Compilation of Nuclear Data Experiments for Radiation Characterisation
- CoNDERC –
to serve SG-47

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Nuclear Data Section

Objectives

- The purpose of the project is to transfer into technology the experimental integral radiation information that can be used as part of the Validation and Verification processes of nuclear model and code systems, to provide various schema, protocol to perform the V&V.

- The IAEA NDS is hosting a forum where institutions can provide, establish, share protocols, databases build from their own extensive V&V activities when associated with inventory, transport and source term codes.

- To better serve protocol & data analytics processes

Key elements

- Identify and compile a comprehensive set of experimental integral radiation characterization benchmark information: spectral indices, reaction rates, decay heat, resonance integral, particle counts and fluxes, transport etc…

- Evaluate the data, quantify, compute, rank their overall goodness, quality, uncertainties; then compile the data into computer format ready for verification, dissemination, assimilation

- Perform simulations of each experimental set-up with the suitable code system & nuclear libraries. Produce a database/repository of the necessary input-output files to repeat those simulations for other code & libraries.

Key elements

- Provide the experimental and computational inputs streams necessary to performs the simulations, compare with the experimental data in order:

  - To repeat any simulation with other data libraries (particle induced, DD and FYs) : JEFF-3.3, ENDF/B-VIII.0, JENDL/Impact, TENDL-2019, etc.

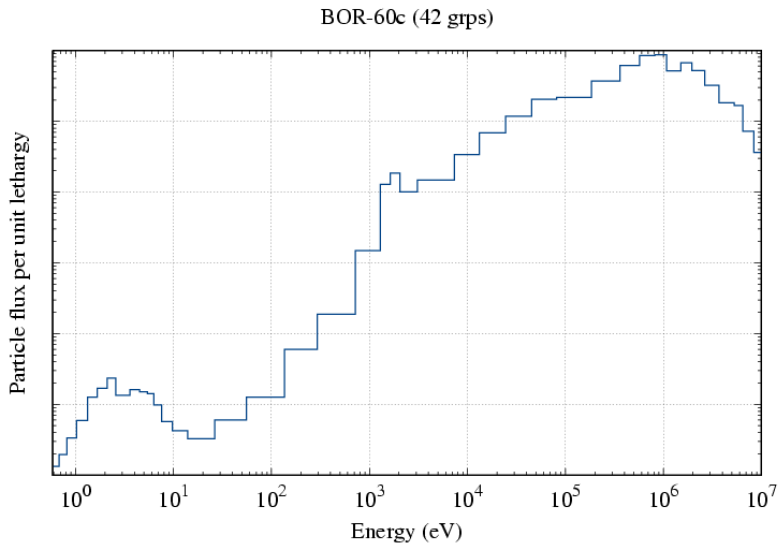
  - To repeat any simulation with other code system:
    - Boltzmann solvers: MCNP6, TRIPOLI4, OpenMc, SERPENT,…
    - Bateman solvers: FISPACT-II, ORIGEN,…

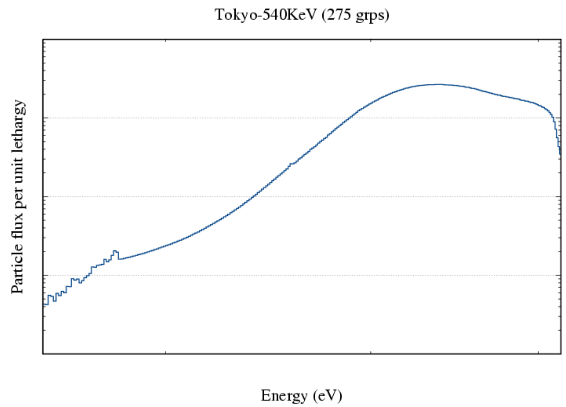
Progress

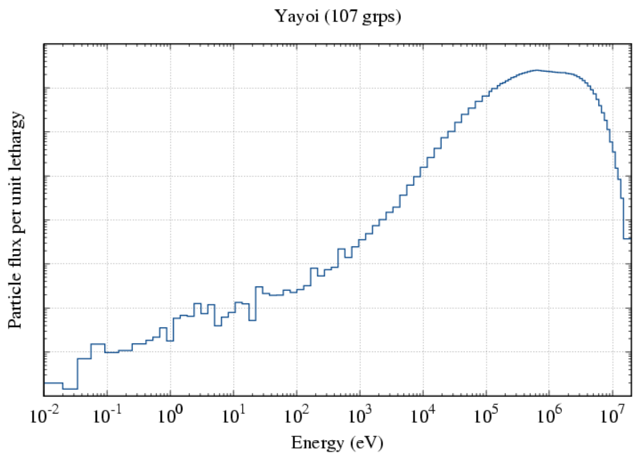
- Spectra ✔
- Spectral indices, reaction rates ✔
- Decay heat
  - Fusion events ✔
  - Fission events in progress
- Integral indices ✔
- Integro-differential validation in progress
- …
- Transport – shielding new
  - Aspis Iron 88
  - TIARA
  - …

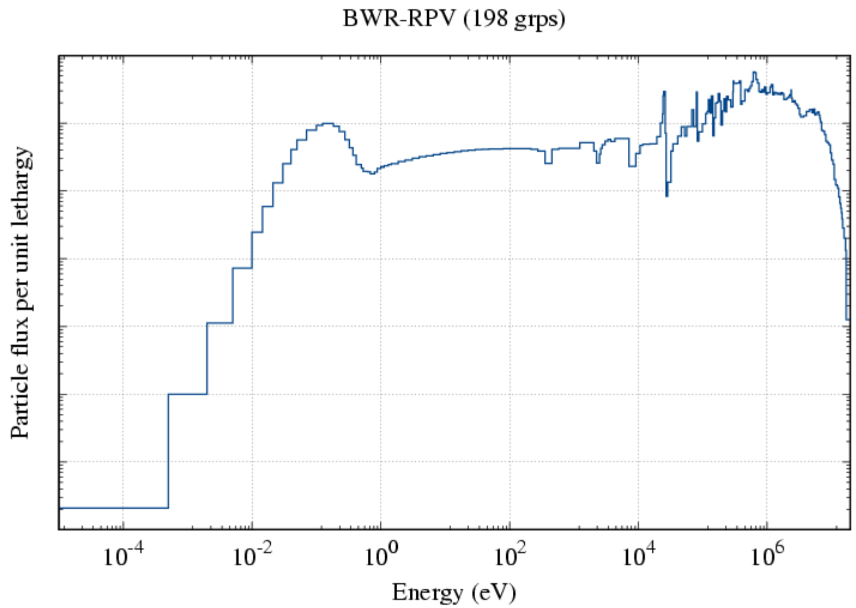
Progress: spectra

- Assemblage of a collection of diverse neutron spectra that have been used in experiments and studies of integral quantities; 85 so far ranging from thermal to high energy







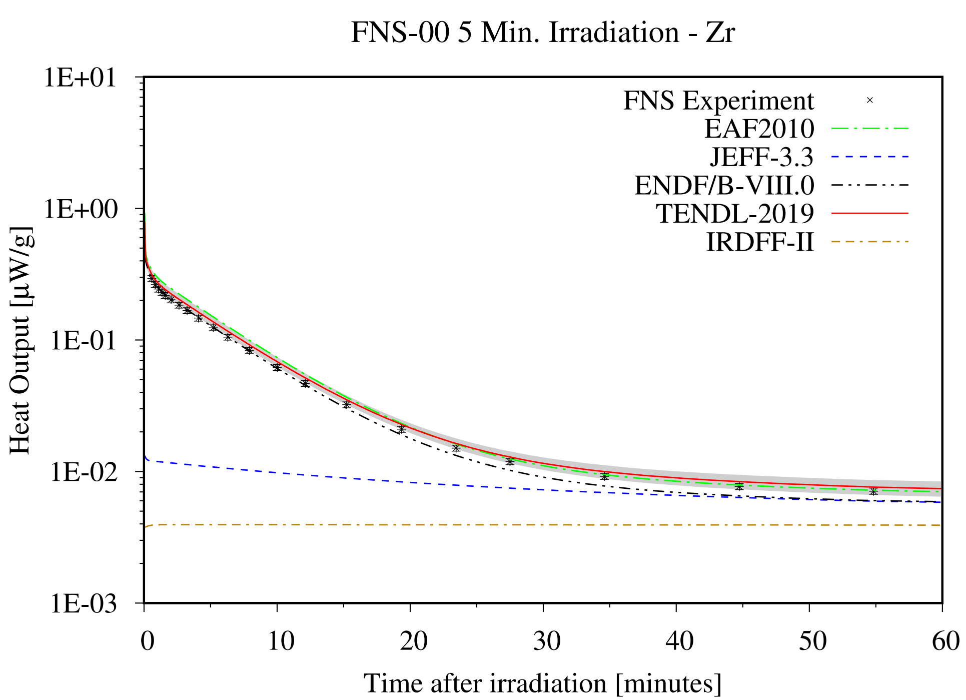


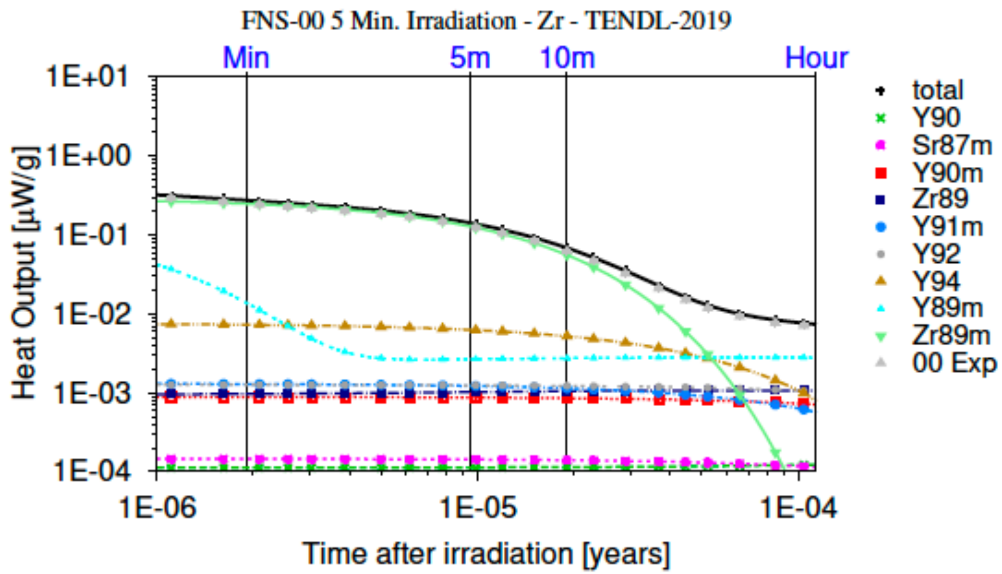
Progress: spectral indices, reaction rates

- A review of the ICSBEP and IRPhEP handbooks as well as other sources such as IAEA TRS No 480 (Research Reactor Benchmarking Database: Facility Specification and Experimental Data) has allowed to determine a variety of critical experiments with reaction rates, spectral index
- Thirteen identified so far, more to come, now available as MCNP6 input decks, outputs results simulated with ENDF-VIII.0 and TENDL-2019
  - Converging reaction rates is much more demanding than simple Keff's simulation: usually 50M, 250M, histories when in fact 1B and 5B histories may be needed for RR
- The same set is in the making with TRIPOLI4
- Deeper review, scouting for gems is continuing

Progress: decay heat

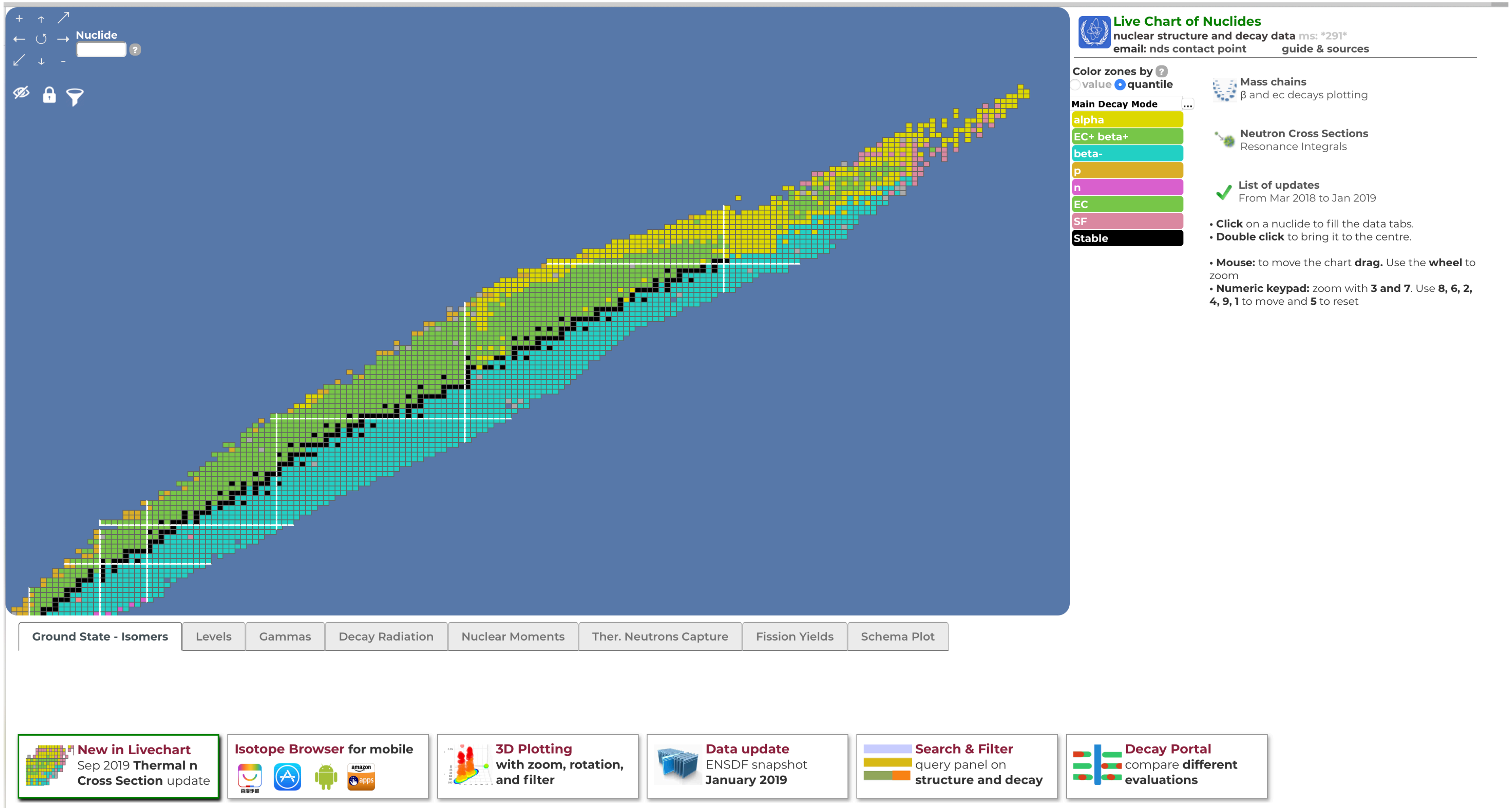
- JAEA FNS, fusion events
- Decay heat validation, FISPACT-II & TENDL-2019, EAF-2010, ENDF/B-VIII.0, JEFF-3.3 and IRDFF-II nuclear data libraries
- All data streams and results from the 83 different samples irradiated at JAEA FNS have been compiled, assembled and tested. Direct computational access on-line.





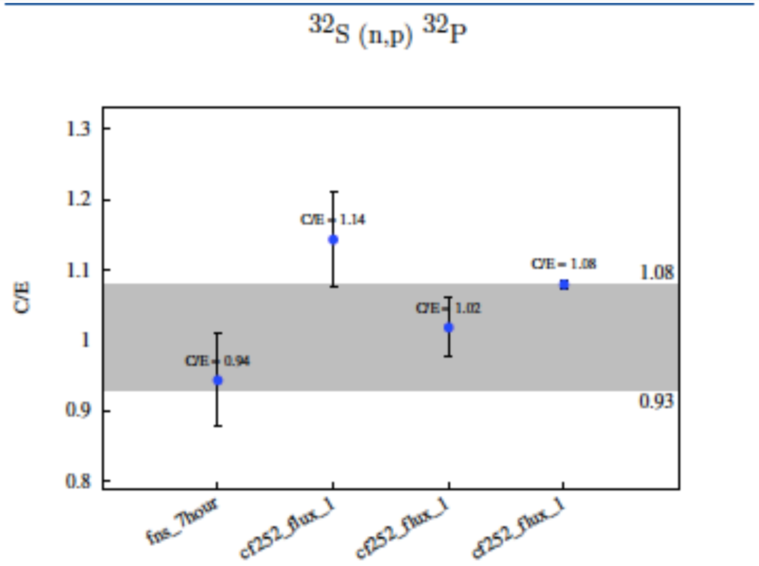
Progress: integral

- **New compilation from EXFOR**, with data from S.F. Mughabghab in Atlas of Resonances (6th ed.); N.E. Holden in Handbook of Chemistry and Physics 99Th Edition; I. Dillmann, R. Plag, F. Käppeler and T. Rauscher in KADoNiS v0.3; J. Kopecky in UKAEA-R(15)30.

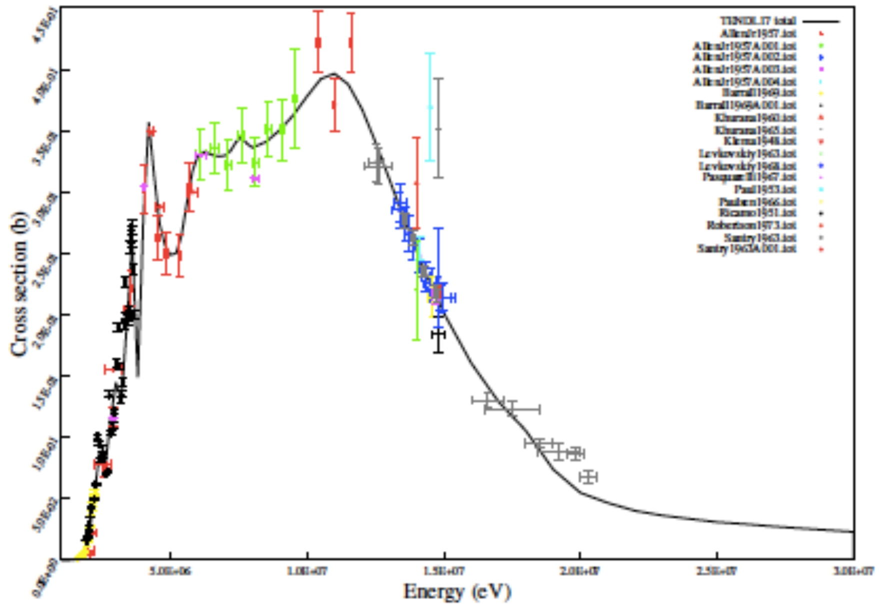


Future works

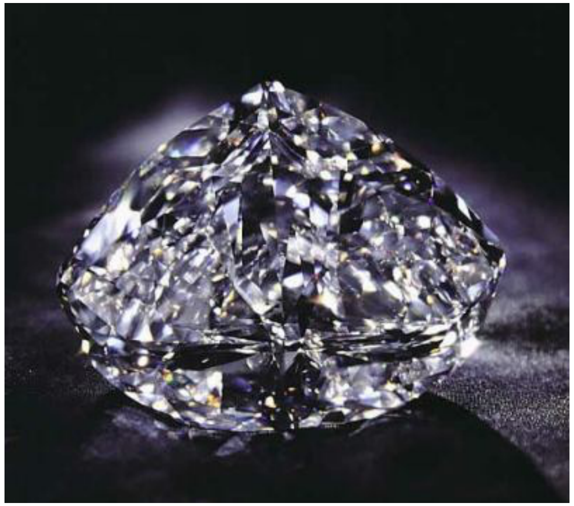
- Decay heat; pulse fission event
- Integro-differential validation
- ….



Author, Institute	Nuclide(s)	Method	Irrad. (s)	Year
Fisher, LANL	$^{232}Th_f$, $^{233}U_f$, $^{235}U_f$, $^{238}U_f$, $^{239}Pu_f$	γ	< 1	1964
McNair, UKAWRE	$^{235}U_{th}$, $^{239}Pu_{th}$	β	10-1E5	1969
MacMahon, SRRC	$^{235}U_{th}$	β	10-1E4	1970
Scobie, SRRC	$^{235}U_{th}$	β	1E4-1E5	1971
Lott, CEA	$^{235}U_{th}$	Total	1E2-5E3	1973
Yarnell, LANL	$^{233}U_{th}$, $^{235}U_{th}$, $^{239}Pu_{th}$	Total	2E4	1978
Jurney, LANL	$^{233}U_{th}$, $^{235}U_{th}$, $^{239}Pu_{th}$	γ	2E4	1979
Murphy, UKAEA	$^{235}U_f$, $^{239}Pu_f$	β	1E5	1979
Dickens, ORNL	$^{235}U_{th}$, $^{239}Pu_{th}$, $^{241}Pu_{th}$	γ & β	1-100	1980
Baumung, Karlsruhe	$^{235}U_{th}$	Total	200	1981
Akiyama, JAEA	$^{233}U_f$, $^{235}U_f$, $^{238}U_f$, $^{239}Pu_f$	γ & β	10-300	1982
Akiyama, JAEA	$^{232}Th_f$, $^{nat}U_f$	γ	10-300	1983
Johansson, Uppsala	$^{235}U_{th}$	γ & β	4-120	1987
Tobias Berkeley NL	$^{235}U_{th}$, $^{239}Pu_{th}$	Stat.	-	1989
Schier, UM Lowell	$^{235}U_{th}$, $^{238}Pu_f$, $^{239}Pu_{th}$	γ & β	<1	1997
Ohkawachi, JAEA	$^{235}U_f$, $^{237}Np_f$	γ & β	10-300	2002



Data mining: from raw to shaped diamond



Blue Zoe