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Fission Product Yield and Gamma-ray Production Evaluation

Status Report 2025

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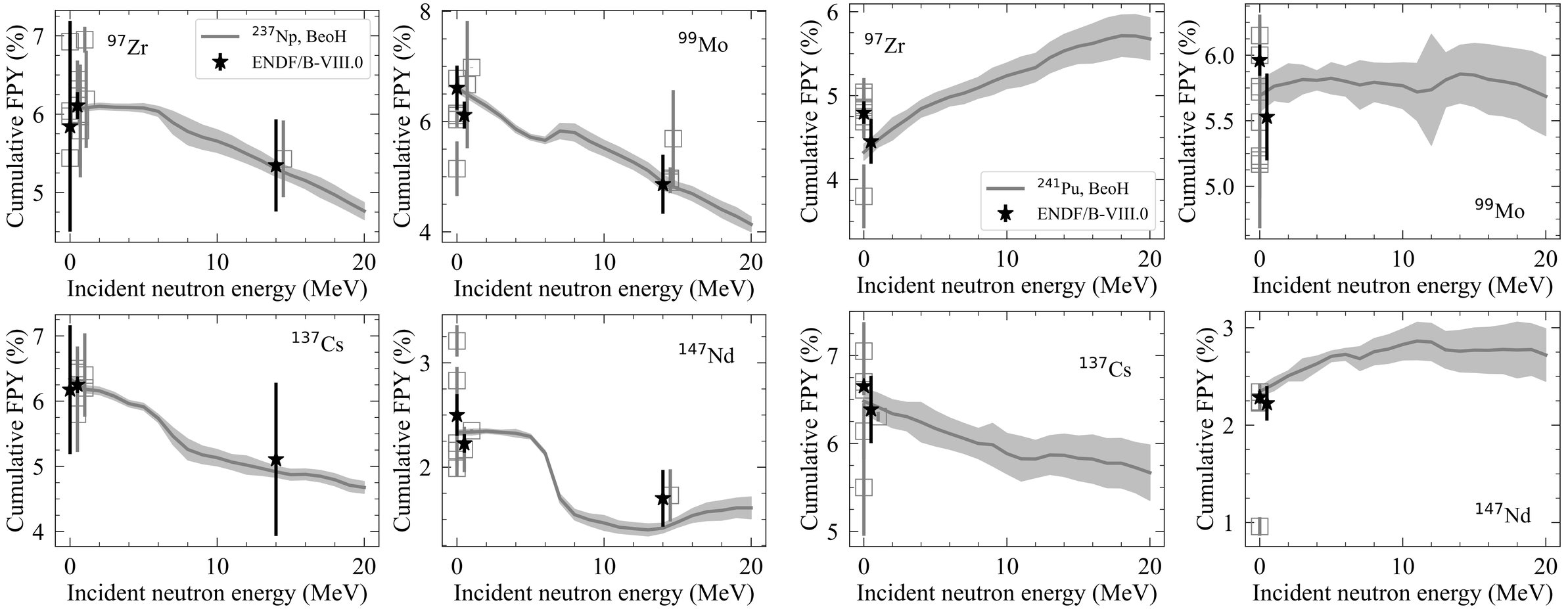
NNSA National Nuclear Security Administration

Energy-Dependent FPY Project Funded by NA22

- **Originally five laboratories (LANL, BNL, LBNL, PNNL, and LLNL) joint effort**
  - Experimental parts finished in FY21, and LANL, BNL, and LLNL continued in FY22 and 23
  - 3 years extension approved, LANL/BNL/LLNL project continues until FY26
- **Recent Relevant Meetings**
  - CSEWG (11/4 - 11/7, 2024), BNL
    - A. Lovell, "Fission Product Yield Modeling and Evaluation"
    - A. Mattera, "FY Activities at BNL"
    - N. Schunck, "LLNL FPY Modeling and Evaluation"
  - IAEA Coordinated Research Project, 12/2 - 6, 2024, Vienna, Austria
    - A. Lovell, "Fission Product Yield Modeling and Evaluation"
  - 5th Gogny Conference, Dec. 10 - 13, 2024, Paris, France
    - N. Schunck, "Microscopic Theory of Nuclear Fission"
  - Future planning meeting (TBD 2025)
    - Researchers from LANL, BNL, and LLNL

LANL: FPY Evaluation

- Major actinide data including covariances shared with BNL for testing
- Extending to minor actinides ongoing



Np237

Preliminary

Pu241

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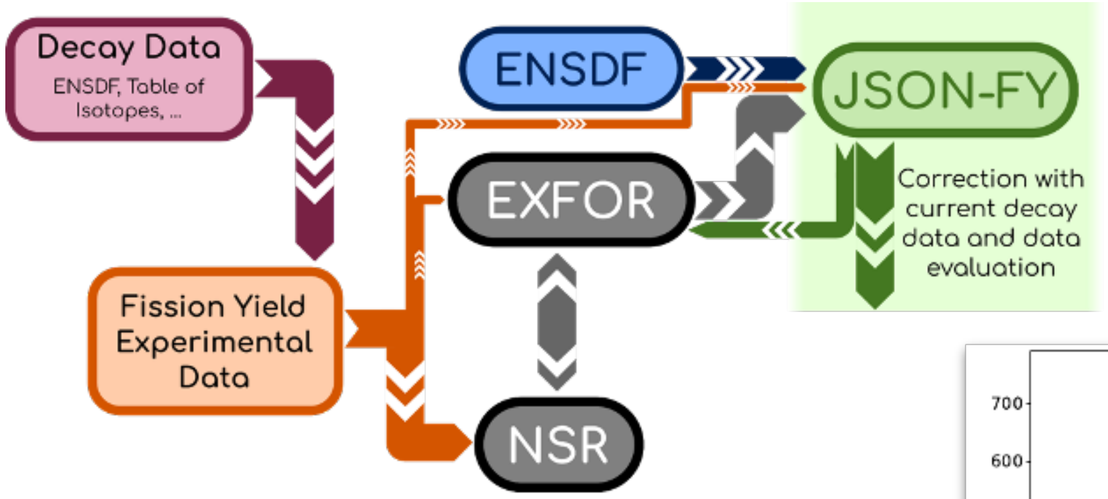
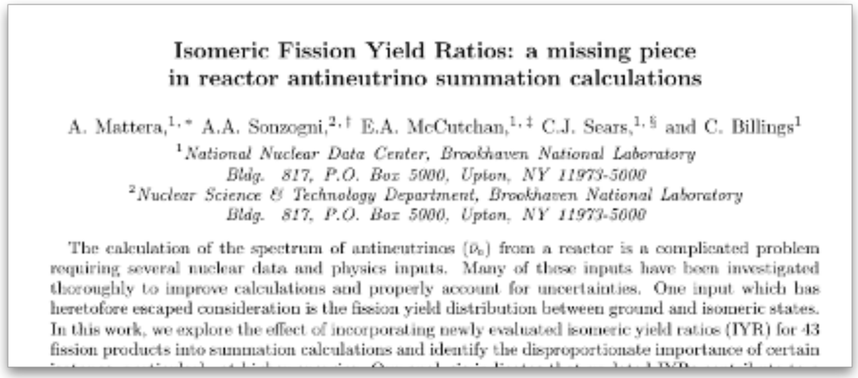
BNL FPY Activities



Continued with the compilation, decay data update and corection of ^{252}Cf spontaneous fission data



Isomeric Fission Yield Ratios: a missing piece in reactor antineutrino summation calculations

A. Mattera,[1,*] A.A. Sonzogni,[2,†] E.A. McCutchan,[1,‡] C.J. Sears,[1,§] and C. Billings[1]

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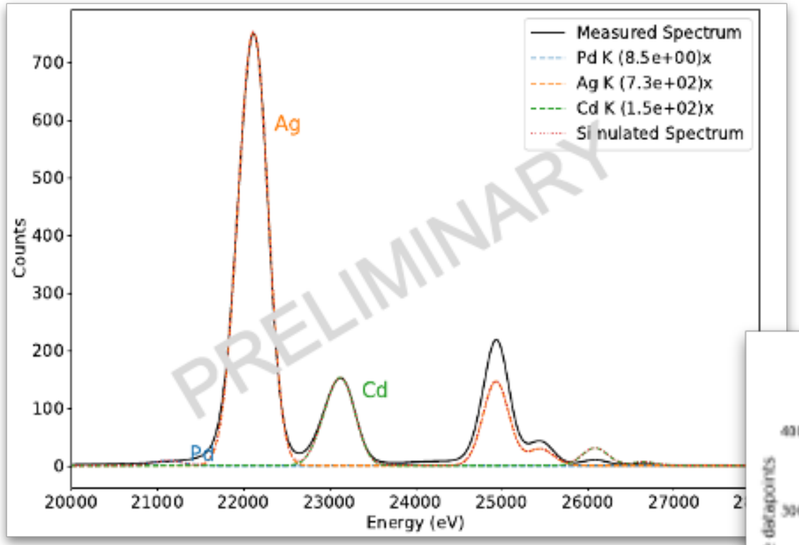
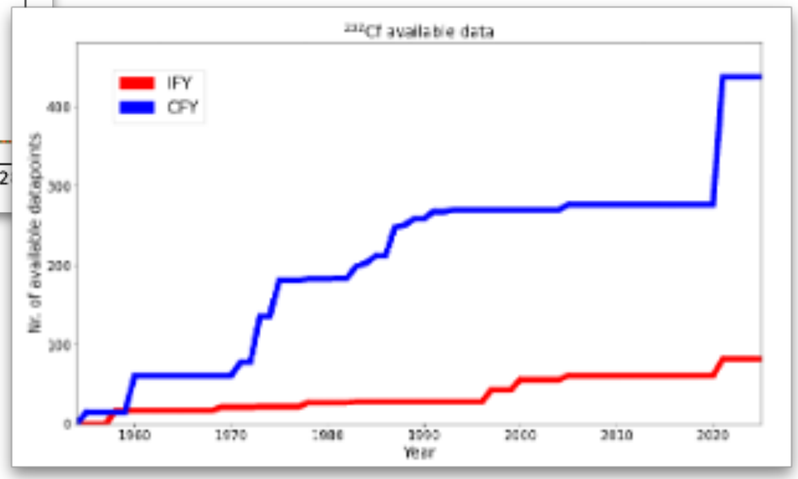
The calculation of the spectrum of antineutrinos ($\bar{\nu}_e$) from a reactor is a complicated problem requiring several nuclear data and physics inputs. Many of these inputs have been investigated thoroughly to improve calculations and properly account for uncertainties. One input which has heretofore escaped consideration is the fission yield distribution between ground and isomeric states. In this work, we explore the effect of incorporating newly evaluated isomeric yield ratios (IYR) for 43 fission products into summation calculations and identify the disproportionate importance of certain

Manuscript studying the effect of isomeric yield ratios on antineutrino spectra submitted to PRL



Started development of a dashboard to access and visualize the JSON-based FY database



Spin-Off: LDRD to investigate the study of fission yields with X-ray fluorescence at NSLS-II

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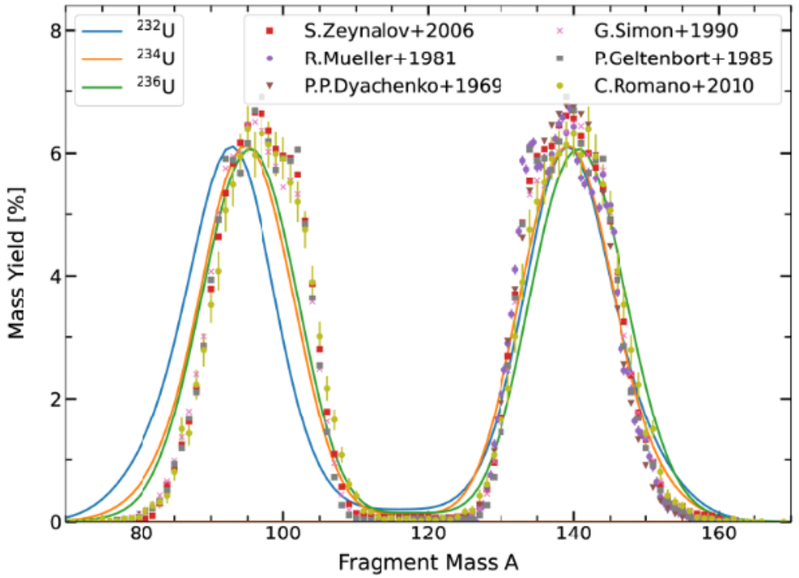
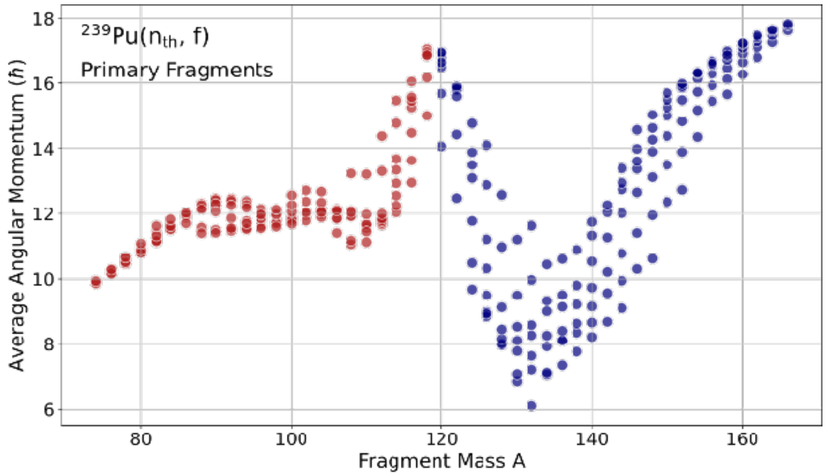
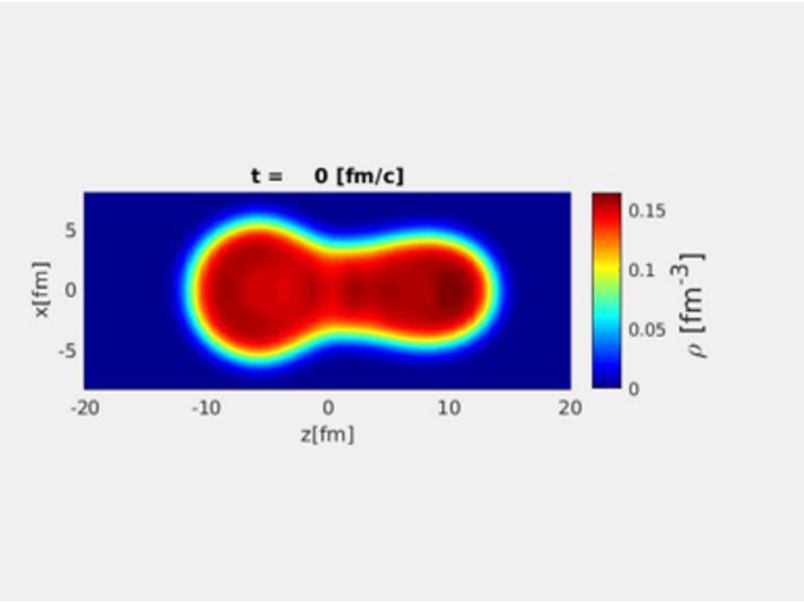
LLNL FPY Activities

- **Develop microscopic theory of fission to predict the initial conditions of fission fragments**

Large-amplitude collective dynamics provide fission fragment distributions	Projection techniques provide spin of fission fragments (parameter free)	Real-time fission dynamics provide fission fragment excitation energy







- **After validation in major actinides, framework can be applied to minor actinides or super-heavies**

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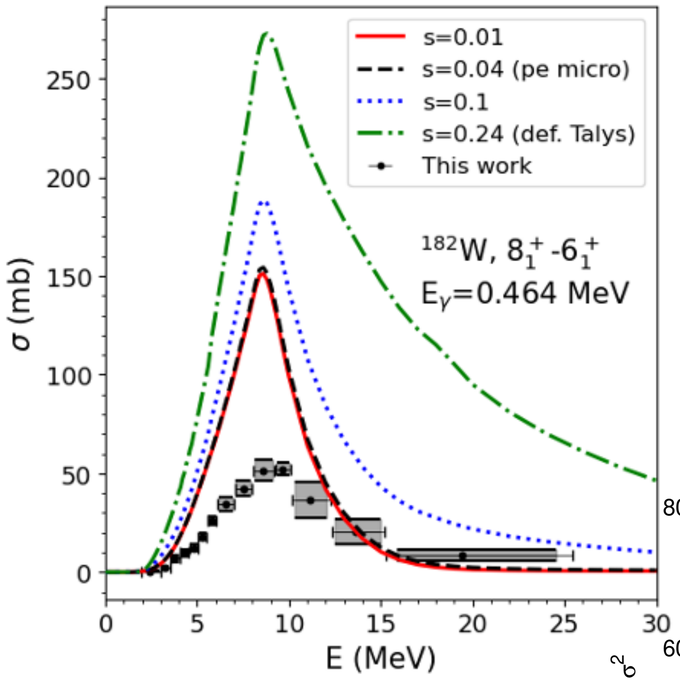
Evaluation of Gamma Production Project Funded by NA22

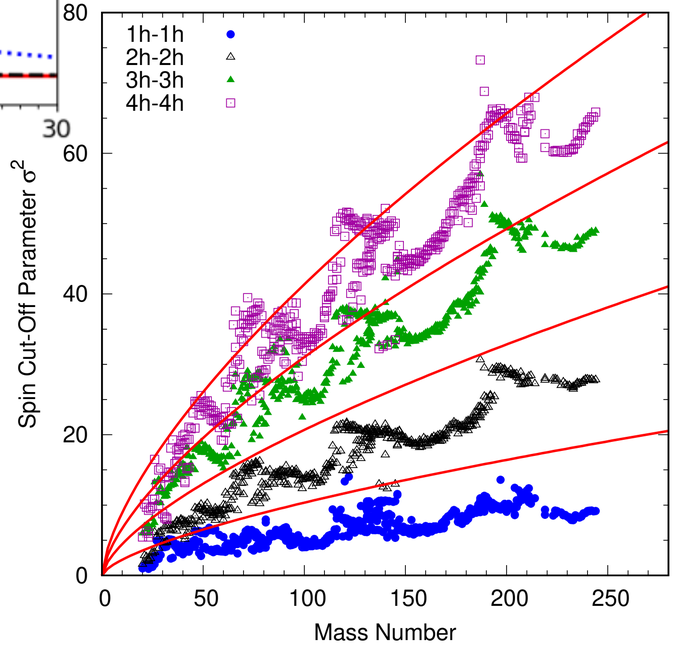
- **This project aims at**
  - improving both the modeling of nuclear structure and nuclear reactions in order to produce the first state-of-the-art comprehensive evaluation of gamma-ray production
  - delivering a complete and realistic data library for applications
  - apply to, and obtain feedback from astrophysical calculations
- **Project profile**
  - LANL, LLNL, U. Notre Dame, North Carolina State U.
- **Recent Relevant Meetings**
  - Informal technical meeting between CEA and LANL held in 3/25 – 29, Paris
  - American Physical Society April meeting 2024, Apr. 3 - 6, 2024, Sacramento
  - International Workshop on Compound Nuclear Reaction and Related Topics, CNR*24, Vienna, Austria
  - 5th Gogny Conference, Dec. 10 - 13, 2024, Paris, France

LANL and LLNL Short Highlights



Spin transfer to W-isotope has strong impact on gamma-ray production

Semi-microscopic partial level density using folding Yukawa potential



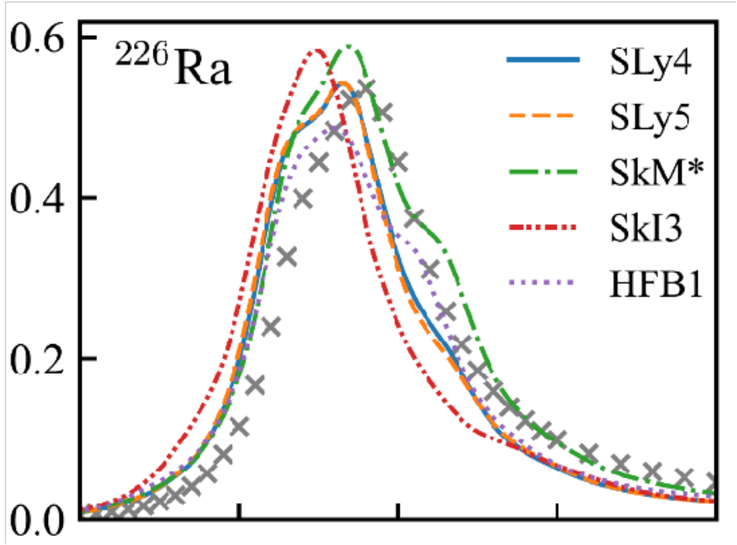
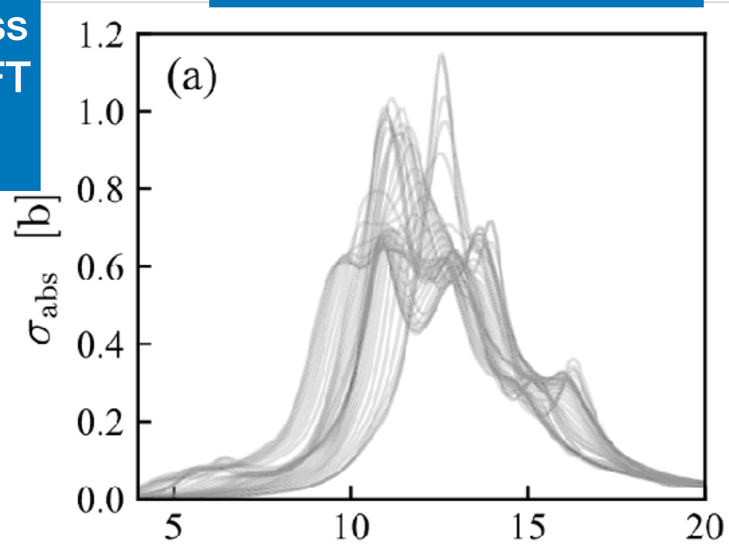


Photo-absorption cross section by different DFT models

Photo-absorption cross section for Pu isotopes from proton to neutron driplines



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- Nuclear Fission - Theories, Experiments and Applications, Eds. P. Talou, R. Vogt, Springer (2023)
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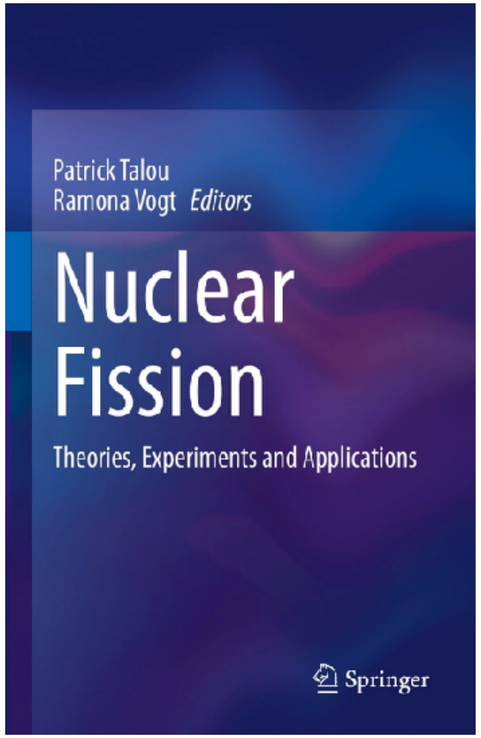

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