

Lawrence Livermore National Laboratory

LLNL Report



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Computational Nuclear Physics Overview

- Main conduit for communication and coordination between LLNL Programs and N Division:
 - Coordinate nuclear data related experiment and theory activities in N Division
 - Chair Homeland Security Nuclear Data Taskforce
 - Manage LLNL nuclear data infrastructure
 - Website
 - Processing codes
 - Data access libraries
 - Neutron and photon transport routines
 - Manage LLNL nuclear data libraries
 - Perform evaluations in support of LLNL program
 - Collect & disseminate other LLNL evaluations
 - Provide non-LLNL nuclear data libraries to LLNL customers



Workforce

- Collaborators inside and outside of LLNL:
 - Inside LLNL:
 - CNP: David Brown, Jason Pruet, Neil Summers, Ramona Vogt, Bret Beck
 - Nuclear Theory: Jutta Escher, Rob Hoffman, Petr Navratil, Erich Ormand, Ian Thompson, Walid Younes
 - Nuclear Experiment: Lee Bernstein, Jason Burke, Rick Norman, Ching-Yen Wu
 - Others at LLNL: Marie-Anne Descalle (former AP division), Brad Sleaford (Engineering), Doug Wright (High Energy)
 - Outside LLNL:
 - Other labs: LANL, LBNL (Rick Firestone, Jorgen Randrup), INL, TUNL
 - Academic Alliance partners: Yale, Richmond, Rutgers, UC Berkeley

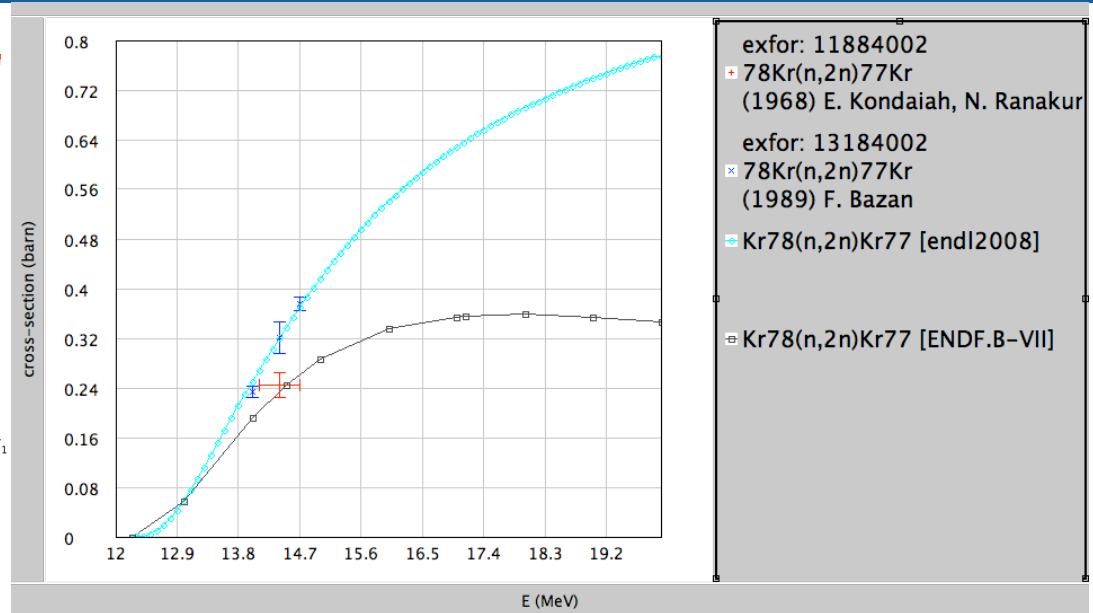
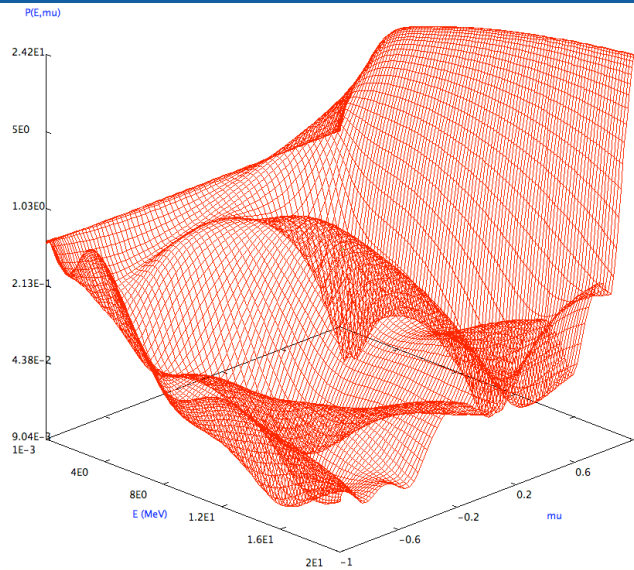


Computational Nuclear Physics is producing many new and revised evaluations for the next ENDF release

- ^{240}Am based on surrogate work of Younes & Britt (D. Brown, N. Summers)
- ^{237}U based on LLNL surrogate work (D. Brown, N. Summers, I. Thompson (NTM), W. Younes (NTM))
- B. Sleaford (Eng.) merged EGAF data with ENDF/B-VII.0 evaluations as part of his Ph.D. in Nuclear Engineering: ^{19}F , ^{182}W , ^{183}W , ^{184}W , ^{186}W
 - Fe, Gd planned for this year (B. Sleaford, N. Summers)
 - Over 200 (n, γ) evaluations in the next 3 years
- Structural materials (I. Thompson (NTM), N. Summers):
 - Co, Ni, Cu, Zn, Ga
- Radiochemical Evaluations (R. Hoffman (NTM), N. Summers)
 - Kr
- Expanding 497 partial evaluations in the Hoffman Radchem library (now in ENDF/A) into full evaluations that are transport ready (N. Summers)



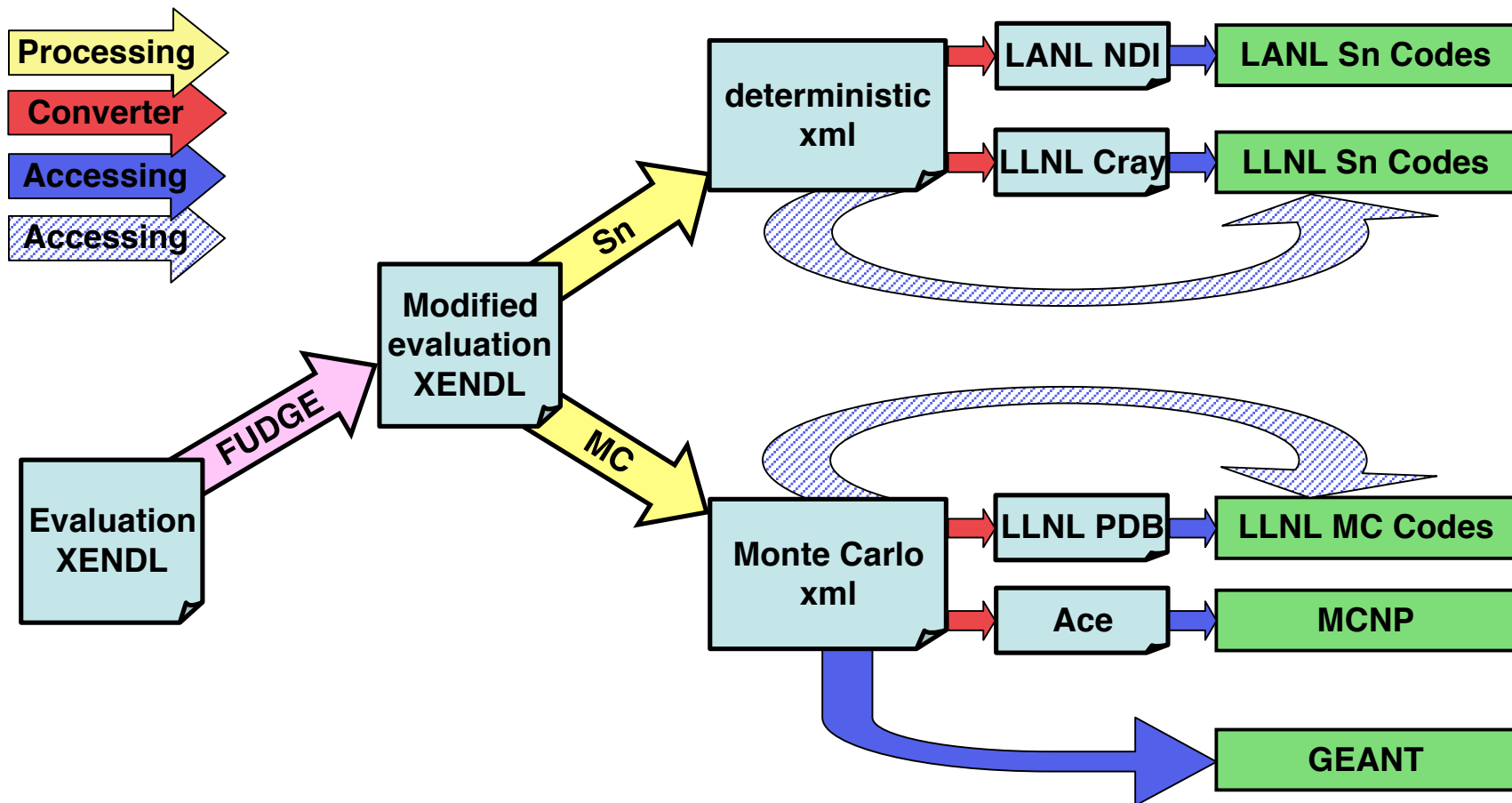
Our NADS nuclear data viewer is publicly available and now shows JEFF, ENDF, ENDL, JENDL, ... and experimental data



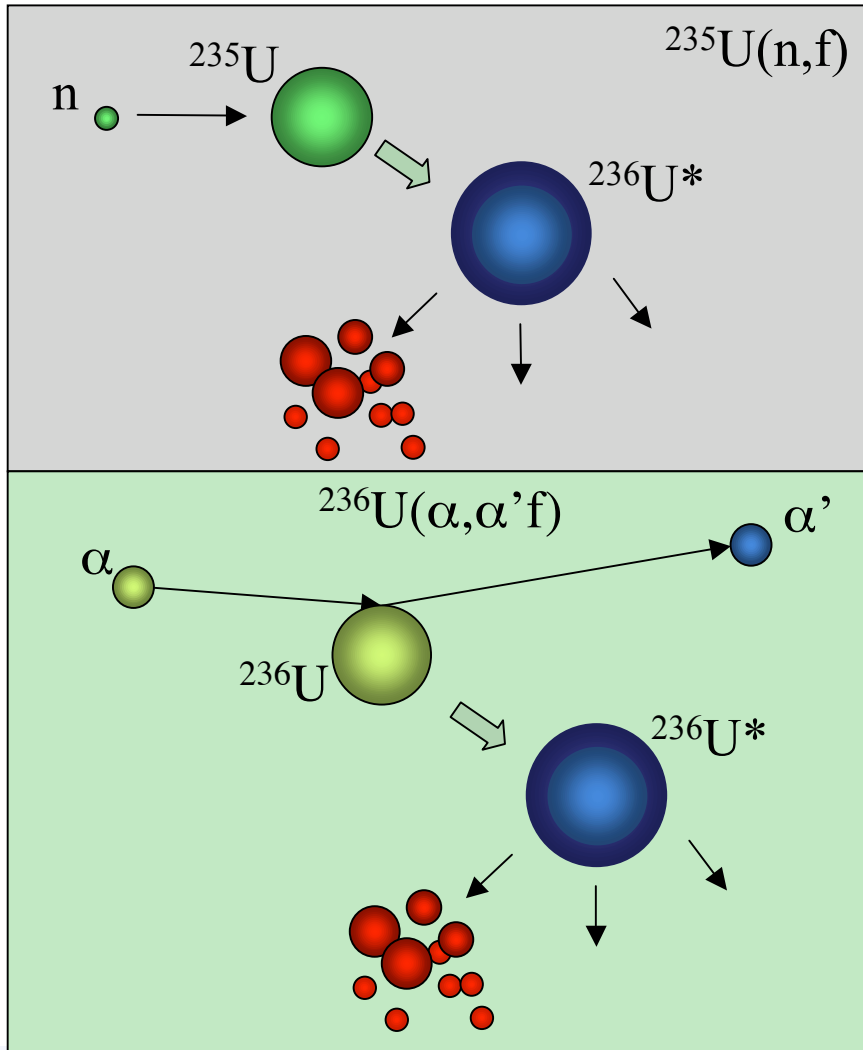
- 2D and 3D plotting
 - rotate and zoom capabilities
- in-line math support
 - allows simple calculations with data
 - useful for seeing the contributions of different cross sections to the total
- Documented experimental data plotting allows quick checks on evaluation quality
- Our long term goal is to provide a simple interface that allows modification and processing of data for transport

LLNL leading the way in modernization of nuclear data formats

- Upgrading data formats to data rich XML format



LLNL continues to lead experimental and theoretical development of the surrogate reaction technique



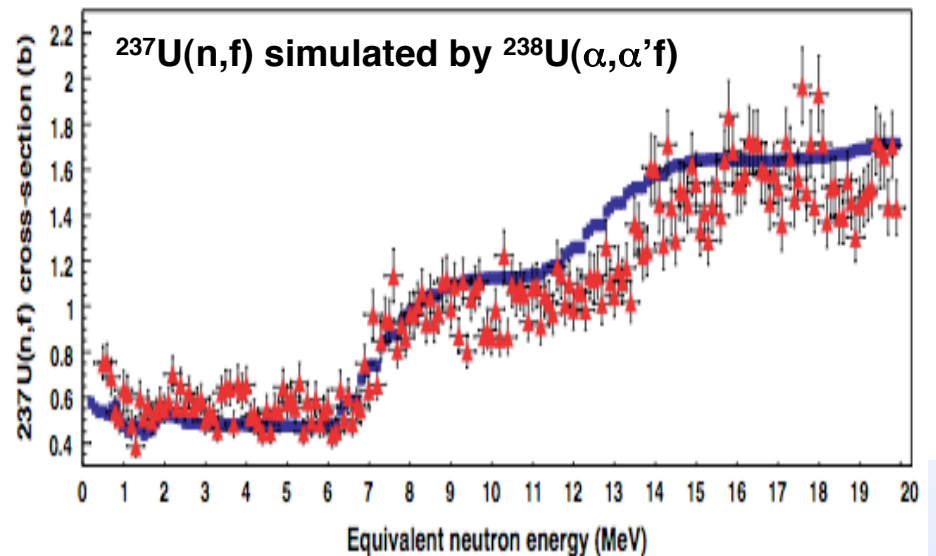
Hauser-Feshbach (HF) for “desired” CN reaction

$$\sigma_{\alpha\chi} = \sum_{J,\pi} \sigma_{\alpha}^{\text{CN}}(E,J,\pi) \cdot G_{\chi}^{\text{CN}}(E,J,\pi)$$

Weisskopf-Ewing limit of reaction:

$$\sigma_{\alpha\chi}^{\text{WE}}(E) = \underbrace{\sigma_{\alpha}^{\text{CN}}(E)}_{\text{calculated}} \cdot \underbrace{P_{\chi}(E)}_{=N_{\text{coinc}}/N_{\text{single}} \text{ measured}}$$

J. Burke *et al.* Phys. Rev. C **73**, 054604 (2006)



Going forward we'd like to try a new model for interacting with USNDP

In the Past (a leverage model)

Lab Program Support (~\$12M)



USNDP investment (\$100K)



Evaluations for the community

The worry here is that we've been spending much more than \$100K on USNDP support.

Future Proposal (a capability model)

USNDP investment (\$100K)



Post-doc effort to develop new reaction model capabilities



Long-term capability growth

Another possibility is to use USNDP support to bring the UQ tools and results developed for NNSA programs to the broader community

At LLNL we have to offer

- library of evaluated uncertainties
- PSUADE - package for statistical studies, design and analysis
- In-line tools for data modification, processing and tests against integral data

