Towards a Standard Experimental Nuclear Data Format (SENDF)

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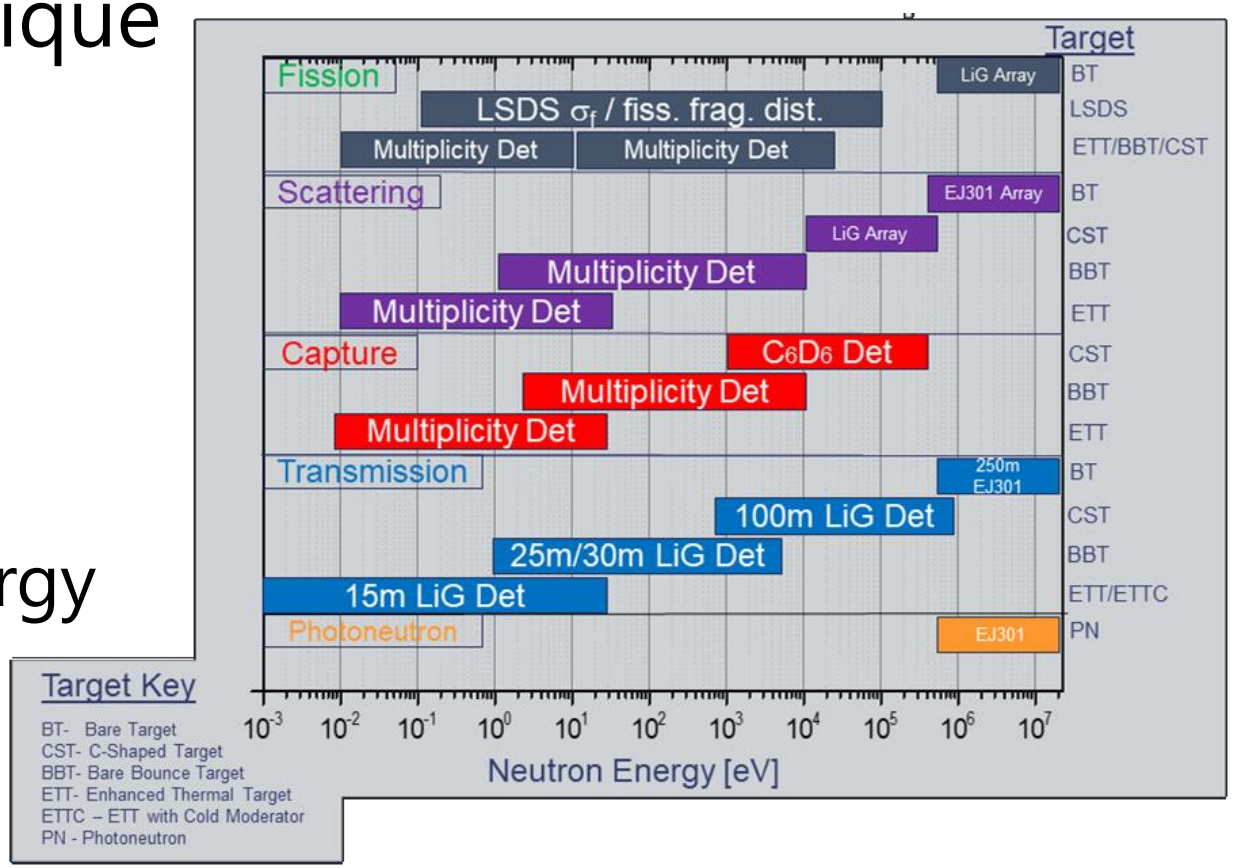
Background

- Nuclear measurements produce data that often requires complex processing and discrimination for the purpose of improving computational models
- Raw experimental nuclear data files are not universal
  - Unique to each facility, and possibly each data acquisition system
  - May not capture all relevant experimental information
    - In-test logs
    - Detector settings, positions, etc.
- Experiments are expensive – goal is to save for posterity all pertinent information to reproduce the analysis
- The EXFOR database
  - Well known collection of measured data that was processed and reported (published)

Challenges in the Modern Landscape

- Each experimental system is unique
  - Liquid scintillators, Li-Glass
  - Analog, 8-bit, 10-bit, 16-bit DAQ
    - Event acquisition length
  - Transmission, scattering, capture
  - Multiple decades of neutron energy
    - <1 meV to 20 MeV

RPI Capability Matrix



Flow of Experiment Nuclear Data

Institute I

250m EJ301 (n) Analog

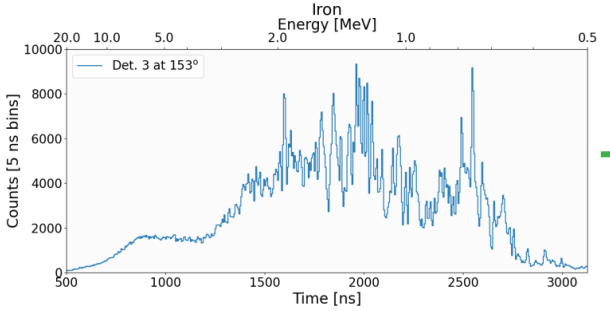
LiG Array (γ) 10-bit

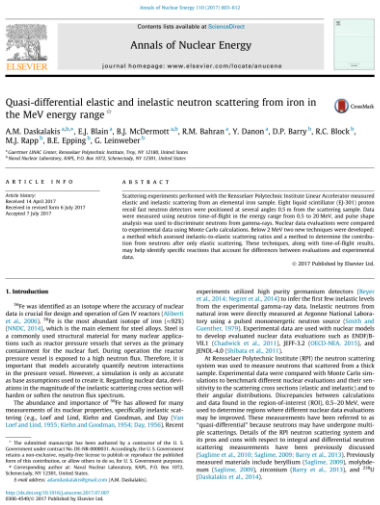
EJ301 Array (n and γ) 8-bit

Multiplicity (γ) 14-bit

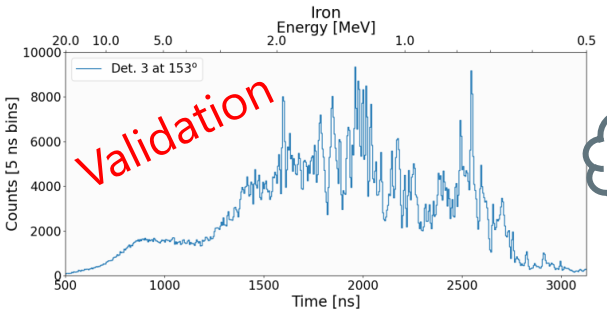
Subject Matter Experts

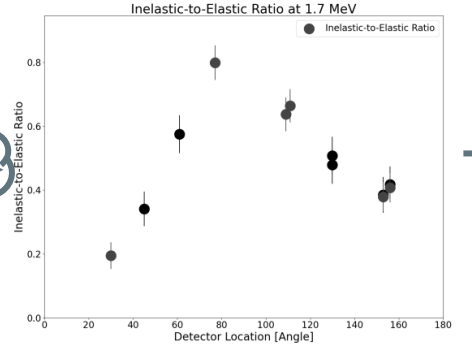
Codes and Tools, Institutional Knowledge, etc.





Institute II





Motivation for a Standard Experimental Nuclear Data Format

- Maximizes appropriate sharing of federally funded scientific data found in peer-reviewed publications and the underlying scientific data contributing to those results
- Benefits from nuclear instruments that rely on similar mechanics to acquire data, which is normally processed to similar products, i.e., cross sections, yields, etc.
- Provides a mechanism for the community to more easily process complex analytical work
  - Easily stored in a machine-readable format
- Allows for the generation of a publicly accessible, open-source analysis tools
- Supports accelerated extraction and long-term governance of measurement data for commercial and national security applications
  - Lifecycles may last decades, i.e., commercial reactors, naval reactors, nuclear weapons

SENDF Example

8-Bit Acqiris Data File(s)

- Extract channel and trigger
- Calculate time
- Pulse analysis
  - Calculate area
  - …
  - Perform PSD

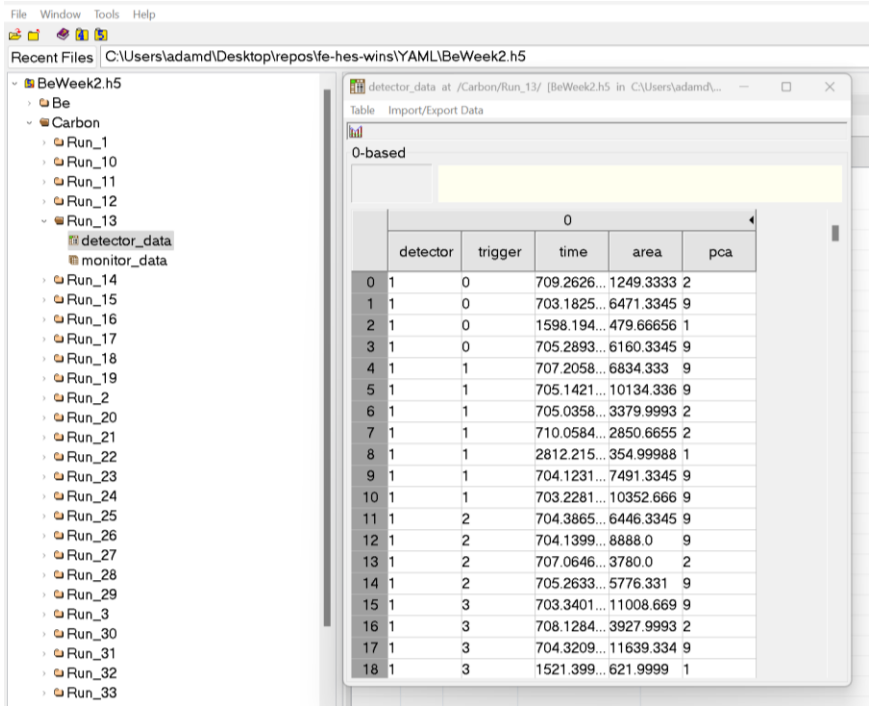
Chi-Nu (LANL) Data File(s)

- Extract channel, area
- Calculate time
- Pulse analysis
  - …
  - PSD

14-Bit MULT Data File(s)

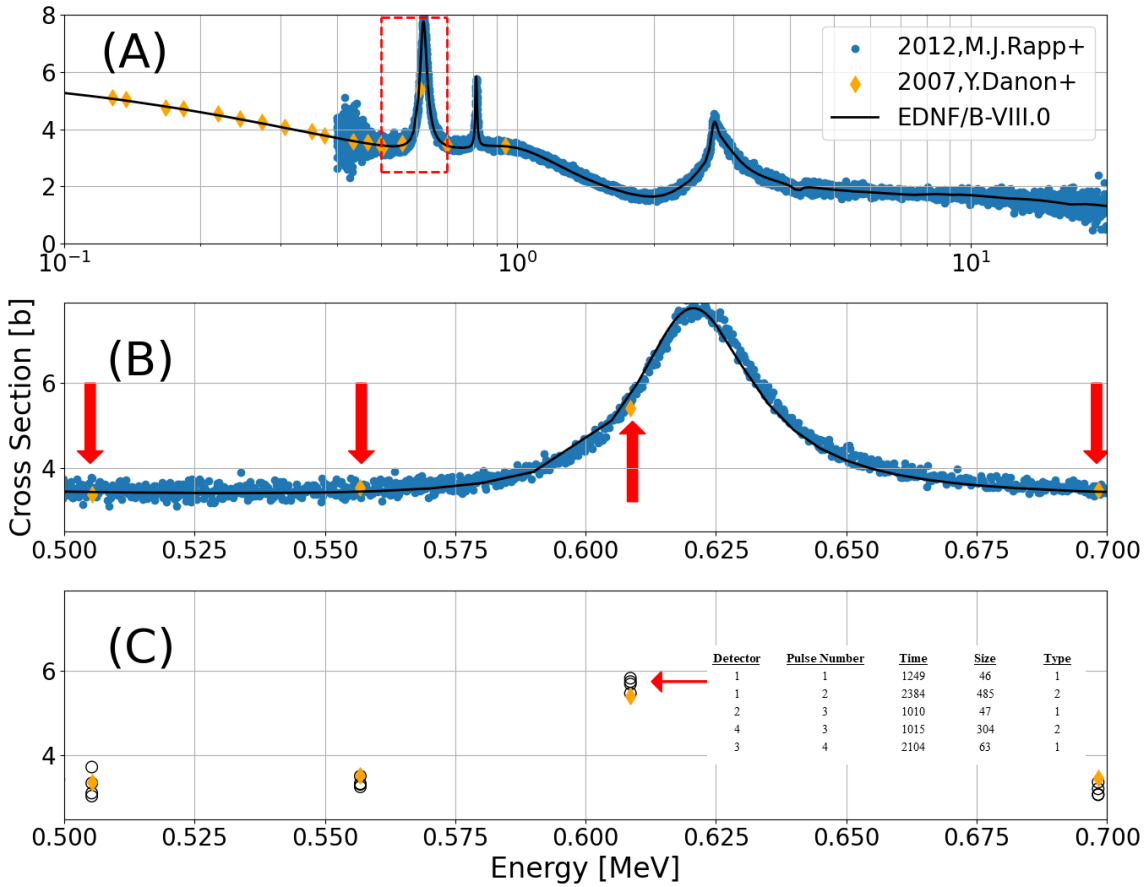
- Extract channel
- Locate pre-trigger
- Calculate time
- Pulse analysis
  - Calculate area
  - …

	Channel	Trigger	Time	Area	Type/PCA
8-bit HES	X		X	X	X
10-bit MES	X		X	X	
MULT.	X	X	X	X	
10-bit MEC	X		X	X	
14-bit MES	X		X	X	



Integration with the Broader Community

- These files should complement information found in databases like EXFOR
  - SENDF data are at a more granular level
  - Data that contributes to final and/or published results



Potential Improvement for Information Flow

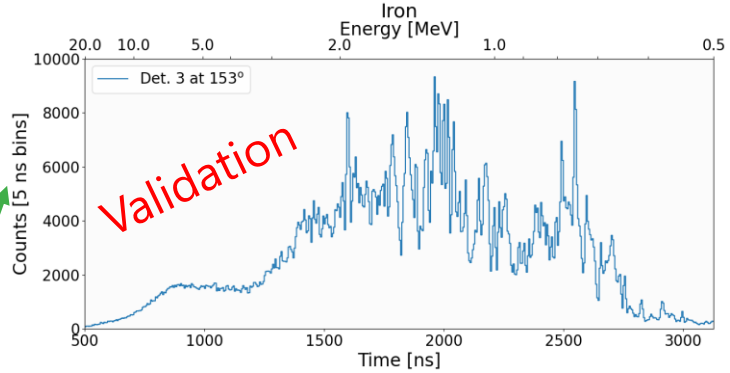
Institute I

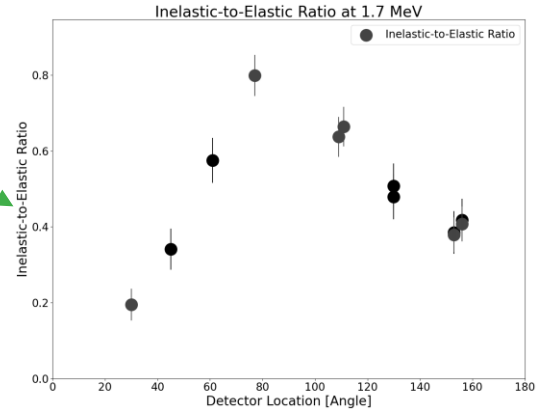
EJ301 Array (n and γ) 8-bit

	detector	trigger	time	area	pca
0	1	0	709.080...	144.66661	2
1	1	0	704.191...	10608.334	9
2	1	2	710.050...	964.3336	2
3	1	2	704.224...	7102.667	9
4	1	2	705.110...	4827.0	9
5	1	2	705.028...	4449.001	2
6	1	2	707.384...	255.6666	1
7	1	2	708.217...	4848.002	9
8	1	2	702.121...	10797.0	9
9	1	3	708.049...	4979.669	9
10	1	3	708.275...	2491.6665	2
11	1	3	703.218...	8088.669	9
12	1	3	708.278...	4751.669	9
13	1	3	705.408...	5323.333	9
14	1	8	710.083...	2179.9995	2
15	1	8	705.370...	8966.334	9
16	1	8	706.014...	258.00003	2
17	1	8	703.510...	13980.998	9
18	1	9	706.255...	1893.3328	2
19	1	10	707.132...	5250.667	9
20	1	13	711.055...	1457.0	2
21	1	13	706.322...	999.3336	2
22	1	13	706.266...	5584.669	9
23	1	13	709.399...	332.0	2
24	1	13	2725.10...	481.66656	1

Open Toolset

Institute II





Going Forward

- SENDF allows the community to make productive use of measurement data sooner and longer, eliminating the need to periodically recreate the wheel
  - Justifying the investment creating a common format and developing analysis tools.
- Additional Challenges
  - Is this the right way forward? Community feedback needed!
    - Identify critical experimental information
    - Implement modern practices that ensures accessibility and versatility
  - Who will develop downstream tools for analysis and validation
  - Who maintain documentation and decide on format, structure, etc.?
  - How will files be stored and/or disseminated?
  - Where will funding come from?

Thank You