Los Alamos NATIONAL LABORATORY

Reevaluating the ^{252}Cf(sf) PFNS and associated covariances

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Why do we care about a new ^{252}Cf PFNS evaluation?

^{252}Cf(sf) PFNS is a standard. It cannot be updated since 1986 because its input data were lost.

Why is this standard important:

- >70% of all other PFNS measurements (including ^{235,238}U and ^{239}Pu!) are measured using the ^{252}Cf PFNS. If its mv or cov are incorrect, we impact PFNS of all actinides.
- New models are often using it as a first test case.
- Dosimetry community uses it to calculate SACS.

Our current ***standards*** evaluation by Mannhart is ***not reproducible*** because:

- Input data are lost,
- Code is lost (executable exists but no PPP correction).

Impact of not having the data:

- New experimental data (7 sets) have been measured that we cannot add,
- No way to link ^{235}U PFNS and SACS to ^{252}Cf(sf) PFNS.

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- Dosim

We render the evaluation reproducible again by:

1) Reproducing Mannhart's evaluation to the best of our ability.
2) Updating the evaluation with similar code.

Our curr

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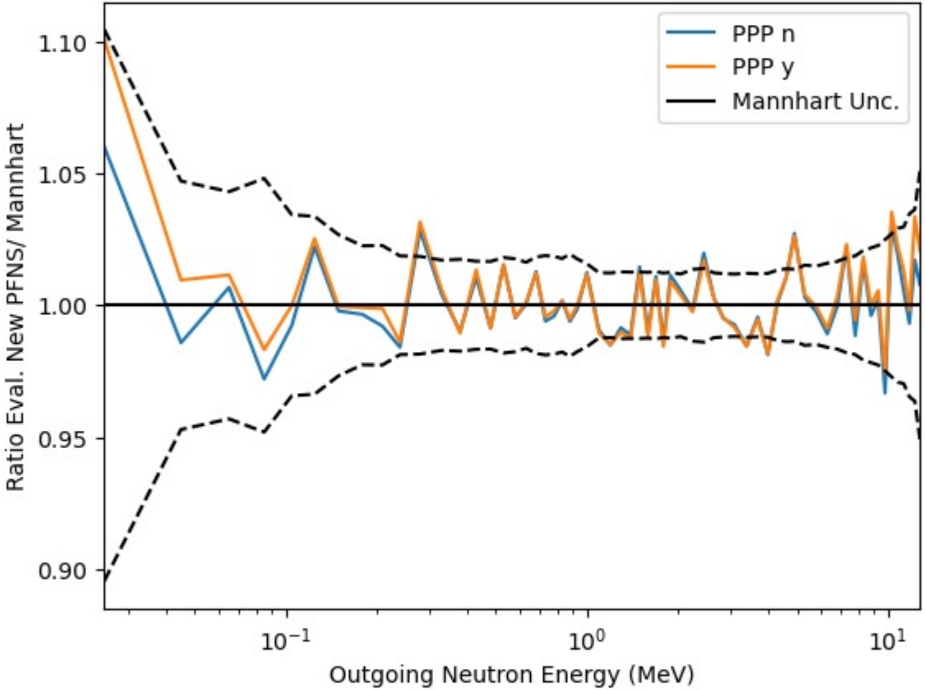
1) Reproducing Mannhart’s evaluation to the best of our ability.

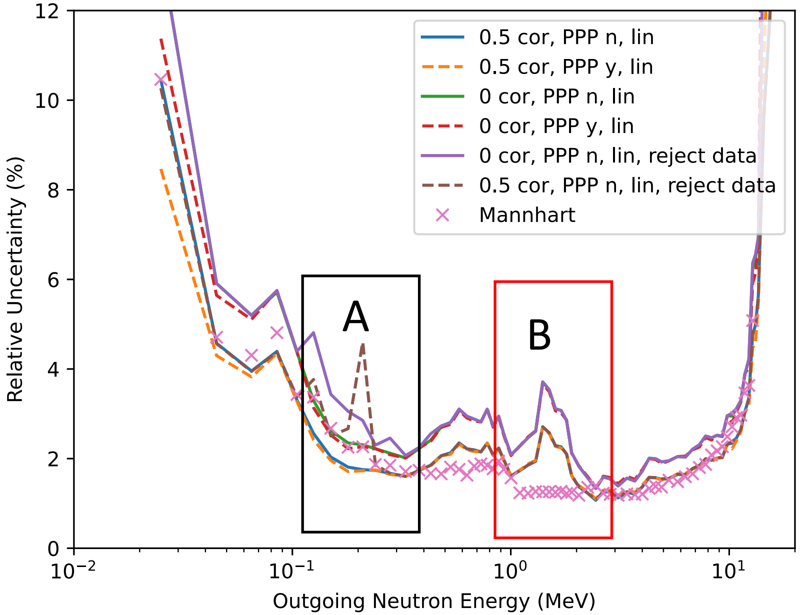
There is a lot we know and a lot we don't know about Mannhart's evaluation, unfortunately.

We know	***We don't know***
GLS algorithm *without PPP correction was used*	Prior mean values and covariances (minor)
We read experimental mean values and uncertainties from plots.	**We do NOT have experimental correlation coefficients! (major)**
How many data points were rejected.	**Which exact experimental data points were rejected! (big)**
Experimental data were transformed to evaluation grid before evaluation.	We cannot reproduce Mannhart's fit results, there is likely a mistake. (minor)

Mannhart evaluation is well documented in: Mannhart, IAEA-TECDOC-410 (1987).

We can still reproduce Mannhart mv within his evaluated uncertainties, but open questions remain:





Final judgment: We are missing information on exp. correlation (B) and which data were rejected (A) to fully reproduce Mannhart's evaluation, but PPP effect likely small.

2) Updating the evaluation with similar code.

New: Updated database, use IRLS (=GLS with Chiba-Smith correction for PPP), detailed new UQ for all data.

Mannhart standard evaluation

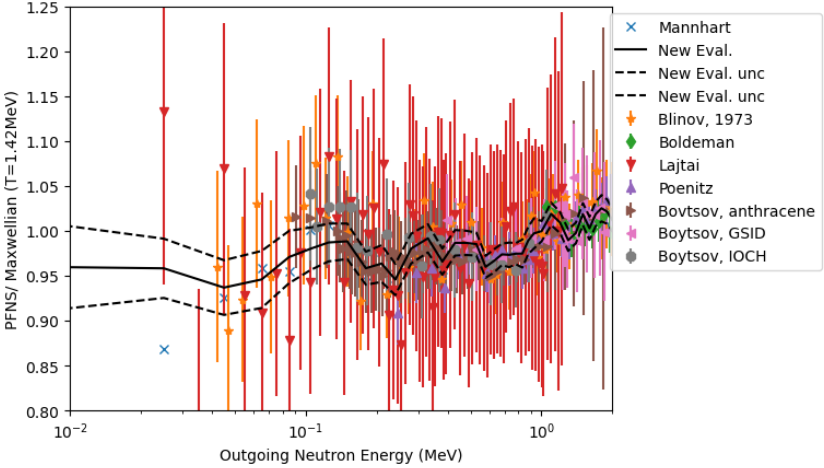
Author & year	EXFOR-number
Dyachenko 1989	41158.003.
Boettger 1990	**Not in EXFOR.**
Poenitz 1983	14278.002
Blinov 1973	40418.007
Boldemann (Li) 1986	30775.003
Boldemann (Plastic)	30775.002
Maerten **1984**	**Not in EXFOR.**

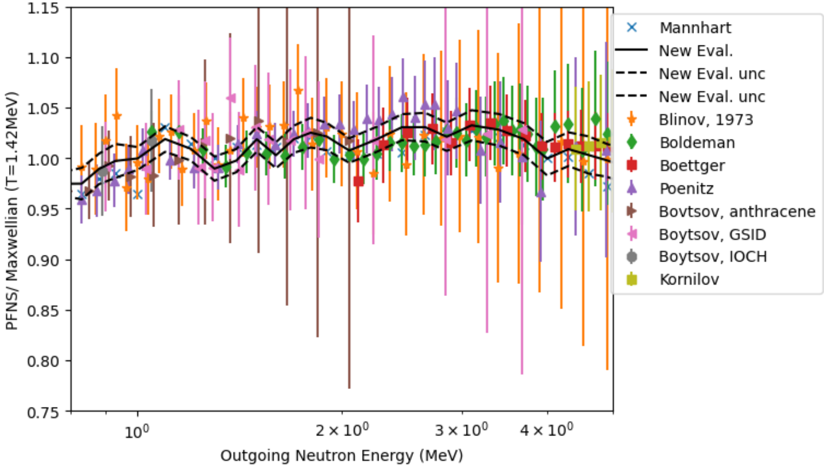
Proposed input for new standard

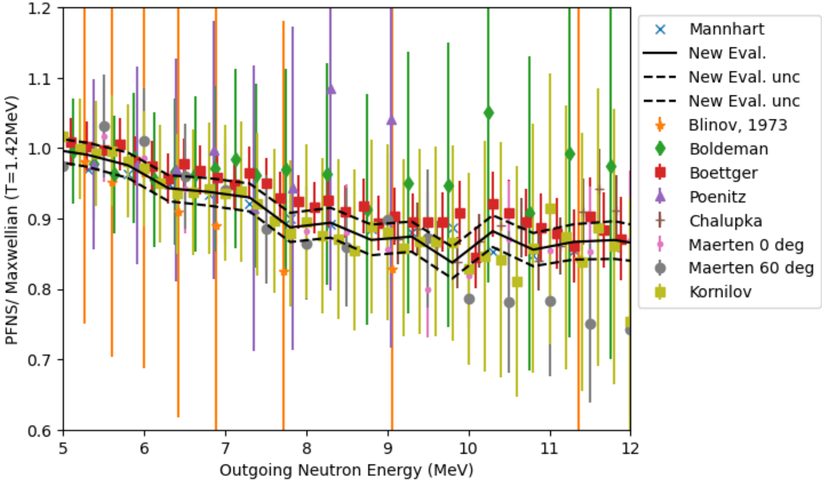
Author + Year	New Experiments
Lajtai 1990	Kornilov 2017
Boettger 1990	3xBoytsov 1983 (low energy)
Poenitz 1983	2xChalupka **1990**
Blinov 1973	4xBlinov 1980 (low energy extension)
X	
Boldemann (Plastic)	
X	2xMaerten **1990**

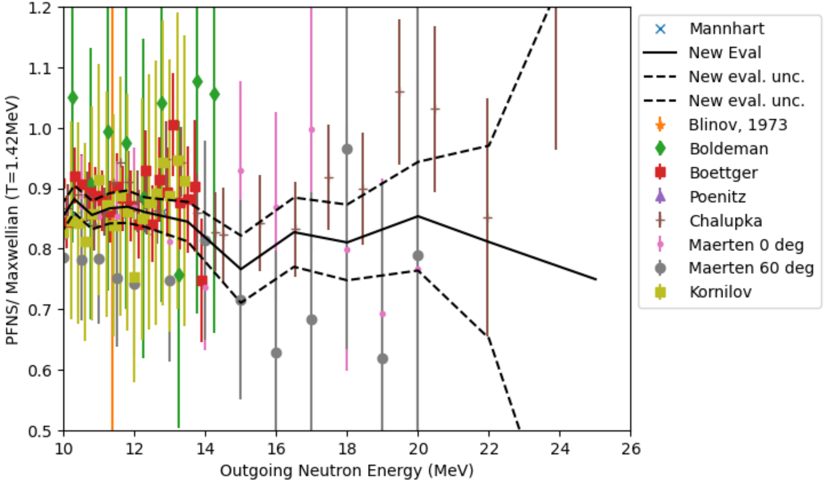
Reason for rejection: Boldeman (Li) data too biased around Li peak. Maerten 1984 used ^{252}Cf PFNS evaluation to get detector efficiency (circular argument!).

The new evaluation captures the bulk of (a lot of) data.

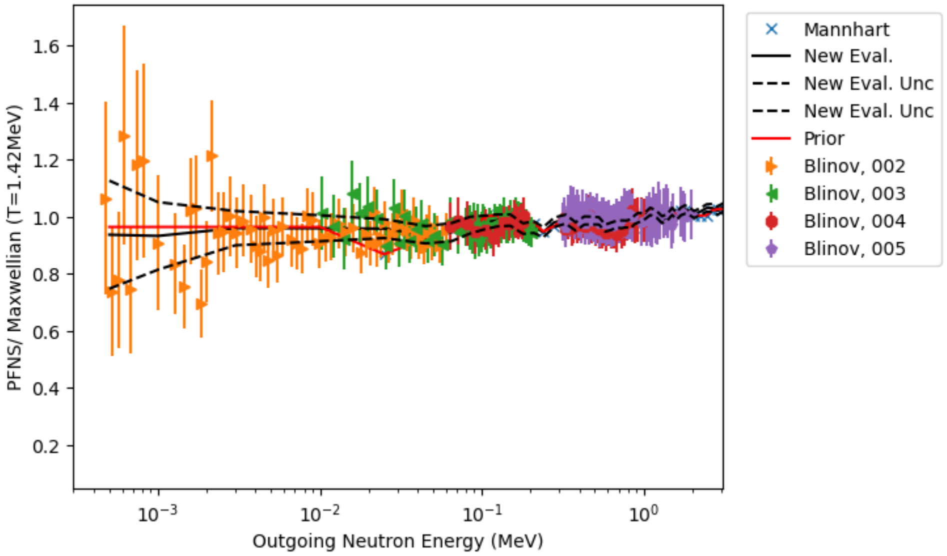


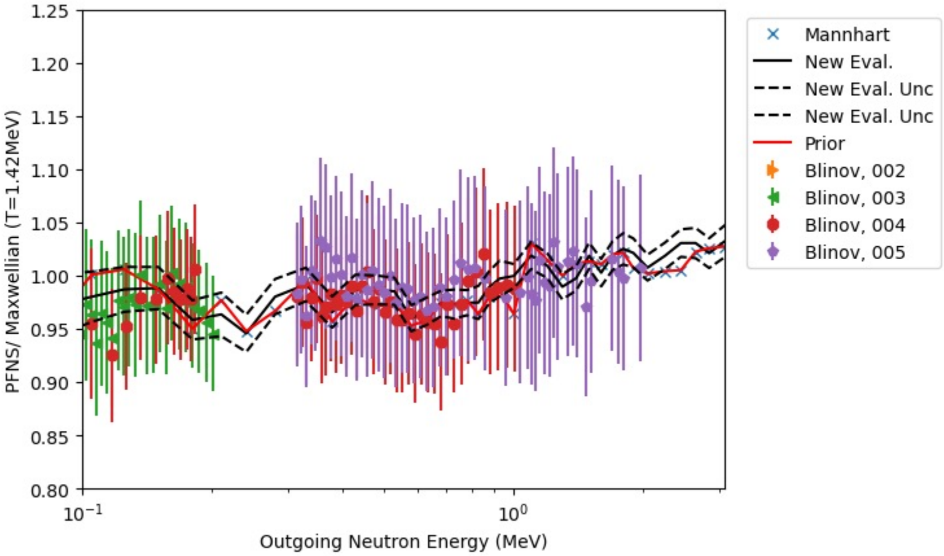




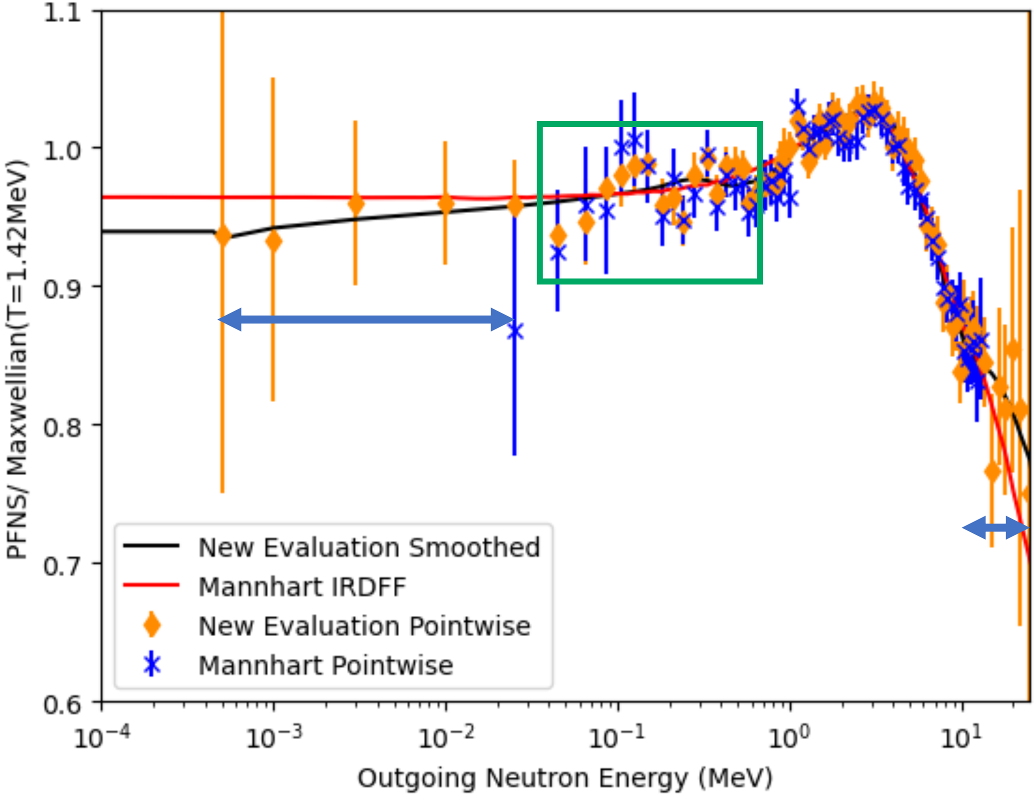


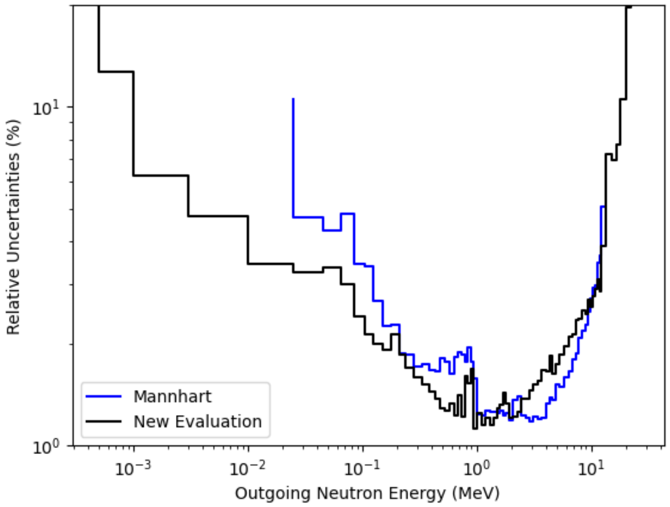
Blinov data allow us to go down to 0.5 keV (previously 25 keV). The data have a minor contamination due to ^{6}Li peak.





New evaluation agrees with Mannhart within uncertainties, but also brings additional benefits.

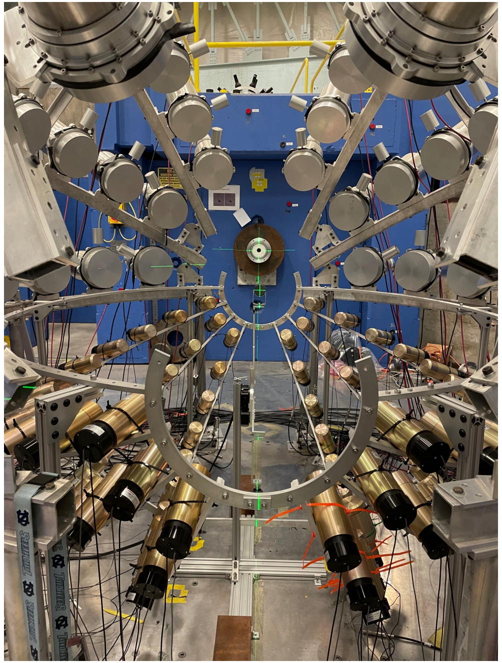




Benefit of new evaluation:

- Reproducible!
- Can be updated!!
- **Reduced ^{6}Li bias.**
- Extended energy range.

New AIACHNE experiment aims to further explore correction fact for ^{6}Li peak and provide new data.

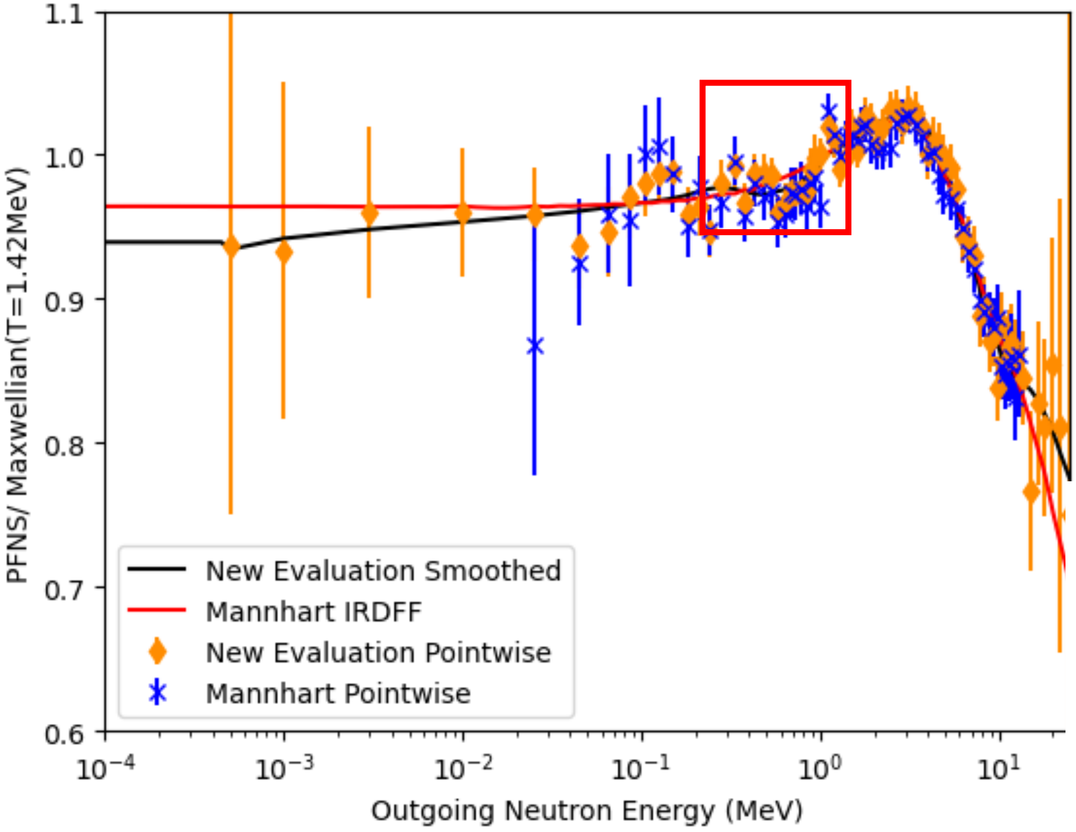


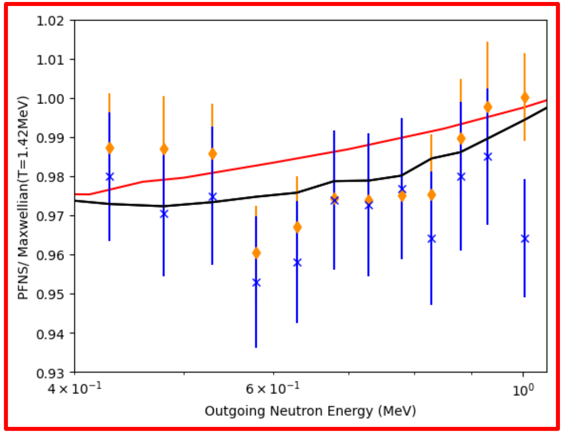
CoGNAC array used by K. Kelly (LANL).

AIACHNE experiment:

- Uses CoGNAC array (liquid scintillators in upper hemisphere, CLYCs in lower),
- Uses ^{252}Cf chamber in the middle.
- Detector response is the main challenge: Keegan uses scattering experiments with neutron-producing reactions (^{12}C, ^{16}O, ^{28}Si, ^{9}Be).
- Comparison of liquids and CLYCs can help explore potential biases coming from ^{6}Li detector response.
- Data taken, analysis ongoing.

Comment: Smoothing of Mannhart data (pointwise versus IRDFF) is quite substantially changing the mean energy.





<u>Mean Energy:</u>

Smoothed new: 2.130 MeV

Change due to smoothing: 0.02% higher.

Smoothed Mannhart (IRDFF): 2.123 MeV

Change due to smoothing: 0.6% higher!

Thank you for your attention!

Next steps:

- Dave is calculating IRDFF SACs.
- Boris compares to EXFOR SACs.
- Then, we will release to standards.
- AI/ ML guided evaluation factoring in systematic experiment discrepancies in progress.
- AIACHNE experiment analysis in progress.
- Questions? Concerns?

Acknowledgements

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