Doing Depletion Diligently: Best Practices for Depletion Calculations with Origen

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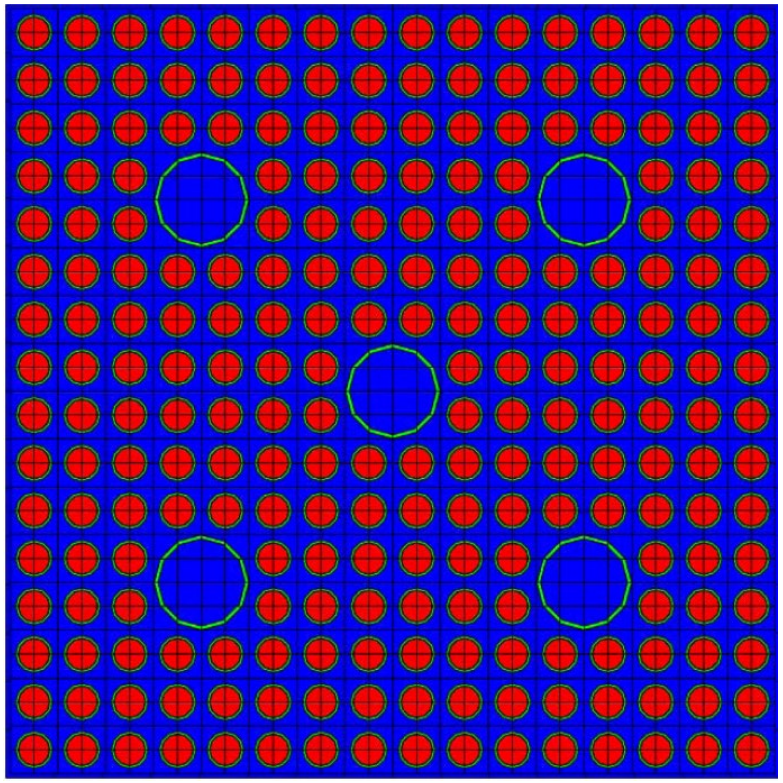
Getting the most out of depletion & decay calculations

- Understanding what Origen is – and isn't
- Give me my GUI back
  - ORIGAMI and the former OrigenExpress form
- Tips for accurate nuclear fuel depletion calculations
- Best practices for decay calculations

Origen libraries represent pre-calculated lattice physics

- **Origen** solves for the time-dependent neutron flux in the assembly using lattice physics transport tools like **TRITON**
- An "assembly average" flux is collapsed to one group to calculate reaction rate coefficients for depletion
  - **Point** depletion (0-D) representing **average** characteristics of the assembly
- Places where the flux shape **significantly deviates** (e.g., adjacent to poisons or holes) can be captured as **separate libraries**
  - Pin-by-pin depletion using ORIGAMI



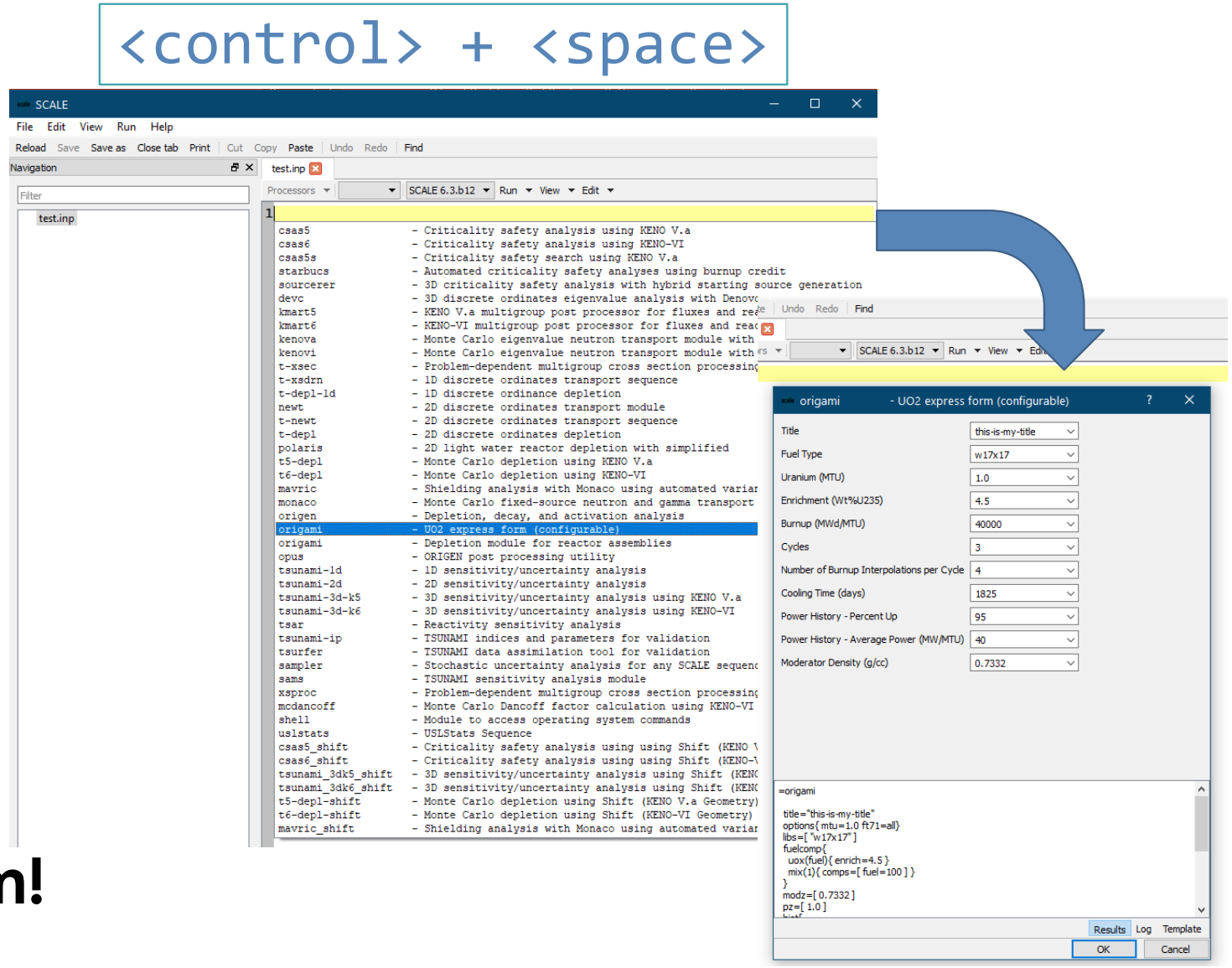
$$\overline{N'} = \overline{N_0} \cdot \bar{\bar{A}} \cdot \phi$$

Give me my GUI back (I want my GUI back)

Since SCALE 6.2, Fulcrum has replaced the former OrigenARP GUI

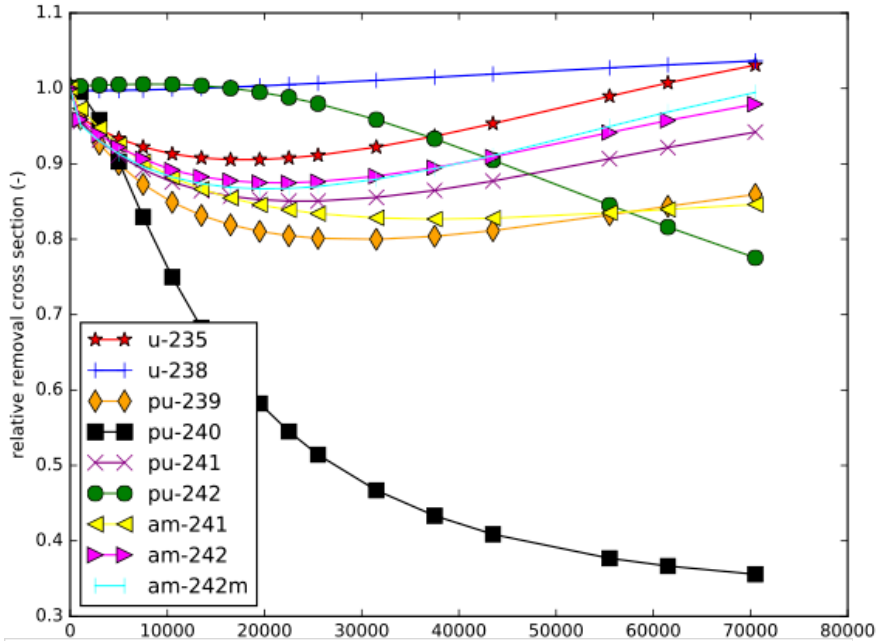
...but sometimes, you just need an "express" solution to calculate UO_2 fuel depletion

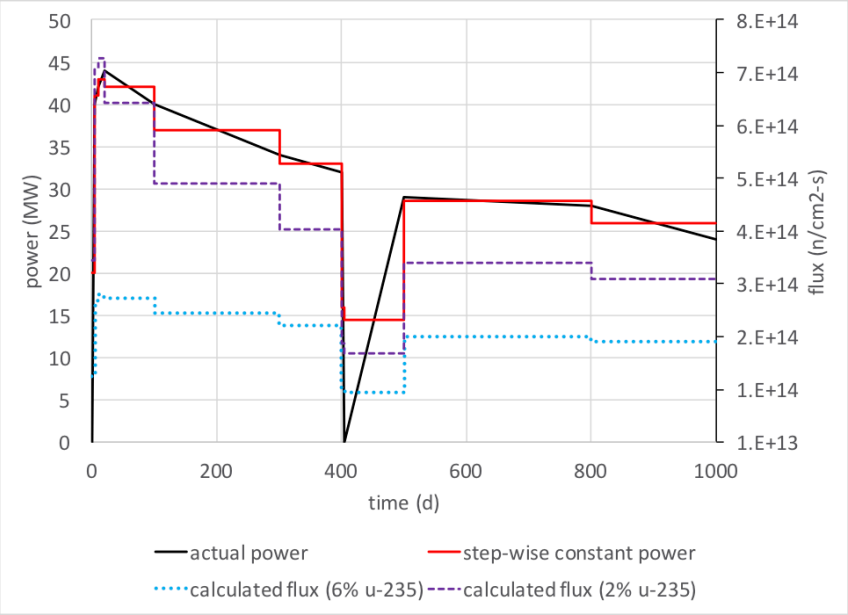
Hence, the **ORIGAMI UO_2 Express form!**



Tips for more accurate depletion calculations

- Cross-section sensitivity tends to be greatest at lower burnups
  - Avoid large timesteps for depletion
  - Use more sub-steps / sub-cycles
  - Generally at least **one** library interpolation per cycle
- Avoid large swings in flux
  - Verify consistency between power and mass basis
  - Use smaller time intervals for large power changes





Best practices for decay calculations

- Use sufficiently granular timesteps to capture phenomena of interest
- Follow the rule of 3's (*MATREX solver only*)
  - $\Delta t_i \leq 3\Delta t_{i-1}$
  - Not required for CRAM solver
- Split up very long decay intervals across multiple cases
  - <u>Example</u>: tracking (a,n) sources over very large decay times