

Use of Shielding Integral Benchmark Archive and Database for Nuclear Data Validation

WPEC Subgroup 47 (SG47)

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CCFE/UKAEA

Highlights

- **Good attendance with 8 presentations**
- **Critical remarks:** more focus needed in gamma and accelerator applications, quality evaluation should be improved/extended (information on exp. uncertainty), availability of inputs, need for more open database
- **New benchmark evaluations for SINBAD:** several proposals made during the meeting, evaluations through EGRTS & ICSBEP/SINBAD review
- **CAD** allows easy conversion for different transport codes: CAD data prepared for FNG-Cu, ASPIS-Fe88 (IJS/CCFE); feedback on format needed
- **Sensitivity profiles:** already prepared for FNG-Cu, ASPIS Iron-88, PCA Replica benchmark evaluations (Kodeli), LLNL (Cabellos);
- **Availability of similar benchmarks is valuable for validation:** KFK & IPPE Fe gamma (Simakov), PCA & PCA Replica & ASPIS Fe88 (Kodeli)
- **Quality review in progress, needs to be completed;**

Agenda

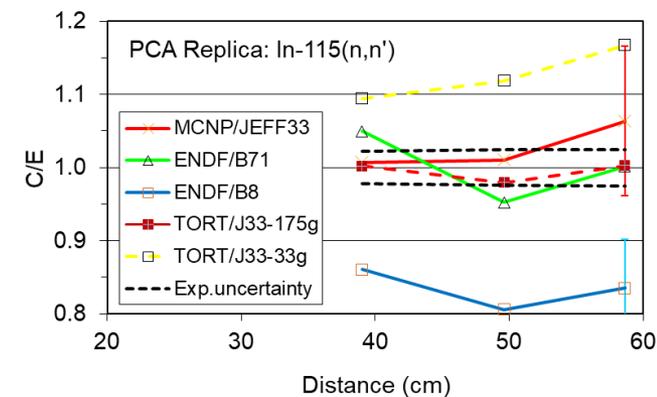
11 May 2021

Duration	PDT	CEST	JST	Topic
00:15	02:00	11:00	18:00	Introduction of participants
00:10	02:15	11:15	18:15	Welcome I. Kodeli
00:20	02:25	11:25	18:25	Review of WPEC SG47 progress and objectives I. Kodeli
00:20	02:45	11:45	18:45	Benchmark experiment on iron with D-T neutrons at CIAE D. Yanyan
00:20	03:05	12:05	19:05	SINBAD new/updated Entries: KFK g-ray leakage and ORNL O-broomstick transmission S. Simakov
00:15	03:25	12:25	19:25	Impact of proton induced data on the accelerator shielding problems Y. Celik
00:10	03:40	12:40	19:40	Break
00:20	03:50	12:50	19:50	Overview of the PETALE program in CROCUS on stainless steel nuclear data V. Lamirand
00:20	04:10	13:10	20:10	Use of SINBAD in validation of emergent radiation transport codes A. Valentine
00:20	04:30	13:30	20:30	Remarks on LLNL pulsed sphere work D. Neudecker, O. Cabellos
00:25	04:50	13:50	20:50	Proposals and status of new SINBAD evaluations I. Kodeli
	05:15	14:15	21:15	Close

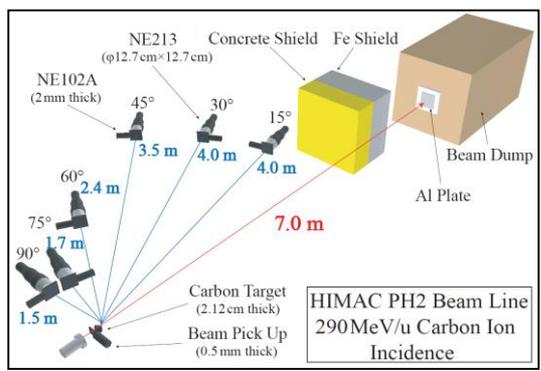
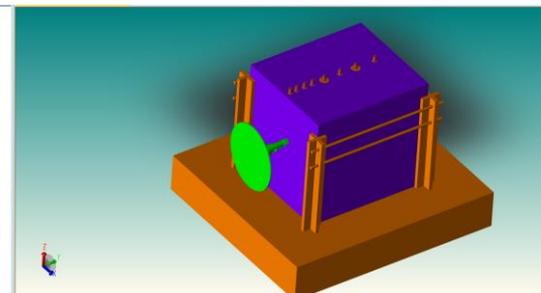
1. Review of WPEC SG47 progress and objectives

- Summary of the focused CAD meeting: CAD files available for ASPIS Fe88 and FNG-Cu
- New SINBAD features: CAD files and sensitivities to be available through WPEC SG47 GitLab. Feedback on the formats used would be appreciated.
- After a long pause SINBAD evaluation activity is restarting with several new contributions and updates in progress within SINBAD TRG: FNG, Rez Fe, KFK-1977, O Broomstick, CIAE Fe, CROCUS, LLNL, HIMAC (S. Tsuda), TIARA (Y. Iwamoto slide), Oktavian).
- Iron XS and code validation using SINBAD benchmarks ASPIS Fe88, PCA Replica, PCA to verify consistency between predictions of different benchmarks.
- Several SINBAD entries need to be updated (quality reviews, transport code inputs.
- Several benchmarks of potential interest for future SINBAD evaluations were identified.

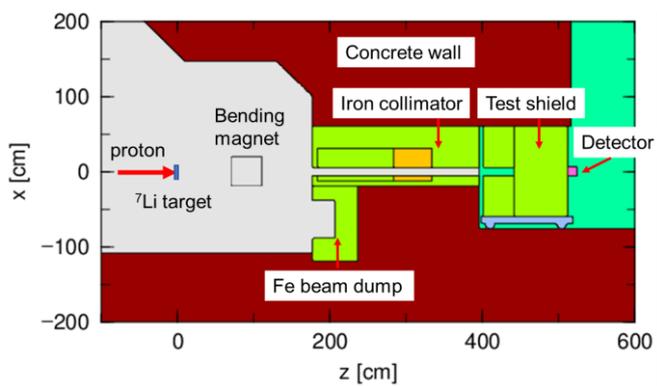
I. Kodeli (CCFE)



- FNG-Cu02 Efs
- Transport
- Material
- Source
- Fully
- Process
- Geometry Boundary
- Geometry
- Air
- AirLarge
- Al
- base
- Cu
- Cu_rnd01
- Cu_rnd02
- Fe01
- Fe02
- Fe01-Al
- Generator01
- Generator02
- GeneratorCu_cup
- Flaps
- Walls



HIMAC
Shuichi Tsuda, JAEA

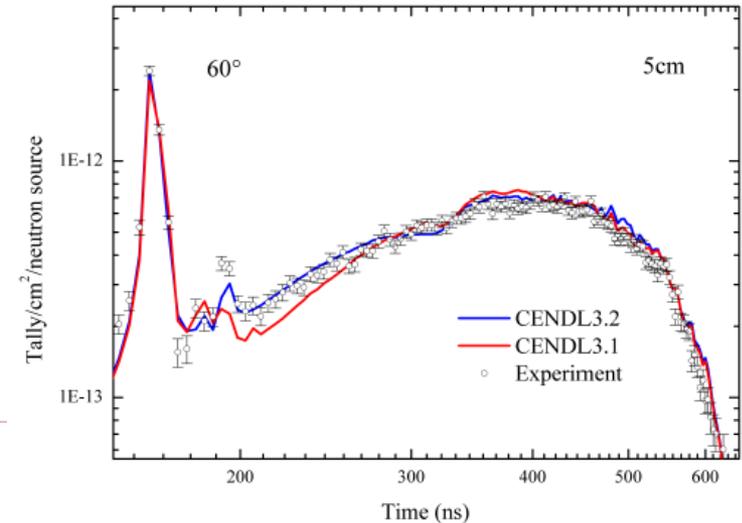
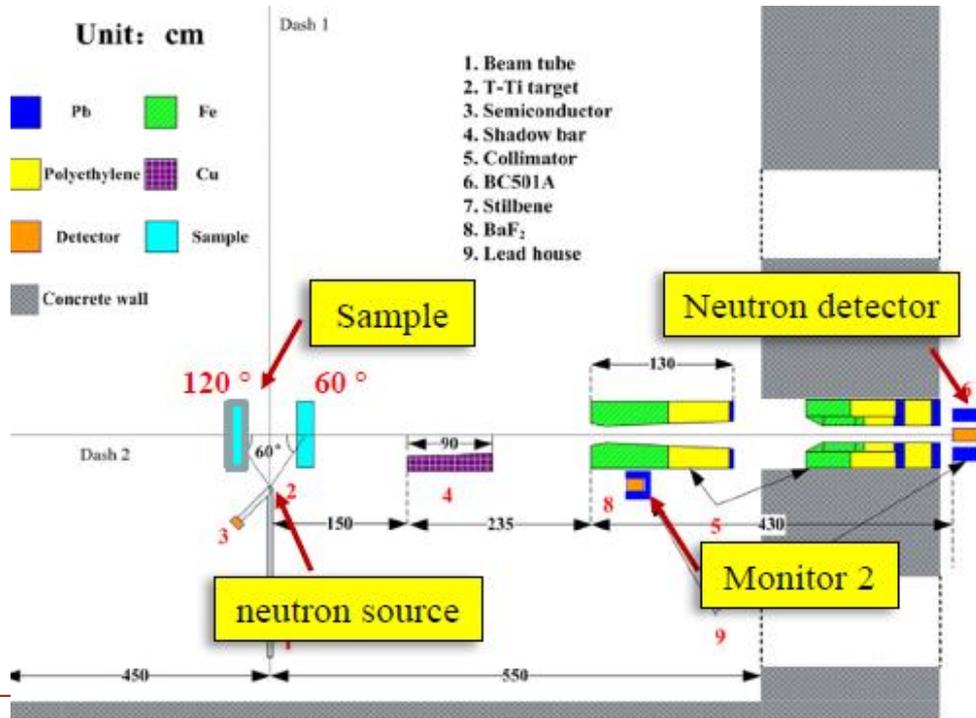


TIARA
Yosuke Iwamoto, JAEA

2. Benchmark experiment on iron with D-T neutrons at CIAE

Yanyan Ding (CIAE)

- CIAE Neutron leakage spectra measurements from iron slab with D-T neutrons were presented, including the uncertainty quantification (systematic, random) and computational models. TOF spectra were measured at 60° and 120° . C/E for CENDL-3.1, ENDF/B-VIII.0, JENDL-4.0 and JEFF-3.3 were shown and discussed.
- SINBAD evaluation in preparation to be presented at ICSBEP/IRPhE/SINBAD TRG meeting.
- CIEA performed benchmarks on ^{238}U , Be, Fe, Ga, W, C, SiC, Pb, Pb-Bi, ThO_2 , Bi, Nb.

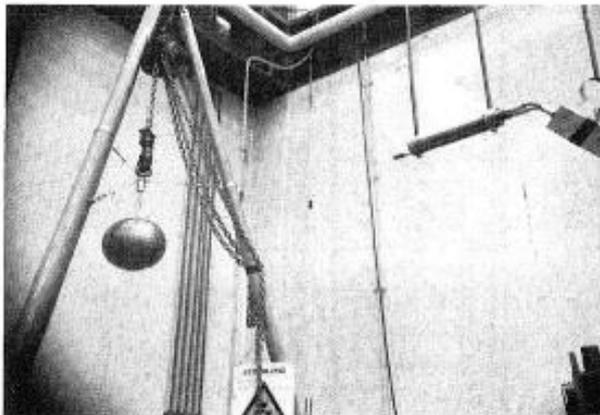


3. SINBAD new/updated Entries: KFK g-ray leakage and ORNL O-broomstick transmission S. Simakov (KIT):

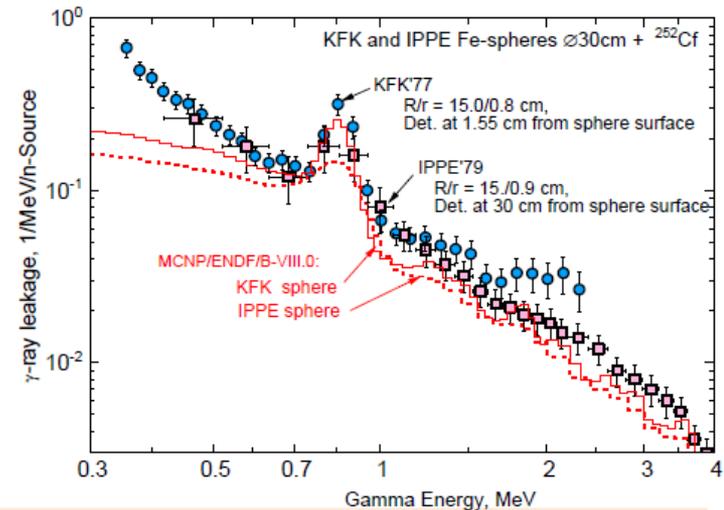
S. Simakov completed and reported on his (many) actions:

- **Action 2:** SINBAD evaluation of KFK-1977 measured gamma from bare ^{252}Cf (s.f.) source and from $\varnothing 25$, 30 and 35 cm Fe spheres was prepared, including detailed descriptions of facility, methods and final numerical results with uncertainties.
- **Action 3:** Existing SINBAD evaluation for ORNL/TSR-II 60”(152.4 cm) Oxygen broomstick was upgraded with MCNP model input, quality assessment and report on validation analysis and recommendations. Benchmarks are useful for total cross section validation;
- Experimental neutron transmission spectra for 24” (60.96cm), 36”(91.44cm) and probably 72” (182.88 cm) could not be found.
- The importance of evaluating a reference PFGS & DFGS of Cf-252 was raised (new action).
- Consistency analysis between $\text{O}16(n,\alpha)\text{C}13$ and $\text{C}13(\alpha,n0)\text{O}16$ nuclear data was presented.

KFK set-up:



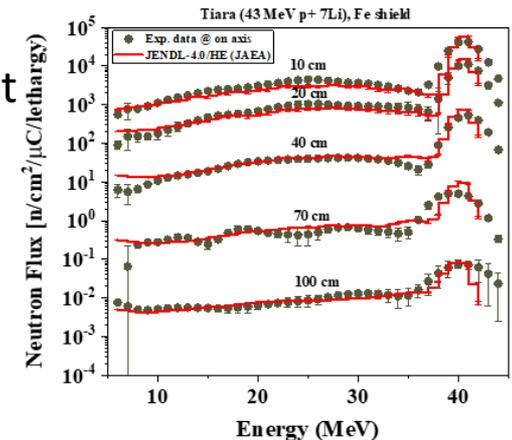
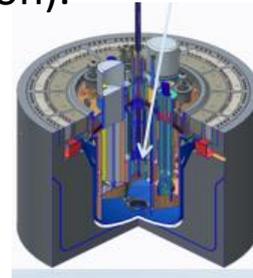
KFK vs. IPPE: γ -ray leakage spectra from Fe $\varnothing 30\text{cm}$ with Cf-source



4. Impact of proton induced data on the accelerator shielding problems

Y. Celik (SCK-CEN)

- Yurdunaz Çelik presented the needs of the MYRRHA ADS project and the conclusions of the analysis of SINBAD benchmarks (52P, 75P, 65P, TIARA). Benchmarks were used to benchmark codes and proton induced ND for shielding calculations of 100 MeV accelerator system.
- Better information on the quality and experimental uncertainty
- More accelerator experiments at different energies and different target materials needed (p induced data validation).



5. Overview of the PETALE program in CROCUS on stainless steel nuclear data V. Lamirand (EPFL)

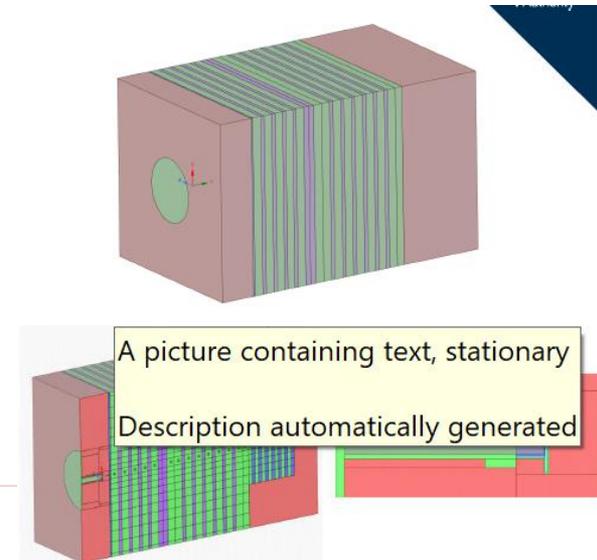
Vincent presented the CROCUS reactor and the PETALE experimental programme to provide integral measurements on measurement using plates of iron, stainless steel and other reflector materials.

Transmission measurements on Fe would be a suitable candidate to be included in SINBAD when available.

6. Use of SINBAD in validation of emergent radiation transport codes (CCFE)

A. Valentine

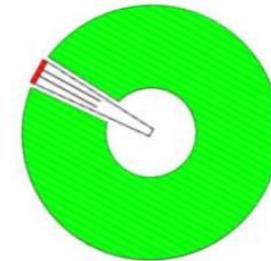
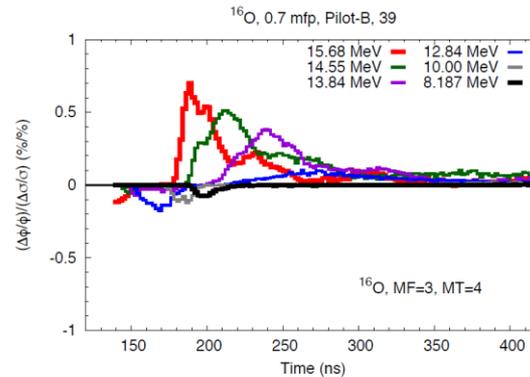
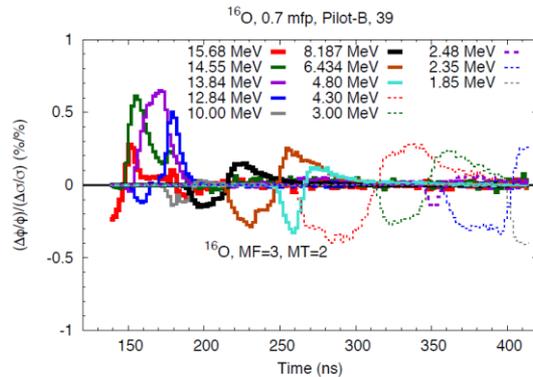
- CCFE is interested in SINBAD project as part of its involvement in fusion programme (JET, ITER, DEMO, MAST-U, STEP). CCFE is in favour of SINBAD remaining an open database which would benefit to further development and use of the database.
- Fusion community is interested in adding additional materials in SINBAD. Materials of interest for fusion community: W, Mo, Cr, Y, W, Mo, Cr, Y, Ti, C, Zr, Li, Pb, Be, Si, Nb, La, Cu, Fe, Vn.
- Experience using fusion-relevant SINBAD benchmarks as part of Serpent 2 validation (FNG HCPB, FNG Bulk shield and FNG WCLL). Performance of Serpent 2 variance reduction techniques were compared with MCNP/ADVANTG.
- Automating benchmark running procedure allows faster validation of emerging transport codes
- ANSYS SpaceClaim is used for CAD modelling. Series of tests of CAD geometry are proposed to be performed before integrating CAD files in SINBAD.



7. Remarks on LLNL pulsed sphere work

D. Neudecker (LANL)/O. Cabellos (UPM)

- O. Cabellos and D. Neudecker presented the conclusions of the simulating of 75 LLNL pulsed-sphere neutron-leakage spectra for 20 different materials using ENDF/B-VII.1 and ENDF/B-VIII.0 and MCNP inputs. Sensitivity profiles were calculated using FRENDY, SANDY and MCSEN codes. A ANE paper was published describing the results.
- Soon Kim briefly commented the evaluation of the Polyethylene and Blank Pulsed Sphere Experiments Using Deuteron Transport Feature in COG. SINBAD evaluations are in progress.



COG Model of Target Assembly and 1.8 MFP Thick Polyethylene Sphere.

8. Proposals and priority list of new SINBAD evaluations

I. Kodeli (CCFE)

- Organisation of focused meeting to discuss new SINBAD evaluations and the review of priority list to guide future work is planned. Needs of fusion and accelerator communities shall also be addressed. The work will be reported to and coordinated with EGPRS and WPEC SGs and other projects interested in these data.
- Action 5. Issue of the scaling of measured neutron fluxes in the FNS oxygen experiment by cosine of the detector angle s still pending. Description in the JAERI documents is open to different interpretations.

Actions of 11 May 2021 SG47 Meeting

1. (NEA): Update SINBAD web page
2. (NEA): Update SINBAD evaluations with data prepared by S. Simakov (KFK-1977 gamma, O- broomstick), old quality reviews and new computer code inputs.
3. (**S. Simakov**, KIT): Establish a reference prompt and delayed γ -ray spectra and multiplicities

Actions of 12 May 2020 SG47 Meeting

1. (**Bin Li**, FDS): potential FDS shielding benchmarks to be considered for SINBAD, e.g. DFLL TBM
2. (**S. Simakov**, KIT): Provide KFK-1977 gamma measurement data for potential SINBAD evaluation **DONE**
3. (**S. Simakov**, KIT): Contribute models for Oxygen ORNL broomstick benchmark and 91.44 cm liquid O data if of interest (sufficient quality) for SINBAD **DONE**
4. (**ORNL, S, Simakov**): investigate the availability of Broomstick experimental data for 24” and 36” O spheres. **Completed (data not found)**
5. (**A.Valentine, CCFE, G. Rimpault**, CEA, All): Contribute Serpent, TRIPOLI and other computer code input data of shielding benchmarks to WPEC SG47 and/or IAEA repository (2021 meeting).
6. (**D.Neudecker**, LANL, O. Cabellos, UPM): Contribute MCNP input data & sensitivities for LLNL benchmarks to WPEC SG47 (2021 meeting). (ongoing)
7. (**S. Lilley** - UKRI STFC, **I. Kodeli**) Provide CAD geometry for IPPE, FNS, FNG, ASPIS and ISIS benchmarks
8. (**B. Jansky**, CVREZ) Contribute TORT & MCNP input data of Rez Fe sphere and slab benchmarks to WPEC SG47 and/or IAEA repositories (ASAP) (**SINBAD TRG evaluation ongoing**)
9. (**J.C. Sublet**, IAEA) Provide instructions for IAEA repository, review & independent verification procedure (ASAP)

Actions of 24 June 2019 SG47 Meeting

1. (**G. Lomakov**, IPPE): Provide comments and review of the FNG Cu benchmark evaluation (**DONE**)
2. (**G. Lomakov**, IPPE): Provide information on the Neutron transmission experiments (1960th) to be included in SINBAD (next meeting)
3. (**S. Simakov**, KIT): Provide KFK-1977 gamma measurement data for potential SINBAD evaluation **Done**
4. (**S. Simakov**, KIT): Contribute models for Oxygen ORNL broomstick benchmark and 91.44 cm liquid O data if of interest (sufficient quality) for SINBAD **DONE**
5. (**Simakov, Kodeli, Milocco**): resolve the issue of dividing by cosine for FNS-O. **ongoing**
6. (**Y.-K. Lee**, CEA): Contribute TRIPOLI input data of few SINBAD benchmarks to WPEC SG47.
7. (**Y.-K. Lee**, CEA): Present a description of the Mn bath experiment for potential inclusion in SINBAD
8. (**S. Lilley** - UKRI STFC, **I. Kodeli**) Provide CAD geometry for IPPE, FNS, FNG, ASPIS and ISIS benchmarks **Reported at 33th WPEC meeting (DONE for ASPIS Fe88 & FNG-Cu)**
9. (**Jun Zou**, FDS): Provide SuperMC inputs for the set of SINBAD benchmarks (OKTAVIAN, FNS, FNG, IPPE, Kant) (beginning 2020) **DONE**
10. (**J. Zou**, FDS): Proposals of potential FDS shielding benchmarks to be included in SINBAD,
11. (**H. Wu**, CIAE) Contribute 14 MeV Fe benchmark data to SINBAD **DONE**
12. (**B. Jansky**, CVREZ) Contribute Rez Fe sphere and slab benchmark data to SINBAD **DONE**
13. (**C. Murphy**, Winfrith) Investigate possible release of ASPIS benchmark data not yet in SINBAD
14. (**O. Cabellos**, UPM) Provide MCNP models and sensitivity profiles for LLNL, FNS, Oktavian benchmarks **DONE (Oktavian & FNS)**
15. (**I. Kodeli**, IJS) Provide updated SINBAD data for ASPIS Fe88 benchmarks **Ongoing**