Criticality safety validation of SCALE 6.2.2

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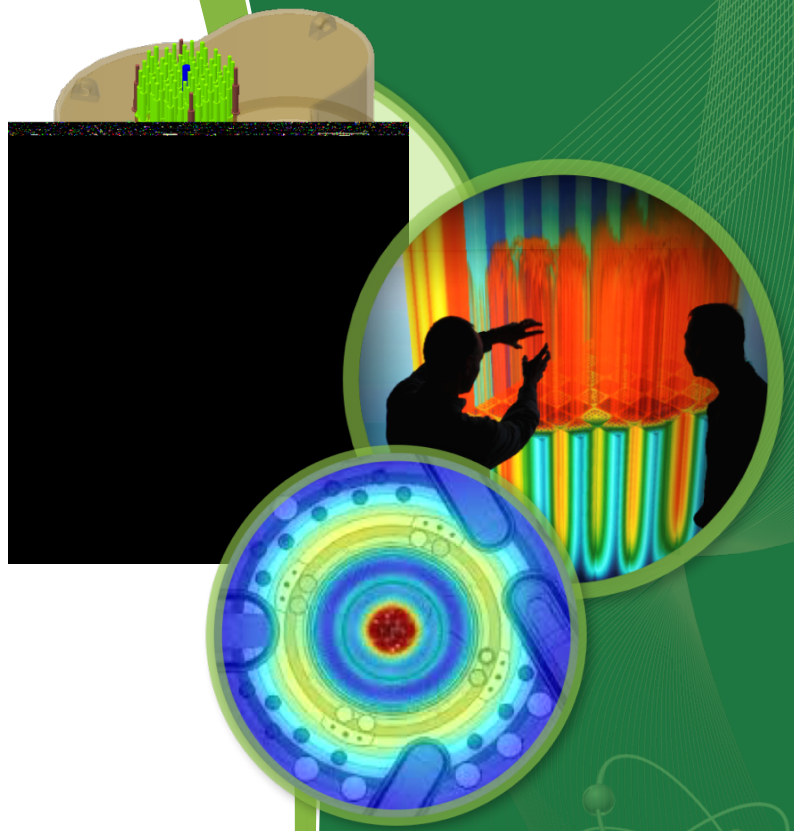


SCALE Users' Group Workshop

Oak Ridge National Laboratory
September 26–28, 2017

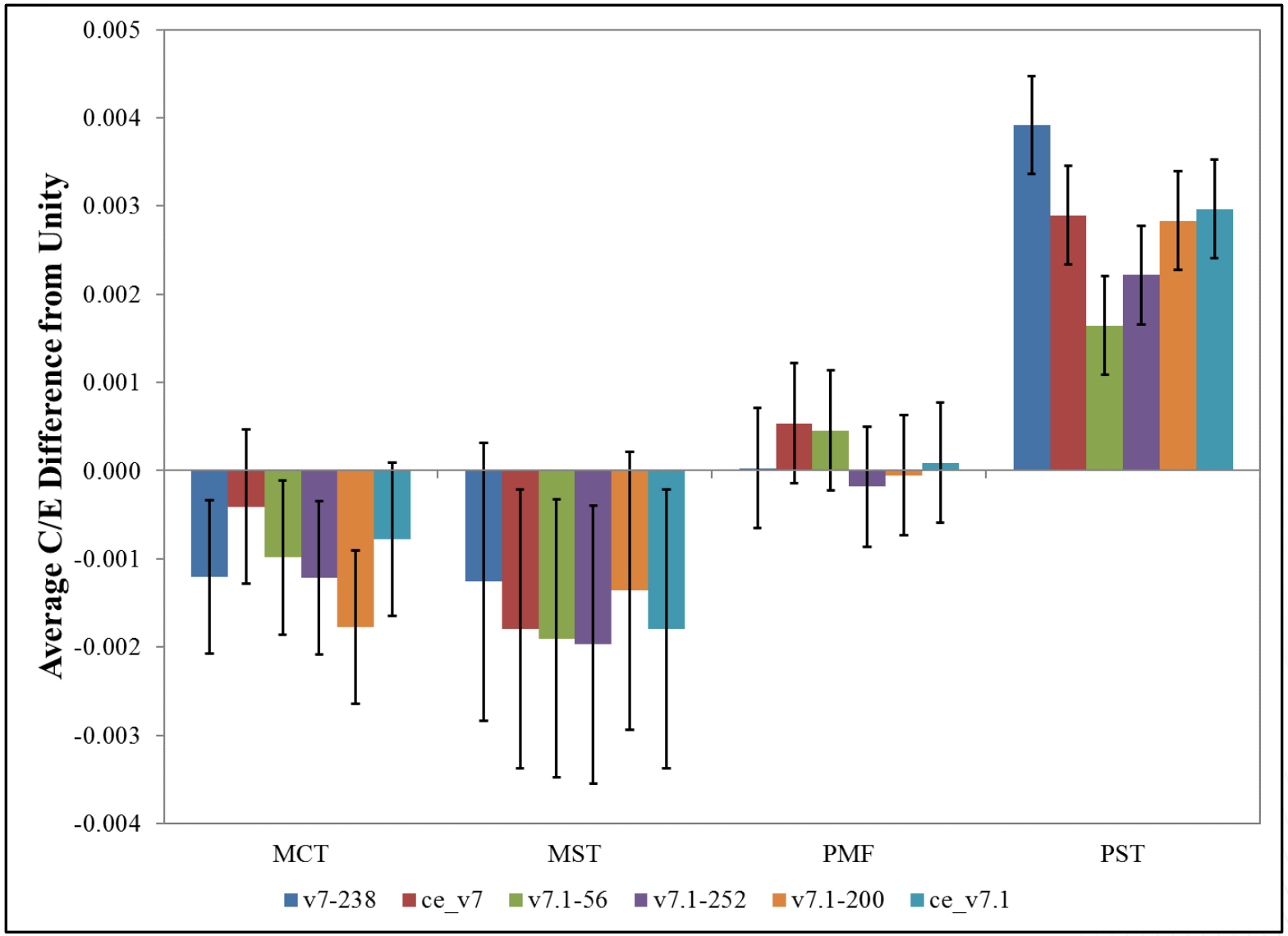
Outline

- General validation of 6.2 release
- Temperature-dependent validation effort
- ^{233}U validation
- Conclusions and future work

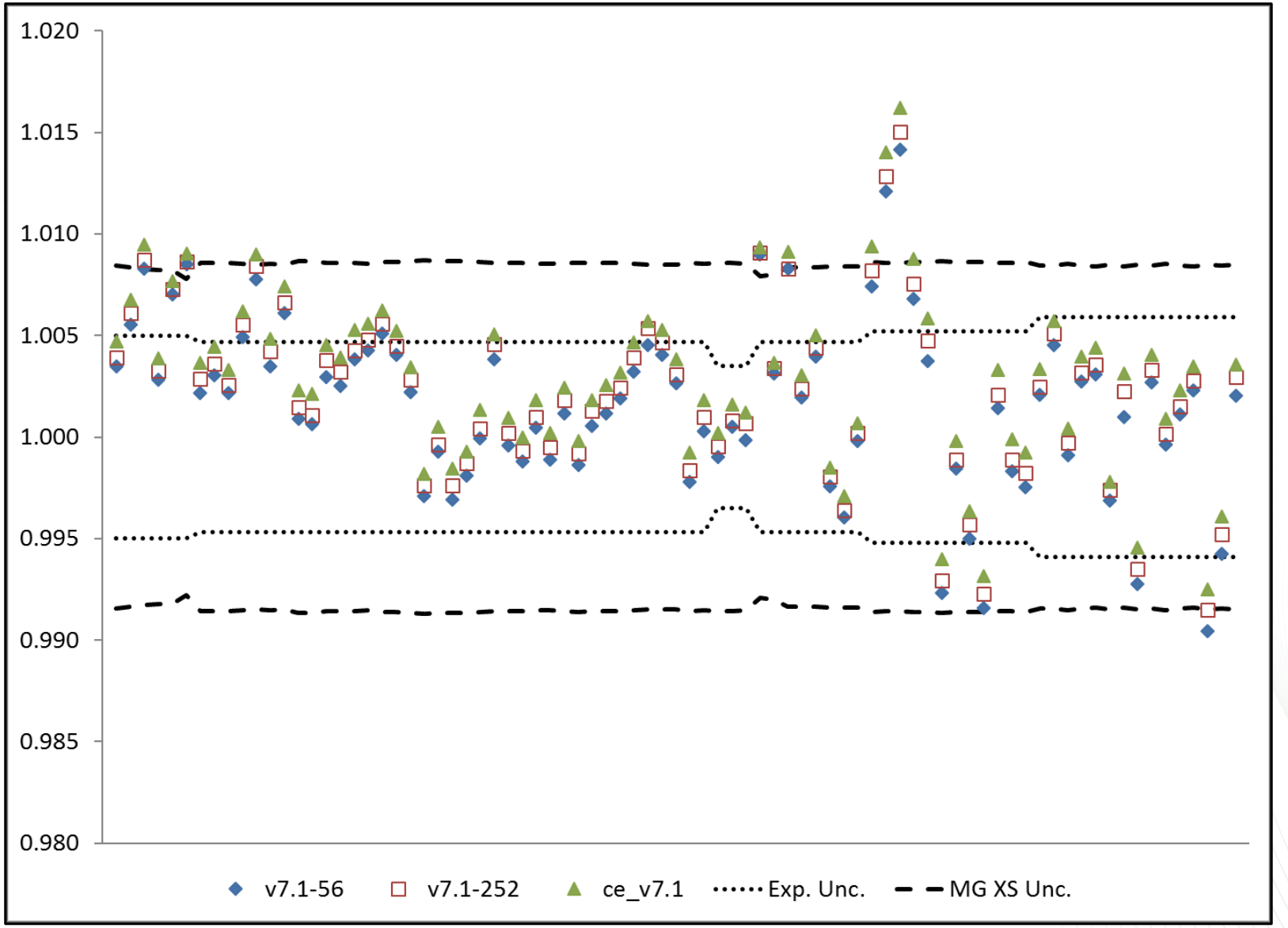
General validation of SCALE 6.2

- Validation studies completed; SCALE 6.2 Beta 1 and Beta 4
  - Beta 1 results published at NCSD 2013
  - Beta 4 results published at ICNC 2015
- Cross section data did not change after Beta 4 release
- Validation effort postponed due to quick turnaround of 6.2.1 and 6.2.2
- All of VALID run (418 cases) plus cases that will be added soon (198 cases)
  - Cases to be added to VALID: 1 HMF case, 7 MST cases, all 190 ^{233}U
- Six libraries included: 2 CE and 4 MG
  - ENDF/B-VII.0: CE and 238-group MG
  - ENDF/B-VII.1: CE and 56-, 200-, and 252-group MG

Summary results for MIX and Pu systems



Detailed results for PST systems

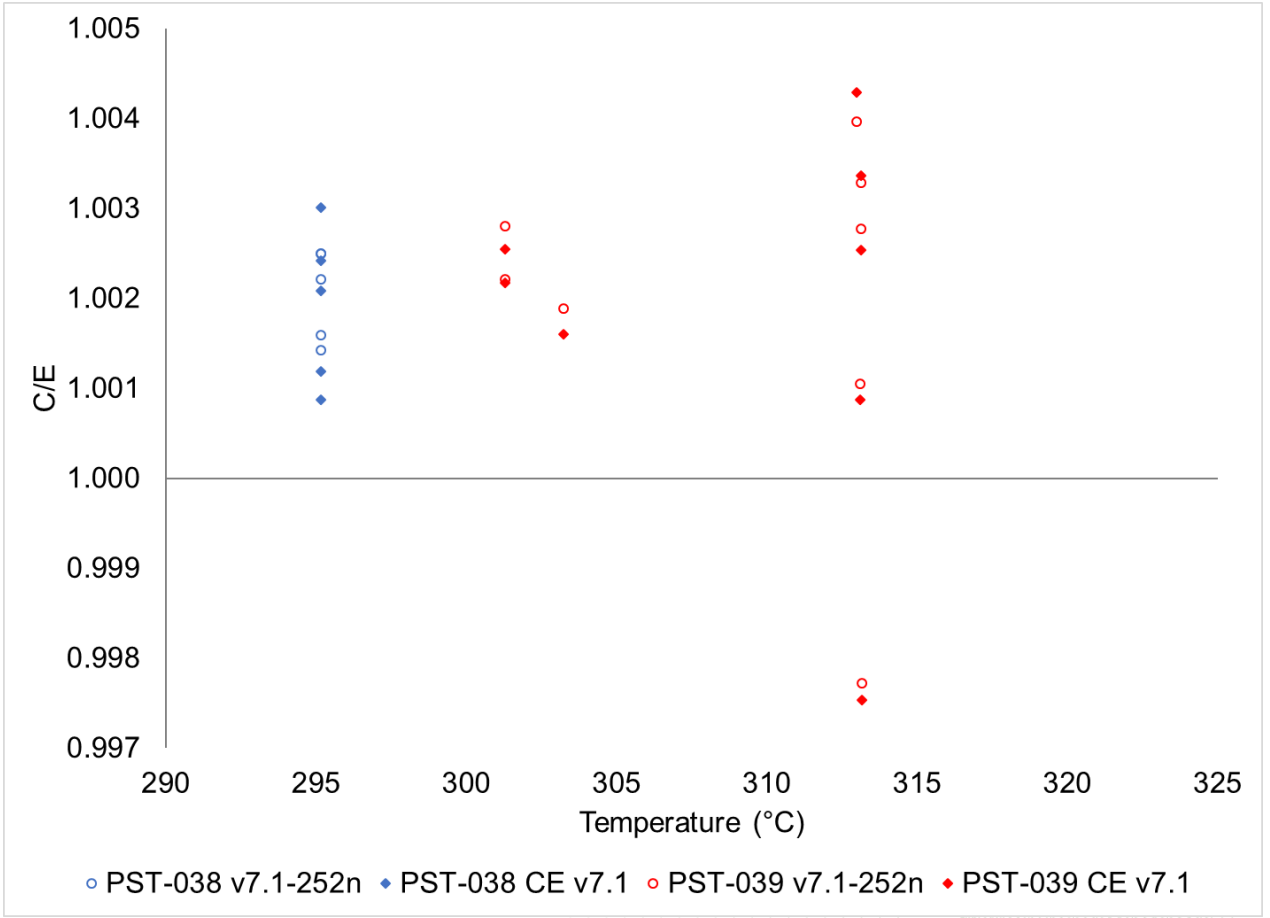


Temperature-dependent validation

- Built models of LCT-046 to examine temperature-dependent bias using funds from NCSP University task with UTK and ORNL
- Results presented in ANS summary, New Orleans, June 2016
- Subsequent review within VALID identified deficiencies in benchmark description
  - Number density and dimension correction factors are inconsistent
  - This causes some changes in mass as a function of temperature
  - Small apparent bias may be a result of temperature dependence or mass changes

Temperature-dependent validation (continued)

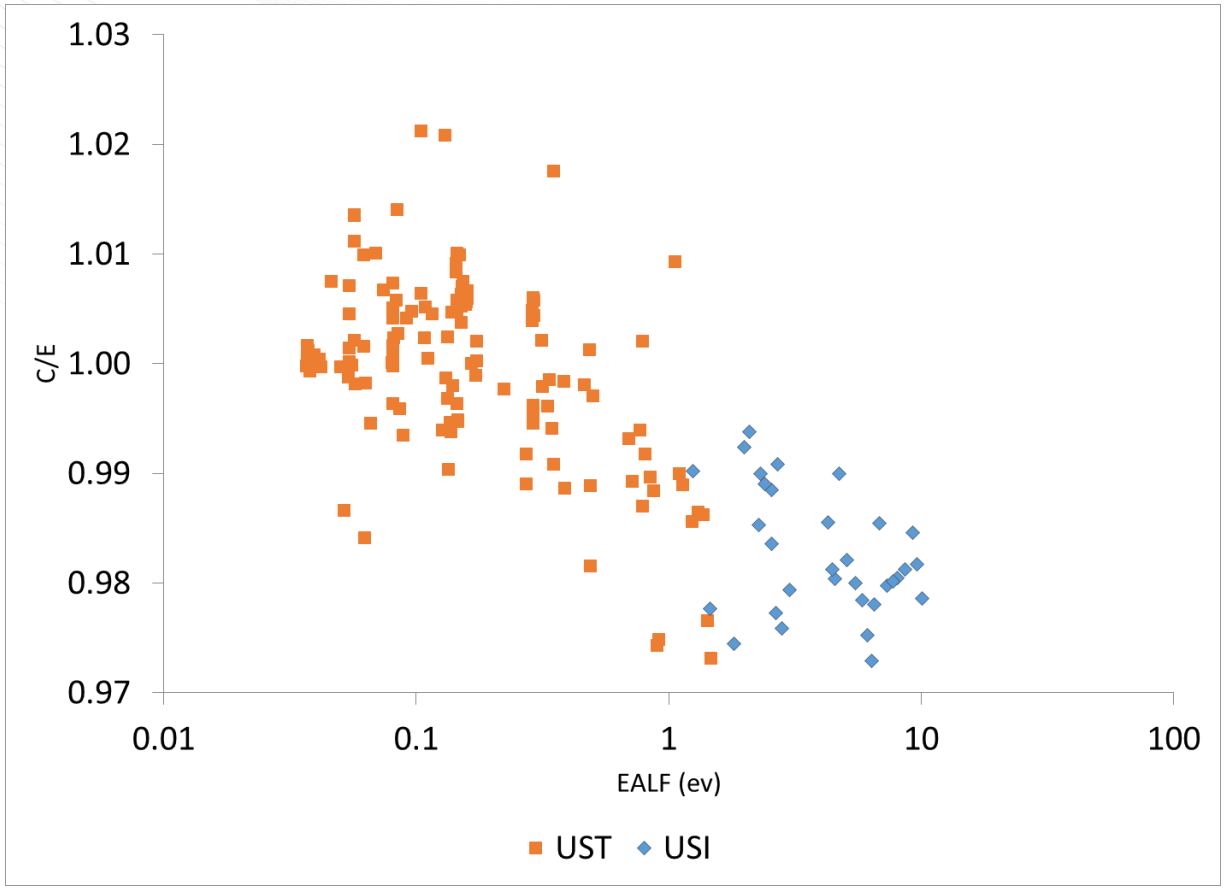
- Built models of PST-038 and PST-039, results shown at right
- No evident trend, but the temperature range examined is small

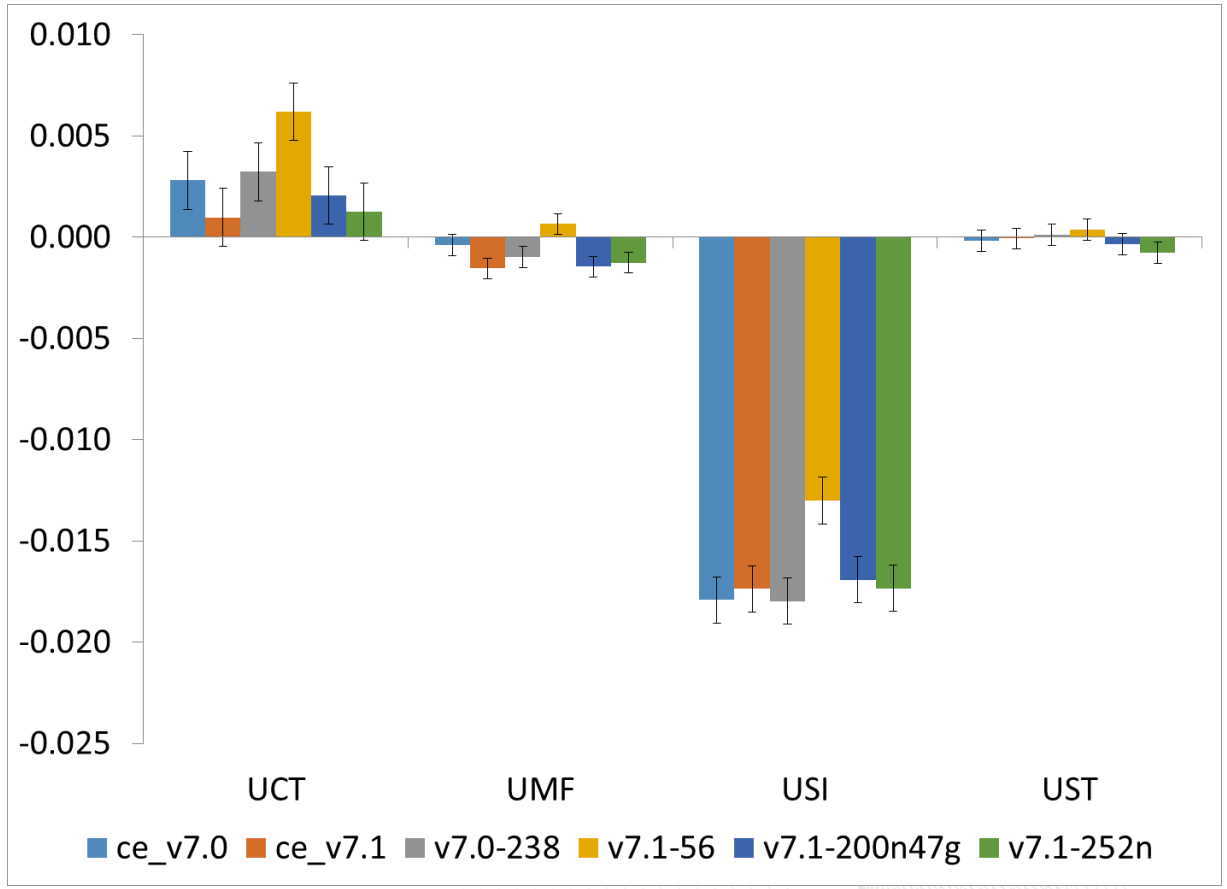


^{233}U validation

- Discrepant results generated by Ian Hill @ OECD/NEA with some ^{233}U systems
- Cause identified and fixed
- Validation of ^{233}U is desired
  - Over 175 models existed from prior work at ORNL
  - Models were updated and run by 2 USNA midshipmen (June 2016)
- Results published in ANS summary, Las Vegas, November 2016
- Significant bias identified in upper thermal and intermediate region

^{233}U results





Conclusions and future work

- SCALE 6.2 improves KENO accuracy with CE and MG libraries for most systems
- Temperature-dependent validation remains problematic: a summer student extracted temperatures from all ICSBEP evaluations this past summer for inclusion in DICE
- ^{233}U validation indicates problems with intermediate spectrum systems
- Working to generate and document a complete validation of SCALE 6.2.2 for 6 libraries with all of VALID

Acknowledgments

- Thanks to NCSP for funding continued validation efforts, including Jenna Clifton, the summer student who collected the temperatures
- Thanks to Defense Threat Reduction Agency (DTRA) for funding that allowed the 2 midshipmen to come to ORNL in 2016