Updates in Nuclear Structure Evaluation Traineeship at LLNL

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USNDP Meeting (Oct. 28-31, 2005)

Prepared by LLNL under Contract DE-AC52-07NA27344.

This work is supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics.

Nuclear Structure Evaluation Traineeship Team

BNL Evaluators

Libby McCutchan (PI)

Manager of XUNDL Database
Manager of ENSDF Database
10+ years as ENSDF evaluator

Chris Morse (Co-I)

Lead on ENSDF modernization project and ENSDF evaluator

LLNL Trainees

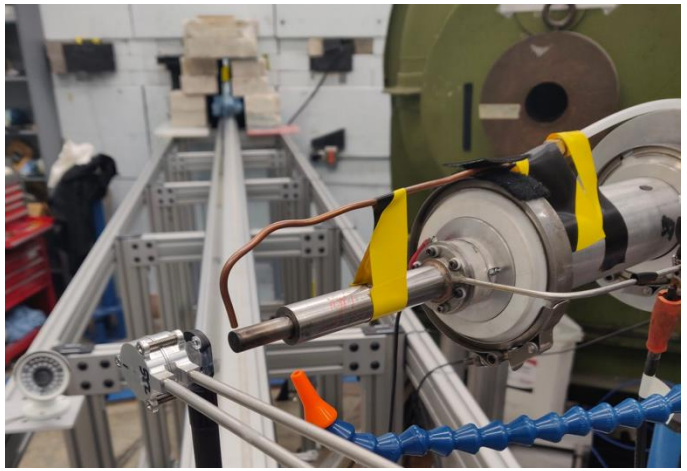
Vincent Cheung
(Theory)

Anthony Ramirez
(Experiment)

Kay Kolos (PI)

My Background (Experimental Low-Energy NP)

- **Fission Product Yields (FPYs)**
  - Require reliable levels and decay data (E_γ, $T_{1/2}$, I_γ, BR) for activation and gamma spectroscopy analysis



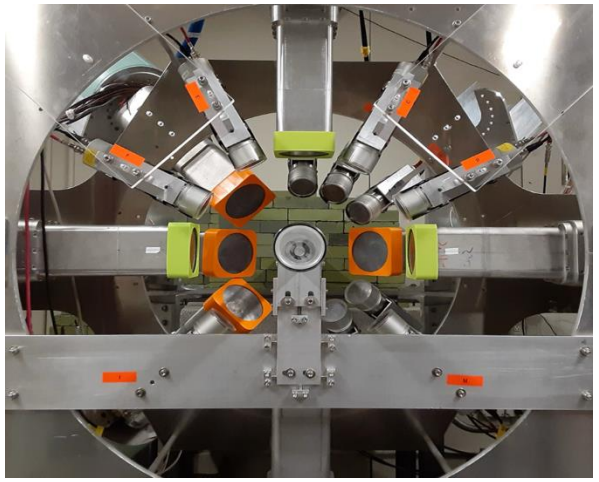
RABITTS at TUNL for FPY Studies

- **Nuclear Forensics**
  - Need accurate E_γ, I_γ, $T_{1/2}$, BR, α and level schemes for cascade and coincidence analyses

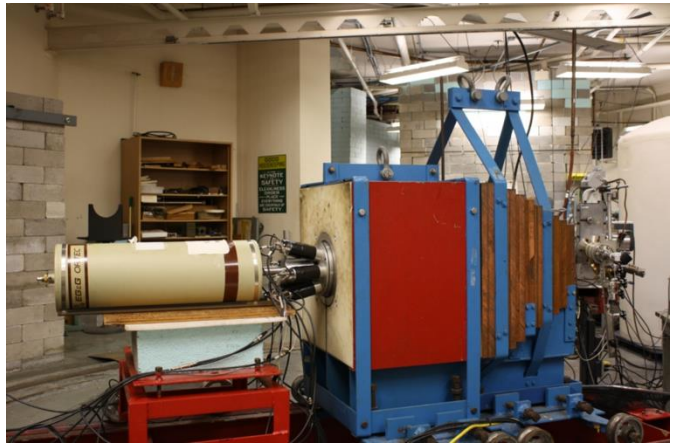
Coincidence Counting System at NCF

My Background (Experimental Low-Energy NP)

- **Neutron and Photon Scattering Measurements**
  - Measure E_γ, I_γ, and $T_{1/2}$
  - Provide level schemes, transition strengths, and spin(parity) assignments
  - Support consistency checks for ENSDF datasets



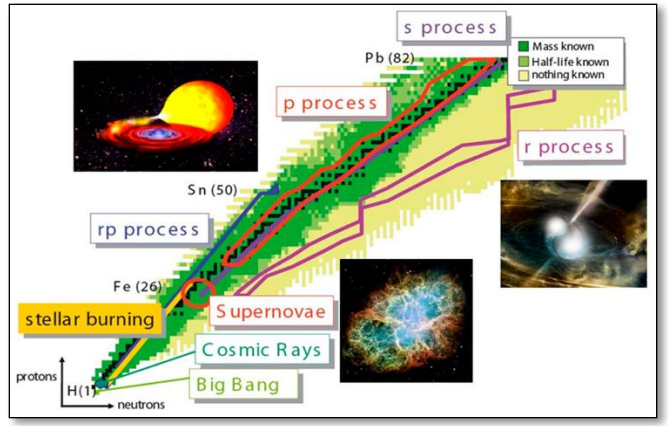
HIGS Clover array for nuclear resonance fluorescence experiments

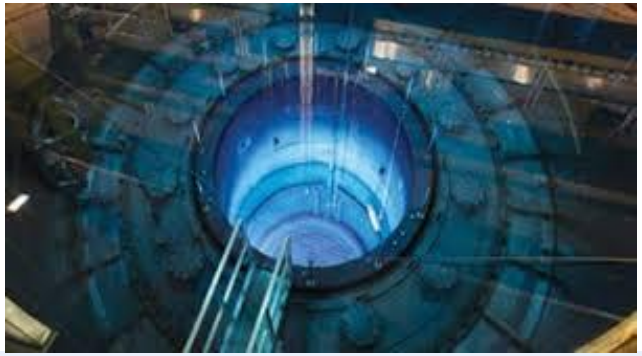


UKAL for angular distribution and DSAM experiments

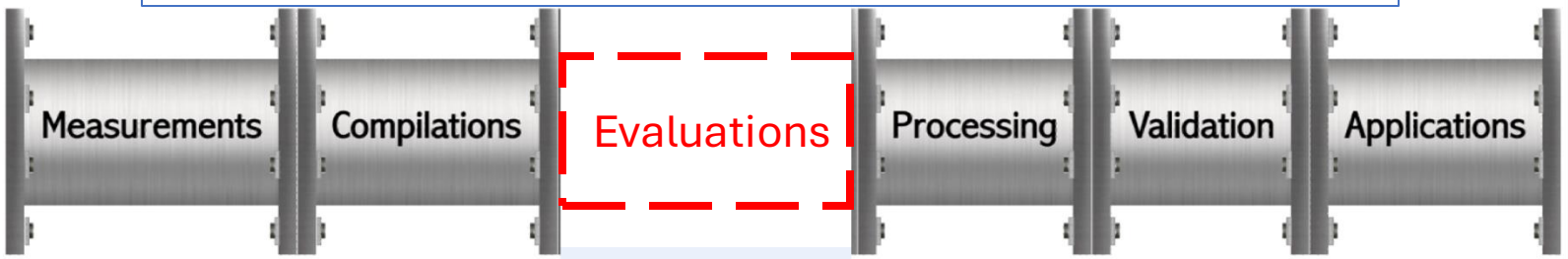
Motivation

- Expand the pool of nuclear structure evaluators
  - provide continuous updated evaluations to support applications (e.g., nuclear energy, astrophysics, and national security)
- Establish in-house nuclear structure evaluation capability at LLNL
- Hands-on training in modern nuclear data evaluation methods with BNL evaluators

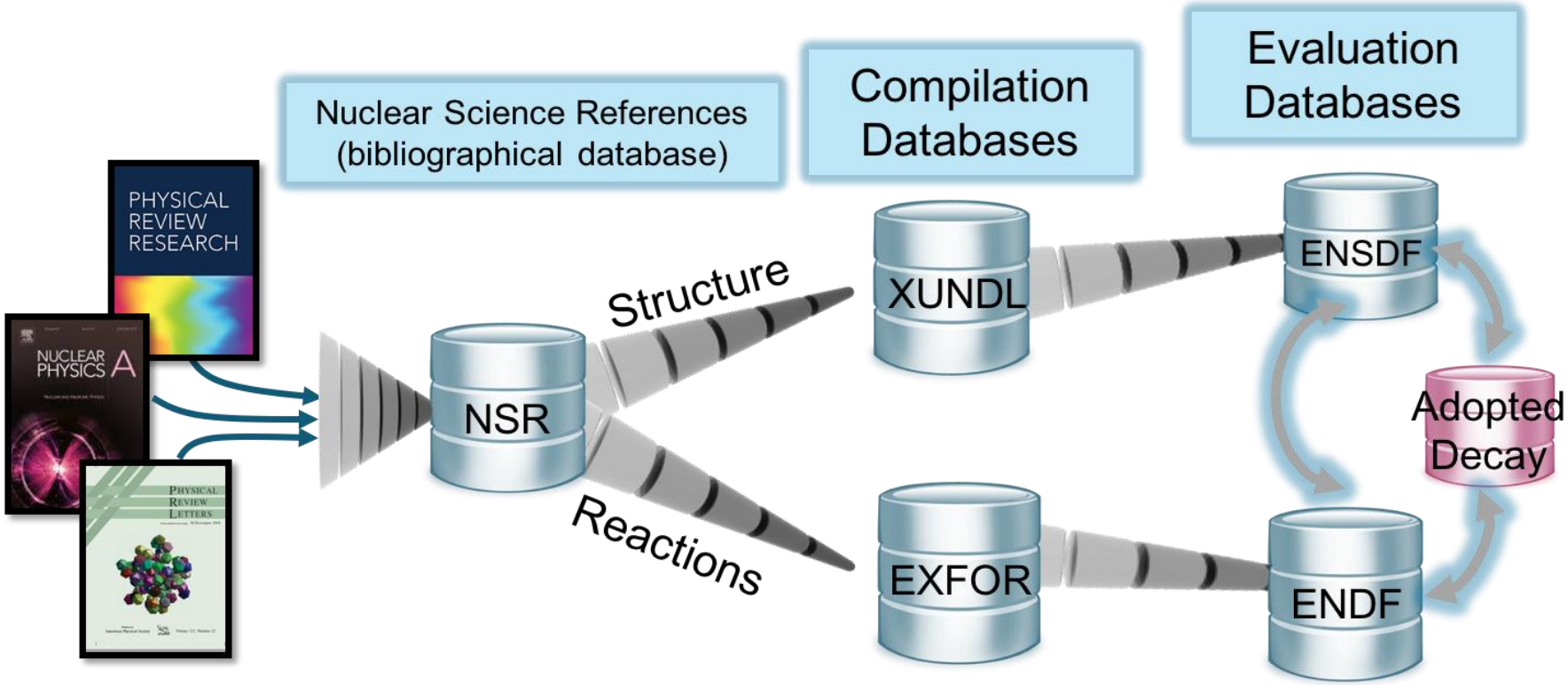




The Nuclear Data Pipeline: From measurements to applications



Comprehensive Role in the Evaluation Process

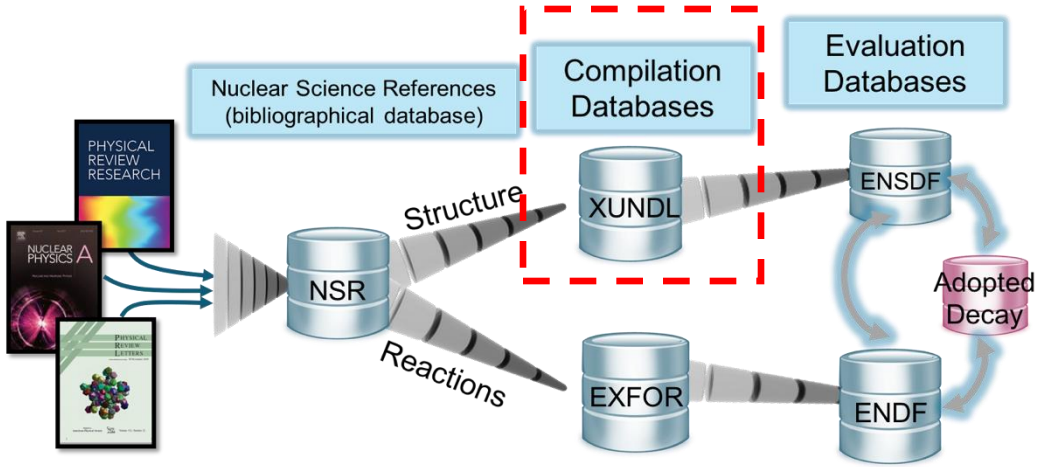


LLNL trainees engage in each stage of the nuclear evaluation workflow – from literature review to data compilation, evaluation, and validation

XUNDL Compilation: Progress and Current Focus

General workflow:

- Check publication/report data in NSR (key number)
- Extract and verify data (levels, gammas, uncertainties, etc.)
- Summarize methods, compile data, and upload to XUNDL



Compiled data from various experiments:

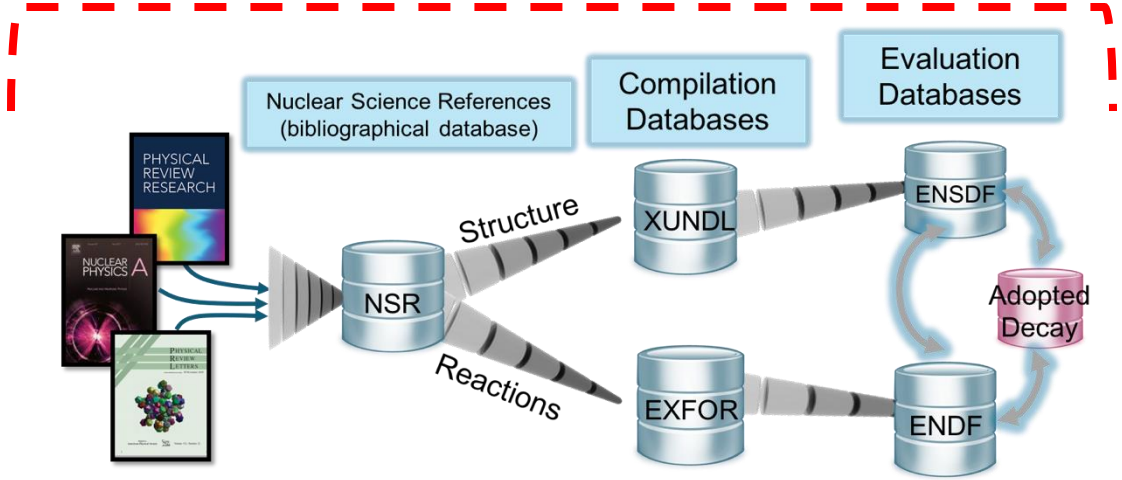
- Beta-, alpha- or isomer decay
- Heavy-ion fusion reaction
- Thermal neutron capture
- Scattering or transfer reaction

FY25 Summary:

Total XUNDL Submissions	Total # of Papers
60	44

ENSDF Evaluation: Methods

- **Data compilation and verification**
  - Gather experimental data from XUNDL – double check NSR for new articles or reports
- **Group information into data sets**
  - Decay data and reaction data
  - Update (no new data); Merge (combine related data sets); Create (add new dataset when significant new data)
  - Produce Adopted Levels, Gammas
- **Discuss evaluation with team and BNL mentors**

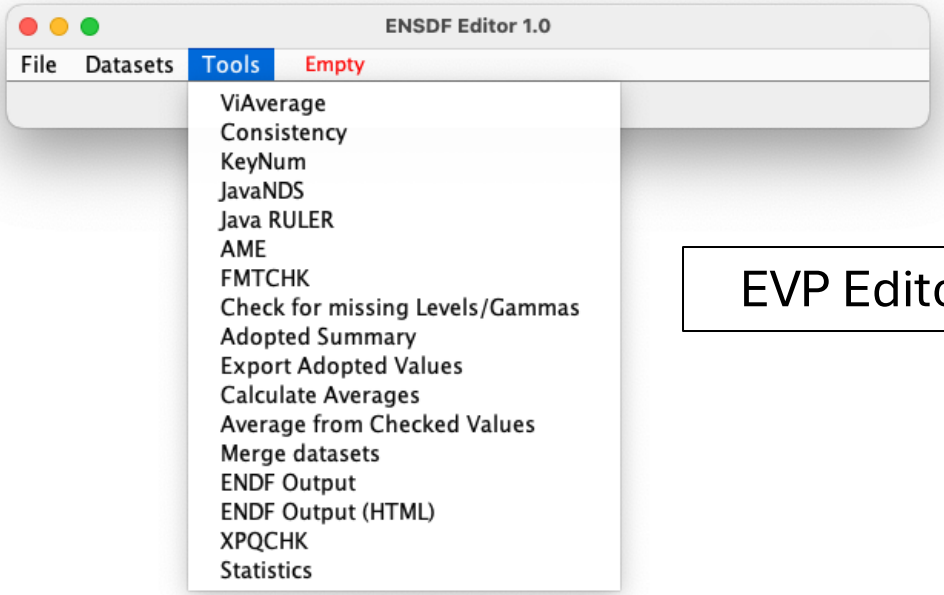


ENSDF Evaluation: Tools

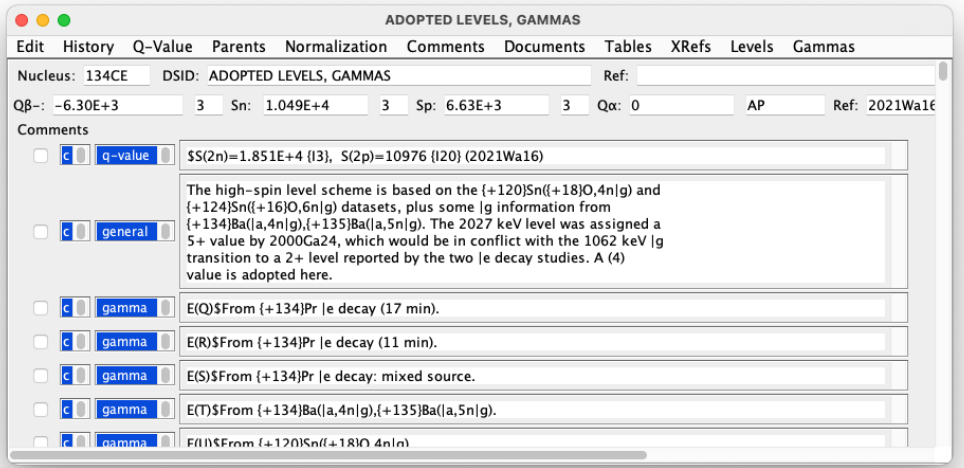
- **Available ENSDF analysis codes:**
  - GTOL
  - RUL
  - FormatCheck
  - BrIcc (ICC calculator)
  - Betashape
  - LOGFT
  - Excel2ENSDF
  - Q-value calculator
  - More codes here:

https://www.nndc.bnl.gov/tools/

https://www-nds.iaea.org/public/ensdf_pgm/



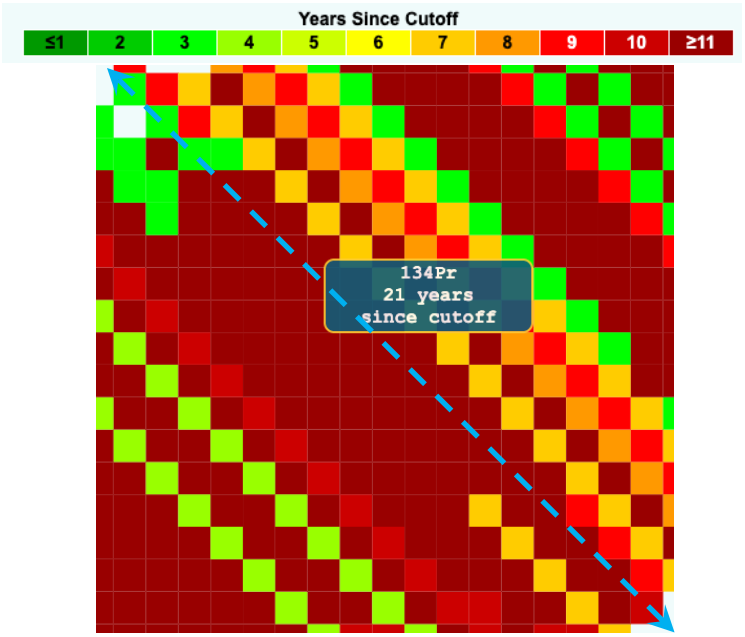
EVP Editor

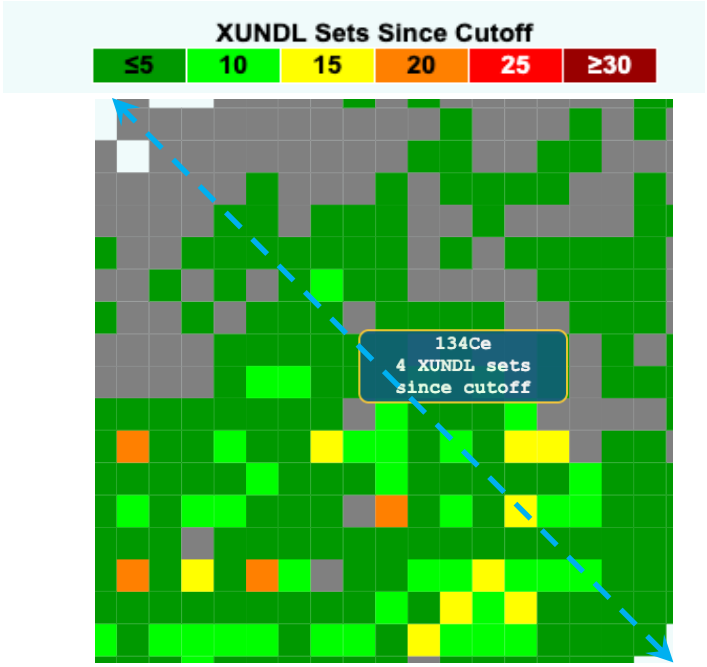


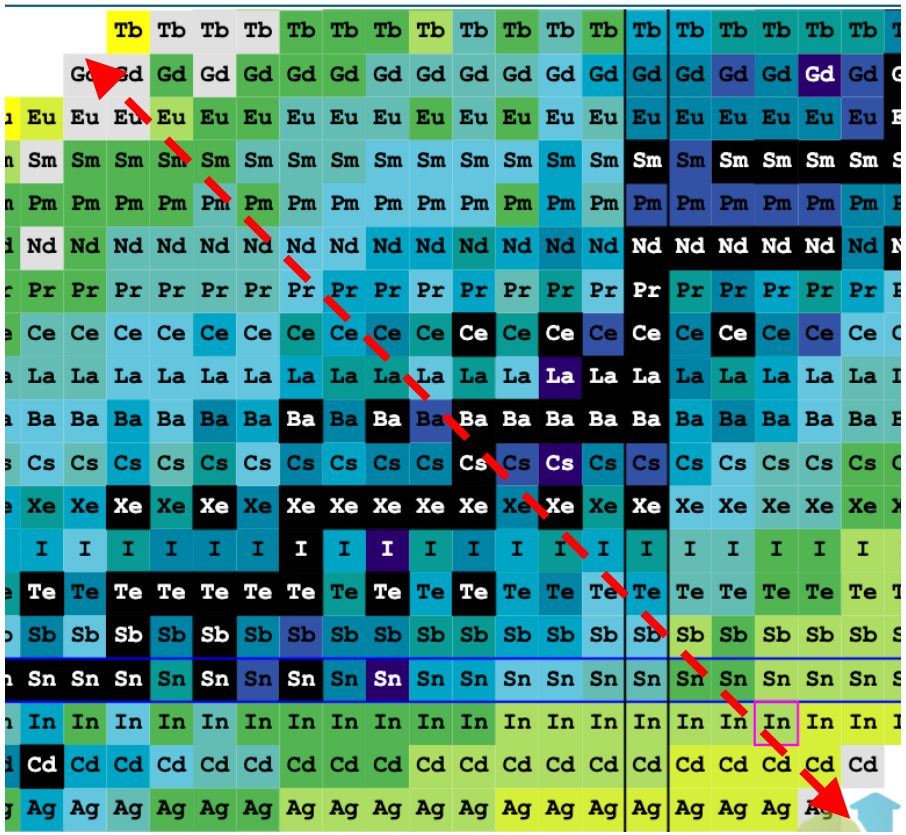
ENSDF Evaluation: A = 134 Mass Chain

Status

- 13 nuclides last evaluated ~21 years ago
  (4 updated in the last decade)
- 57 XUNDL sets since cutoff date







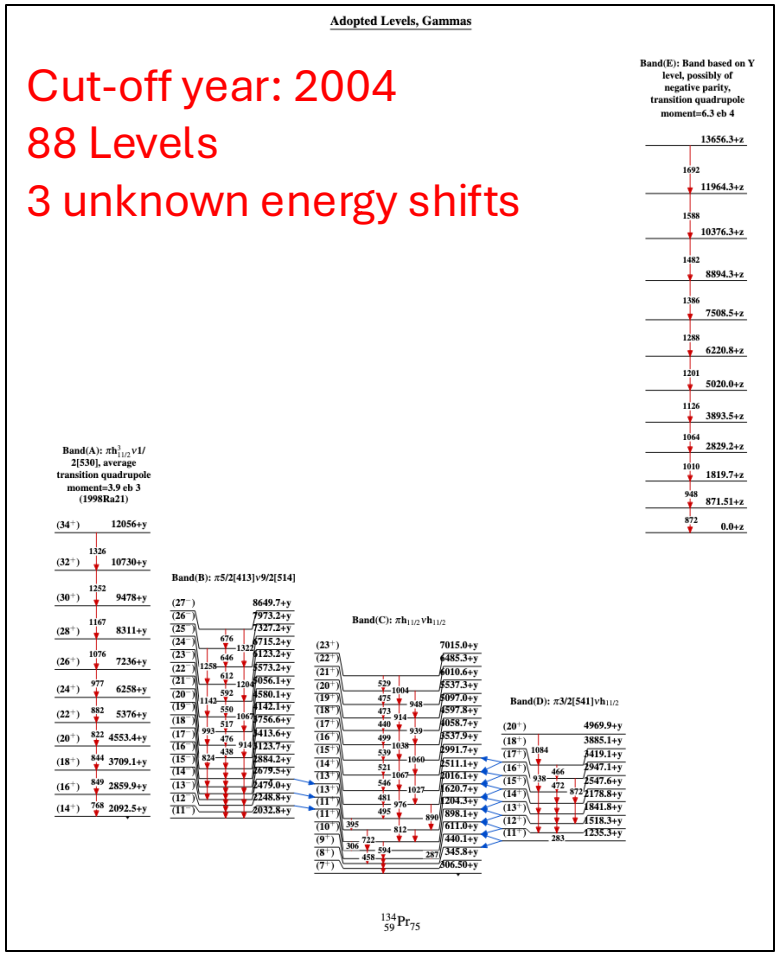
ENSDF Evaluation: Mass A = 134 Chain

Evaluation Activities

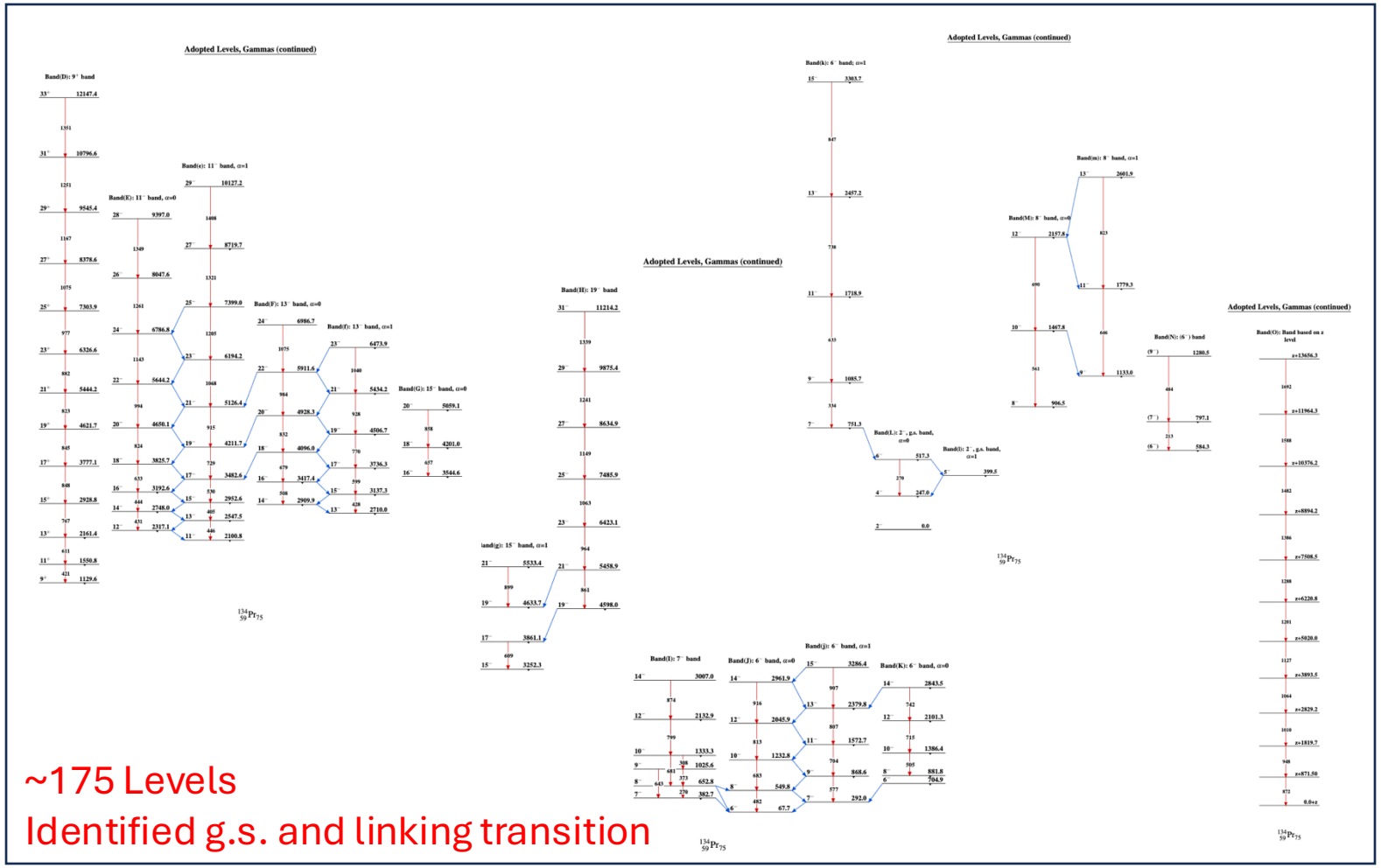
- Learning evaluation workflow: guidelines and general policies
- Incorporating recent XUNDL compilations (review literature and check consistency)
- Merging data sets (HI reactions)
- Extending Adopted Levels and Gammas for ^{134}Pr, ^{134}Ce, and neighboring nuclides

^{134}Pr Adopted Levels and Gammas

Cut-off year: 2004
88 Levels
3 unknown energy shifts



^{134}Pr – 2004 ALG



~175 Levels
Identified g.s. and linking transition

^{134}Pr – 2025 ALG

Outlook

- Continue learning ENSDF evaluation workflow and analysis/utility tools including the new JSON-based editor
- FY26 goal: Complete ENSDF evaluation for the A=134 mass chain