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Title: Evaluated 239Pu prompt fission neutron spectra and associated covariances for thermal to 30 MeV incident neutron energies

Author(s): Neudecker, Denise

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Evaluated ^{239}Pu prompt fission neutron spectra and associated covariances for thermal to 30 MeV incident neutron energies

Denise Neudecker

CSEWG/CIELO meeting 2014, 11/4

In collaboration with/ thanks to:
+) T-2, LANL: P. Talou, T. Kawano, A.C. Kahler
+) P-27, LANL: T.N. Taddeucci, R.C. Haight, H.-Y. Lee
+) X, LANL: M. Rising, M.C. White, J. Lestone
+) ANL: D.L. Smith
+) IAEA Vienna: R. Capote

MAIN AIM

Evaluation of the ^{239}Pu prompt fission neutron spectrum for E_{inc} = thermal – 30 MeV:

- Including *improved theoretical information* taking into account *expected physics processes*
- Including *new experiments & detailed experimental UQ*
- Right now, *benchmarking ongoing*

The evaluated results take into account physics processes.

Physics Processes

Theory

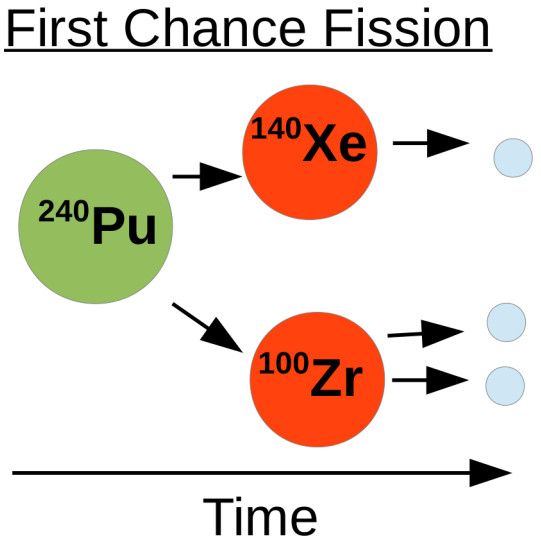
Experiment

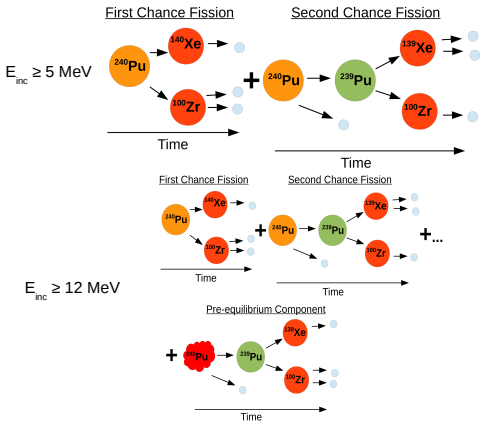
Results

Benchmarks

Summary

$E_{inc} \leq 5\ MeV$





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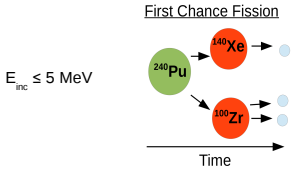
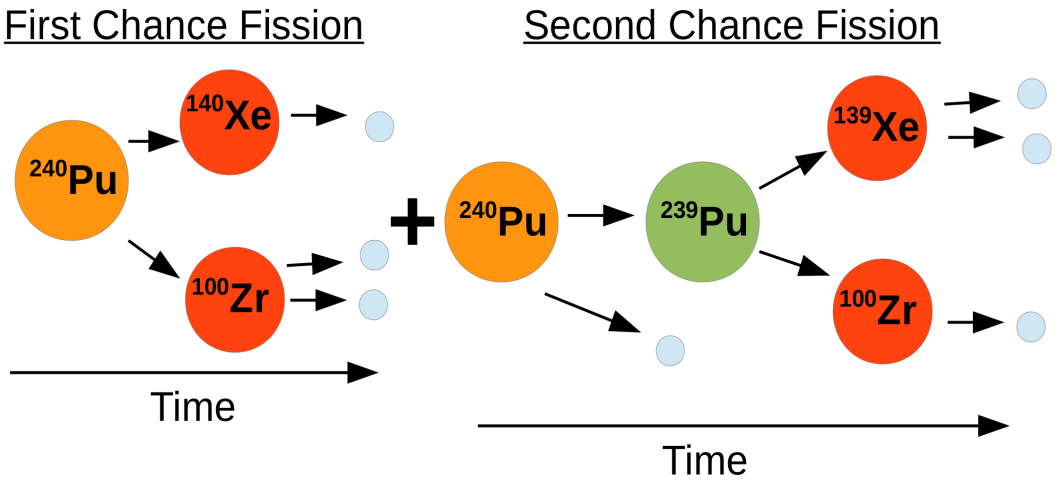
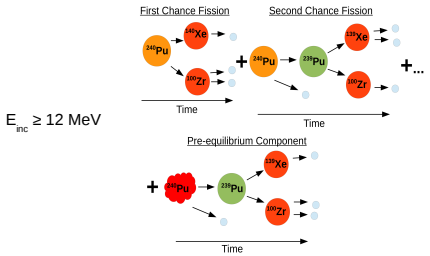
$E_{inc} \geq 5\ MeV$







The evaluated results take into account physics processes.

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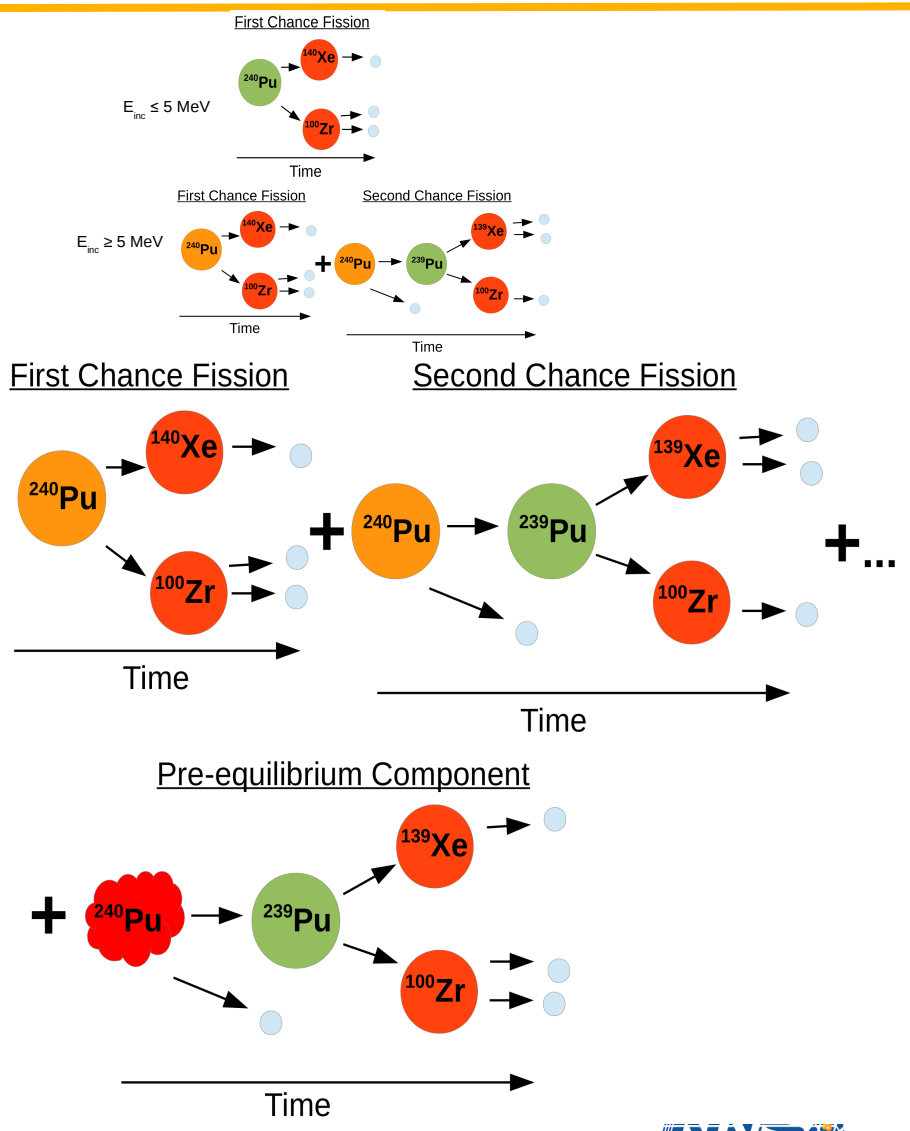
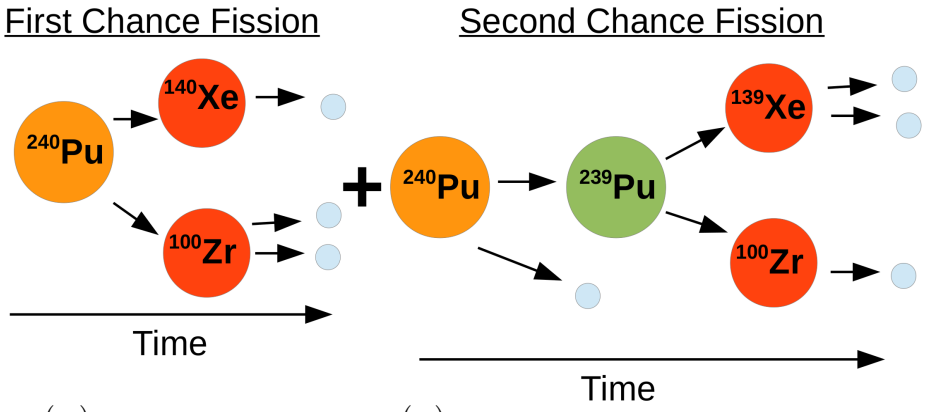
$$E_{inc} \geq 12\ MeV$$



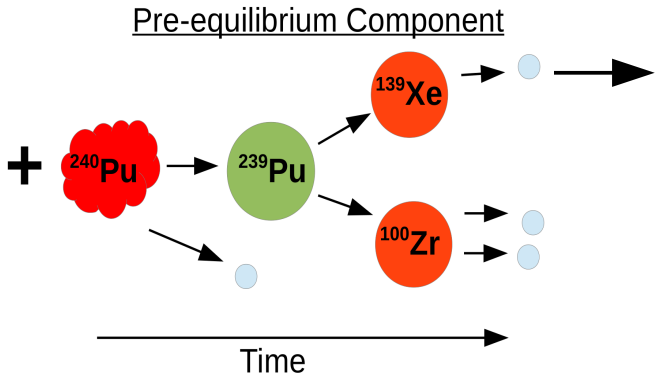
The Los Alamos model and the exciton model are used.



The **LAM** is used for **compound nucleus processes.**

$$\chi(E) \propto p_f^{(1)} \overline{\nu}_1 \chi_1(E) + p_f^{(2)} [\phi_1(E) + \overline{\nu}_2 \chi_2(E)]$$

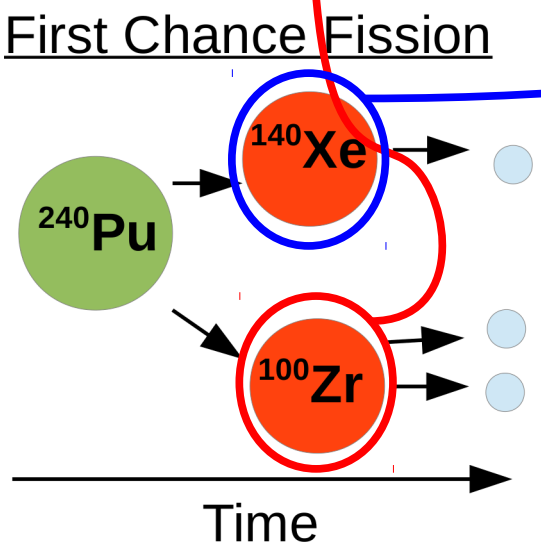
$$+ p_f^{(3)} [\phi_1(E) + \phi_2(E) + \overline{\nu}_3 \chi_3(E)] + \ldots$$



The **exciton model** is used for the **pre-equilibrium component.**

The LAM PFNS are a weighted sum of average light and heavy fission fragment PFNS.

$$\chi_1(E) = \frac{\overline{\nu_{1L}}\,\chi_{1L}(E, T_{mL}, a_L, b, s, \ldots) + \overline{\nu_{1H}}\,\chi_{1H}(E, T_{mH}, a_H, b, s, \ldots)}{\overline{\nu_{1L}} + \overline{\nu_{1H}}}$$

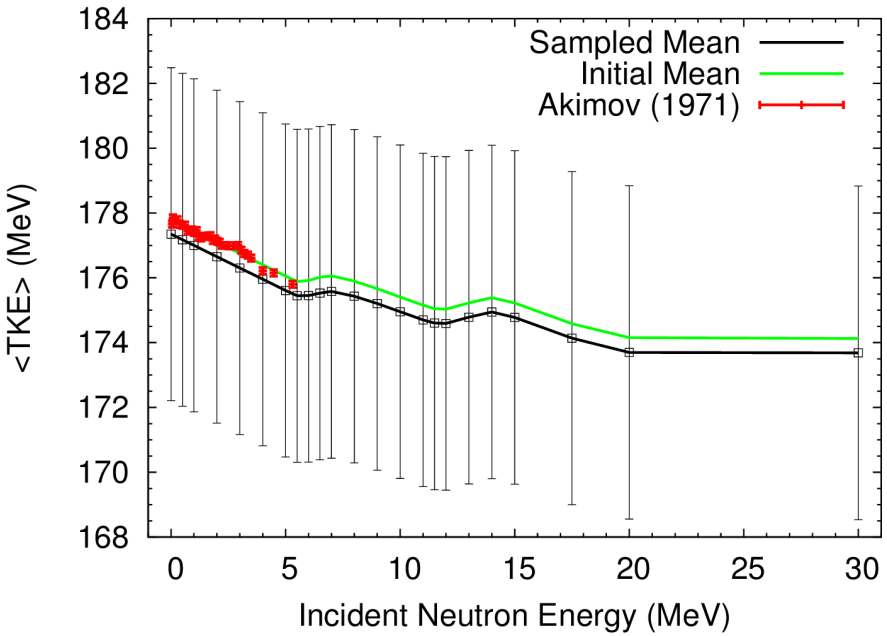


We extended the LAM by:

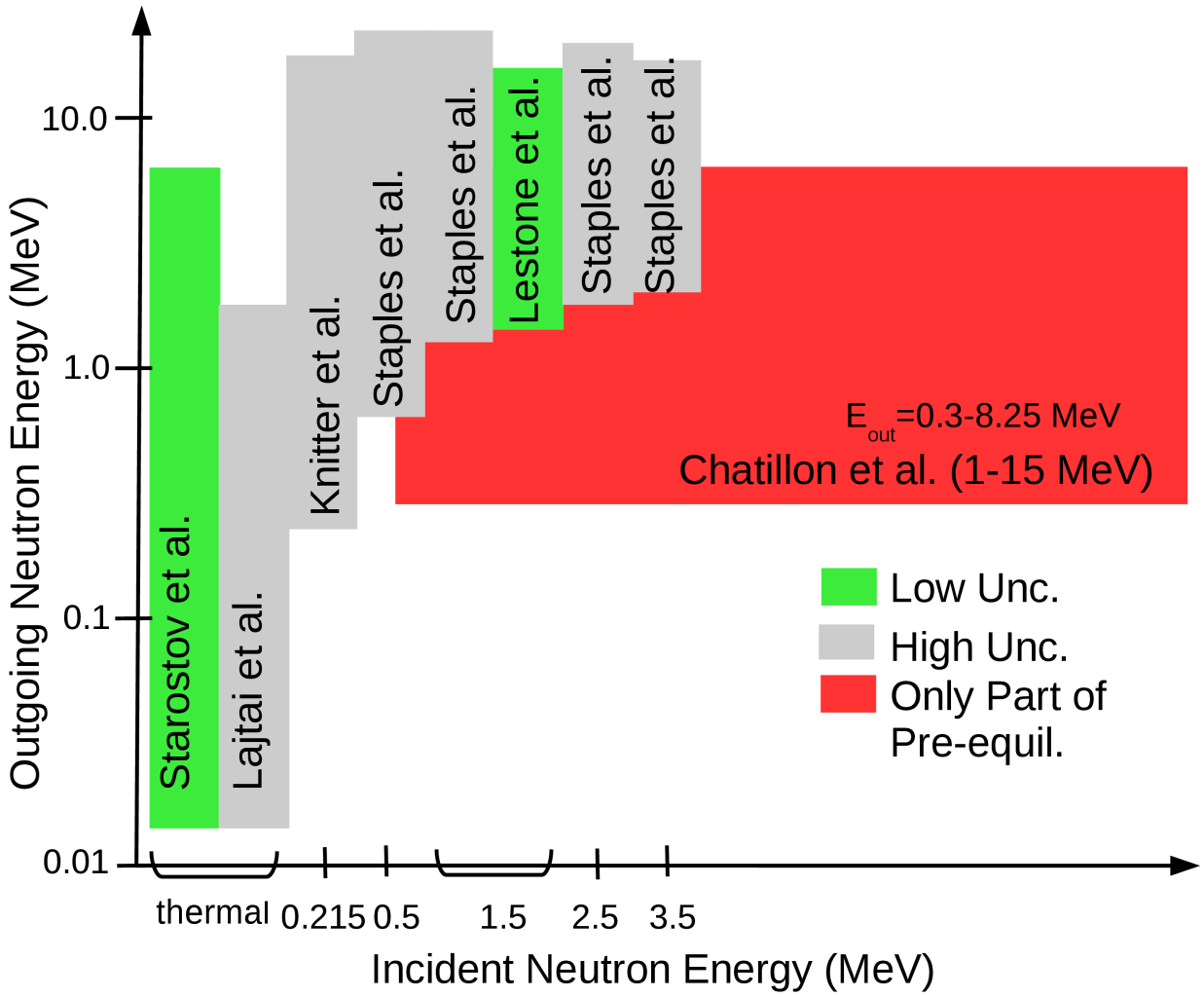
- *Anisotropy* in the neutron emission in the cms frame (parameter *b*)
- $\overline{\nu_{1L}} \neq \overline{\nu_{1H}}$ and $T_{mL} \neq T_{mH}$
- *Temperature distribution* by Hambsch (parameter *s*).

We extended the original LAM and considered E_{inc}-dependent of processes involved:

- ***Multi-chance fission*** considered.
- ***Pre-equilibrium component*** considered.
- ***E_{inc}-dependent parametrization of <TKE> and <E_r>*** of Lestone and Madland used.
- ***Fission barrier parameters fitted*** to reproduce ENDF/B-VI.0 fission probabilities.

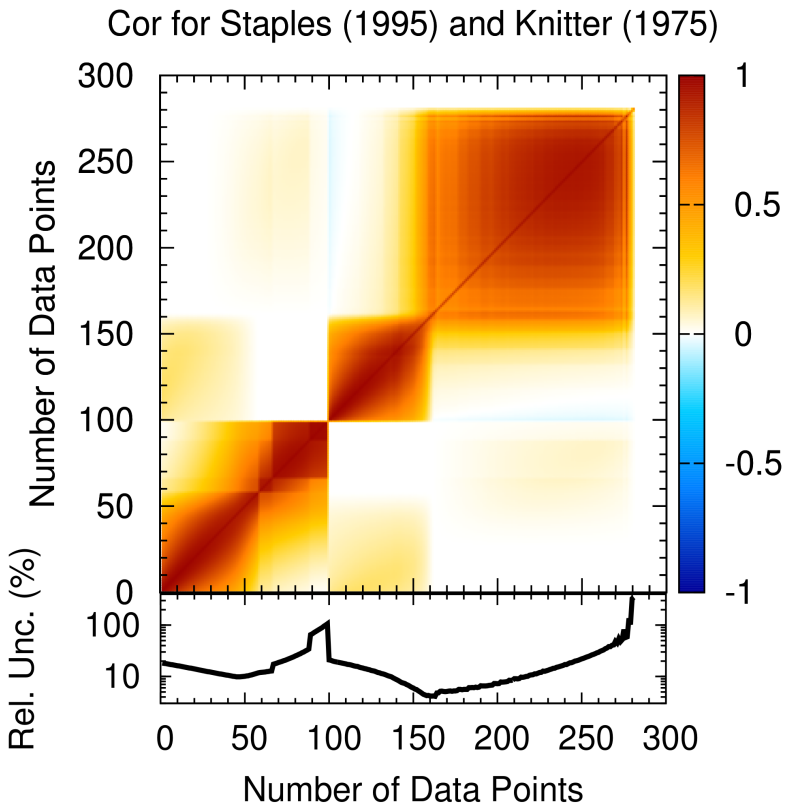


The experimental data base:



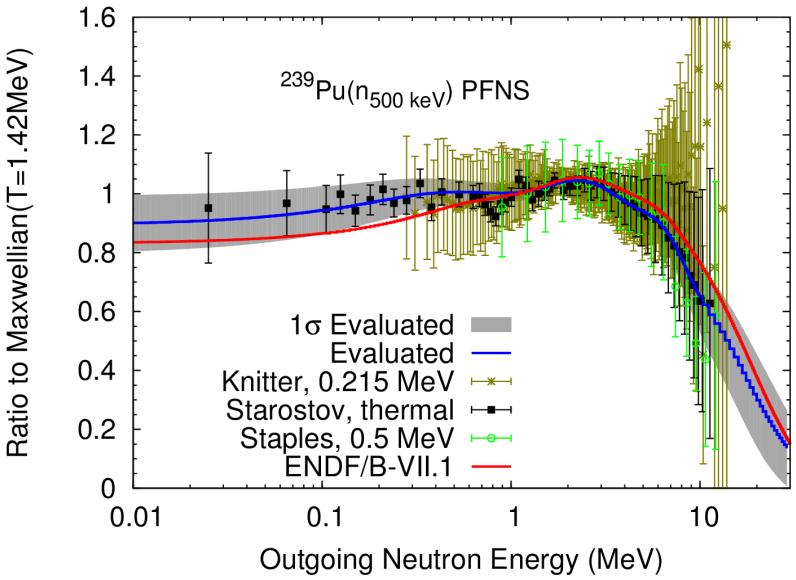
Experimental Uncertainties are estimated in detail.

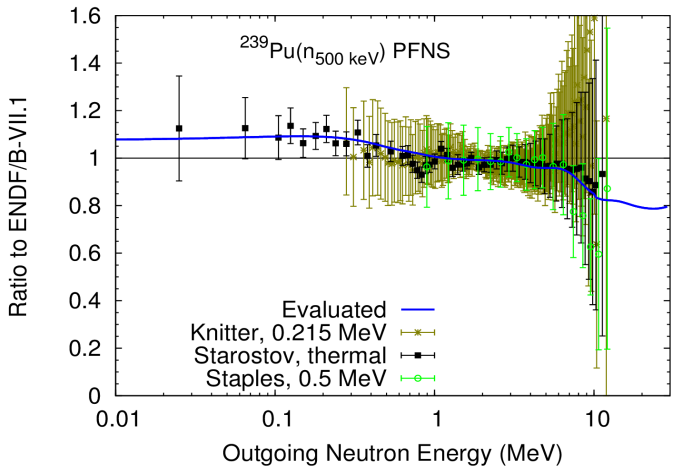
- Experimental uncertainties were estimated by partitioning into ***partial unc. sources***.
- Correlation matrices were estimated for partial unc.
- ***Correlations between*** two ***different experiments*** were estimated in the same way.

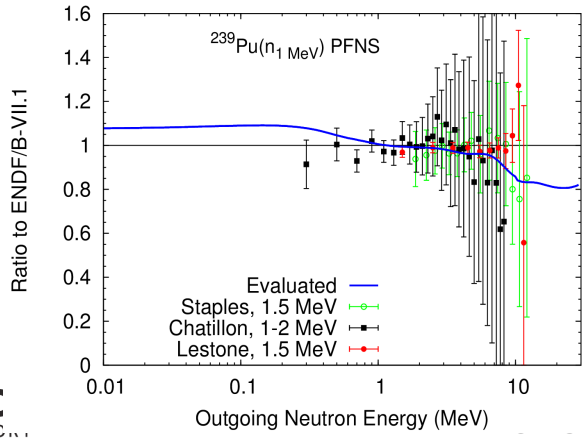


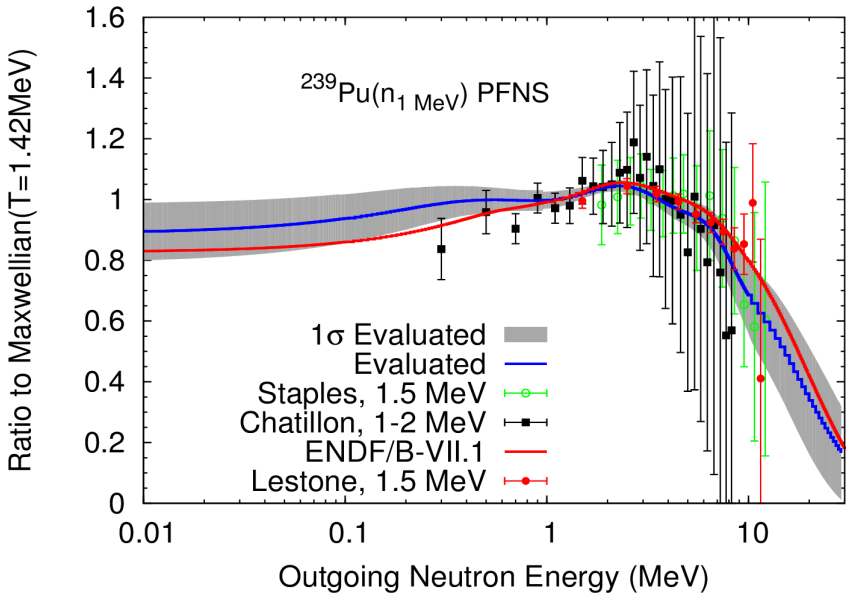
Selected results:

- Physics Processes
- Theory
- Experiment
- ***Results***
- Benchmarks
- Summary

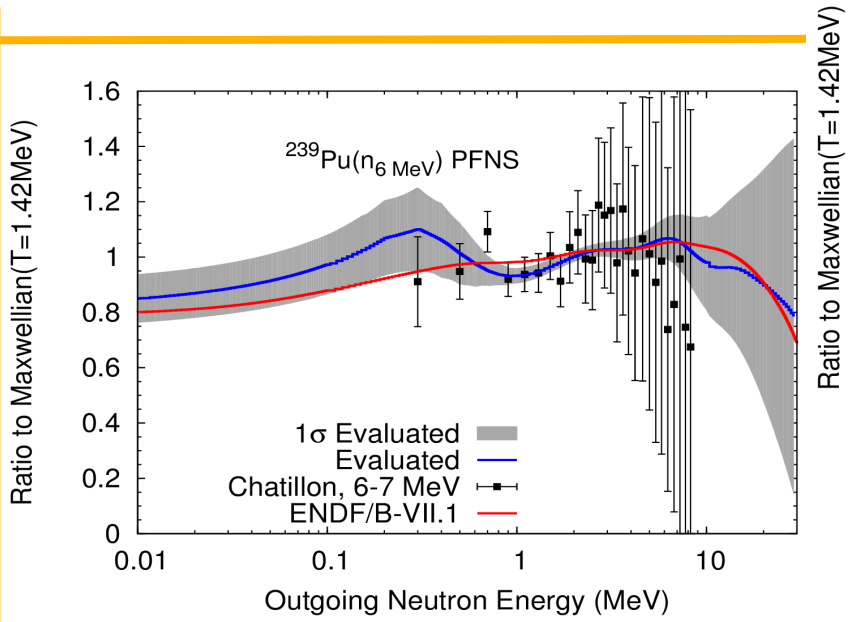


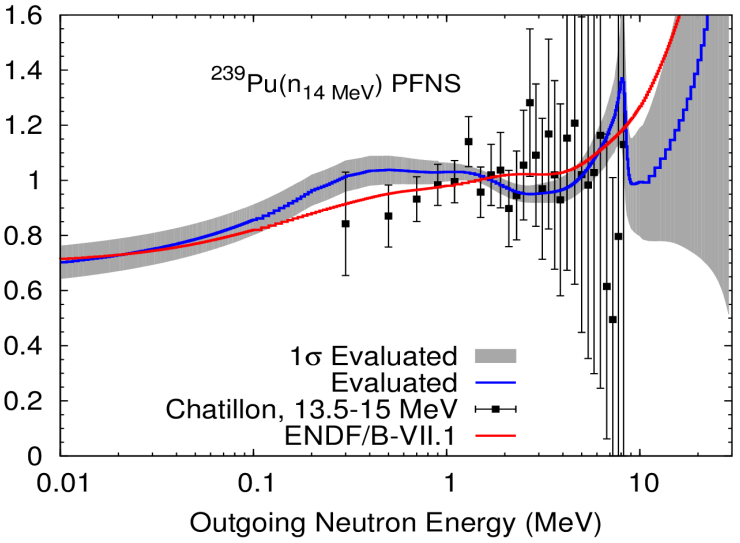




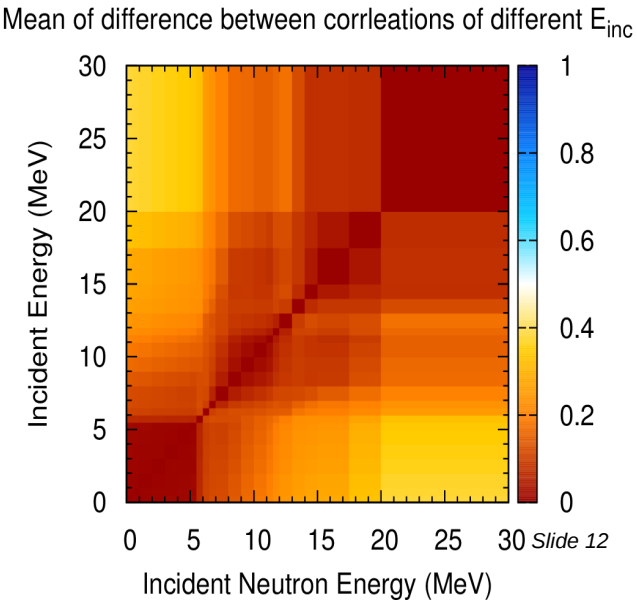


Selected results:





We provide evaluated covariances for all incident neutron energies.



Selected results:

Physics Processes

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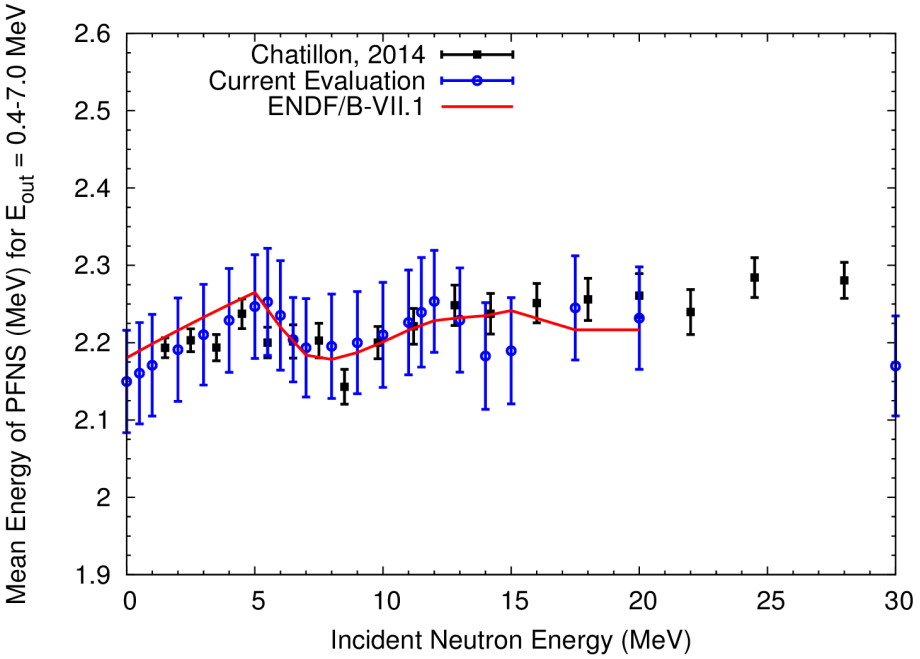
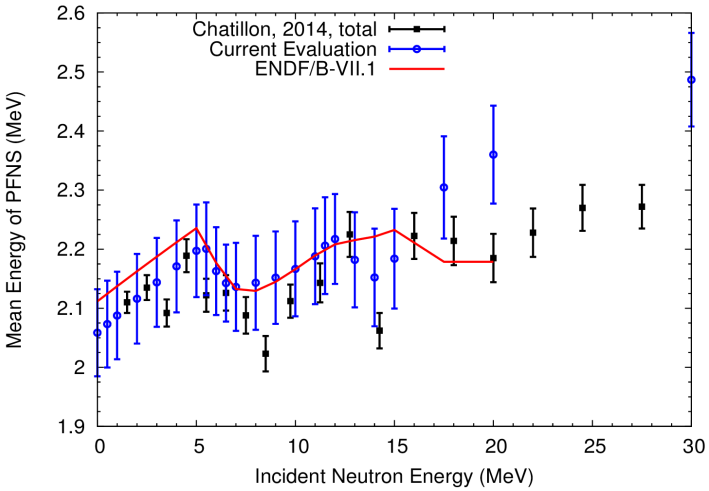
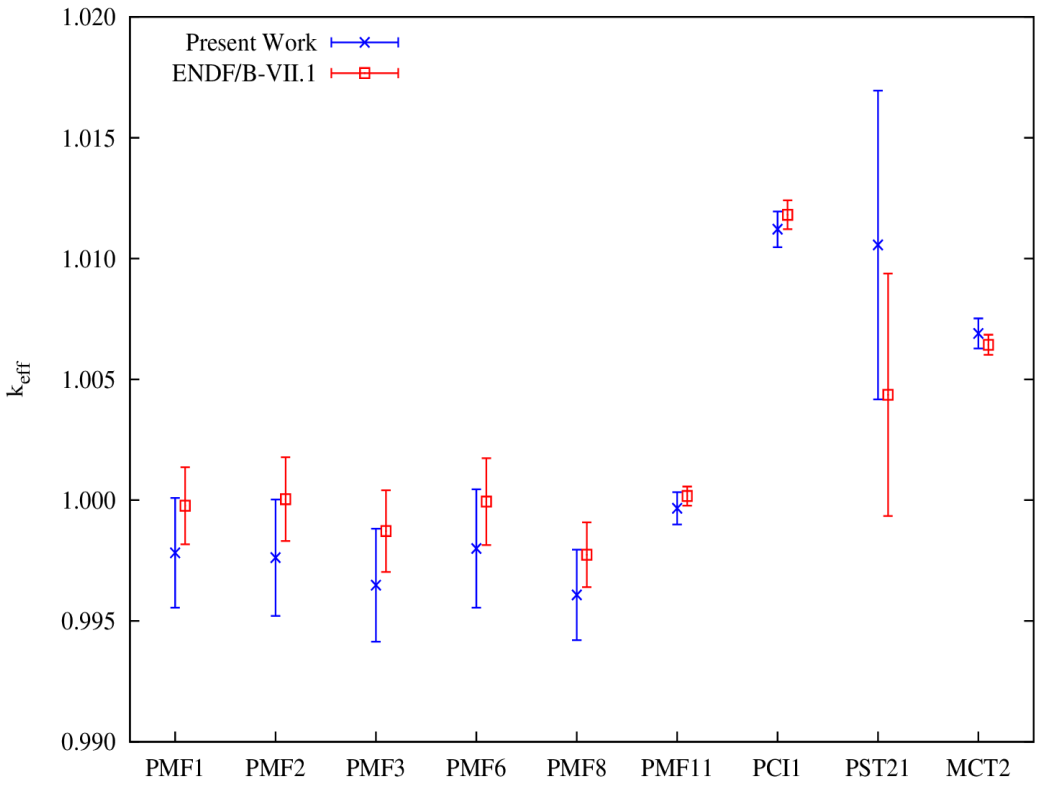




Selected benchmark results of Mike Rising using a similar evaluation:



More in talk of A.C. Kahler.

To-Do:

- Study differential data of A. Smith recently recovered by the IAEA

- ***Adjustment of data*** using benchmark data. (e.g., ^{239}Pu(n,2n)/^{239}Pu(n,f) and ^{241}Am(n,2n)/^{239}Pu(n,f))

- ***Further benchmark*** tests.

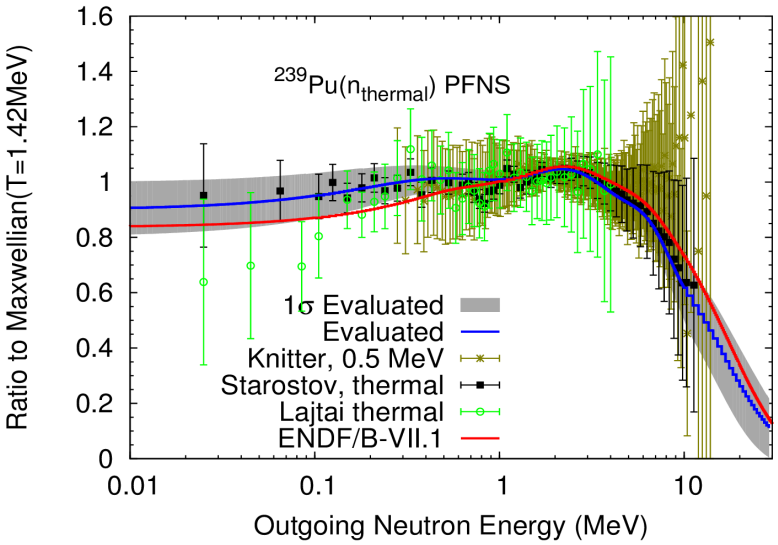
Summary:

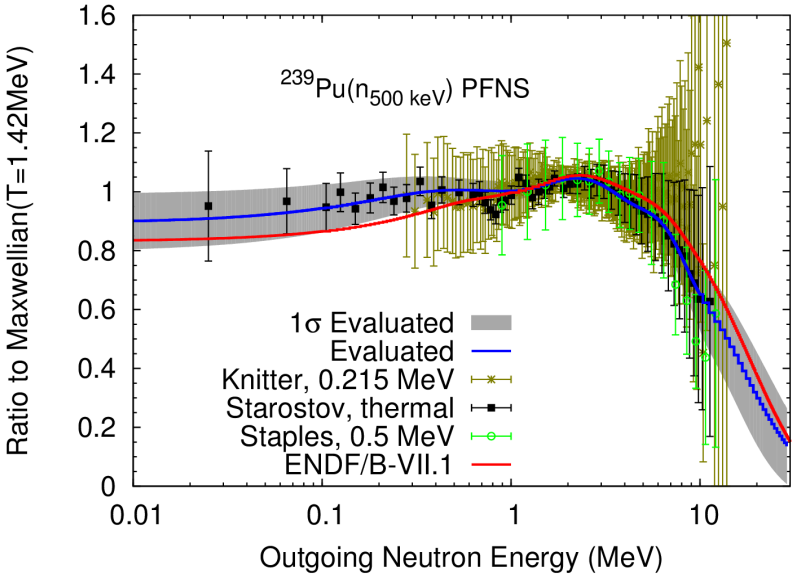
Evaluation of the ^{239}Pu prompt fission neutron spectrum for E_{inc} = thermal – 30 MeV:

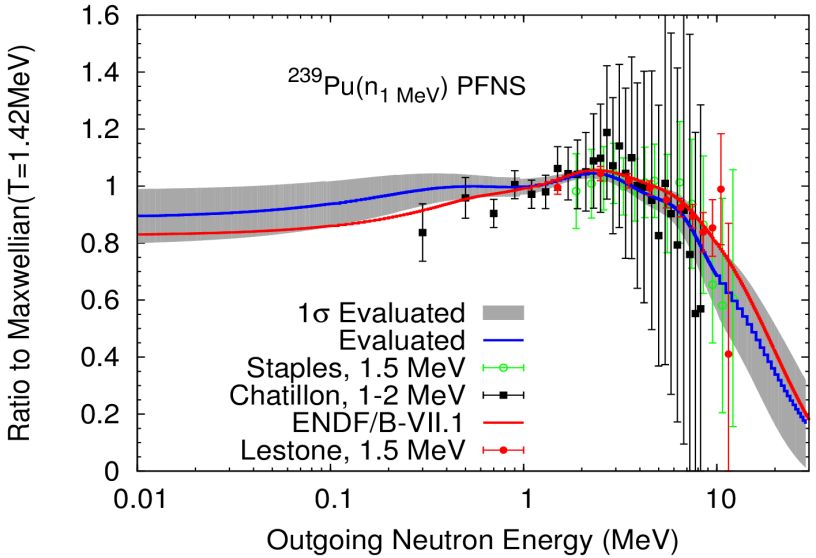
- Including *improved theoretical information* taking into account *expected physics processes*
- Including *new experiments & detailed experimental UQ*
- Right now, *benchmarking ongoing*

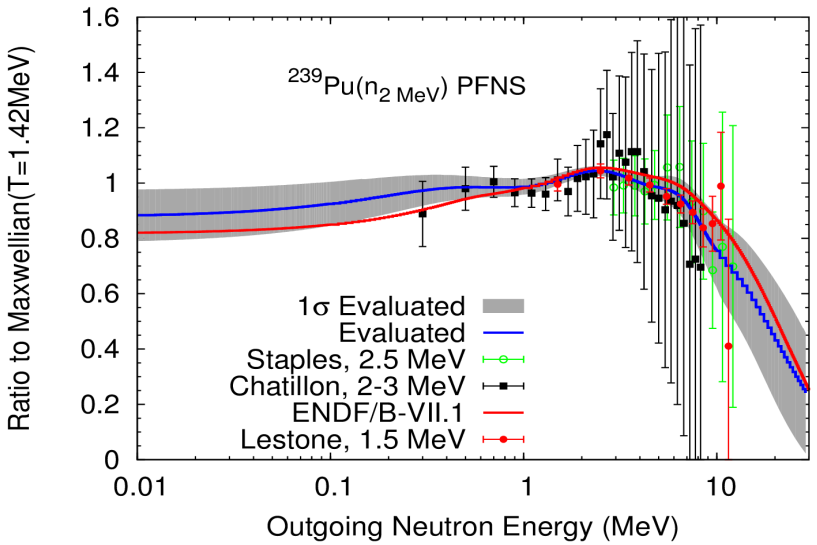
CW2014 conference proceeding will appear in Nuclear Data Sheets 123, January 2015

Backup: All results I

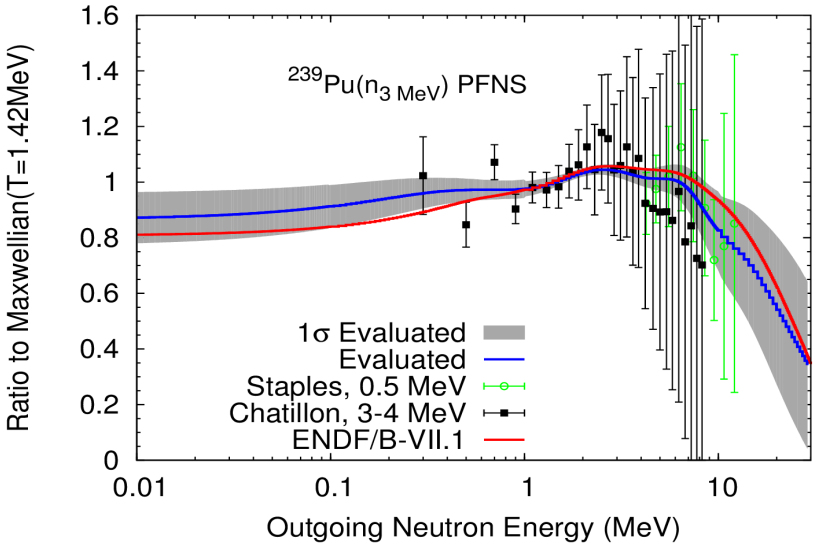


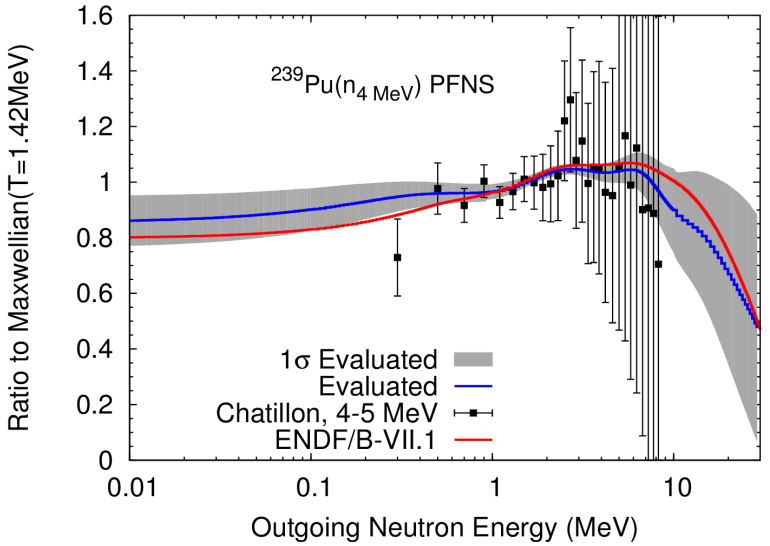


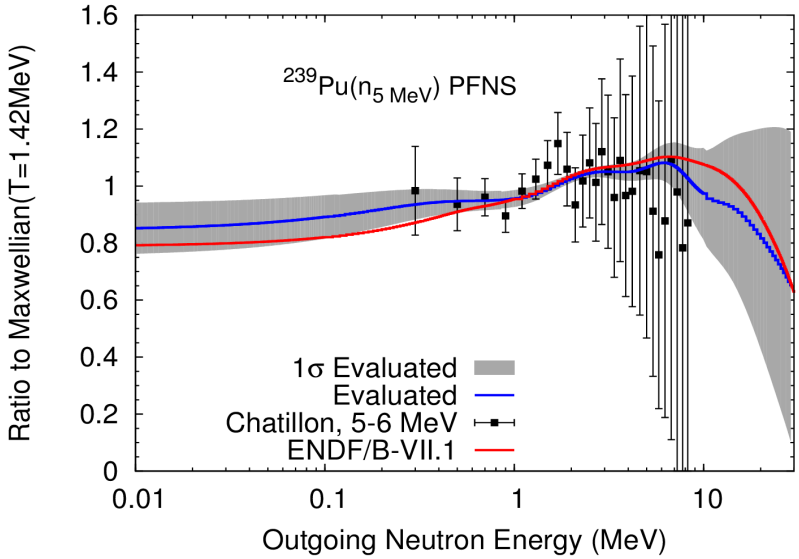


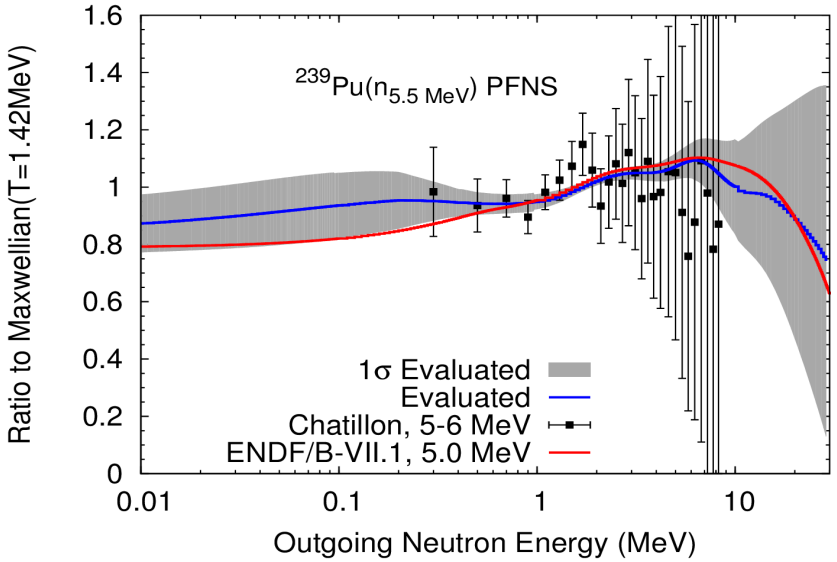


Backup: All results II

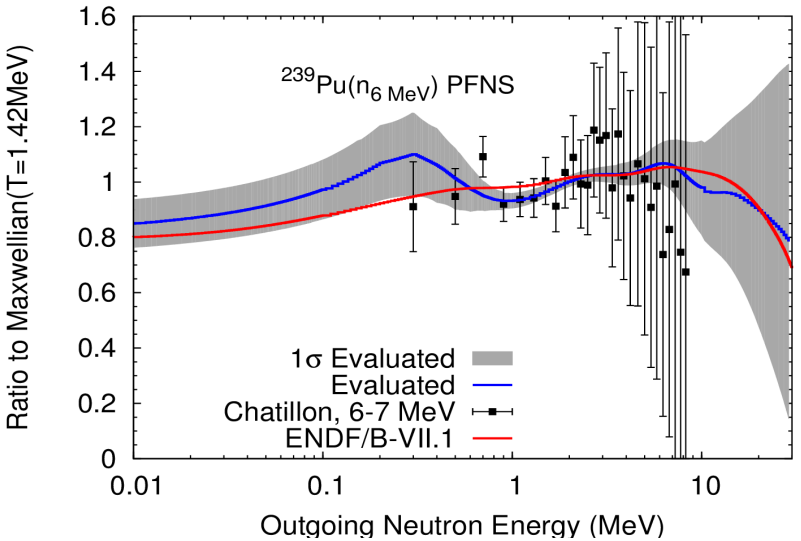


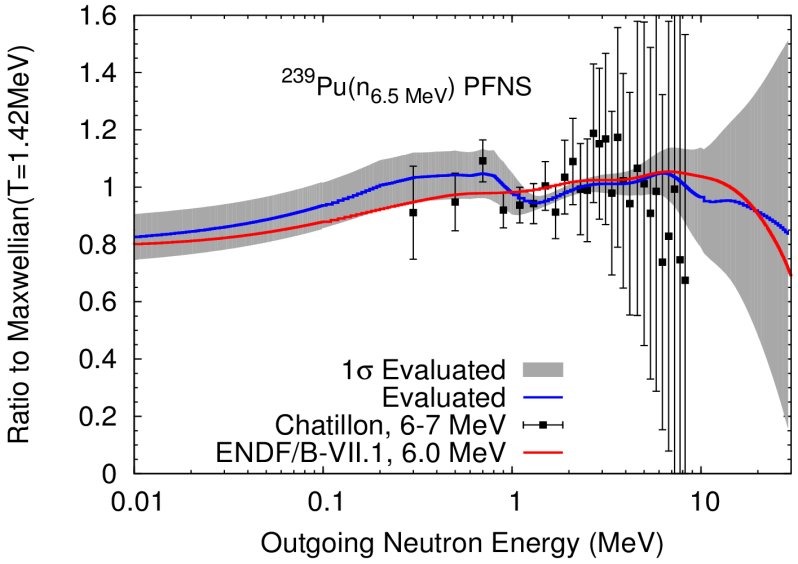


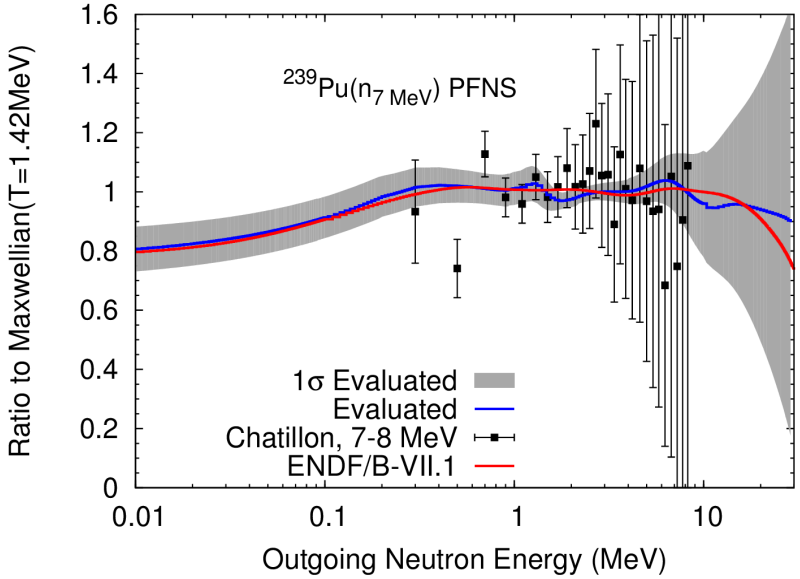


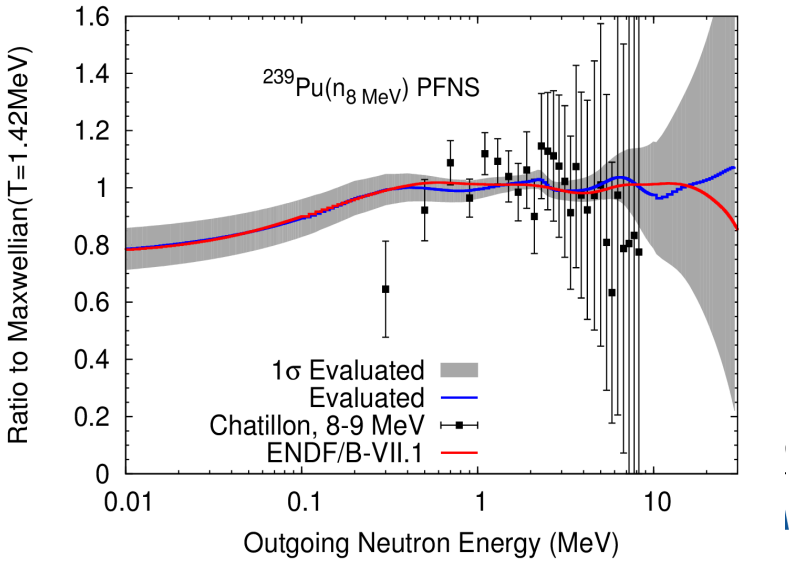


Backup: All results III

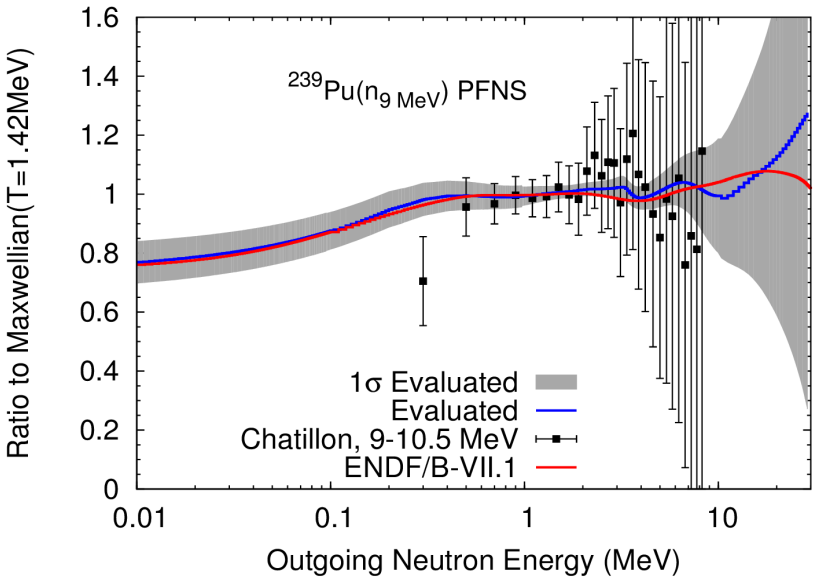


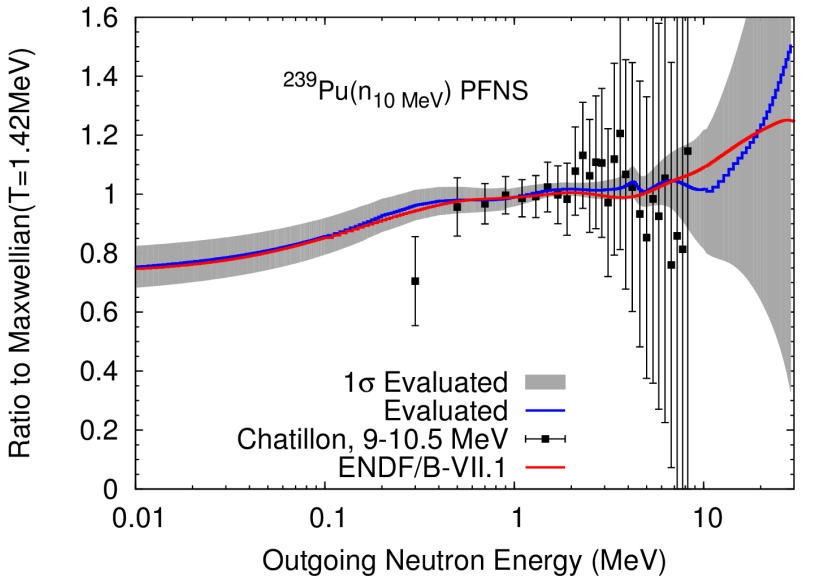


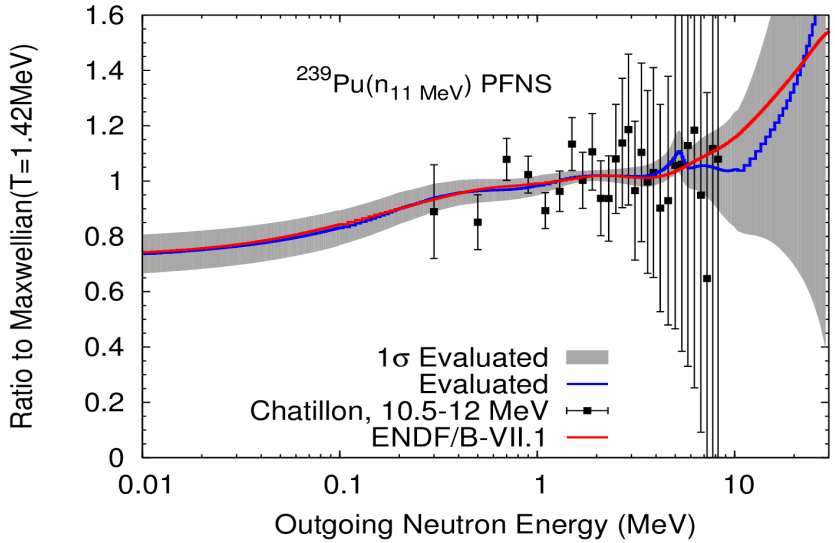


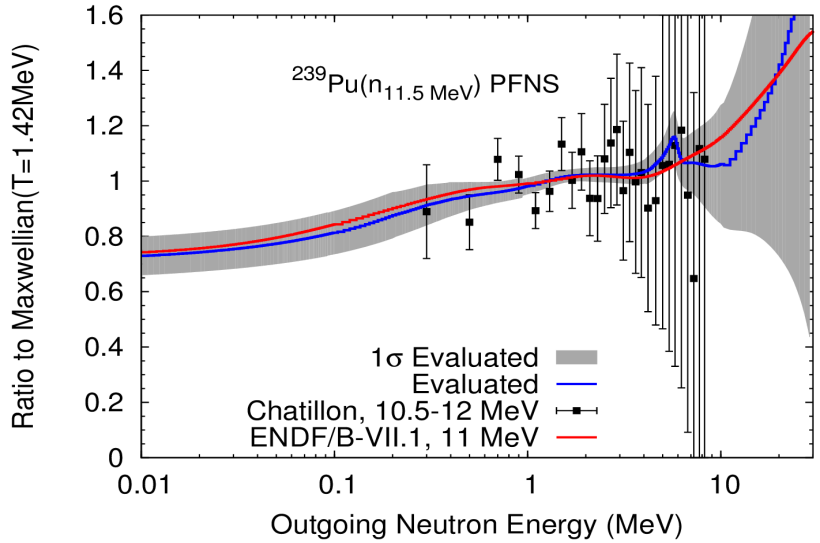


Backup: All results IV

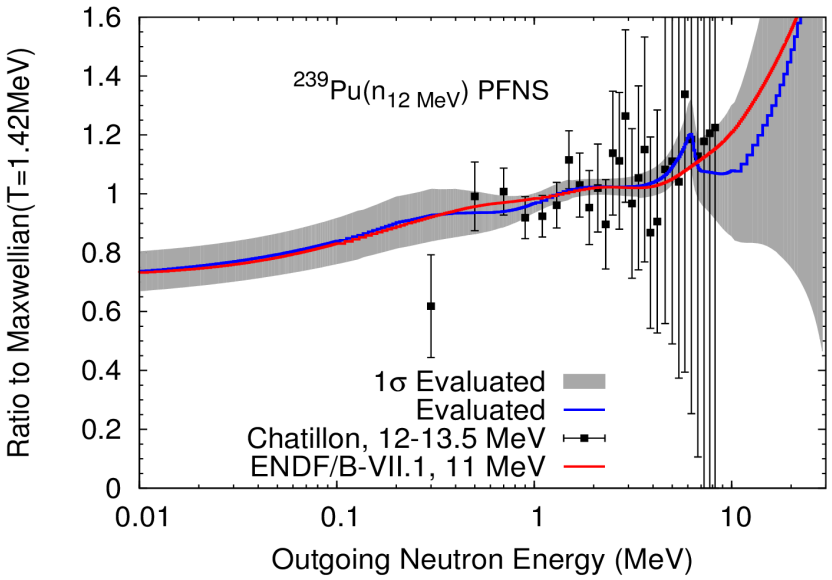


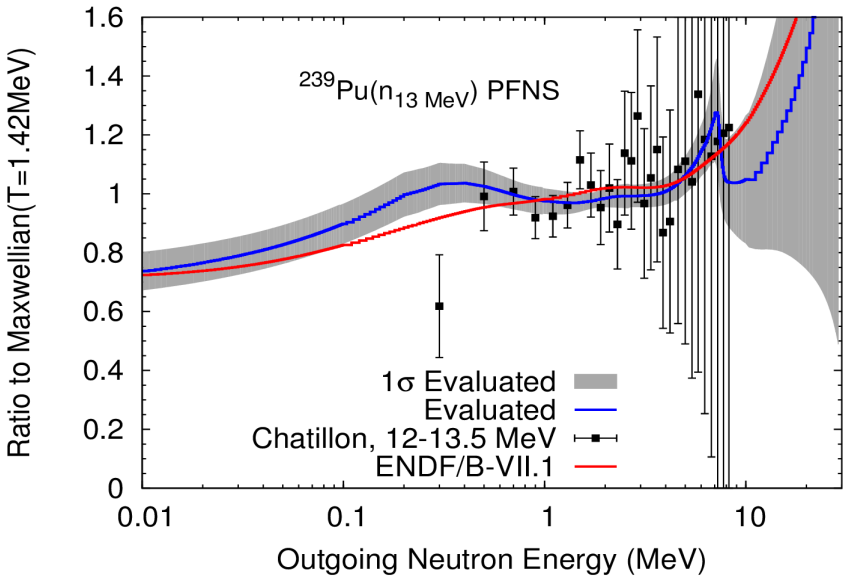


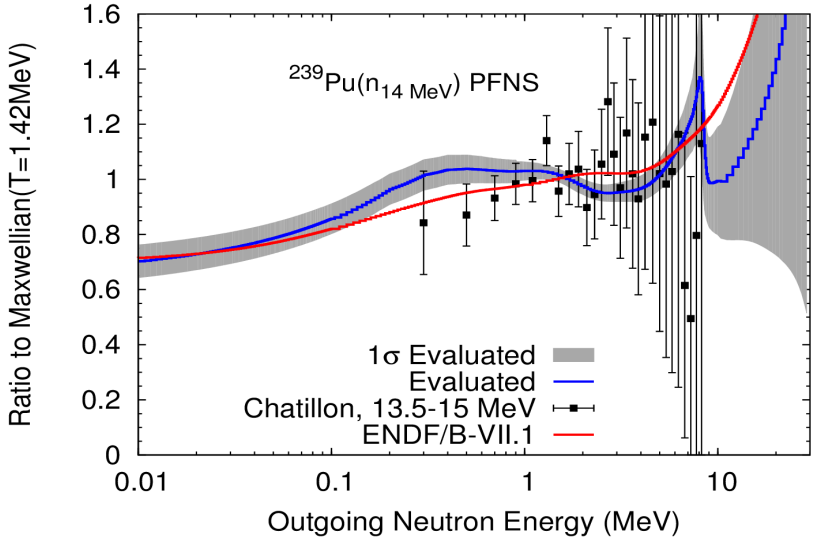


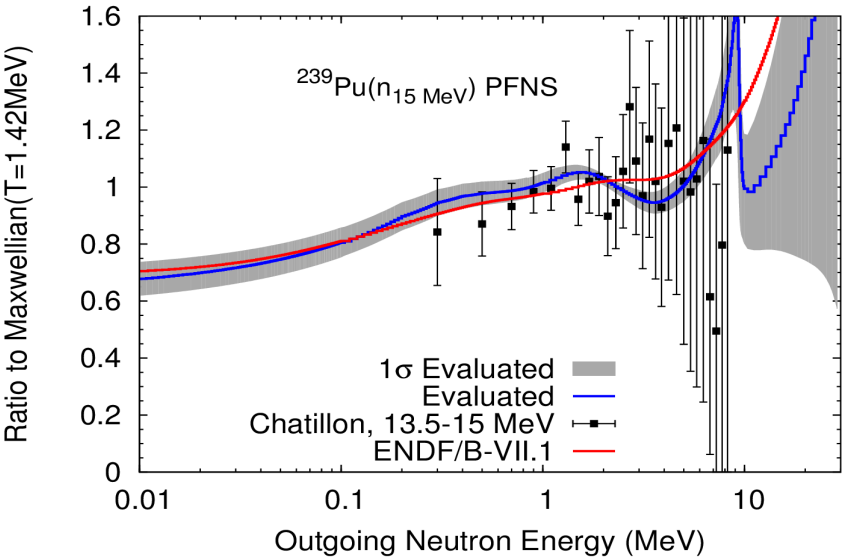


Backup: All results V

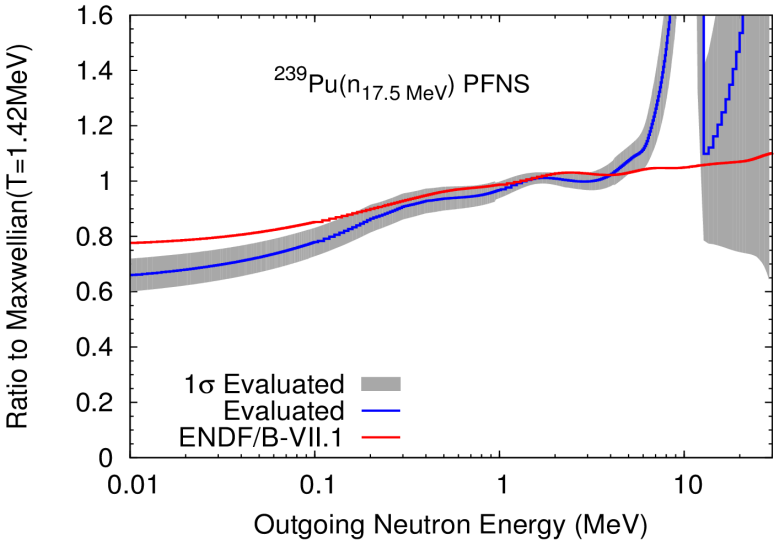


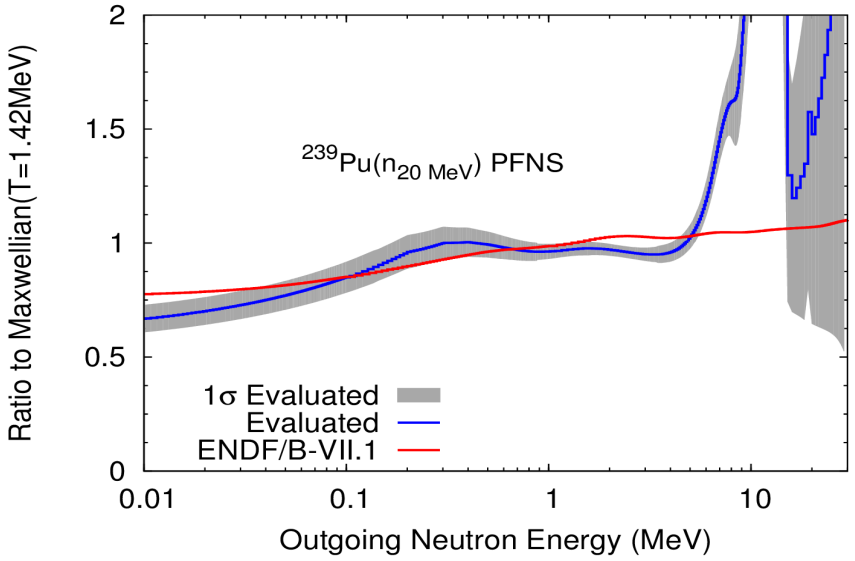


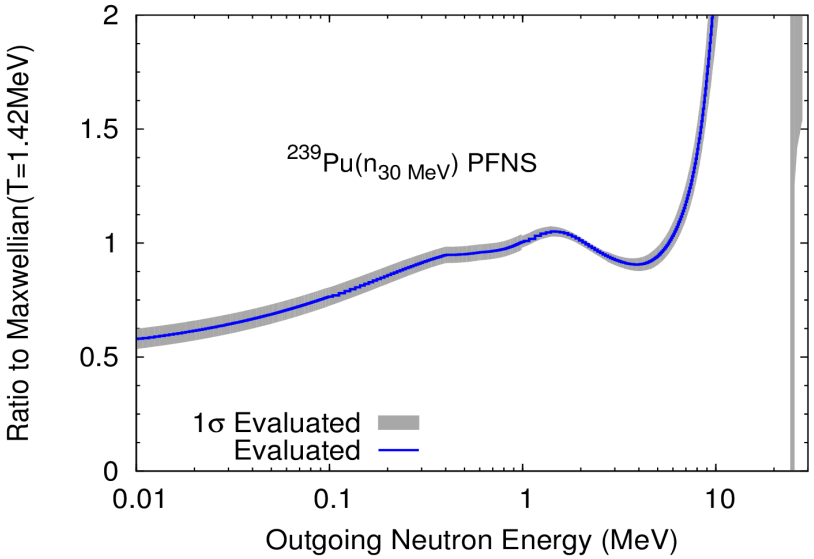




Backup: All results VI







Backup: All results VII