

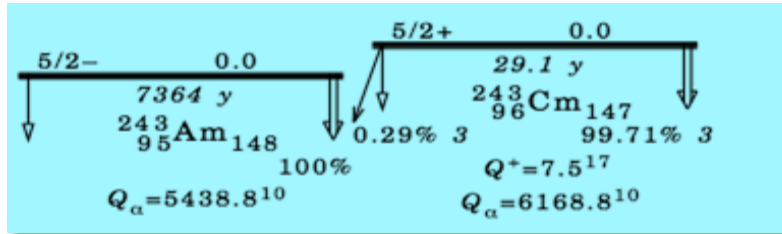
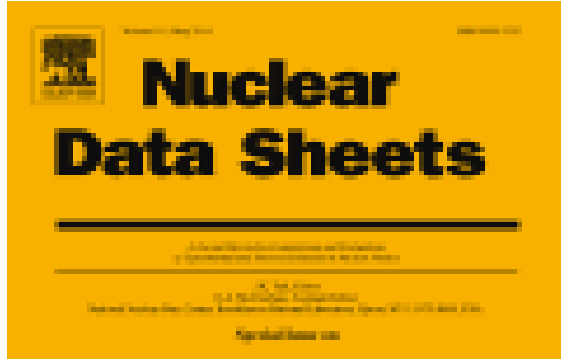
Status Report on Nuclear Data Activities at Oak Ridge National Laboratory

USNDP 2024

Michael Smith, Caroline Nesaraja, Larry Zhang

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

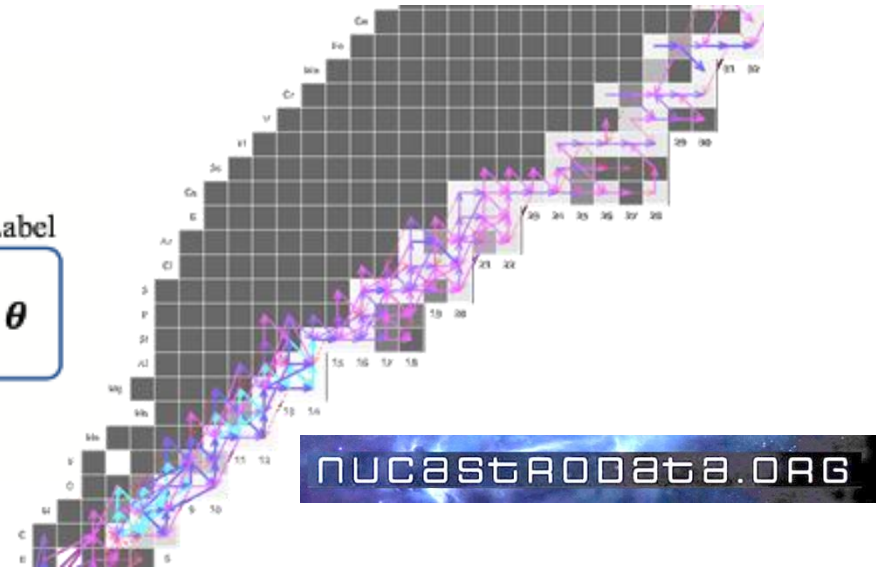
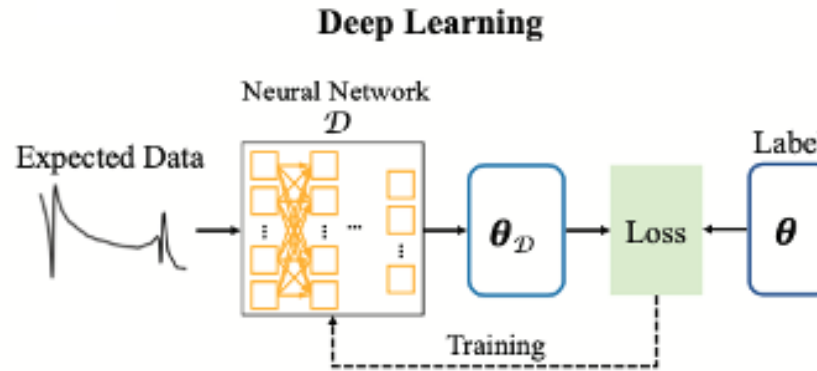
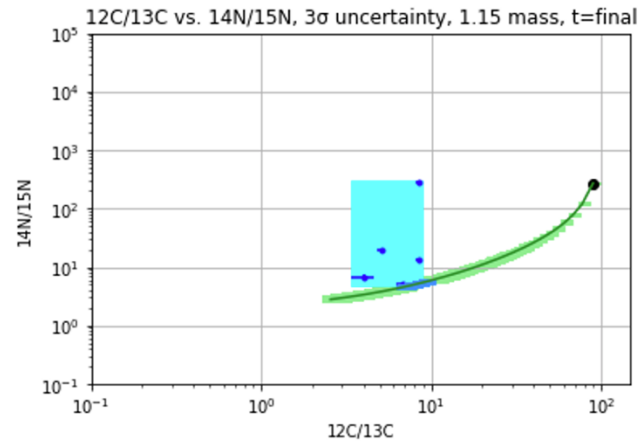
Members and Scope of Activities



Adopted Levels, Gammas (continued)

$\gamma(^{243}\text{Pu})$ (continued)

E(level)	E_γ^f	I_γ^f
1213	879.8^{10}_{10}	75 35
	925.3^{10}_{10}	100 50
1261.1	328.1	100
1301.7	648.8^{10}_{8}	$\approx 37^{\frac{1}{2}}$
	676.0 3	100 10
	918.0 10	43 16
1367.9	663.9 6	100 16
	714.7^{10}_{11}	31 16
	976.0 12	84 42

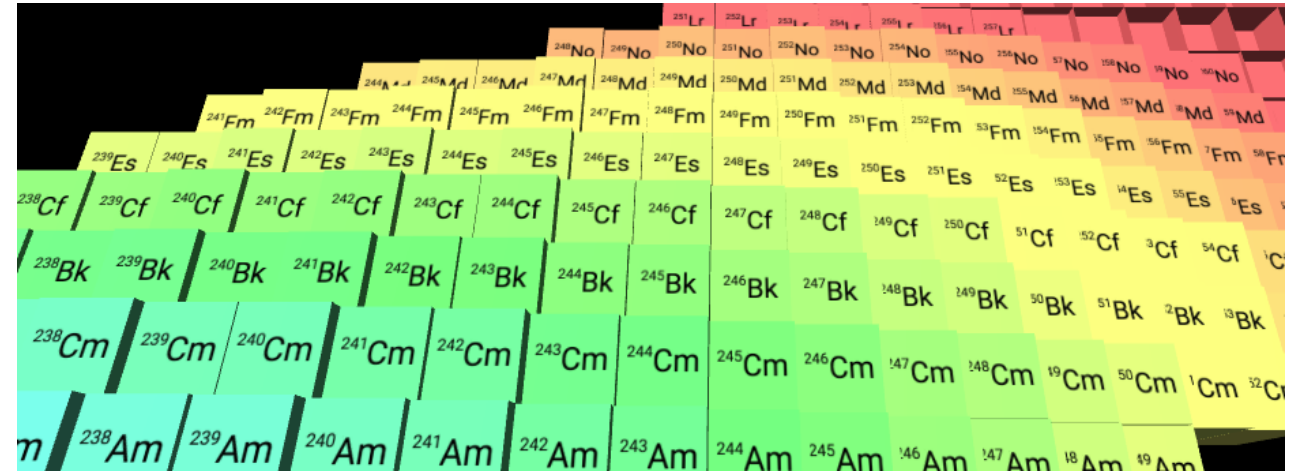


Members and Activities:

- **Caroline Nesaraja**: Research Staff Member - ENSDF evaluator
- **Michael Smith**: Research Staff Member - nuclear astro data, software systems
- **Larry Zhang**: Student - nuclear astrophysics data

Nuclear Structure Data ENSDF Evaluations

Caroline Nesaraja



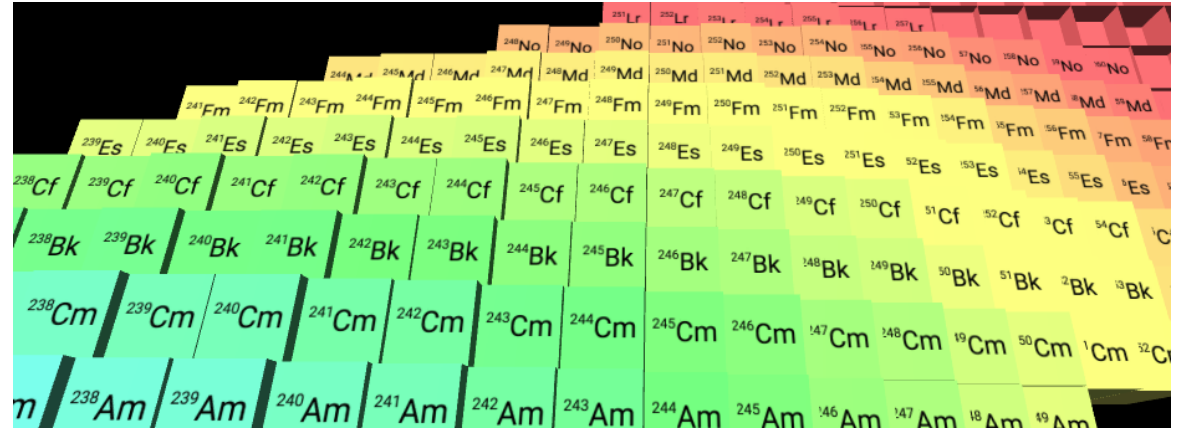
- **ORNL responsibility: A=241-249**
A = 69

Mass Chain	Current ENSDF Database (from NNDC website)	
241	C.D. Nesaraja. NDS 130, 183 (2015)	(Lit cut-off Sept. 2015)
242	M.J. Martin & C.D. Nesaraja. NDS 186, 263 (2002)	(Lit cut-off Dec. 2021)
243	C.D. Nesaraja & E.A. McCutchan. NDS 121, 695 (2014)	(Lit cut-off Sept. 2013)
244	C.D. Nesaraja. NDS 146, 387 (2017)	(Lit cut-off Aug. 2017)
245	C.D. Nesaraja. NDS 189, 1 (2023)	(Lit. cut-off Feb. 2023)
246	C.D. Nesaraja (be published in next issue)	(Lit. cut-off Jul. 2022)
247	C.D. Nesaraja. NDS 125, 395 (2015)	(Lit. cut-off Mar. 2014)
248	C.D. Nesaraja (submitted to NNDC)	(Lit. cut-off June.2024)
249	C.D. Nesaraja. NDS 195, 718 (2024)	(Lit. cut-off Oct. 2023)
69	C.D. Nesaraja. (post review)	(Lit. cut-off Apr. 2023)

Nuclear Structure Data

ENSDF Evaluations FY24

Caroline Nesaraja: 0.75 FTE



A=249 : Post edits: Published

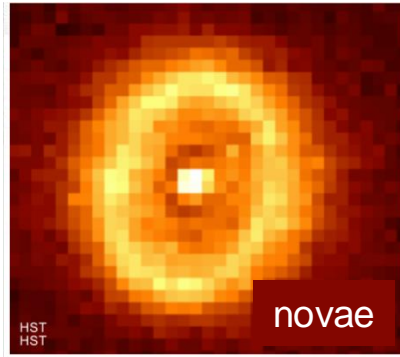
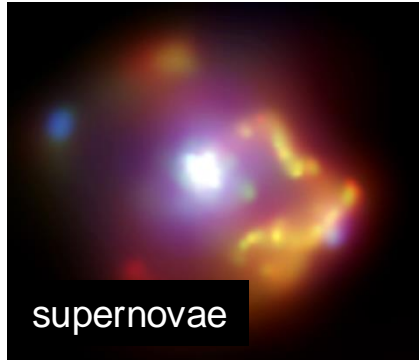
A=246 : Post edits: To be published on next issue

A=148 : Reviewed

A=248 : Evaluated



Nuclear Astrophysics Data



- focus on Stellar Explosions
- we **closely couple data activities to measurements** on unstable nuclei as recommended in NSAC LRP and listed as DOE NP milestones
- recent focus on **UQ: the role of nuclear reaction uncertainties in astro model predictions**
- Personnel
 - *Michael Smith – Staff*
 - *Larry Zhang – Student*

Review Article on Nuclear Astro Data



frontiers

Frontiers in **Astronomy and Space Sciences**

Nuclear data resources and initiatives for nuclear astrophysics

TYPE Review

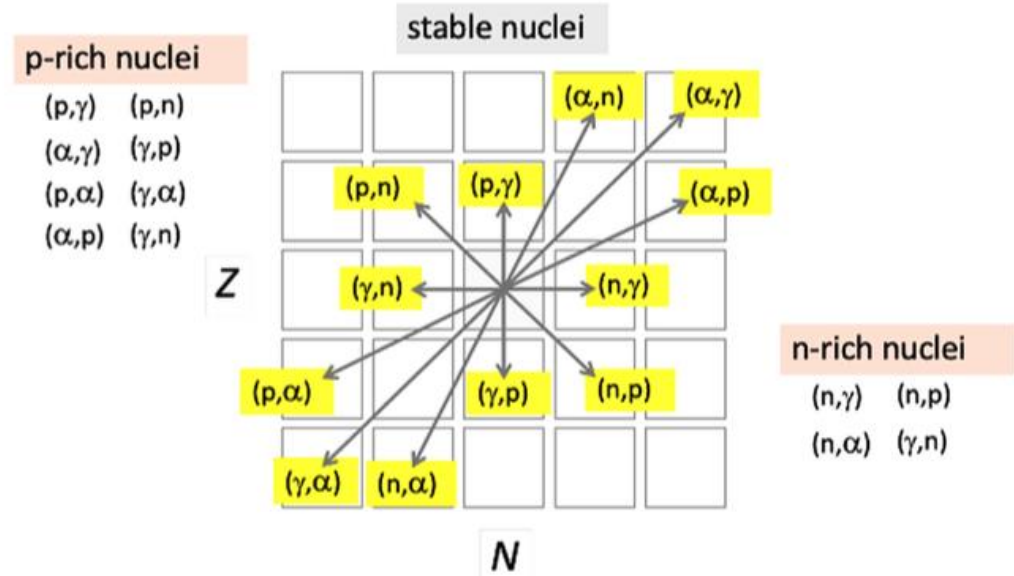
PUBLISHED 10 November 2023

DOI 10.3389/fspas.2023.1243615

230 references

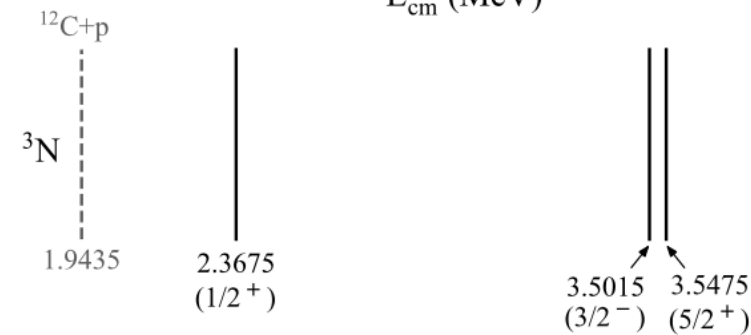
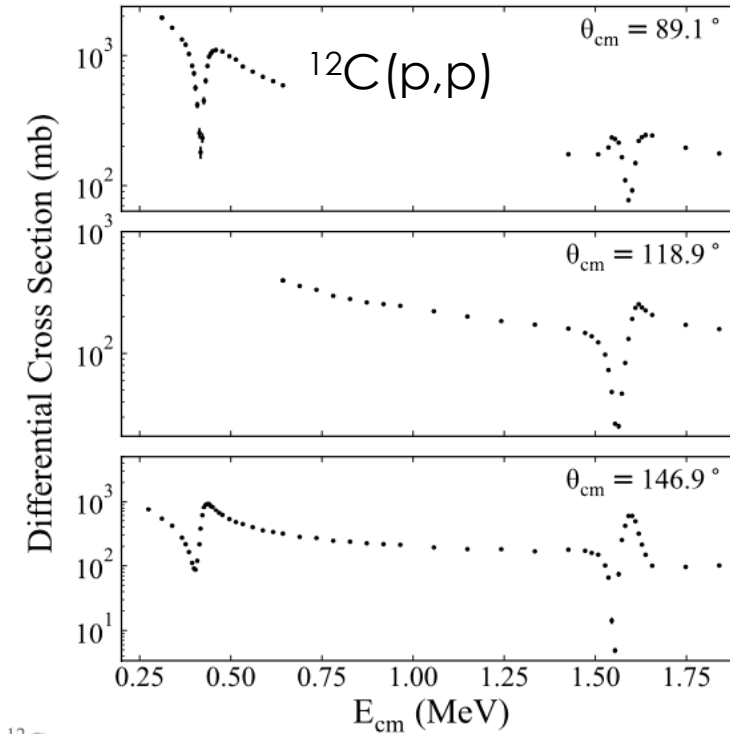
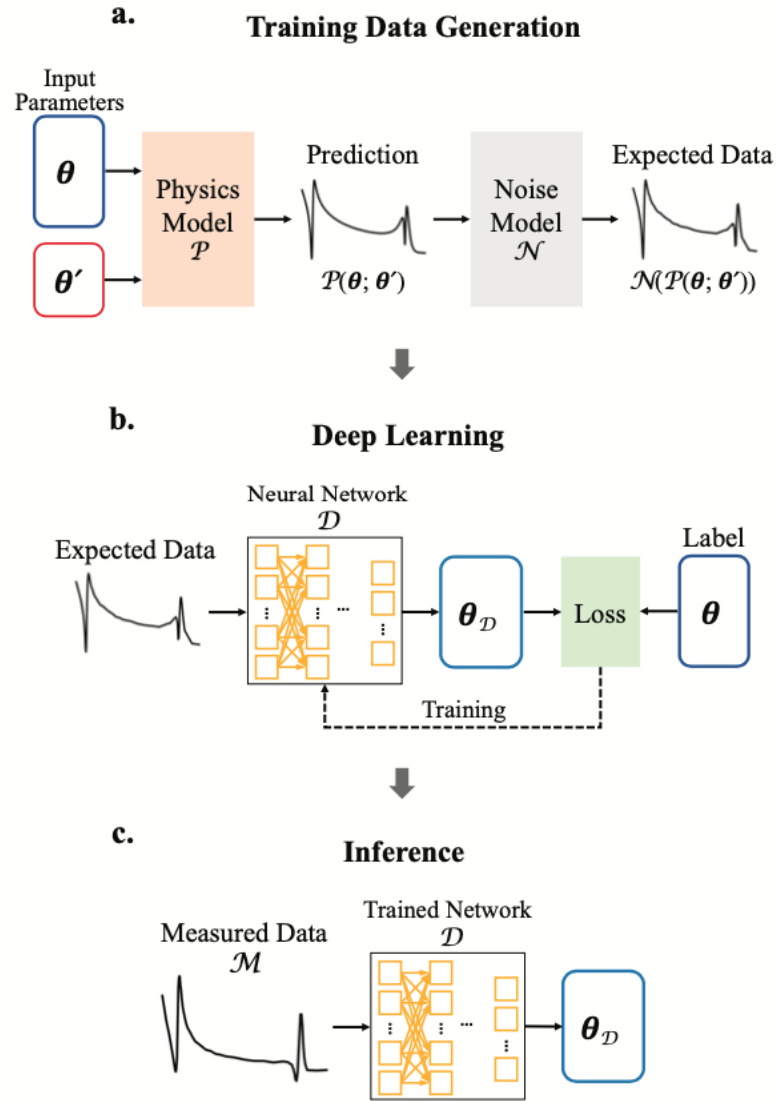
Michael S. Smith*

Physics Division, Oak Ridge National Laboratory, Oak Ridge, TN, United States



- reviews the field and guides future directions

Phys. Rev. C
(submitted)
Phys. Rev. C
(submitted)

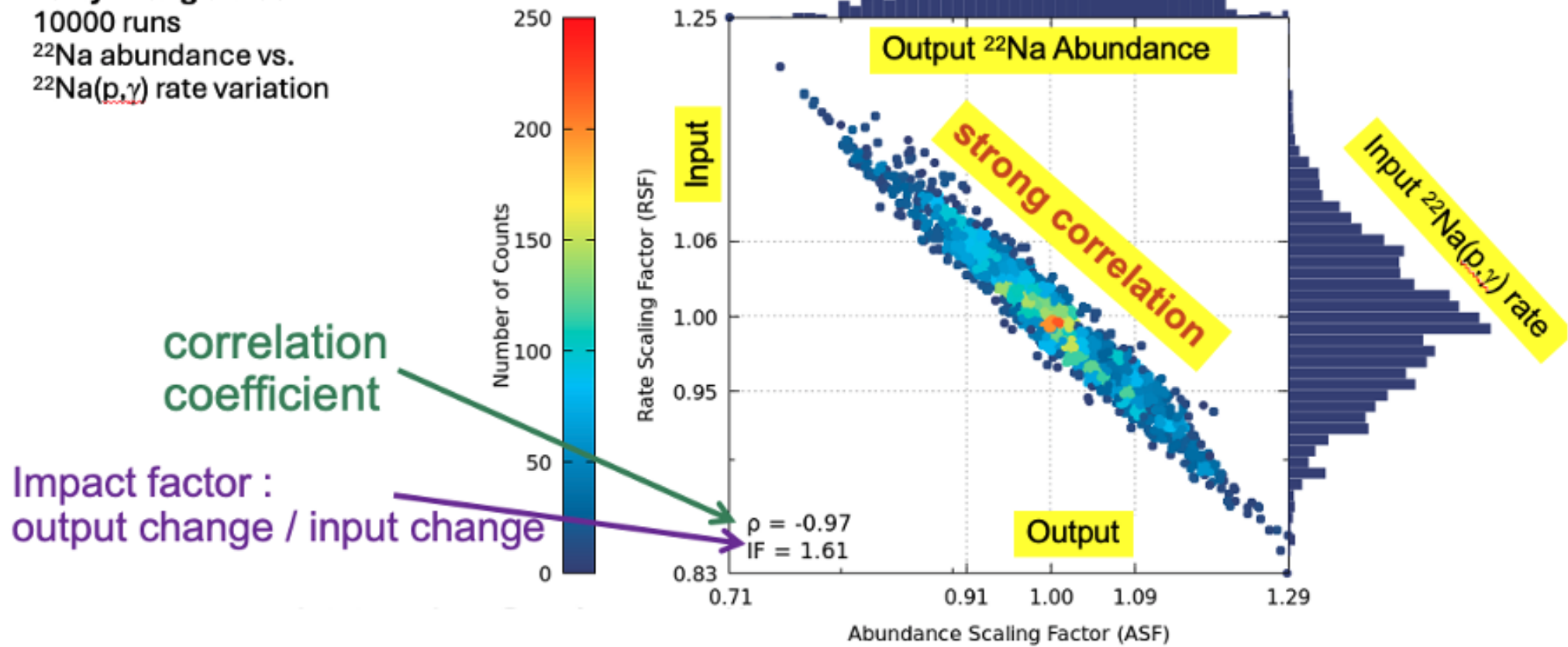


- ML can rapidly reproduce R-matrix fits to data *with uncertainties*

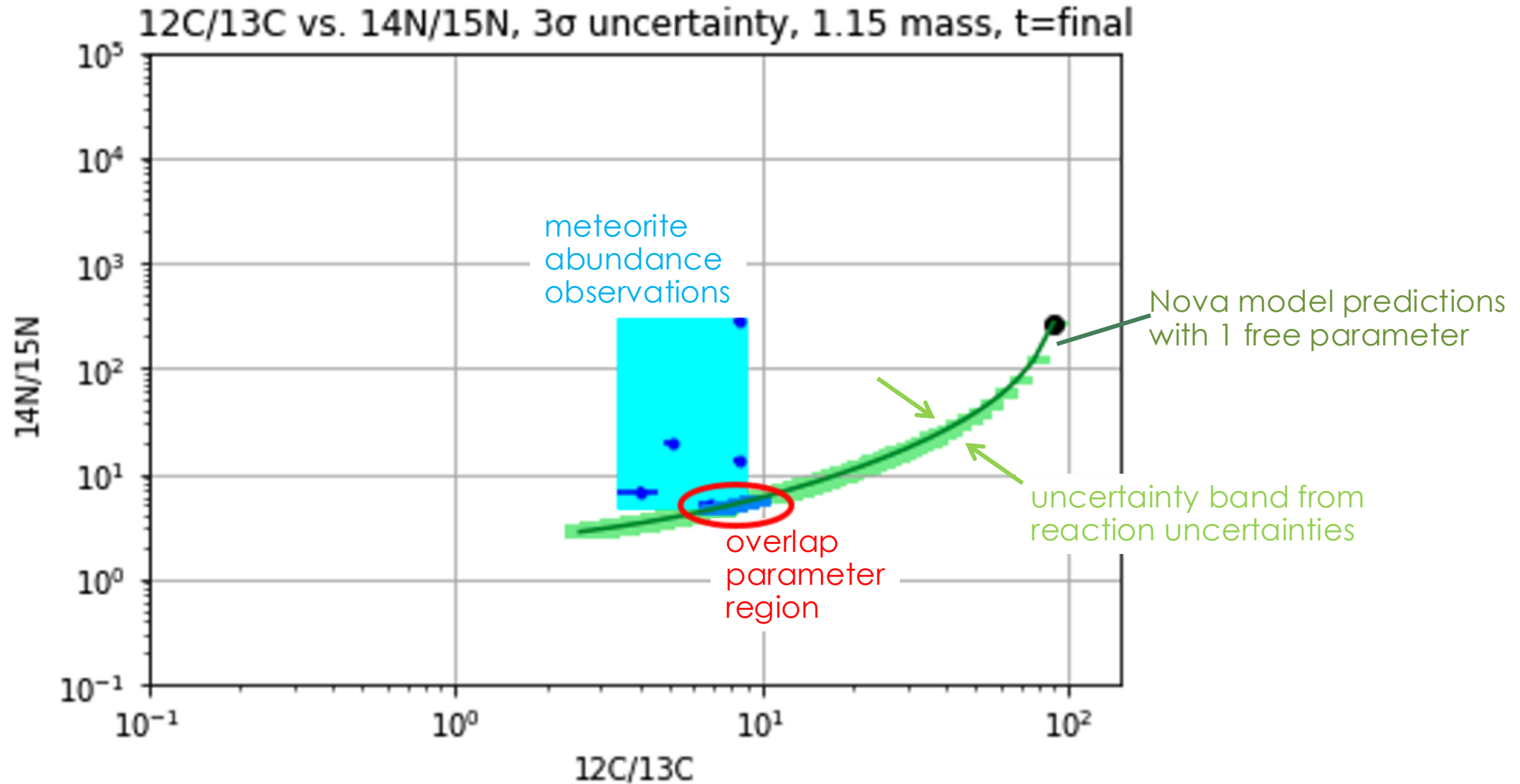
Monte Carlo Approaches in Nova Nucleosynthesis

Monte Carlo Results
Larry Zhang & MSS
10000 runs
 ^{22}Na abundance vs.
 $^{22}\text{Na}(p,\gamma)$ rate variation

^{22}Na uncertainty
 $\pm 9\%$ at 1 sigma
 $\pm 28\%$ at 3 sigma



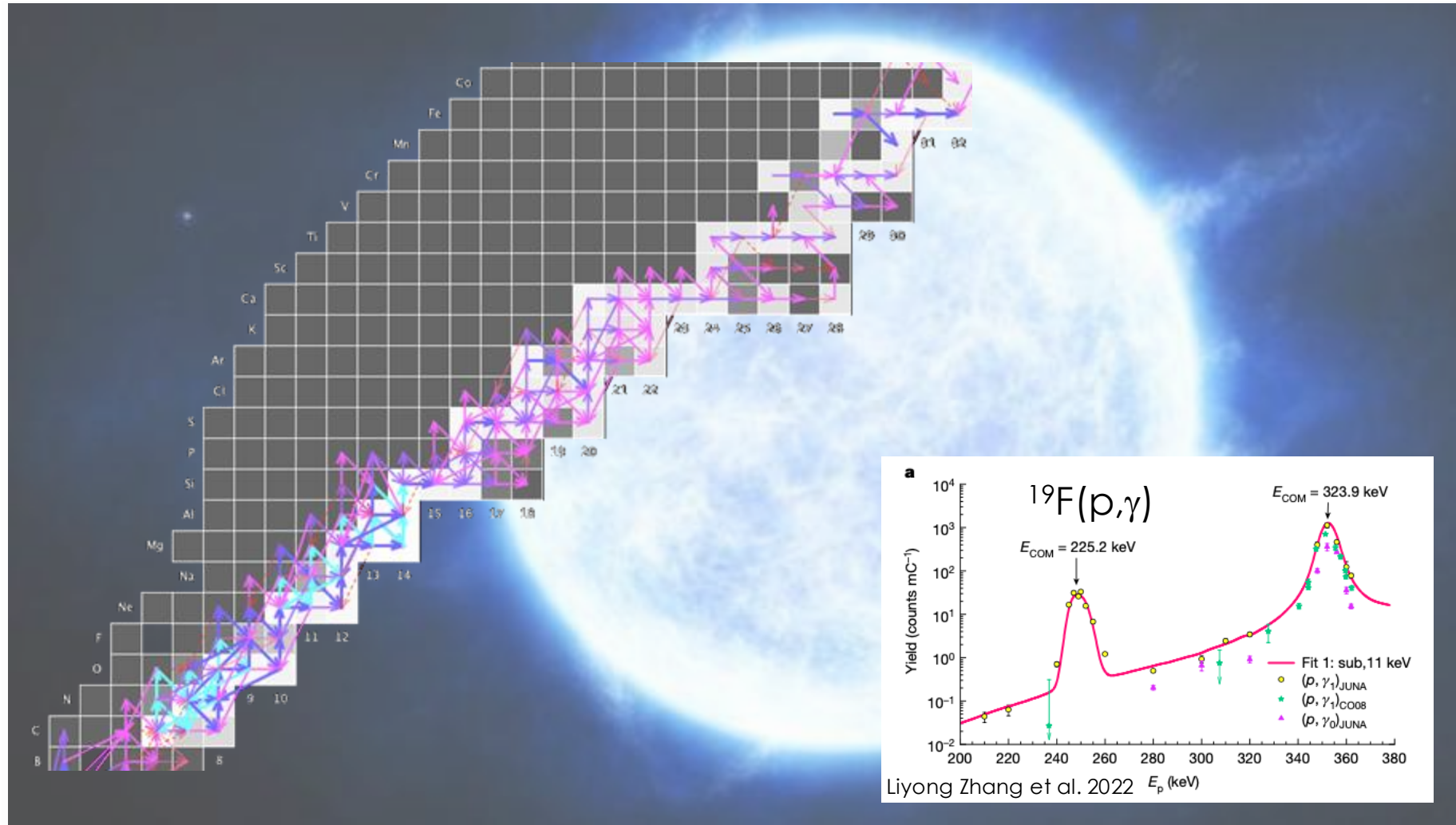
- quantitatively comparing uncertainties of input reactions and hydrodynamics



- addressing a 20-year puzzle in nuclear astrophysics

UQ in Supermassive Star Nucleosynthesis Efforts

Simon Yu (Lynbrook HS, New York) & MSS



- attempting to verify literature claims of role of ¹⁹F(p,γ) reaction in SMS

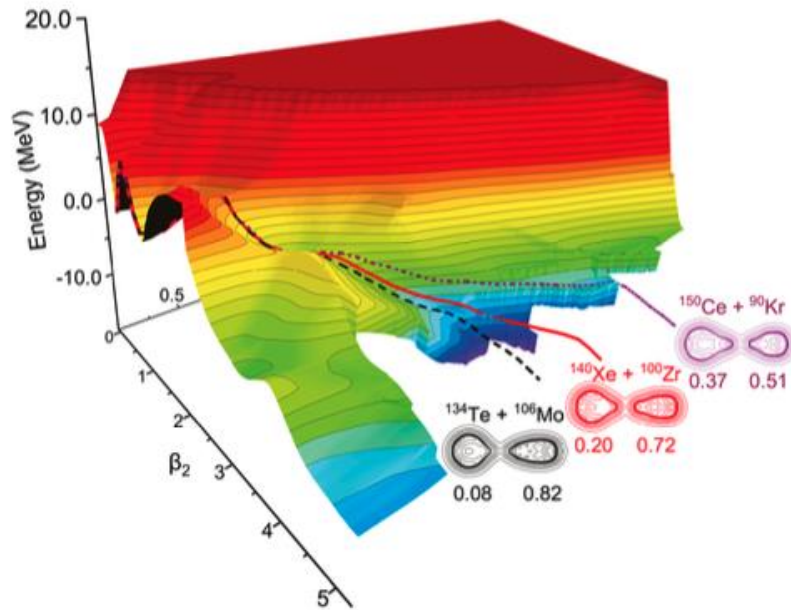


Fig.2 Potential energy surface of ^{240}Pu in the β_2 - β_3 space calculated by CDFT with the PC-PK1 functional⁴². The contour line is 1 MeV, and the potential energy is set to 0 MeV at the ground state. The fission channels: $^{134}\text{Te}+^{106}\text{Mo}$, $^{140}\text{Xe}+^{100}\text{Zr}$, and $^{150}\text{Ce}+^{90}\text{Kr}$ are shown by the dashed, solid, and dotted lines, respectively. The corresponding scission configurations and quadrupole deformations of the nascent fission fragments are also shown.

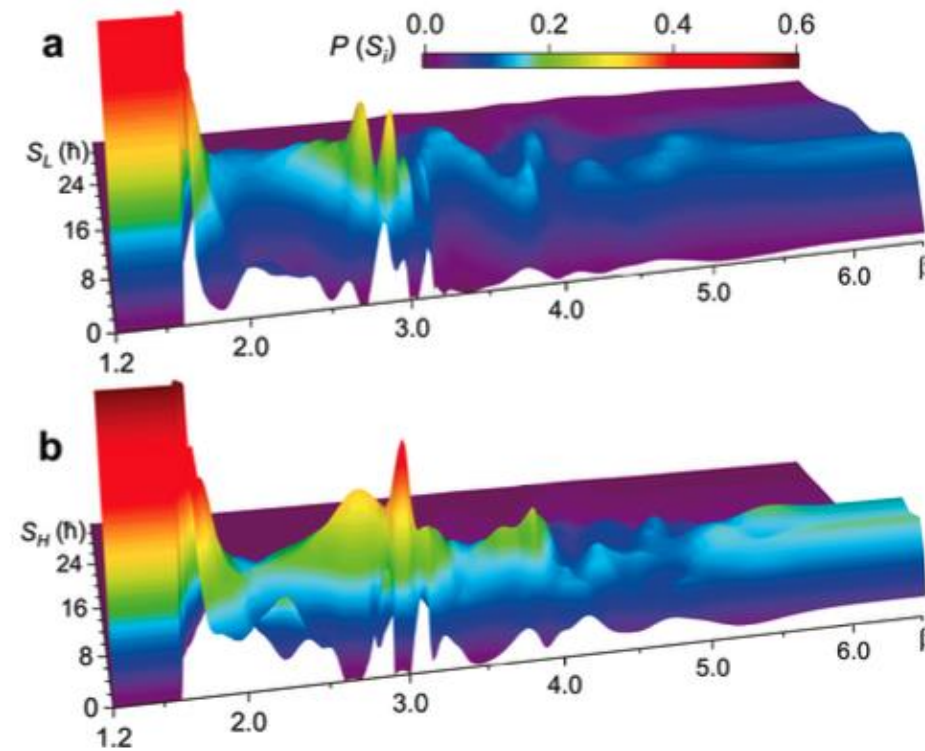
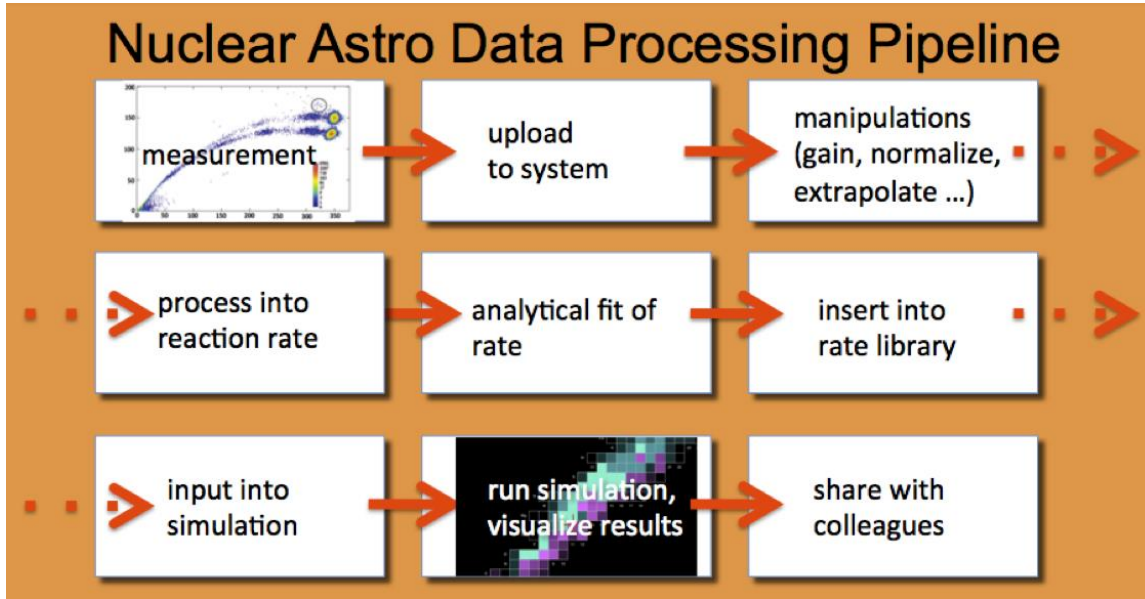


Fig.3 Angular momentum distributions for the light (upper) and heavy (lower) fragments along the fission path for the channel $^{140}\text{Xe}+^{100}\text{Zr}$.

- found chaotic evolution of fission fragment angular momenta distribution

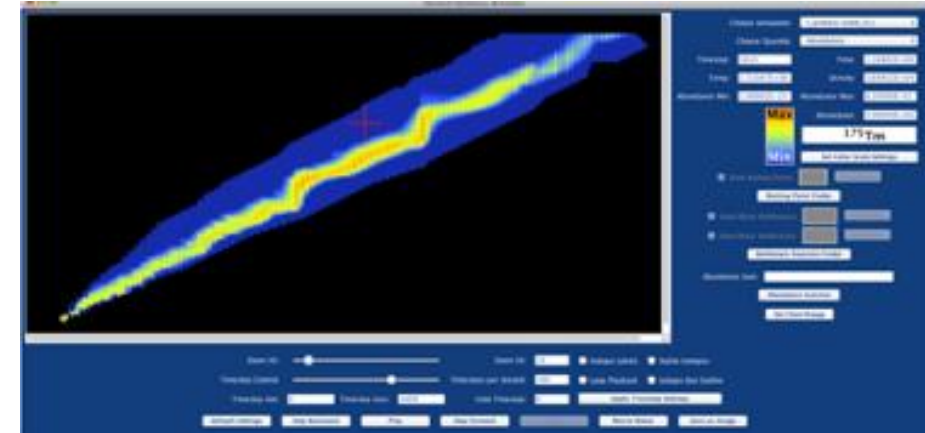
Online Software Systems



Computational Infrastructure for Nuclear Astrophysics

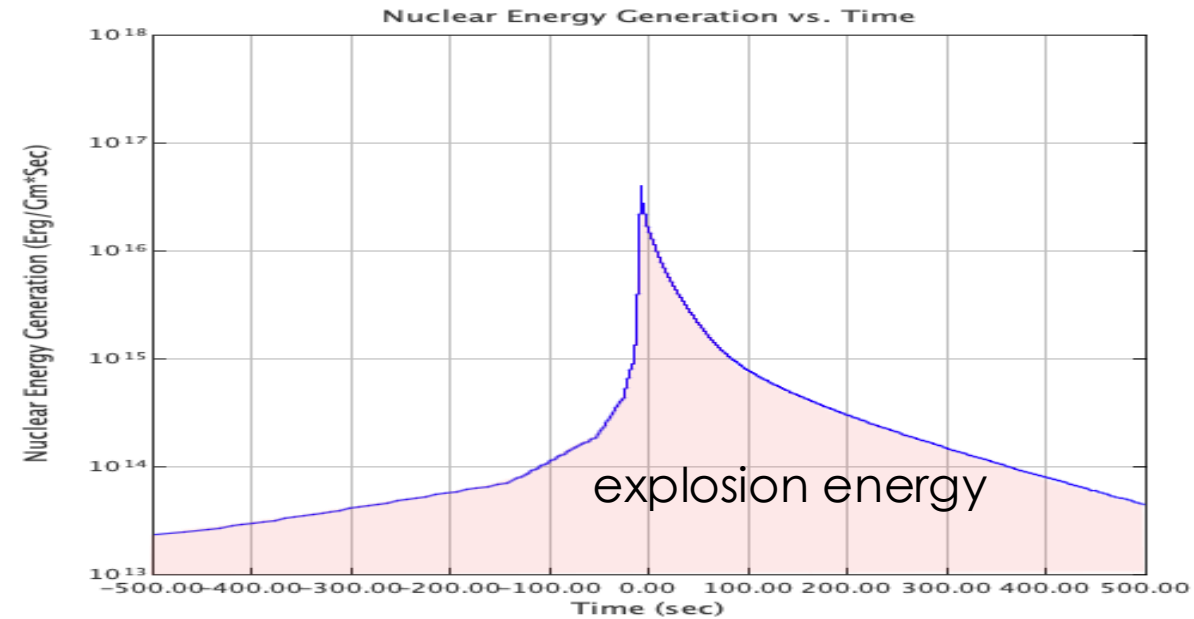
since 2004

NUCASTRODATA.ORG



- **unique** set of online software systems that **serve** the community carrying out DOE NP-supported research programs and endorsed by NSAC LRP
- systems used by researchers in over **180 institutions** in **45 countries**
- systems improve return on investment of **nuclear data for research projects**
- many ideas for expanding and improving these services
- currently working to improve the backbone of the system

Future Possible Projects



- Add **UQ & Machine Learning tools** to Computational Infrastructure for Nuclear Astrophysics
- develop **benchmark simulations** and **integral parameters** (e.g., k_{eff} equivalents) to help validate nuclear astrophysics rate libraries
- explore processing (some) TALYS cross sections into REACLIB rate format

Synergistic Activities – Public Engagement & DEIAB



PROPOSED APS STATEMENT ON PUBLIC ENGAGEMENT

The American Physical Society (APS) commends its members who engage with the public. Such activities can take many forms. APS encourages its members to pursue public engagement activities, and to take advantage of APS resources in support of effective methods of public engagement across a wide range of platforms.[1] APS urges educational institutions, national laboratories, and companies that employ physicists to recognize the high value of public engagement when making hiring, assessment, promotion, and investment decisions.

nuclear data tutorials (South Korea)

- **Nuclear Data tutorials** at Nuclei in the Cosmos School Sept. 2023
- **Led APS Statement on Public Engagement** (will be released in early 2025)
- **Past Chair** of APS **Committee to Inform the Public** & on APS **FOEP** Exec Cmtee
- Working with DOE SC SW-DEI office on **national workshop for PIER Plans**

also

- proposal responding to NDIAWG FOA for nuclear structure evaluator at ORNL (Caroline Nesaraja PI)
- NNSA **NSP** Workforce Survey activities