

# “Towards reliable cross sections for astrophysics, nuclear energy and security”

## Ian Thompson – Lawrence Livermore National Laboratory

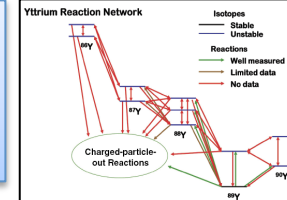
### Reaction Highlights

#### Objectives

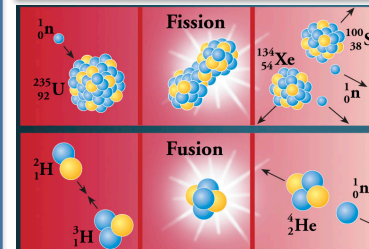
- Use refined structure models, such as QRPA, and energy density functionals validated by the UNEDF collaboration, to obtain reaction inputs.
- Perform reaction calculations consistent with the structure ingredients, obtaining predictions for elastic, inelastic, and reaction cross sections.
- Compare reaction predictions with experimental data to extract information about the structure model and the energy density functional.
- Overcome all computational challenges arising in the QRPA, folding and coupled-channels steps.

#### Impact

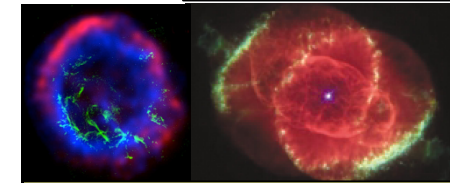
Modeling astrophysical phenomena, simulating nuclear reactor performance and waste transmutation scenarios, and investigating national security issues requires reliable cross sections for thousands of reactions.



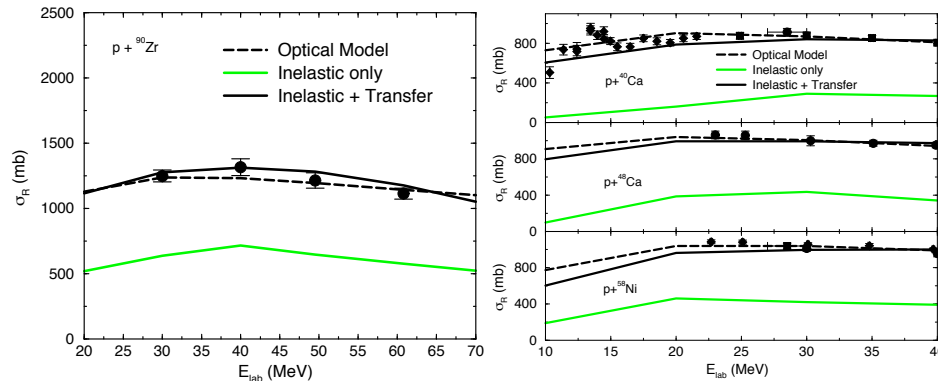
Keeping the nation safe.



Developing safe and efficient energy resources.



Understanding stellar evolution and energy generation.



First microscopic predictions (solid black lines) for reaction cross sections agree well with measurements, giving confidence in the approach.

#### Progress and Accomplishments

- Applied extensions of energy density functional theory developed under UNEDF to calculate reaction cross sections and angular distributions.
- First successful description of experimental absorption data for a wide range of nucleon-nucleus reactions.
- “Coupled-channel calculation of nonelastic cross sections using a density-functional structure model” by G. P. A. Nobre, F. S. Dietrich, J. E. Escher, I. J. Thompson, M. Dupuis, J. Terasaki and J. Engel, *Physical Review Letters*, 105, 202502 (2010).



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UNEDF SciDAC Collaboration  
Universal Nuclear Energy Density Functional

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