

Calculating Radiation Damage (DPA) from Transmutation Products

September 2022

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PRESENTER:

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BACKGROUND:

- Radiation damage changes materials
- Methods ignore changing compositions
- 20% of damage can be missed in some materials

METHODS

- . Use existing transmutation solvers
- Tested with Greenwood Ni-59 work

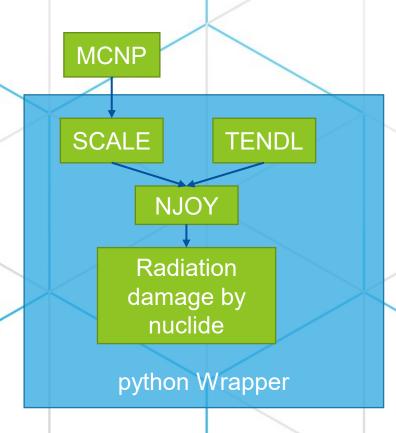
$$\frac{\partial \hat{E}}{\partial t} = \sum_{p=1}^{P} \left(\lambda_p \eta_p N_p(t) + N_p(t) \int_0^\infty \sigma_{D,p}(E) \phi(E,t) dE \right)$$

Introduced New Terms to Bateman System

$$\widetilde{N} \equiv \begin{pmatrix} N_1, ..., N_I, \widehat{E} \end{pmatrix}^T \ rac{\partial \widetilde{N}}{\partial t} = \widetilde{A}\widetilde{N}$$

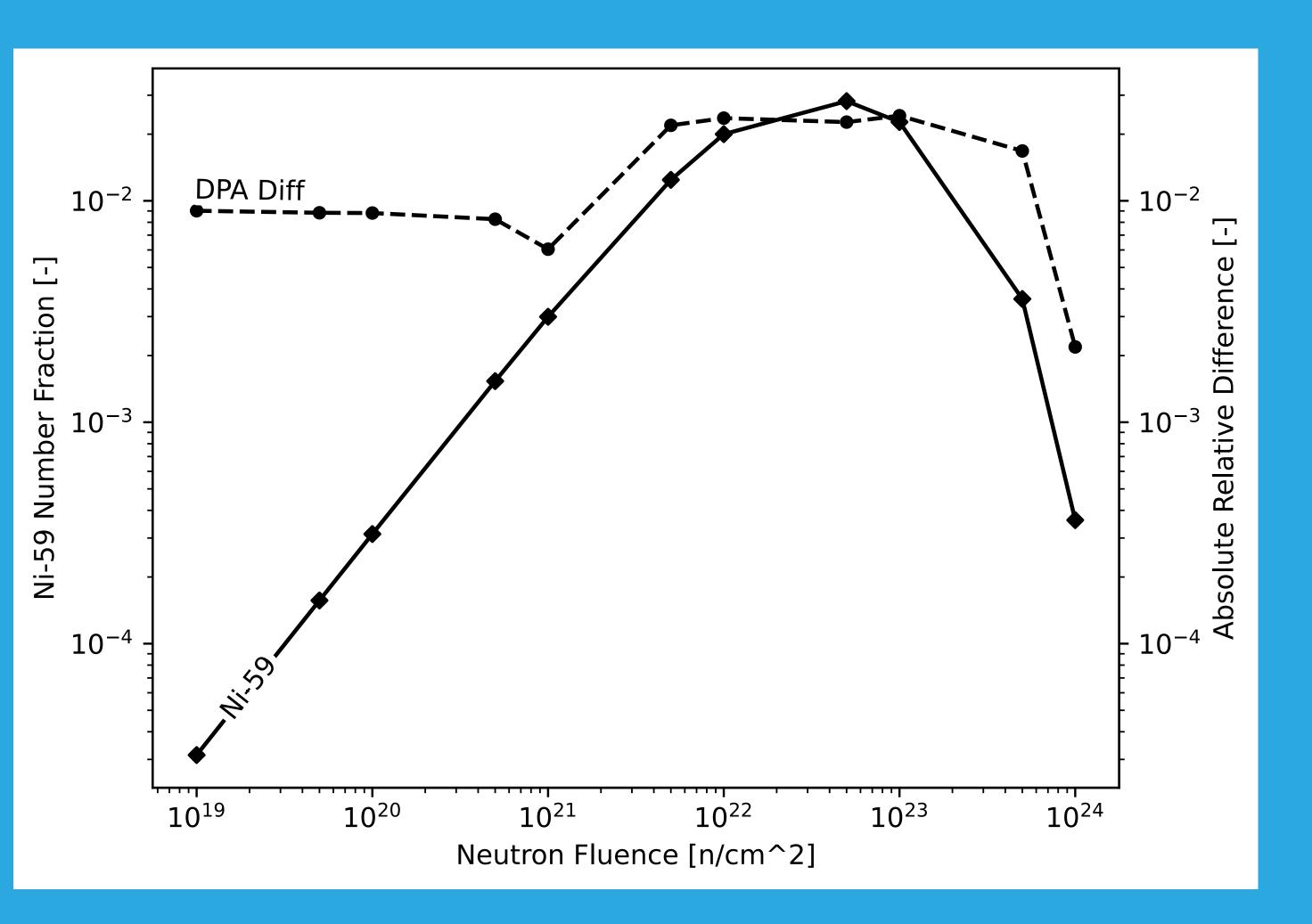
Systematically found sources of DPA

See examples in plot



Created ab initio models for damage from radioactive decay

Demonstrated that Existing Tools Can Easily & Accurately Calculate Radiation Damage. Demonstration performed in **Griffin Transmutation Solver**



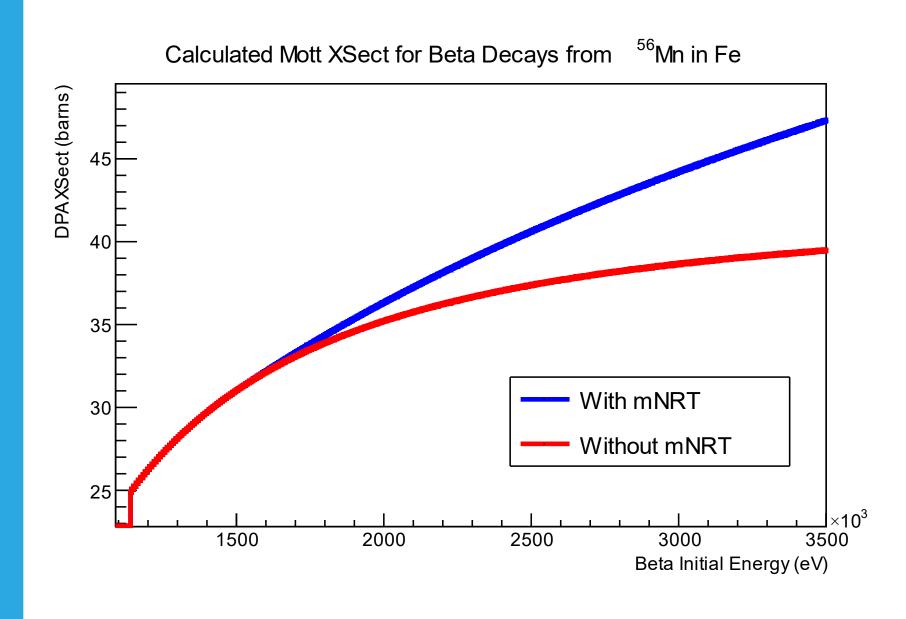
Difference in DPA in demonstration were due to rounding in benchmark article

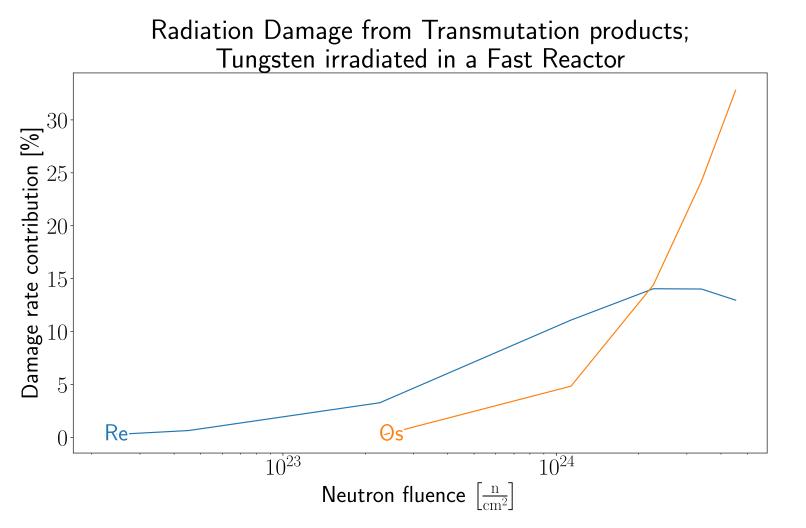




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Additional Information





Publications

- M. Gale, O. Calvin, and S. Schunert, "Using Griffin's Transmutation Solver to Calculate Radiation Damage," PHYSOR. Pittsburgh, Pennsylvania, May 2022.
- M. Gale, O. Calvin, and S. Schunert. "Calculating Non-Nuclide Number Density Quantities of Interest in the Bateman Depletion Equations." Nuclear Science and Engineering. Planned.
- M. Gale and A. Mata Cruz. "A Systematic Review of the Effect of Transmutation Products on Radiation Damage in Fission Reactors." Journal of Nuclear Materials. Planned.
- D. van Wasshenova. "Investigation of Beta Decay Produced Damage with GEANT4." Journal of Computational Physics. Planned.
- Micah Gale, Sebastian Schunert, Angelica Mata Cruz, Olin Calvin, Daniela Van Wasshenova

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