IAEA-NDS and the CIELO Project
Fe-56

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The CIELO Project – Fe-56

Quote: “A new paradigm to facilitate evaluated nuclear reaction data advances” (ND2013)

Evaluated nuclear data for the isotopes of Fe

- BNL/IAEA-NDS Collaboration (fast E-range)
- ORNL (resonance E-range)

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Fe-isotopes evaluation

- Focus first on Fe-56
- Current status of Fe-56 evaluation:
  - ORNL Version 4 resonance parameters in RML format up to 2 MeV (including discrete inelastic channel) were delivered
  - Lane-consistent Dispersive Coupled-Channel OMP prepared
  - EMPIRE calculations performed
  - ENDF file assembled – testing in progress

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Fe-56 Evaluation Testing

- Criticality benchmarks predominantly sensitive to the resonance range
- RML Format allows scattering angular distributions to be calculated from res.par.
- Scope of testing at this stage:
  - Overall performance on criticality benchmarks
  - Consider separately x.s. and ang.distrib.
  - Investigate the effects of smoothing ang.distrib.

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Fe-56 Resonance Processing

- RML format processable by PREPRO and by NJOY2012 (but not by NJOY99)
- Detailed angular distributions reconstructed from resonance parameters (only NJOY2012)
- ACE file with detailed ang.distrib. produced
- WARNING: by default NJOY performs Doppler Broadening only up to the lowest threshold (i.e. ~850 keV)
- After patching, inelastic still not Doppler-broadened

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Fe-56 Resonance Data

Criticality benchmarks (ref. to ENDF/B-VII.1):

- Most benchmark cases unaffected
- Resonance cross sections produce a slight positive reactivity bias in some cases
- Including detailed angular distributions diminishes the positive bias

Note:

Large ACE file (~100 Mb)

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Fe-56 Resonance and Fast Data

- Combining resonance data with new evaluation in the fast energy range produces a modest positive reactivity bias
- Most criticality benchmarks remain within the uncertainty band

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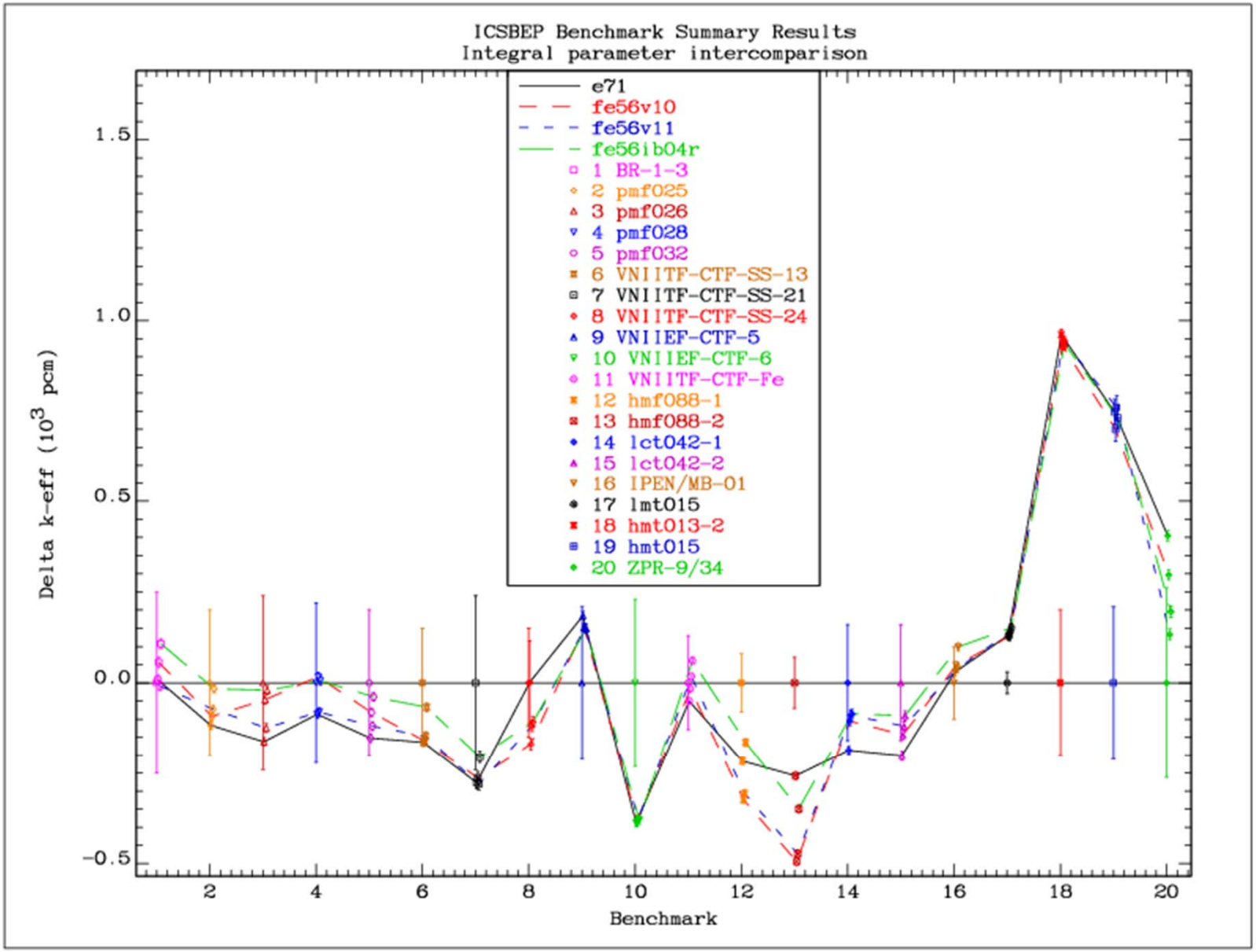
ICSBEP Benchmark Summary Results
Integral parameter intercomparison
e71
fe56v10
fe56v11
fe56ib04r
1 BR-1-3
2 pmf025
3 pmf026
4 pmf028
5 pmf032
6 VNIITF-CTF-SS-13
7 VNIITF-CTF-SS-21
8 VNIITF-CTF-SS-24
9 VNIIEF-CTF-5
10 VNIIEF-CTF-6
11 VNIITF-CTF-Fe
12 hmf088-1
13 hmf088-2
14 lct042-1
15 lct042-2
16 IPEN/MB-01
17 lmt015
18 hmt013-2
19 hmt015
20 ZPR-9/34
Delta k-eff (10^3 pcm)
1.5
1.0
0.5
0.0
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Benchmark

Fe-56 Angular distributions smoothing

- Inconsistency: Doppler-broadened cross sections – cold angular distributions
- Doppler-broadening of ang.distrib. Is unphysical (should use zero-Kelvin data and sample target for speed and direction)
- Smooth ang.distrib.have been used ever since (!)
- Smoothing to capture the general trends:
  - Gaussian resolution-broadening of Legendre Coefficients
  - Gaussian resolution-broadening of Legendre scattering moments
  - Check impact on integral benchmarks

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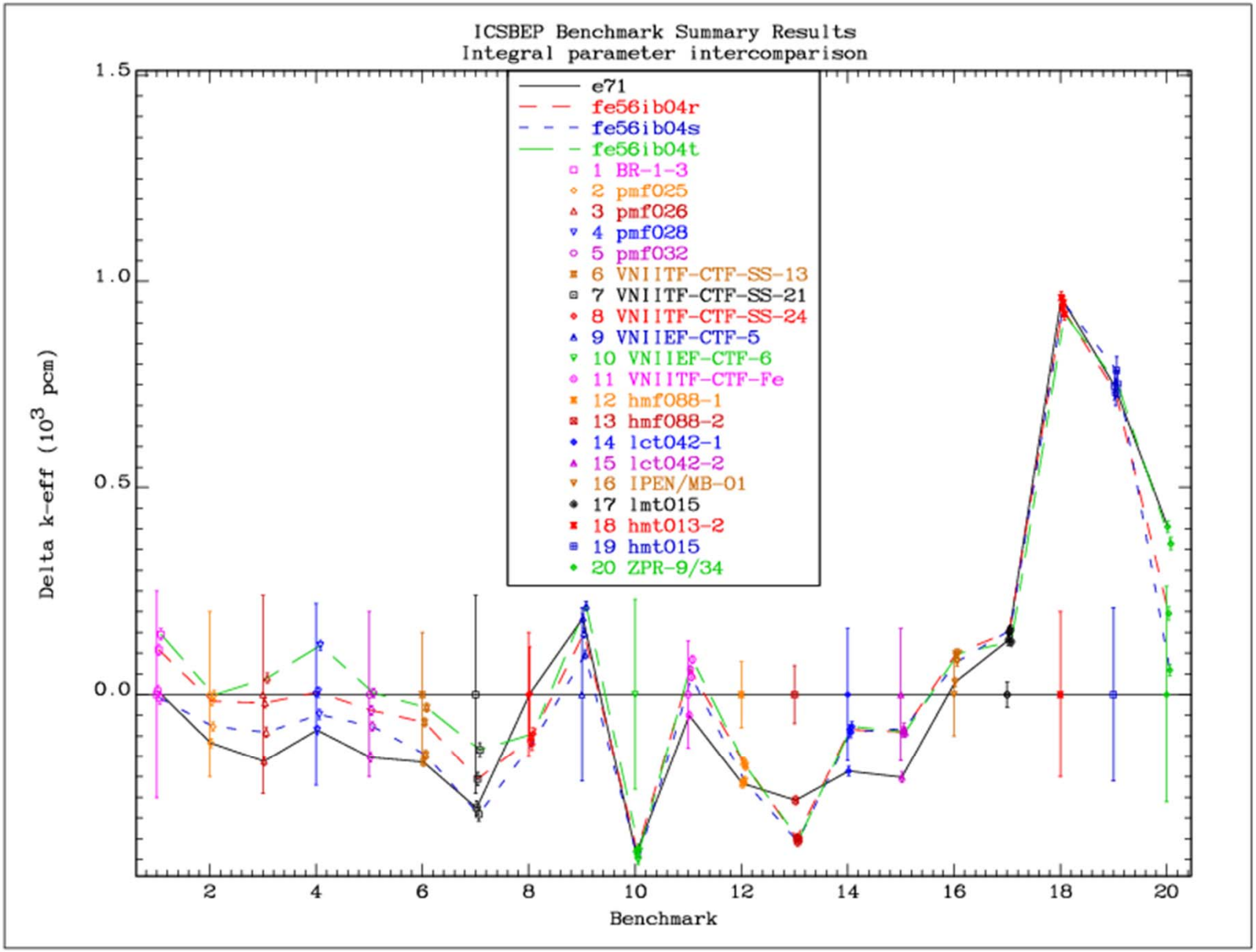
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Benchmark

Conclusions

- Performance of the current evaluation for criticality benchmarks is comparable to ENDF/B-VII.1
- Advantages:
  - model-based → internal consistency,
  - no artificial split in representation above 20 MeV (extension tbd)
  - Same nuclear models applicable to minor isotopes (tbd)

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Conclusions (Cont.)

- Some remaining outliers possibly not due to Fe-56 data
- Testing of data at higher energies is in progress
- Smoothing of angular distributions seems feasible for the ENDF files (detailed representation can be reconstructed from resonance parameters, if needed)

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