



WPEC SG47

SINBAD - Recent progress

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WPEC Subgroup 47 (SG47) on Use of Shielding Integral Benchmark Archive and Database for ND Validation

Justification for a Subgroup

Nuclear cross-sections have been under continuous improvement for many years, and integral benchmark experiments have proven to be valuable for validation. In recent years, the evaluations have been predominantly validated against criticality benchmarks, and are “tuned” to better match the measurements. However, the effective multiplication factor (k_{eff}) is a very global parameter, dependent on many “free” parameters. Besides criticality, there are other important concerns, of which shielding is a priority for many applications. Including shielding benchmarks in the validation process is expected to provide a complementary view and would allow more broad evaluation of the performance of the nuclear data. This would ultimately contribute to a production of general-purpose cross-section evaluations.

Subgroup Monitor(s): O. Cabellos, L. Leal

Subgroup Coordinator: I. Kodeli

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Shielding benchmarks to be considered in the scope of WPEC SG47

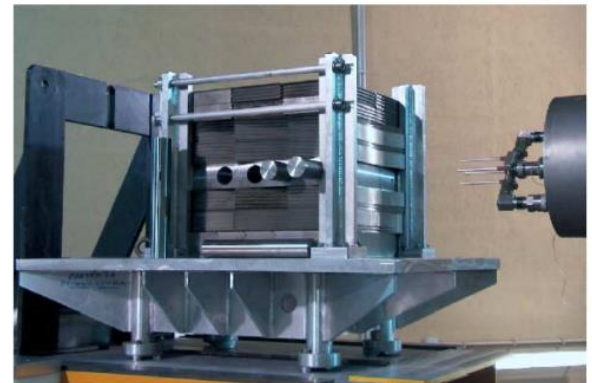
- FNG (SS, ITER Blanket, ITER Streaming, SiC, W, HCPB, HCLL, Cu)
- LLNL spheres
- ASPIS IRON88
- JANUS phase I to VIII
- TIARA (Fe, concrete)
- FNS
- OKTAVIAN
- Rez Iron spheres

Drawbacks, critics:

- evaluations and review process less complete/thorough than ICSBEP/IRPhE
- format (EGRTS)
- (MCNP) computer code inputs missing
- long CPU time calculations

Benchmark Experiment on W (2002)

Validate EFF data for tungsten



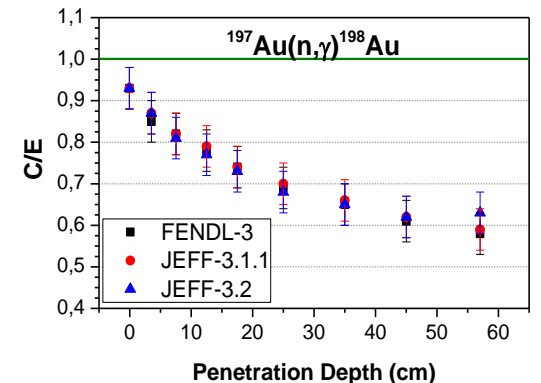
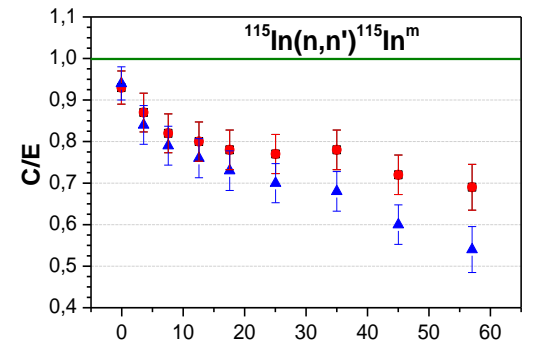
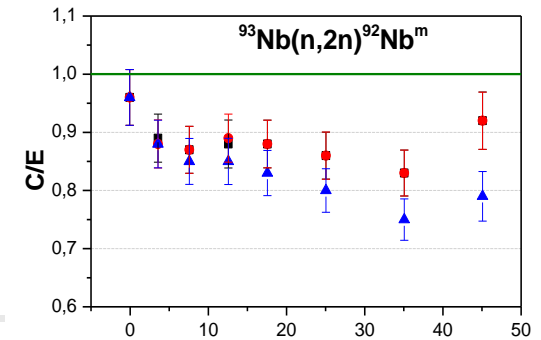
SINBAD evaluation and independent review process review in conjunction with ICSBEP/IRPhE meeting



- **FNG-HCLL benchmark**
- **FNG-Cu benchmark**
- **HIMAC experiments** with He, C, Ne, Ar, Fe, Xe, and Si ions on C, Al, Cu & Pb targets

FNG-Cu: nuclear data uncertainties vs. C/E

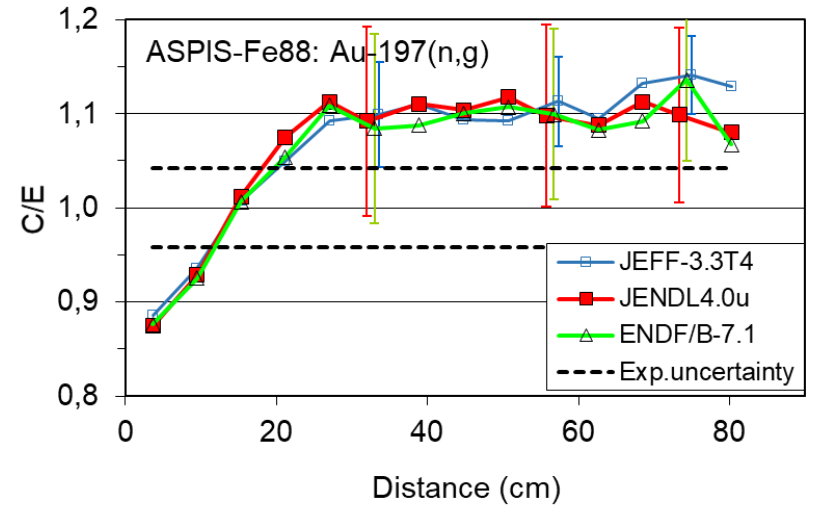
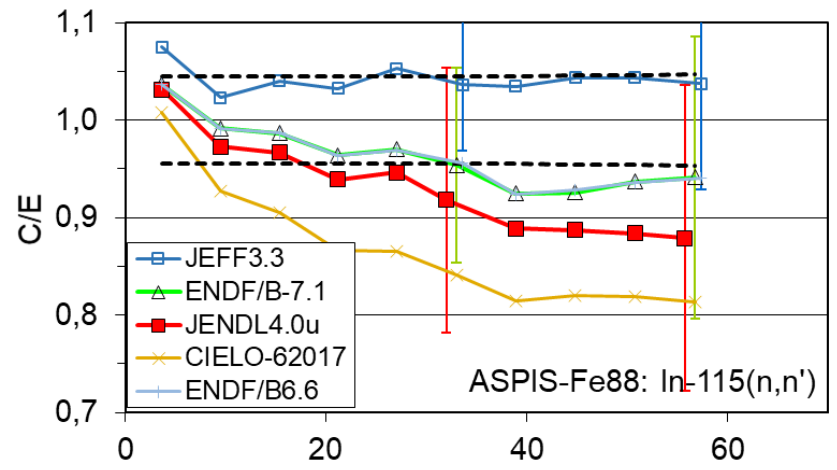
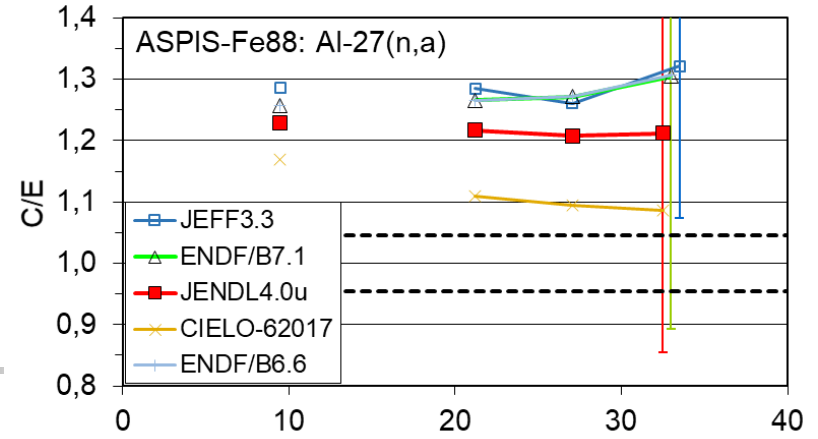
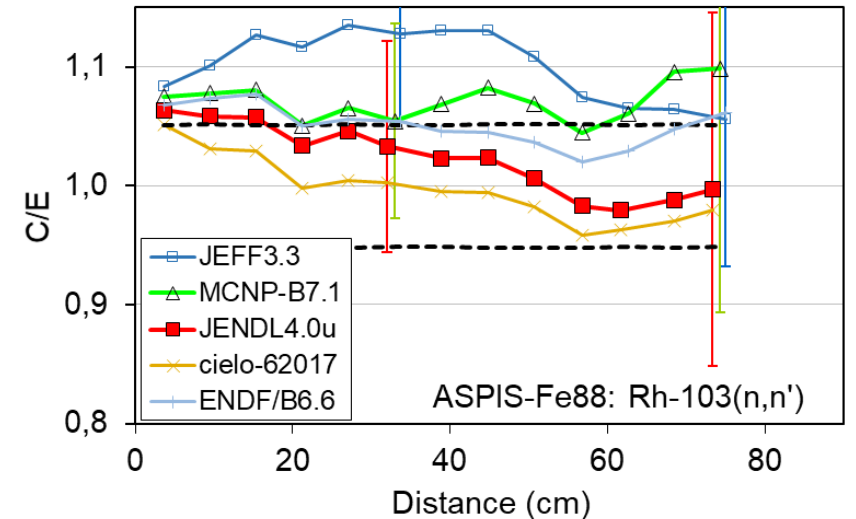
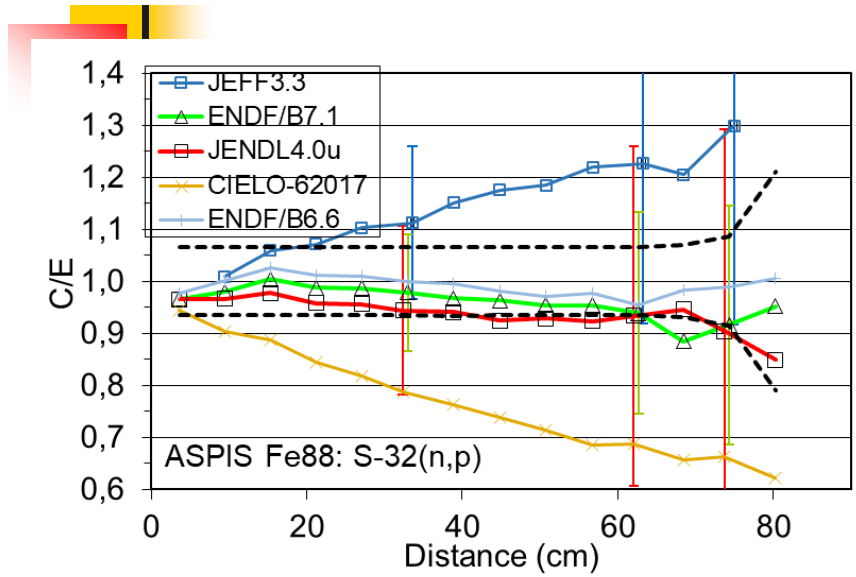
Reaction rate / det. position	Uncertainty (%)		
	Transport cross-section		
	JEFF-3.3	ENDF/B-VI.8	TENDL-2013
$^{58}\text{Ni}(n,p)$ -35cm	4.8	13.7	22.9
-57cm	9.1	27.2	41.9
$^{115}\text{In}(n,n')$ -35cm	8.2	9.4	12.1
-57cm	12.7	18.7	23.5
$^{27}\text{Al}(n,\alpha)$ -57cm	12.5	33.2	51.9
$^{93}\text{Nb}(n,2n)$ -57cm	13.3	34.7	53.4
$^{197}\text{Au}(n,\gamma)$ -57cm	15.3	19.9	18.6
$^{186}\text{W}(n,\gamma)$ -57cm	23.2	28.6	27.3
$^{55}\text{Mn}(n,\gamma)$ -35cm		24.9	18.8



FNG HCLL: sensitivity/uncertainty results

ND UNCERTAINTY	Au(n, γ) D7	Mn(n, γ) D7	Ni(n,2n) D7	In(n,n') D8	Al(n, α) D8	Nb(n,n') D8	Ni(n,p) D8
Δ_{tr} (ENDF/B6.8)	3.3%	3.3%	5.2%	3.0%	4.8%	5.3%	3.1%
Δ_{tr} (JEF3.2)	1.1%	1.0%	4.0%	1.2%	5.1%	5.2%	3.2%

ASPIS-Fe88: C/E using JEFF-3.3, ENDF/B-VII.1, JENDL-4.0, CIELO, ENDF/B-VI.6



Acceleration of MCNP calculations using ADVANTG



Typical CPU running times for shielding benchmark calculations are of the order of days/weeks. Reducing the CPU times can open new applications.

Application of **ADVANTG** to **ASPIS-IRON88** and **TIARA** benchmarks proved very encouraging:

- **No bias observed,**
- **Substantial acceleration achieved.**

ADVANTG hybrid deterministic/Monte Carlo code: Forward-Weighted Consistent Adjoint Driven Importance Sampling (FWCADIS) method was used to determine the WW windows for multiple detector locations

Conclusions

- SINBAD database currently contains compilations and evaluations for 48 reactor shielding problems, 31 fusion neutronics shielding and 23 accelerator shielding cases. 17 experiment re-evaluations to be updated. Few new data since 2009.
- June 2019: **WPEC SG47** on Use of SINBAD benchmarks for ND validation.
- **ASPIS, FNG, LLNL, and other benchmarks will be studied within WPEC SG47**
- **New acquisitions after WPEC meeting:**
 - SuperMC input files (large number of fusion relevant benchmarks)
 - ASPIS Fe88, REPLICIA (ENEA Bologna),
 - IPPE Fe (Elena/Stanslav),
 - CAD geometry,
 - FNG-Cu review
- SINBAD review meeting in conjunction with ICSBEP/IRPhE meeting in October 2018 useful to establish link and feedback between the groups
- Quality re-evaluated SINBAD benchmarks should be integrated in the database
- Work on revision and classification of existing benchmark and on **new evaluations according to the SINBAD priority list.**
- **Close coordination and feedback from other WPEC SG expected**