Testing ENDF-VIII.1 beta1 / beta1.1 / phase1

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Mini-CSEWG
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Outline

- Translating, testing and processing ENDF-VIII.1 – beta1
- Initial tests on beta1.1
- Status of the latest ‘phase1’ evaluations

FUDGE processing starts by translating ENDF-6 into GNDS

- Translation for files in the beta-1 release mostly went well, with the exception of the α + Li6 evaluation
- a-003_Li_006.endf raises the question – *What's the right way to handle Be-8 breakup*?
- In VIII.1 beta-1, a-003_Li_006 evaluation includes Li6 (α,d) to g.s. and excited resonance in Be8, both followed by breakup to two alphas
  - Problem: MF6 lists both Be8 *and* two alphas as products. FUDGE flags this as not conserving Z and A.
  - In other such cases like B10 (n,t), only the outgoing alphas are listed (or special LR breakup flags like LR=22 are used). Be8 is not explicitly included.
- Recommendation: modify section 3.4 of ENDF manual to clarify whether intermediate products (before breakup) should be listed explicitly when LR=1 "complex breakup" flag is used.

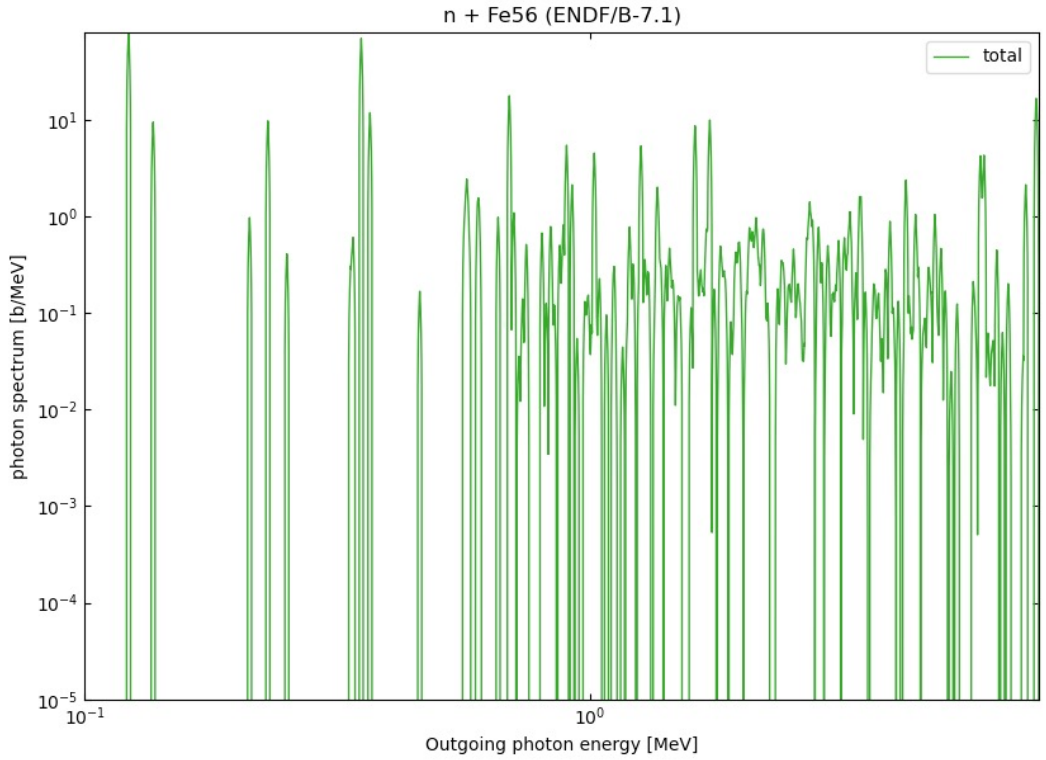
After translation, run some physics checks

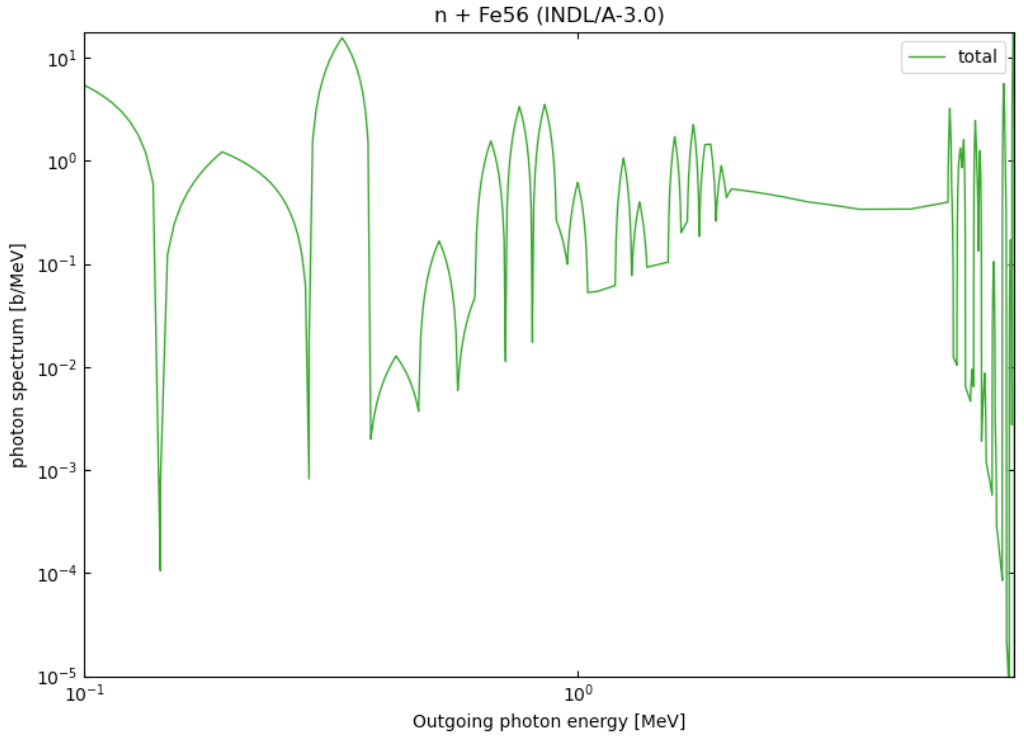
Issues encountered (not an exhaustive list):

- Detailed capture gamma spectra (e.g. for Fe56) that were overwritten in VIII.0 still need to be restored!
- Particle masses not consistent with AME or with tabulated Q-values (more detail in Bret's talk)
- Confusion about whether to include electron mass
  - ENDF manual section 0.5.1.1 states that electron mass should be included in AWR / AWP except for 'light' reaction products (p, d, t, h and α). Several new evaluations appear to include electron mass for light products
- Interpolation issue for Be9 (n,γ) cross section – partially fixed in beta-1.1
- Covariance issues – see Robert Casperson's talk on Thursday

Fe56 detailed capture gammas were lost in VIII.0 and have not been restored

- Compare thermal photon spectrum from VII.1 (left) to VIII.0 and VIII.1 (right)





Beta-1 was processed using FUDGE for Monte Carlo and deterministic transport codes

- Step 1 – process at room temperature only
- Step 2 – process neutron sub-library to 23 temperatures, from 300 K – 0.1 MeV/k
  - Thanks Gregory Potel for pushing these through!

- Main processing problem was with unrealistic masses, especially for heavy residuals in MF=6 LAW=1 LANG=2 Kalbach-Mann distributions
  - Merced code (for generating transfer matrices) includes a sanity check on particle masses

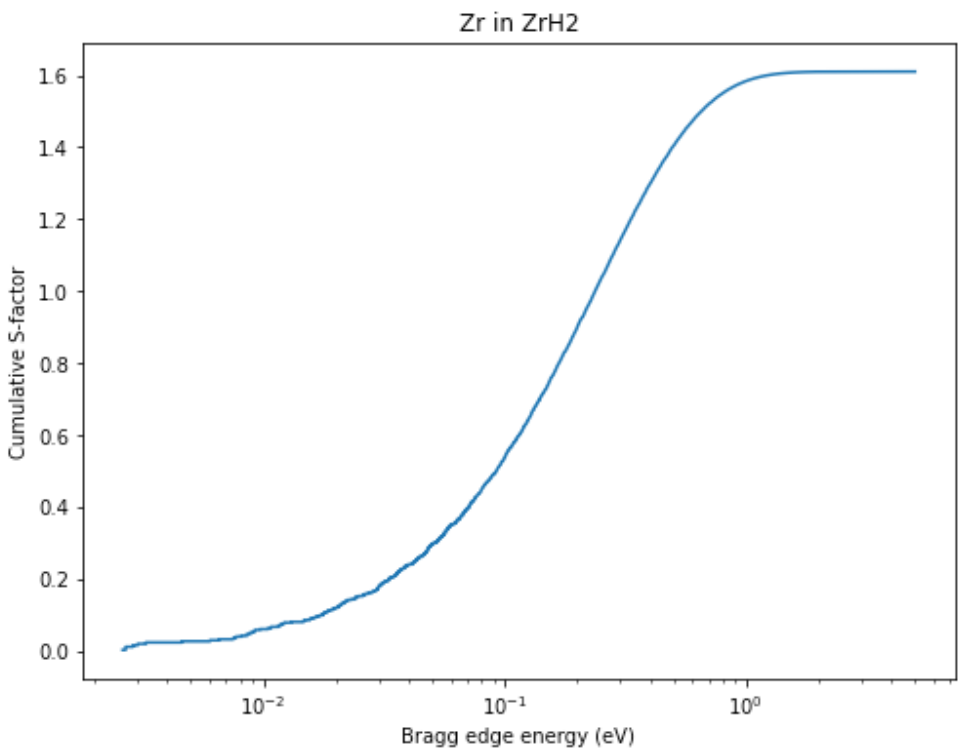
- Tested using LLNL V&V Suite **Metis** – more details from Marie-Anne Descalle on Wednesday

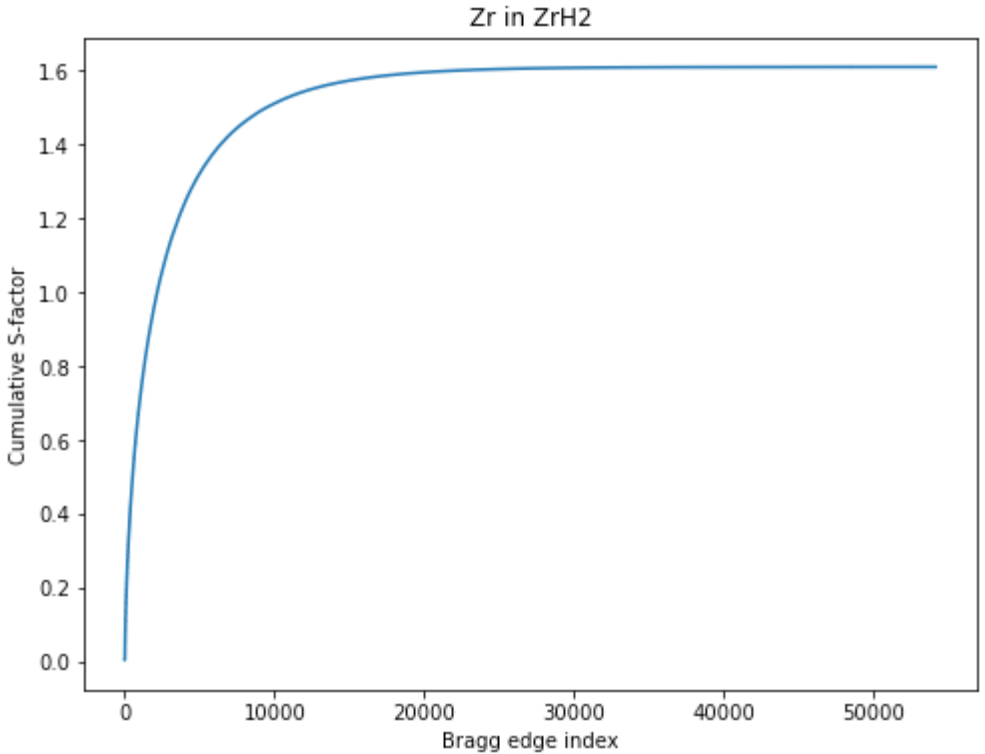
Brief overview of Beta-1.1

- Interpolation issue in n + Be9 was partially fixed, but (n,total) also needs to use log-log interpolation at low energies to get correct 1/v behavior
- Four new TNSL evaluations fail ENDF – GNDS translation
  - Incoherent elastic data in CinC5O2H8 and OinC5O2H8 have temperatures out of order: first room temperature, then 20 K, 77 K, 196 K, etc. Temperatures should be in ascending order in TAB1
    - See issues #76 and #77 on https://git.nndc.bnl.gov/endf/library/thermal_scatt
  - Wrong format for evaluation dates in CinCF2 and FinCF2 (dates overlap with 'AUTH' section)
    - Fixed on 'phase1' branch

Attempted processing beta1.1 TNSL files at room temperature (skipping cryogenic / hot materials for the moment)

- Several new evaluations have very detailed coherent elastic cross sections, with 5,000 to 55,000 Bragg edges
  - Including Be and O in BeO, Ca in CaH2, Si and O in SiO2-alpha, U metal, Be metal, ZrH2
  - Problem: ENDF-6 stores the *cumulative* S-factor below each Bragg edge, but with only 8 or so significant digits the impact of many of these Bragg edges is lost ($\Delta S < 1e\text{-}8$)





Status of the bleeding edge (phase1 branch as of Friday Apr. 21)

- Neutron sub-library: 2 GNDS translation failures
  - La-139 and U-233 both have inconsistencies between MF=2 and MF=32 resonance parameters
  - See issues #436 and #437 at https://git.nndc.bnl.gov/endf/library/neutrons/-/issues
- Gamma sub-library: 4 translation failures
  - Three evaluations (N14, O16 and Al27) list products not consistent with MT number
  - Tm169 has MF=12 but no corresponding MF=3 for several MTs in range 600 – 850
  - See issues #11 and #12 at https://git.nndc.bnl.gov/endf/library/gammas/-/issues
- TNSL issues with O and C in C5O2H8, mentioned on prior slide

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