Lawrence Livermore National Laboratory

New LLNL evaluations of ^{237}U, ^{240}Am and structural materials

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New tools developed for creating evaluations

geft

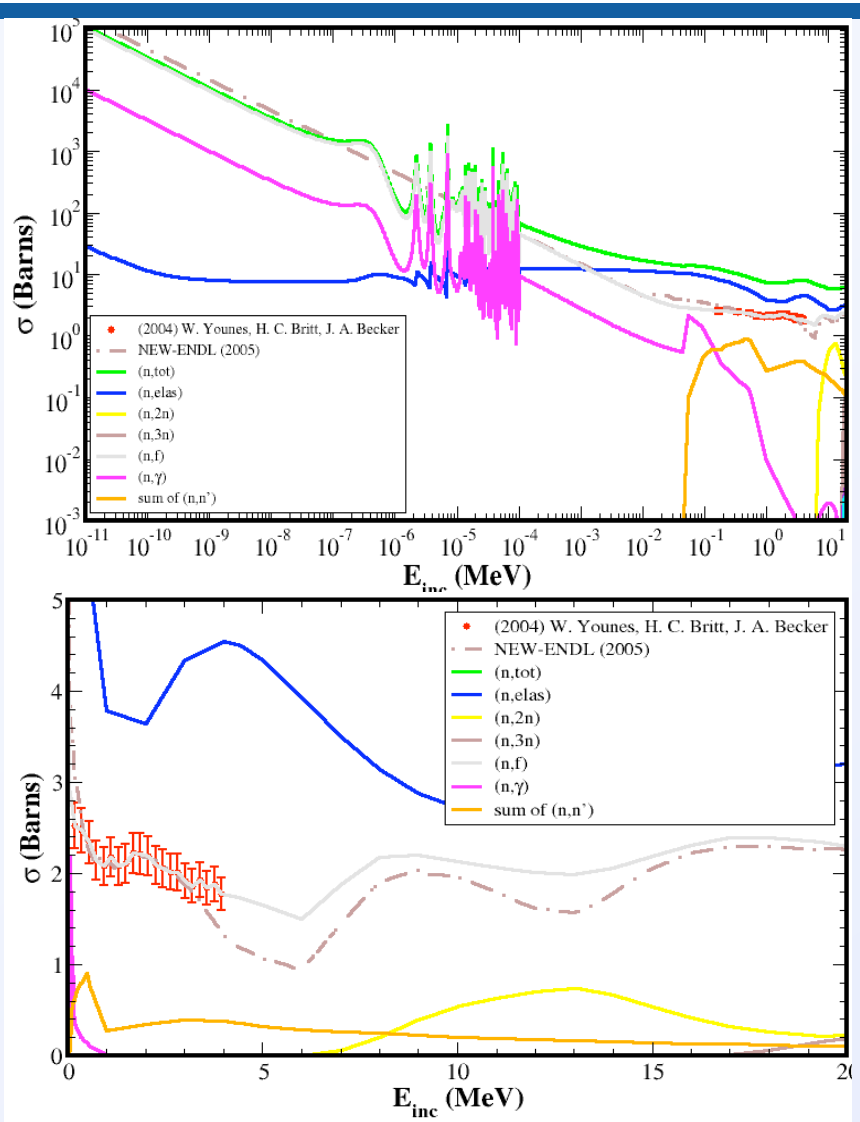
- Set of python widgets to convert output of TALYS to ENDL format
- Can create ENDL files for
  - Channel cross sections and particle spectra
  - Inelastic and binary cross sections and angular distributions
  - Gamma multiplicities, continuum and discrete spectra

endl2endf

- Can read in an ENDF evaluation and chop it into channels
  - Allows copying untranslated ENDF sections between evaluations
  - ENDL has no equivalent for several reaction types (e.g. resonance region)
- Can reformat any ENDL data type into ENDF

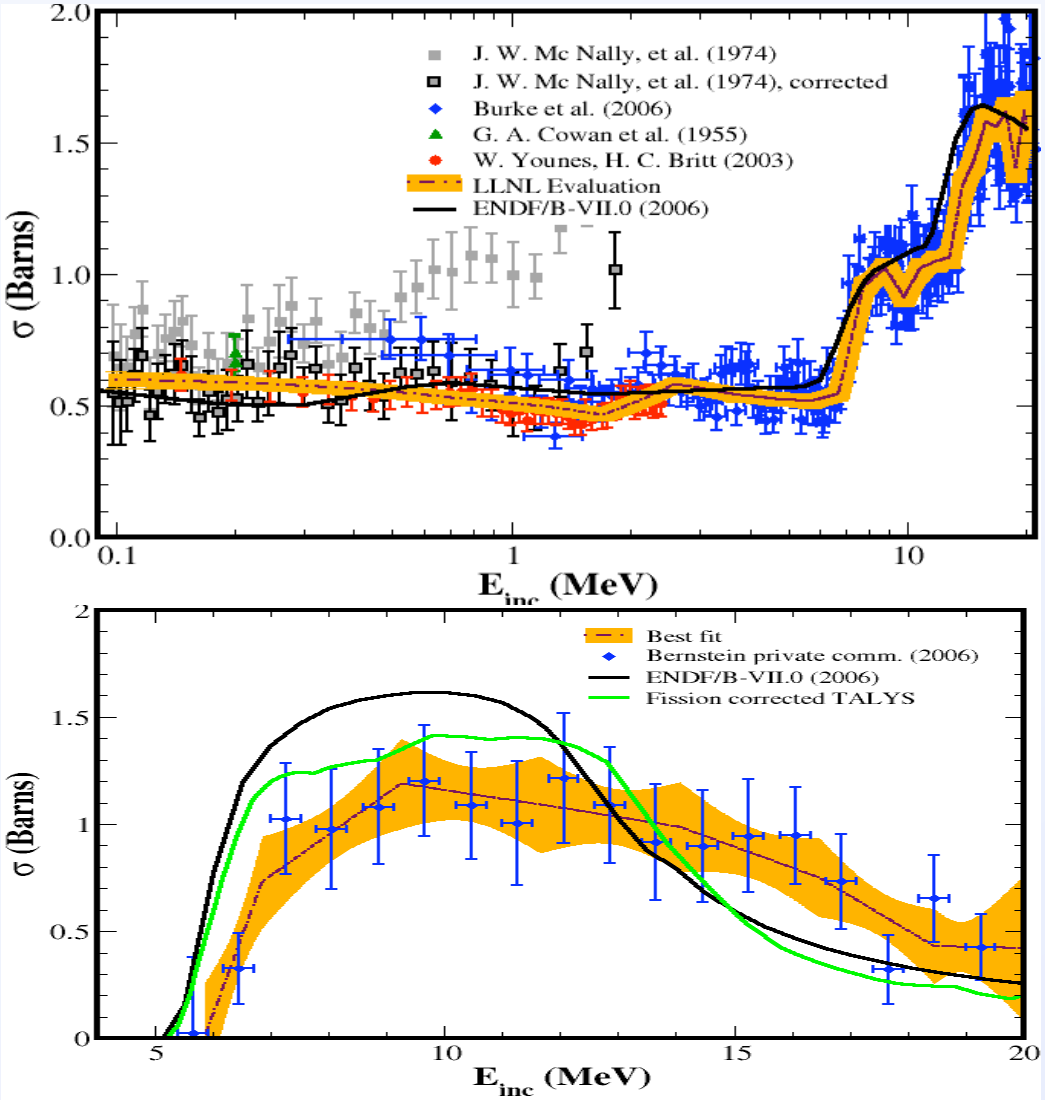
Using combination of these tools, can create evaluations using TALYS and produce data in both ENDL and ENDF formats

^{240}Am evaluation



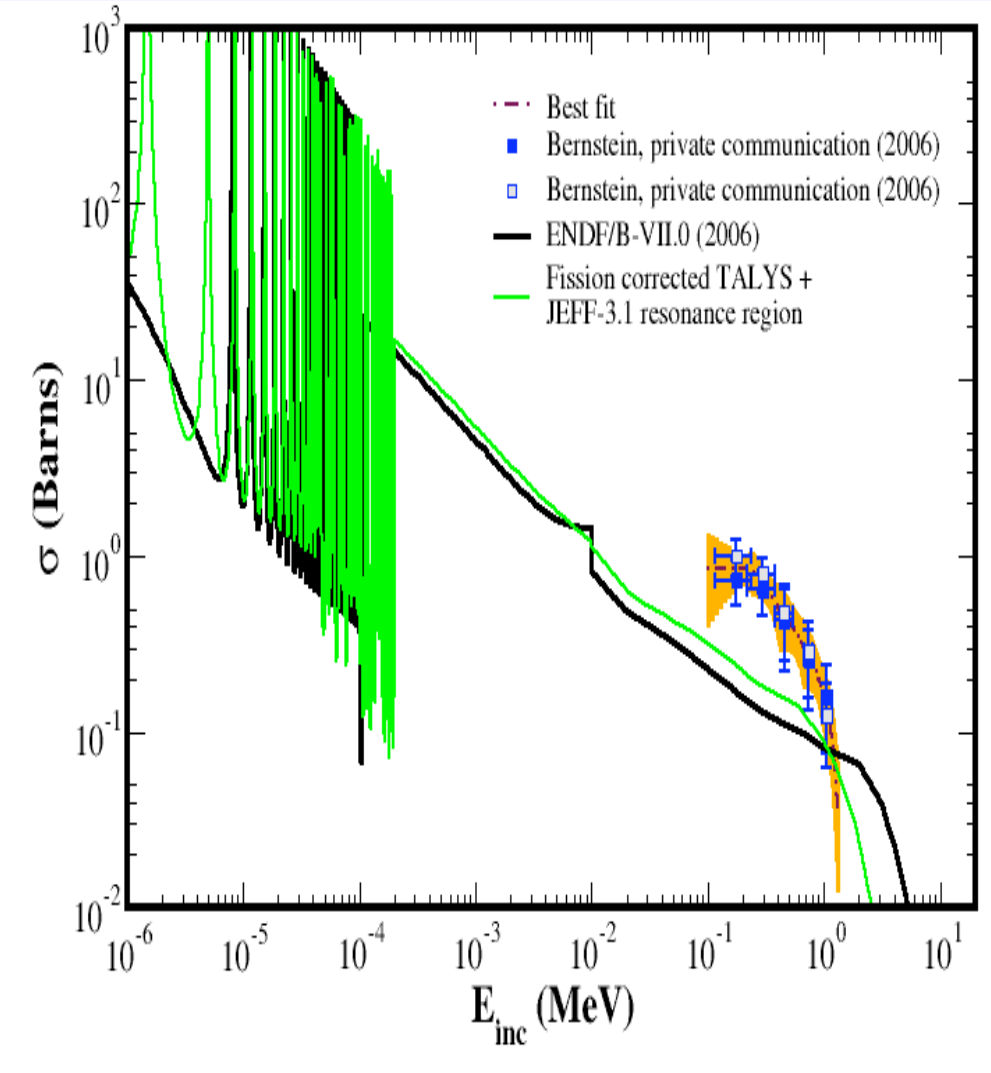
- Used TALYS + geft.py + endl2endf.py
  - Soukhovitskii, Chiba et al. OMP
  - real coupled channel calc.
  - RIPL levels, masses, etc.
- Resonance data, ν and fission spectrum from ^{242}Am evaluation in ENDF/B-VII.0
- *Everything else* from TALYS:
  - σ's
  - spectra
  - γ's
  - angular distributions
- We tuned cross-sections:
  - swap in Younes, Britt (n,f) evaluation based on surrogate (t,pf)
  - match σ's onto resonances

New ^{237}U evaluation based on surrogate data shows important differences with previous estimates



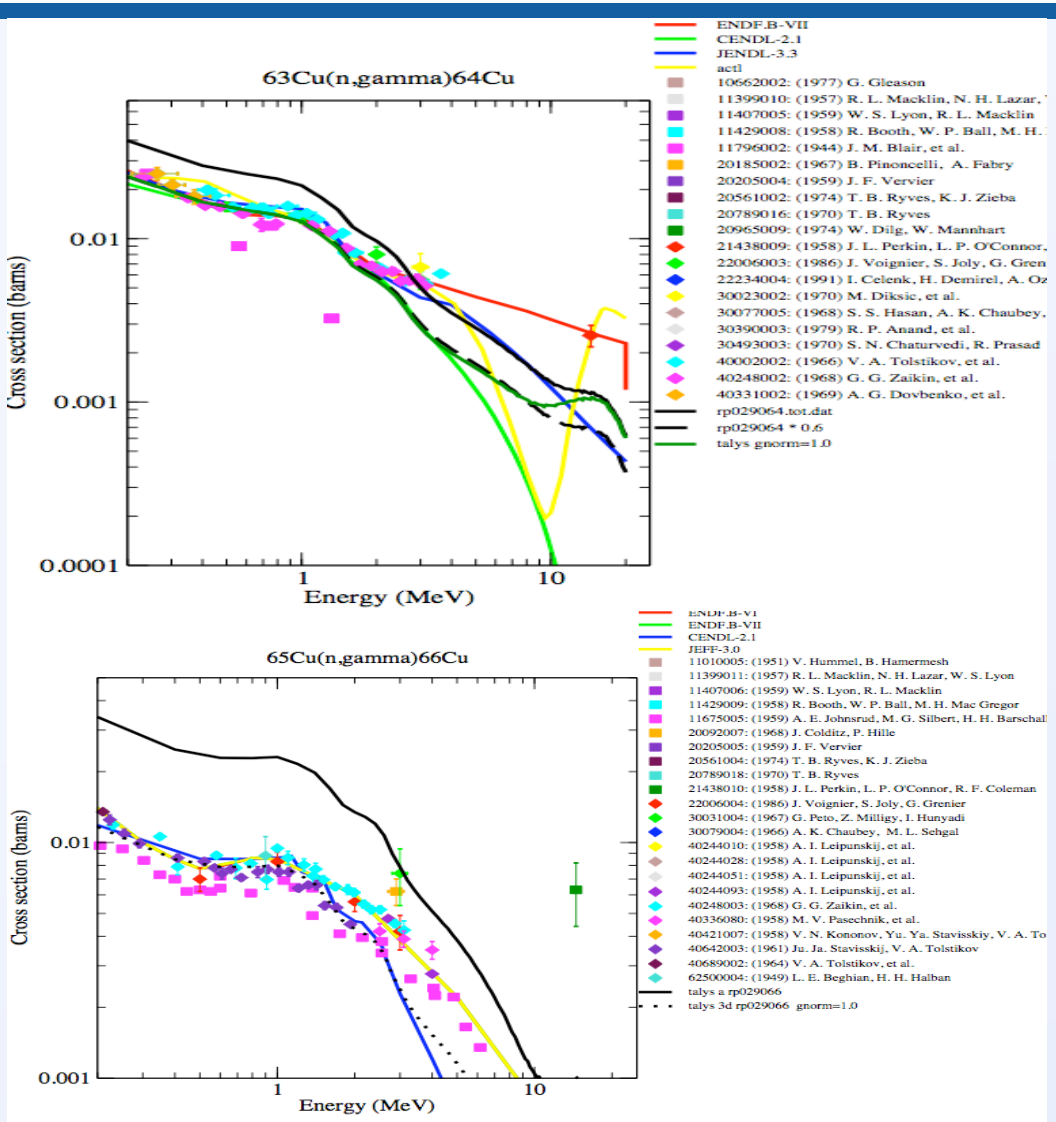
- Hauser-Feshbach modeling w/ TALYS
- Can't model fission, need other scheme:
  - Fit to $\sigma_{(n,f)}$
  - Scale other TALYS σ's so consistent with $\sigma_{(n,f)}$ and non-elastic σ
- Outgoing particle distributions from TALYS
- Resonance data, ν, and fission spectrum, γ data from JEFF-3.1
- Matches LLNL surrogate (n,f), (n,2n)

We have not attempted to match surrogate (n,γ) data



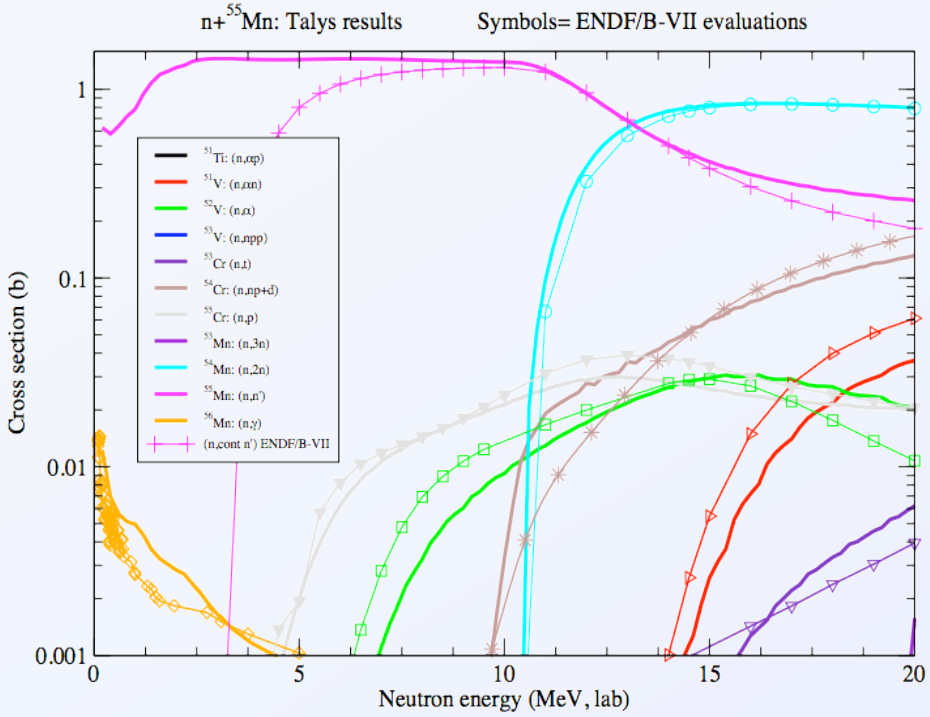
- Preliminary data of Bernstein *et al.* (2007)
- Could match by increasing
  - γ-ray strength function
  - absorption cross-section
- Important experimental questions yet to be resolved

Structural Materials - $^{62\text{-}66}$Cu

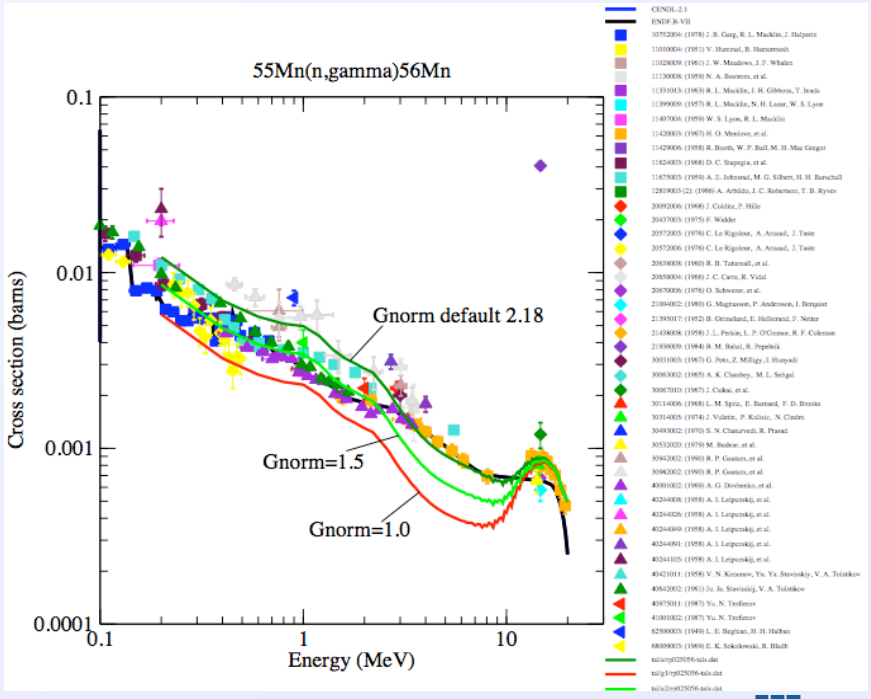


- TALYS calculations for Cu isotopes overall fit data well
- Data only for odd isotopes: need to set gamma strength function (G_{norm}) to 1 to fit data (default behavior of scaling to fit GDR produced poor fits)
- Need method to produce resonance data

Structural Materials - ^{54,56,57}Mn

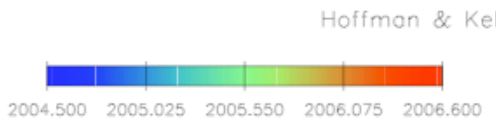


- TALYS calculations satisfactory except for (n,γ) (a 'small' cross section)
  - cannot fit E<3, 3<E<12 and 12<E<15 all at the same time by scaling G_{norm}

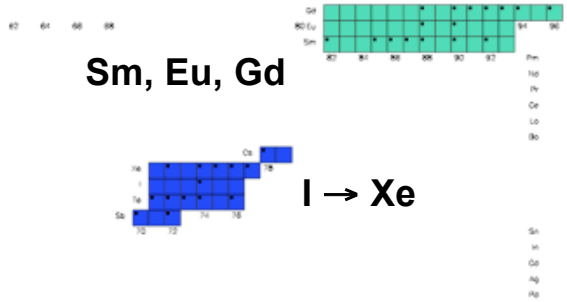


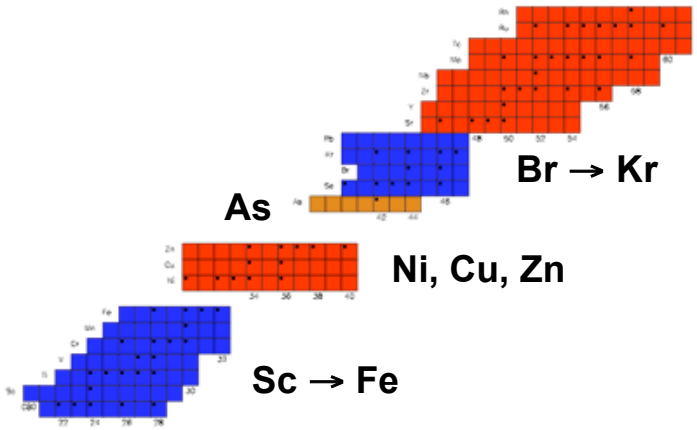
- ENDF/B-VII satisfactory everywhere
  - except perhaps GDR in (n,γ)

Hoffman radchem activation library



- Radchem library from 2004-2006 has activation cross sections for 497 reactions
  - n,p,d incident on a range of targets from Sc to Gd





- Using geft/endl2endf can fill out evaluations to include particle spectra, elastic and inelastic cross sections and angular distributions
- TALYS used to calculate needed cross sections, renormalized to radchem library calculations from STAPRE
- Filled-out evaluations can then be used in transport codes (MCAPM)