



LANL FPY Summary

A.E. Lovell, T. Kawano, P. Talou, A.M.
Lewis, G. Rusev

CSEWG, January 6, 2026

LA-UR-25-30667

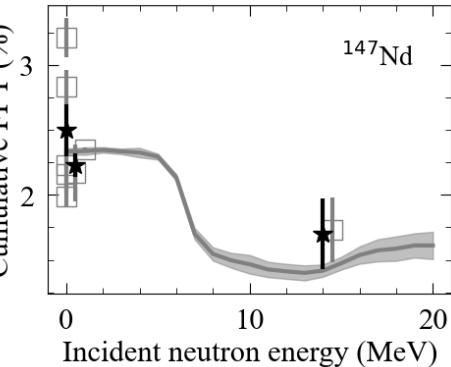
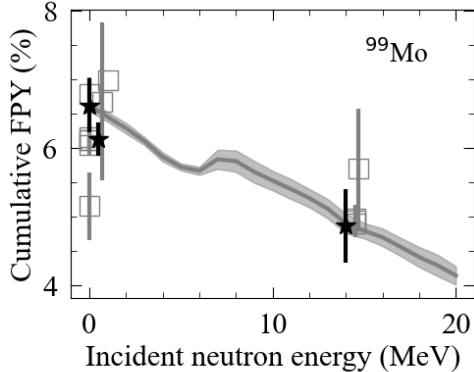
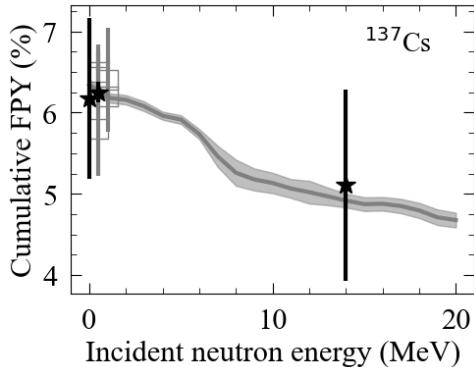
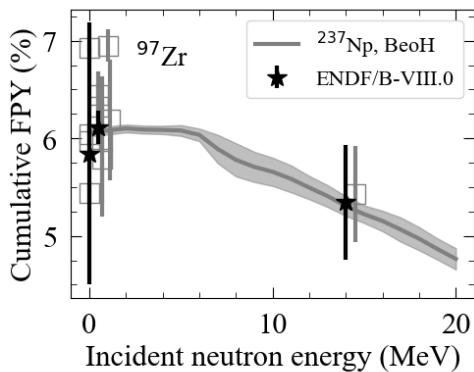
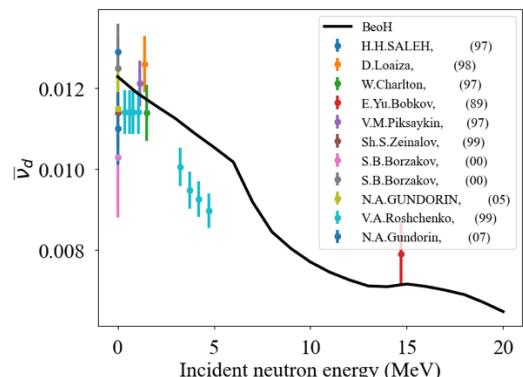
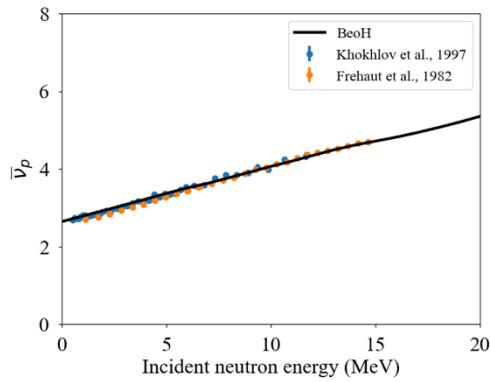
Recent LANL FPY work has focused on two topics

- FPYs for minor actinides
 - $^{237,238}\text{Np}$
 - $^{241,242\text{m},243}\text{Am}$
- More rigorous V&V for major actinides
 - Revisiting sensitivities and uncertainty propagation
 - Automatic file checks (format and physics)
 - Propagation of full (FPY & energy) covariances

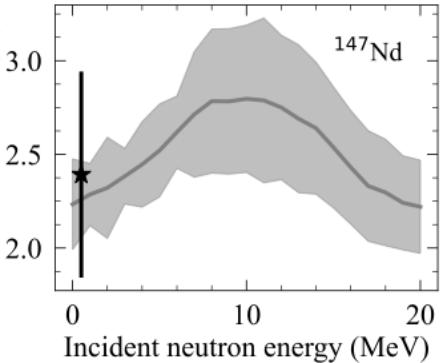
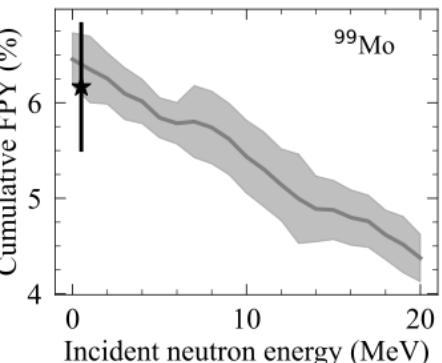
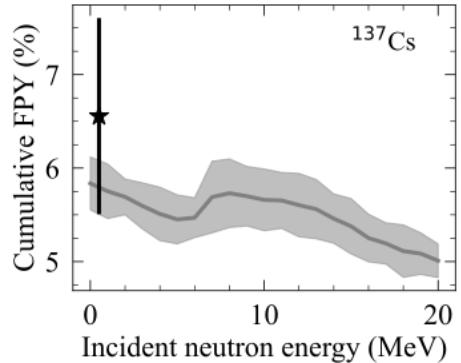
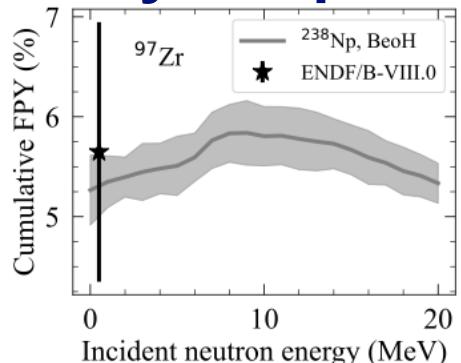
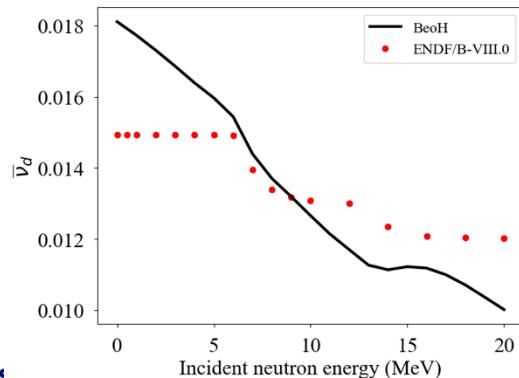
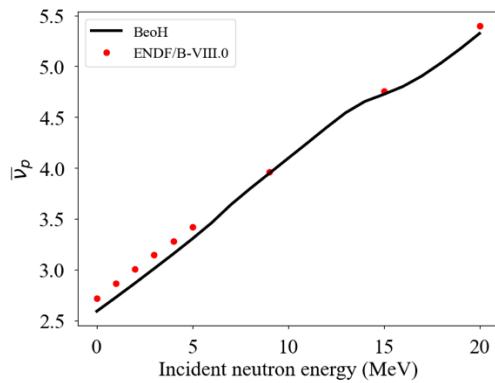
Reminders:

- Using BeoH to consistently calculate independent and cumulative FPYs with other fission observables
- Specifically constrain cumulative FPYs, prompt and delayed nubar
- Kalman filter for optimization and covariance creation

^{237}Np has a significant amount of data that can be included in the optimization



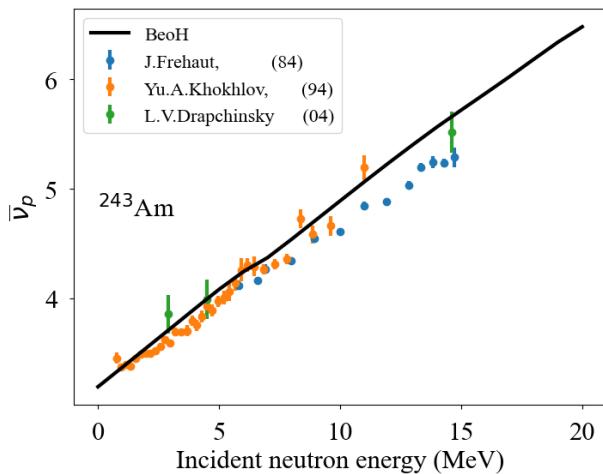
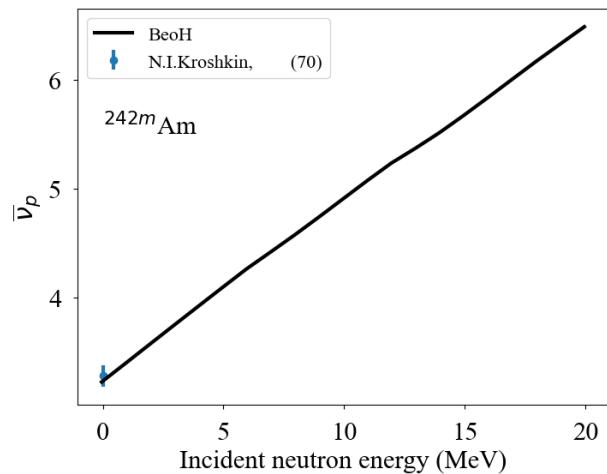
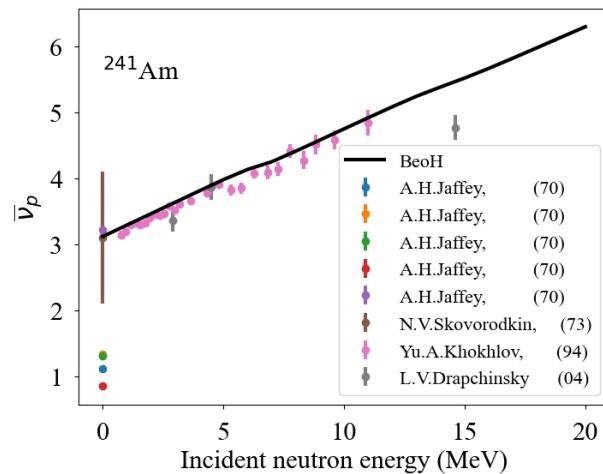
^{238}Np lacks much experimental data but model parameters are constrained by ^{237}Np



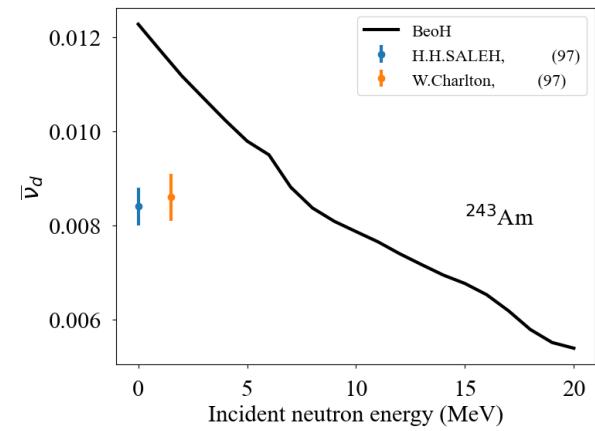
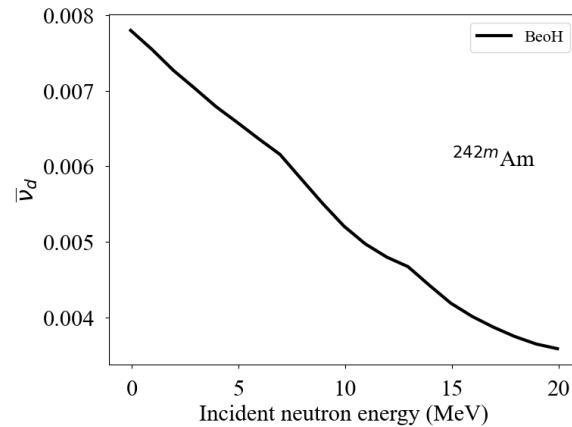
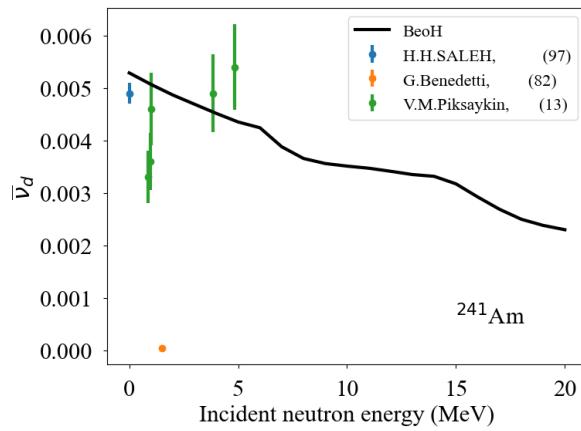
Most Am isotopes have little experimental data, especially as a function of incident neutron energy

- We use our $^{239}\text{Pu}(n,f)$ parametrization to make predictions for FPYs on $^{241,242\text{m},243}\text{Am}$
- Kinetic energy parametrizations are updated to reproduce available prompt neutron multiplicity data
- Discrepancies in predicted FPYs compared to experimental data can provide feedback to our ^{239}Pu energy dependence

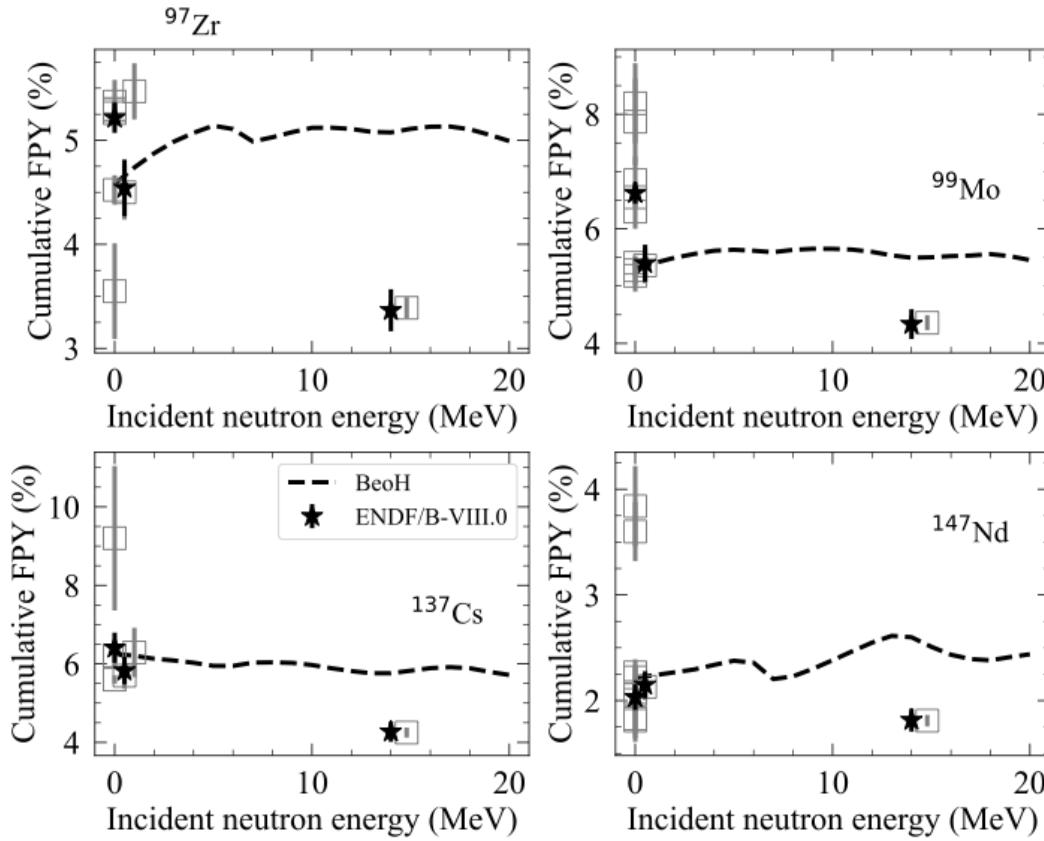
Average prompt neutron multiplicity



Average delayed neutron multiplicity

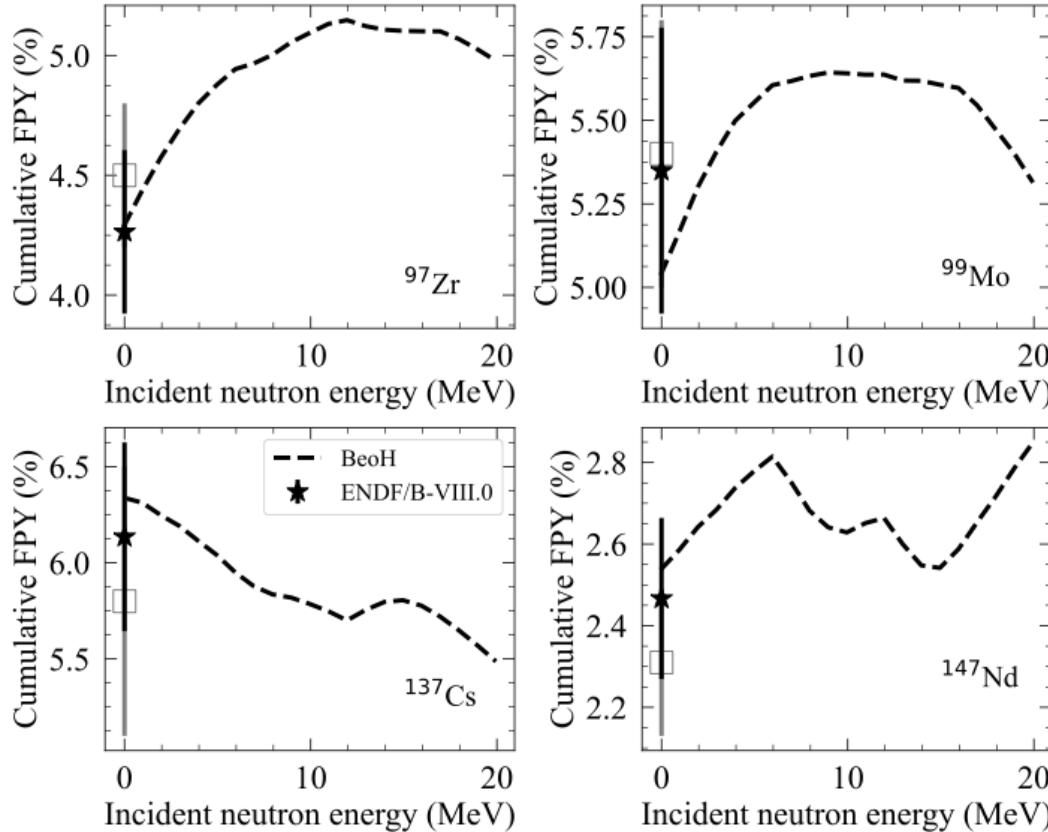


^{241}Am cumulative FPYs

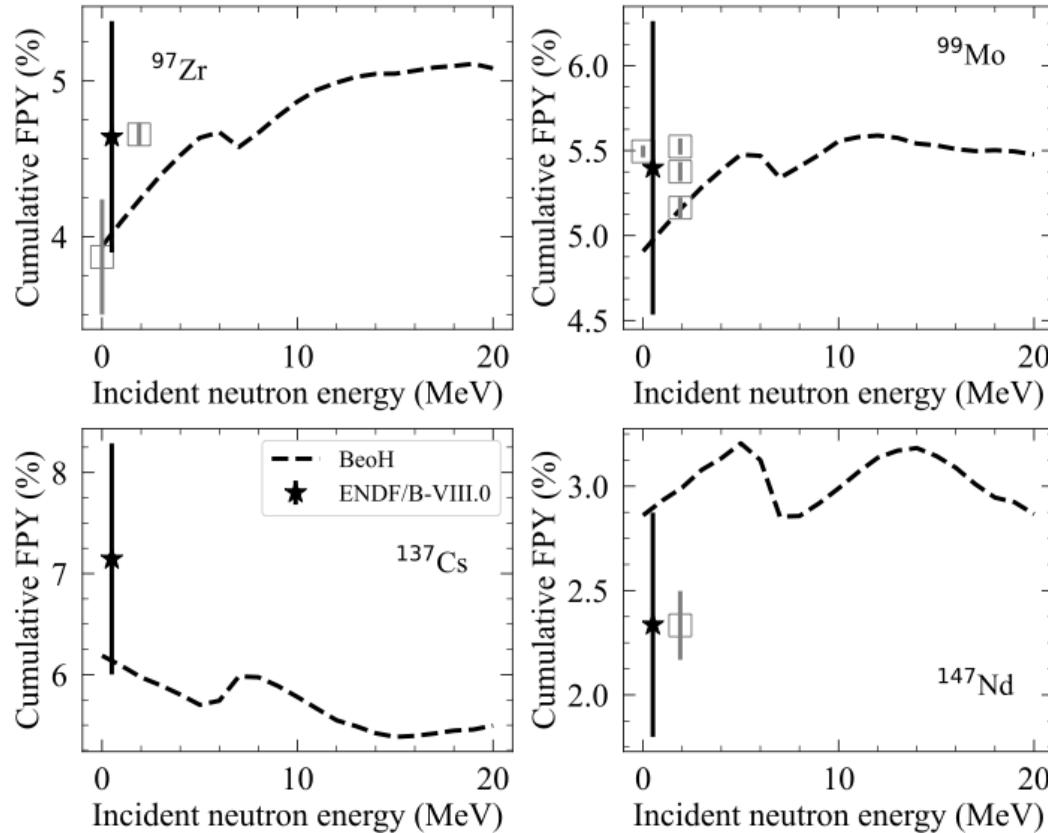


^{242m}Am cumulative FPYs

^{242}Am ground state calculations can also be performed by changing the incident neutron energy



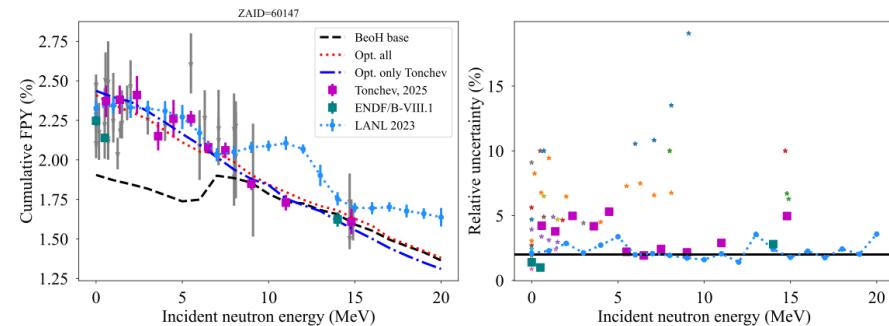
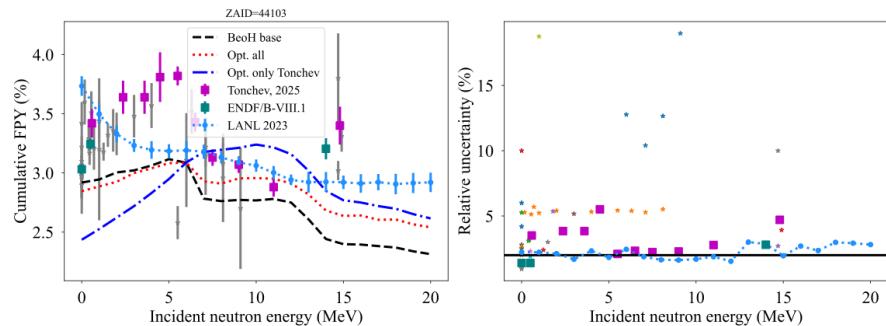
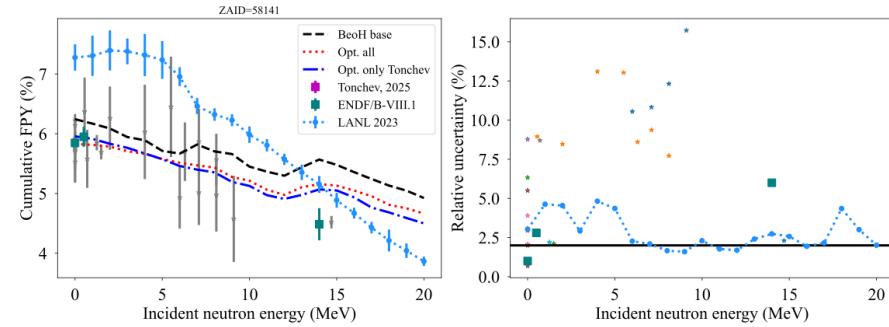
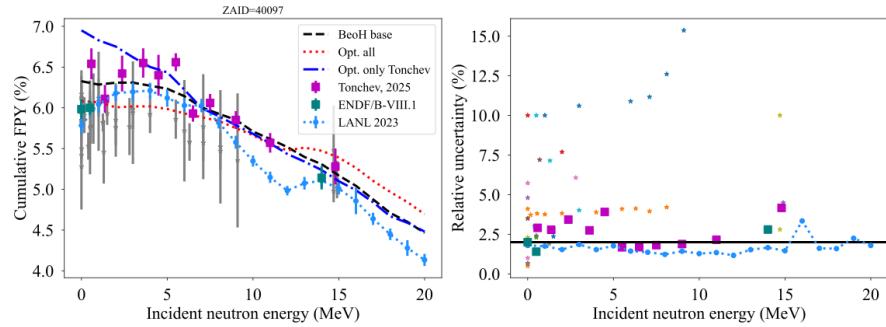
^{243}Am cumulative FPYs



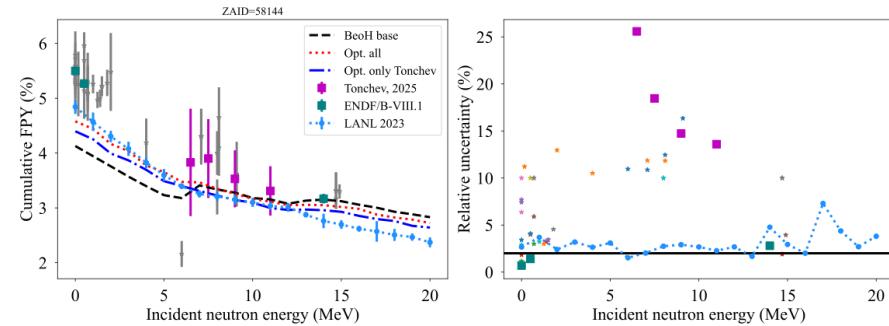
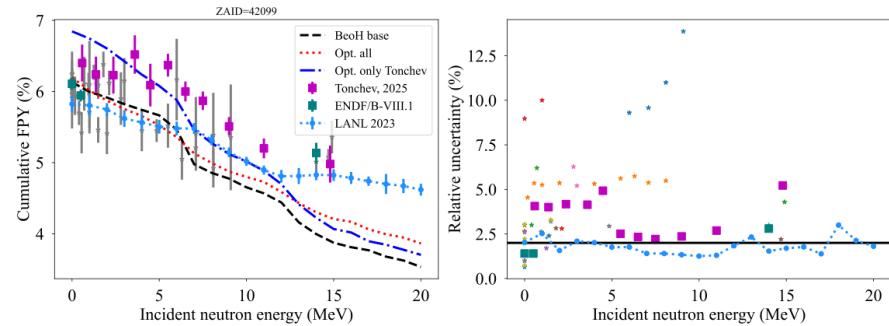
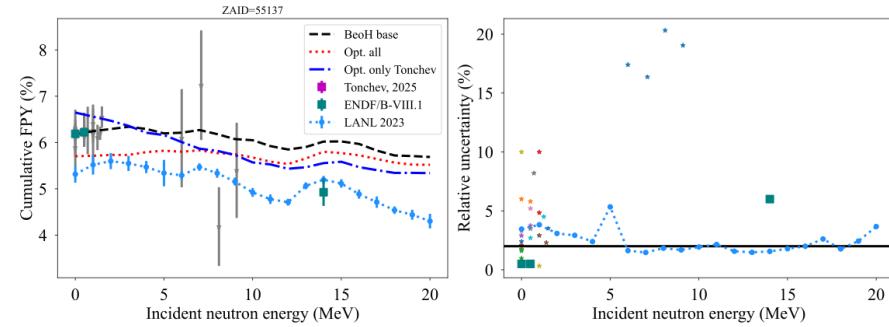
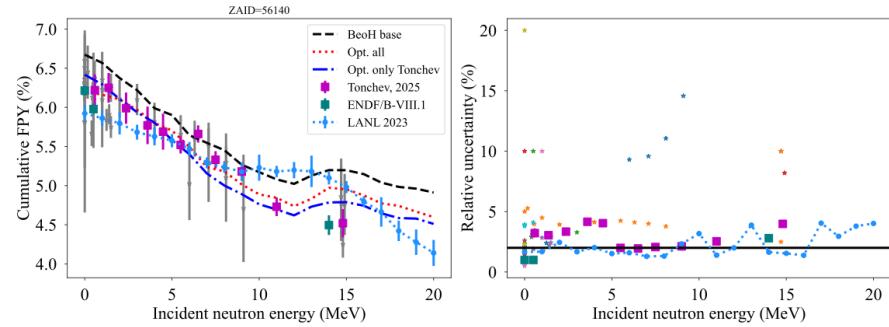
New V&V efforts are being applied to major actinides

- New, robust V&V efforts (Talou and Lewis) identified non-physical values in previous LANL internal ENDF files, which led to investigations into the non-linearities in the model sensitivities
- New optimization method has been implemented which avoids these issues
- Impact of full energy-FPY covariances will be shown (Thursday AM)
- New format for FPY covariances presented (Wednesday AM)

^{235}U cumulative FPYs



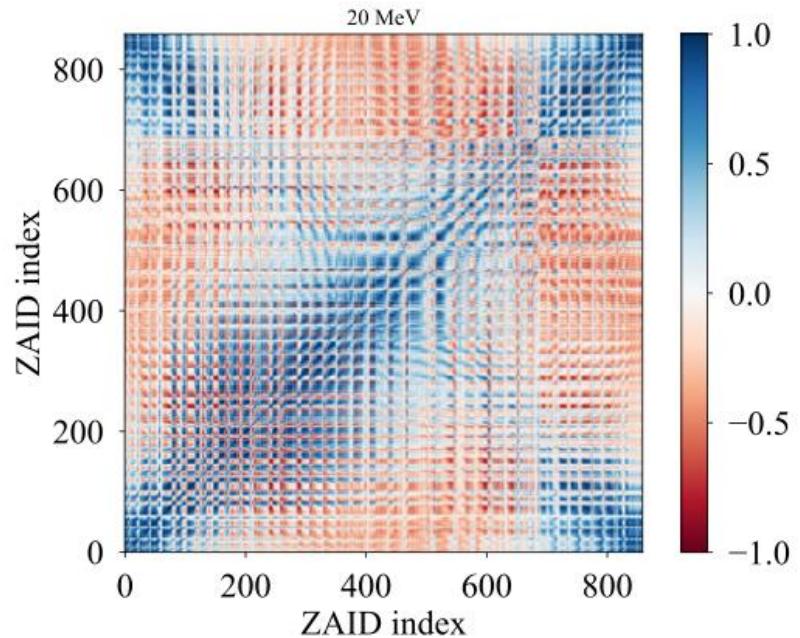
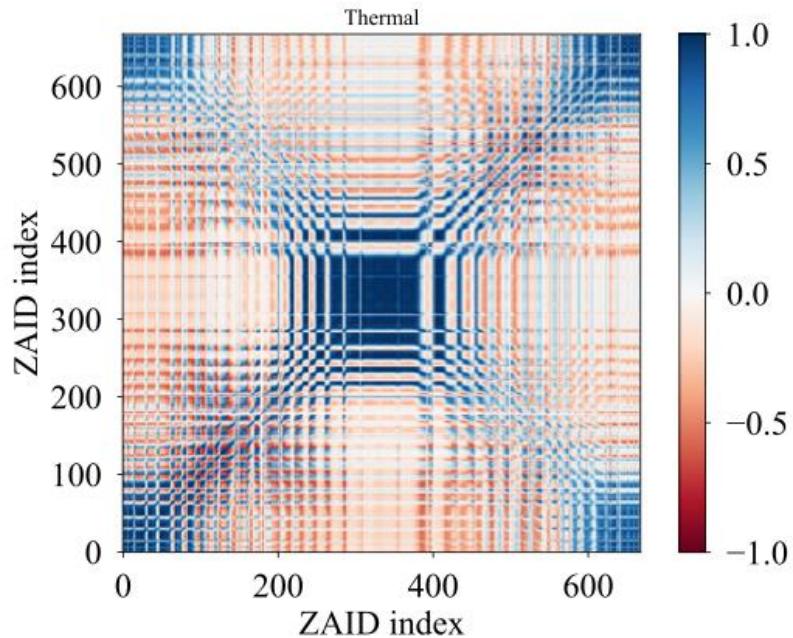
^{235}U cumulative FPYs



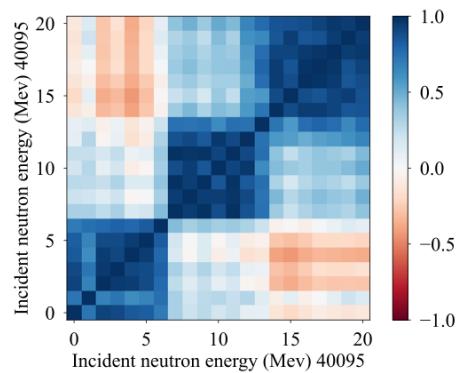
Conclusions

- Minor actinide FPYs can be constrained using available experimental data (if it exists or is very limited) combined with parametrizations of near-by nuclei (e.g. $^{239}\text{Pu} \rightarrow \text{Am}$ isotopes).
- Updated optimization techniques are being explored to better take into account non-linearities in our model (with the expectation that we will still have to do some modification in a post-processing step).
- Robust V&V procedures are being put into place.
- Covariance demonstrations and formats are coming this week (Wednesday AM and Thursday AM).

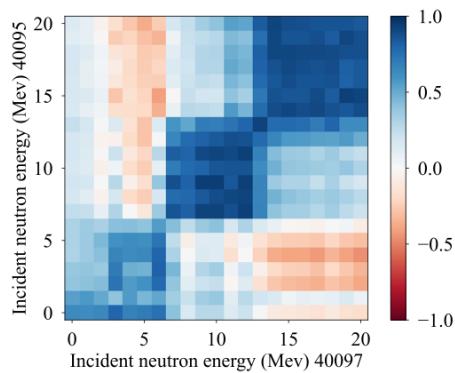
Correlations between cumulative FPYs at different incident neutron energies, $^{235}\text{U}(\text{n},\text{f})$



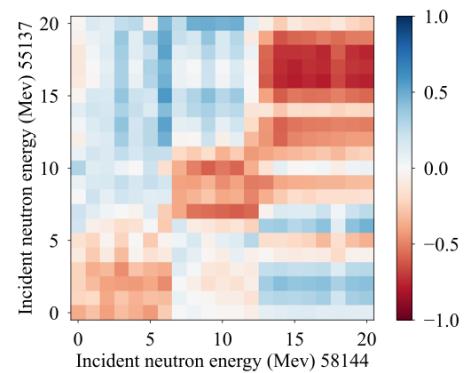
Most cross-energy correlations show distinct block structures for different fission chances



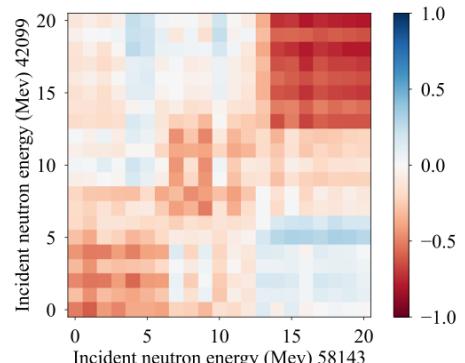
$^{95}\text{Zr}-^{95}\text{Zr}$



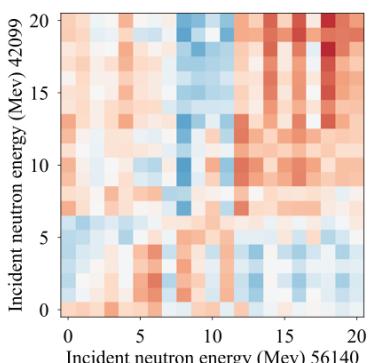
$^{95}\text{Zr}-^{97}\text{Zr}$



$^{137}\text{Cs}-^{144}\text{Ce}$



$^{99}\text{Mo}-^{143}\text{Ce}$



$^{99}\text{Mo}-^{140}\text{Ba}$