fission neutron spectrum (Maslov, Talou, refined Madland-Nix(?), …)
  - This work is at an early stage.
    - Initial result with latest Maslov spectrum seems to raise calculated eigenvalues.
    - Inclusion of Leal's latest RR parameters reduces the calculated eigenvalues to near unity (☺), but some indication of trends.
  - **Much more to do here!**

ENDF/B-VII.0 & JENDL-4.0 ^{235}U



- **A selection of Fast, Thermal and Intermediate Spectrum Benchmarks**
  - Godiva, Flattop-25, Big-10
  - HST's for min and max average energy
  - LCT-6 (Japan) & LCT-7 (France)
  - HMF7 (ORNL)

ENDF/B-VII.0 & JENDL-4.0 ^{235}U



- **Red Circles illustrate (E70 – J40) k_{calc} difference (scale given on right side axis).**
- **Relatively smooth parabolic trend is observed.**
- **JENDL-40 is more reactive for intermediate spectrum energies.**