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Title: MCNP tallied weight functions to improve multigroup simulations

Author(s): Kreher, Miriam Anne

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MCNP tallied weight functions to improve multigroup simulations

Miriam Kreher

August 20, 2024

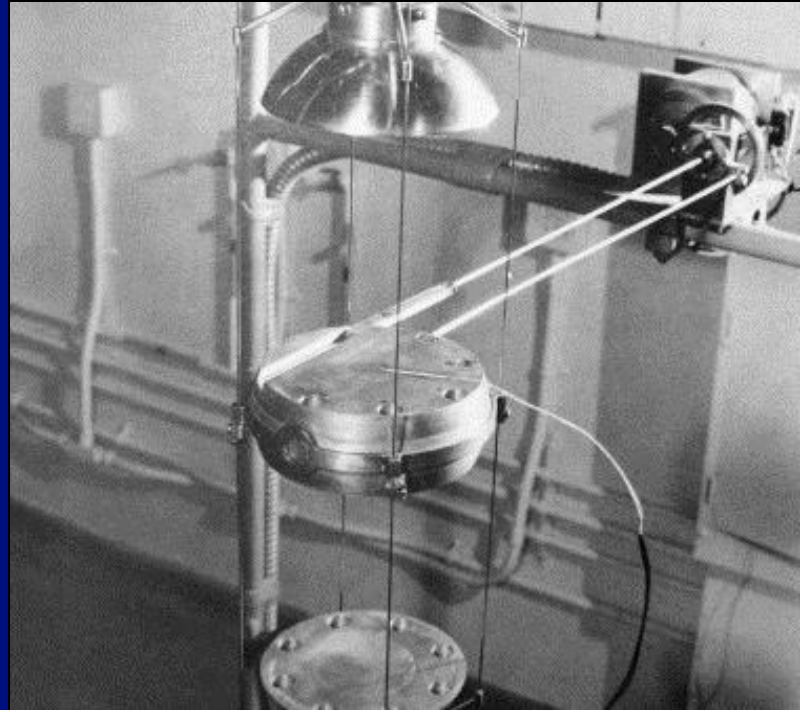
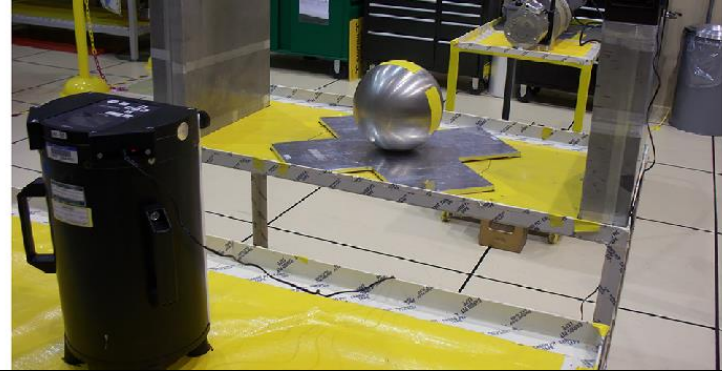
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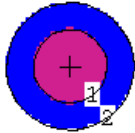
Metropolis
Postdoctoral Fellow
PhD MIT '23

Motivation

- LANL-30 to LANL-618 group structures are relied on heavily at LANL for fast system modeling.
- While proven useful, “why it works” is still an open question.
- Fast plutonium critical experiments are the testbed for exploring the group structures and potential optimization paths.
- The following examples use MCNP generated data to run a deterministic simulation.

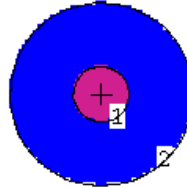


Which problems?



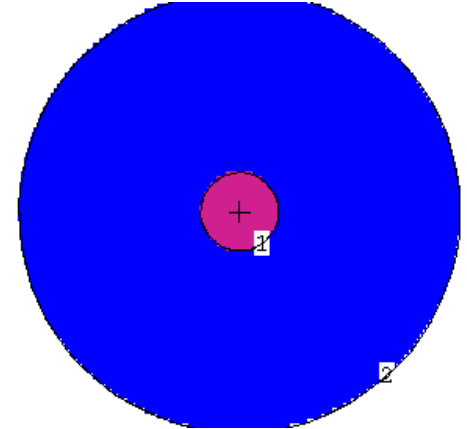
PMF018

Plutonium core
Beryllium reflector



PMF038 (BeRP)

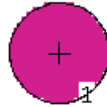
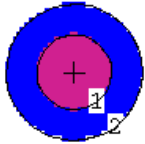
Plutonium core
Beryllium reflector



PMF008

Plutonium core
Thorium reflector

Which problems?



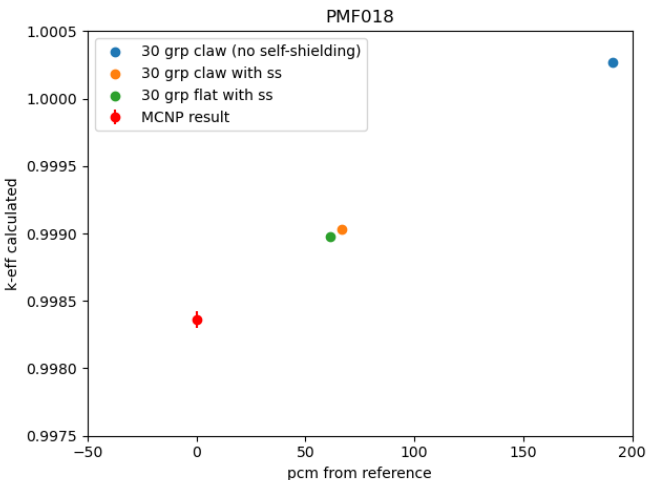
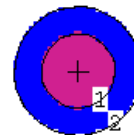
PMF010

Plutonium core
Natural Uranium reflector

PMF002

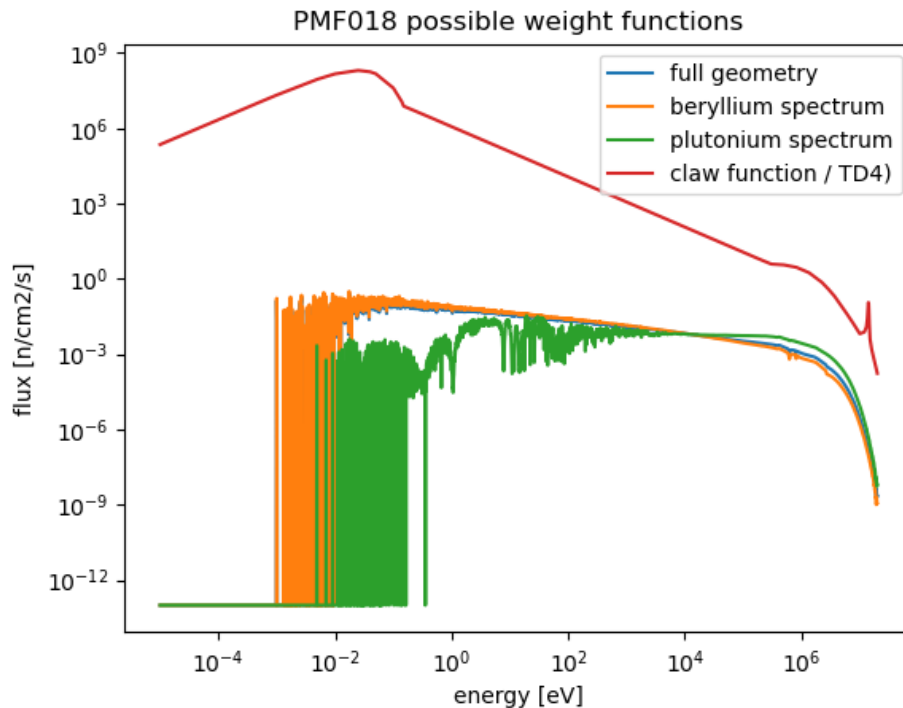
Bare plutonium

How do they behave?

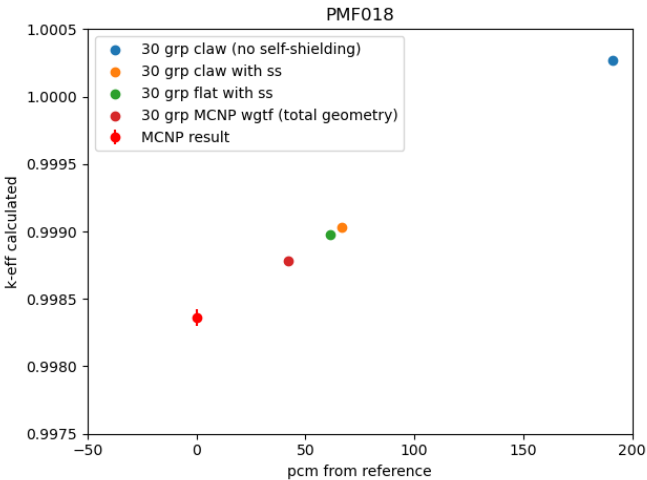
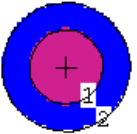


PMF018

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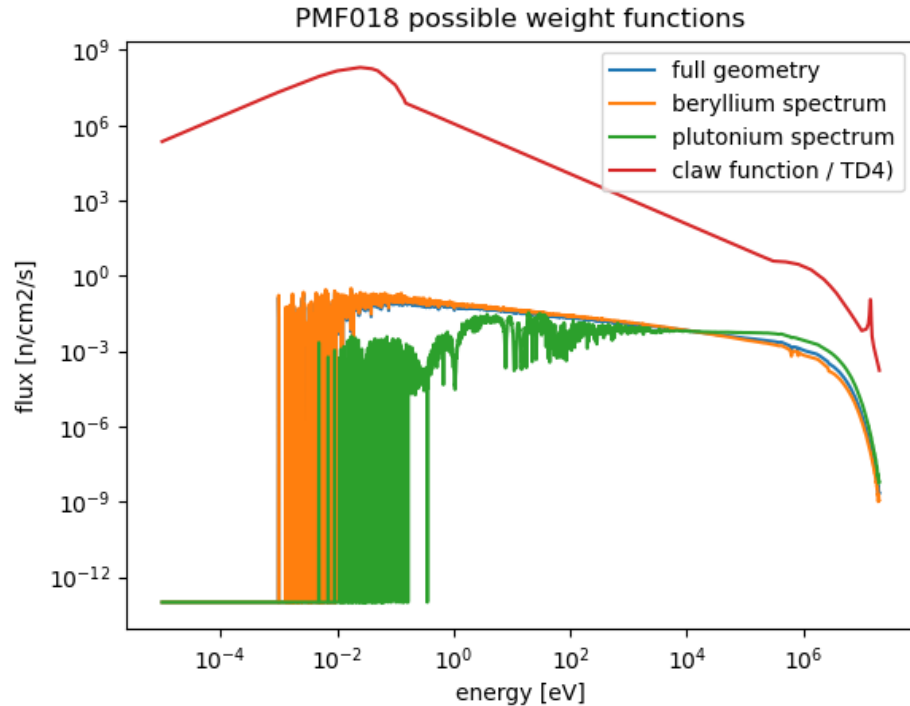


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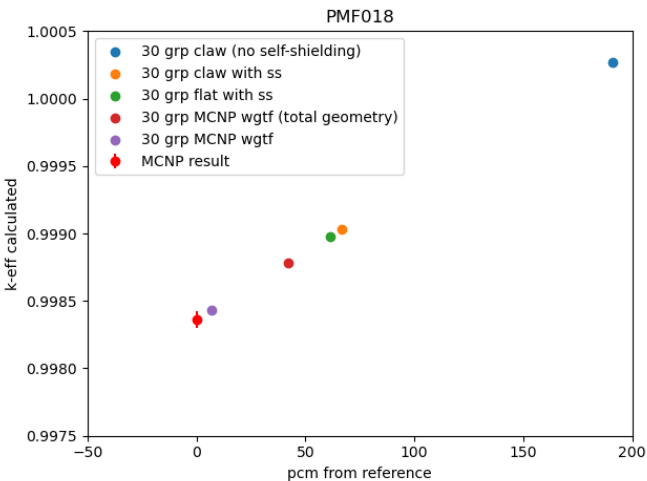
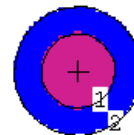


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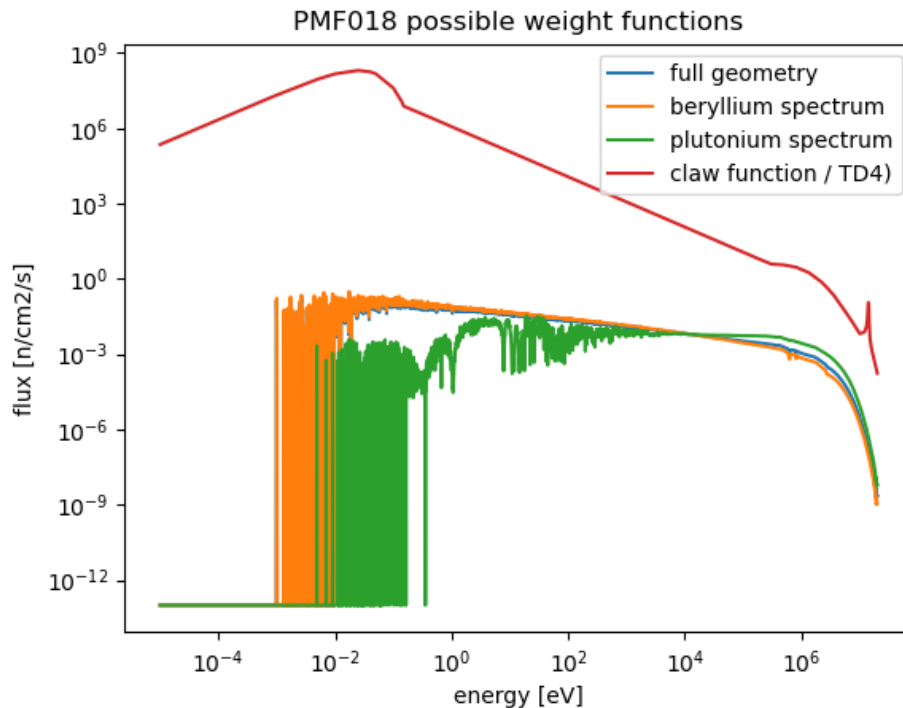


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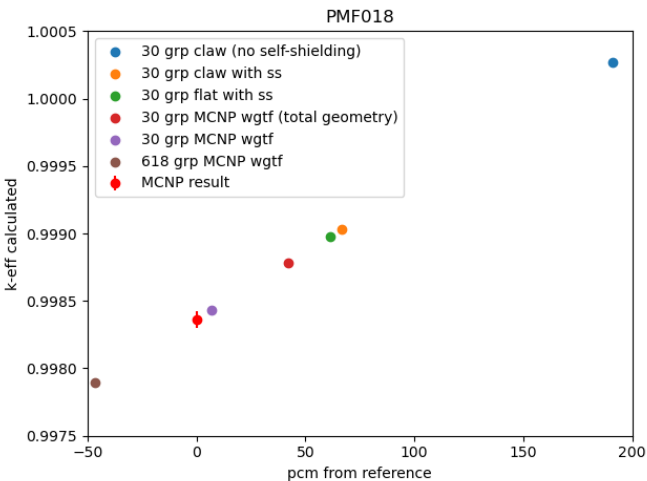
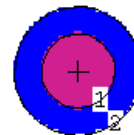


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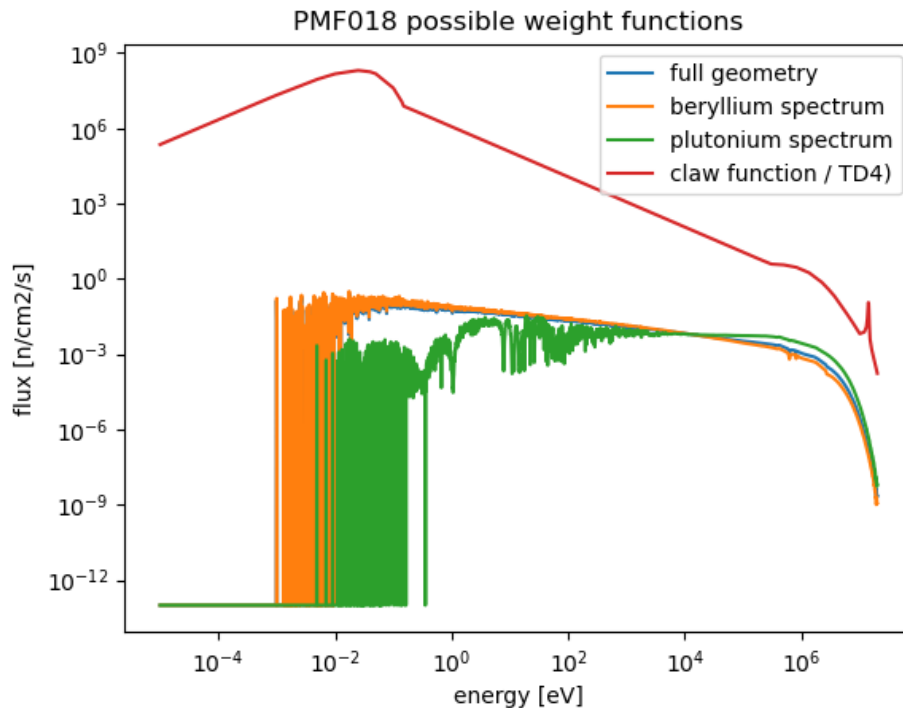


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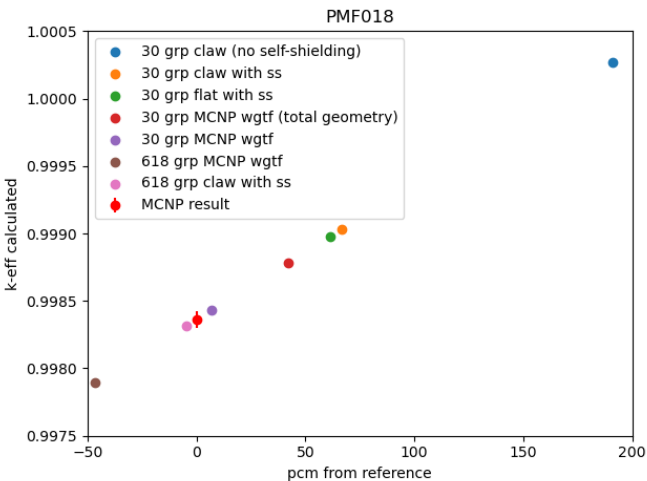
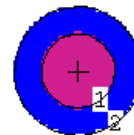


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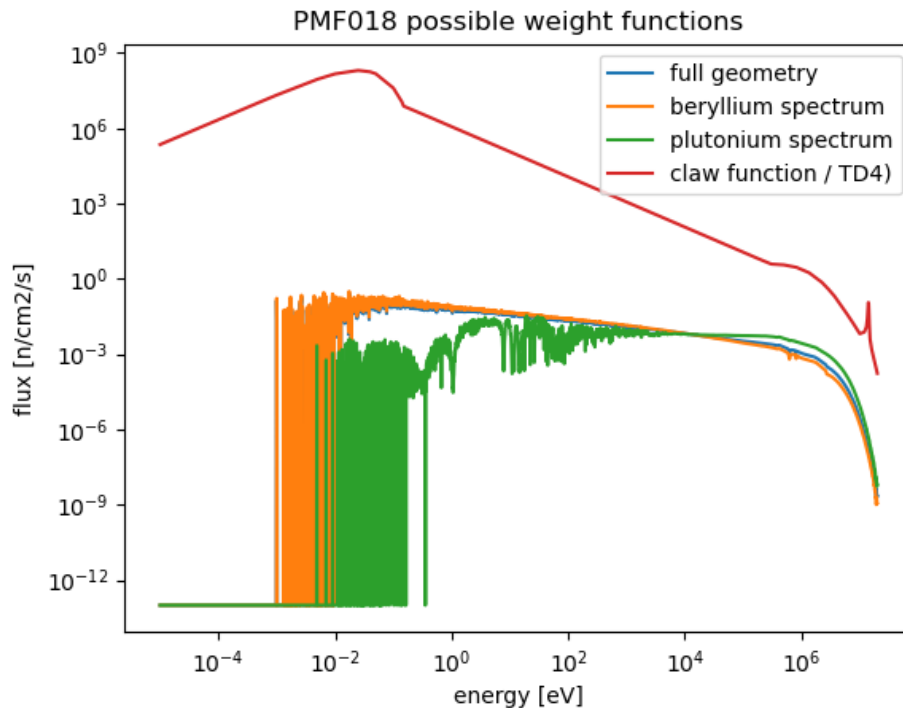


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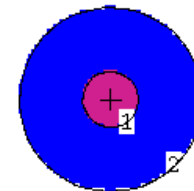


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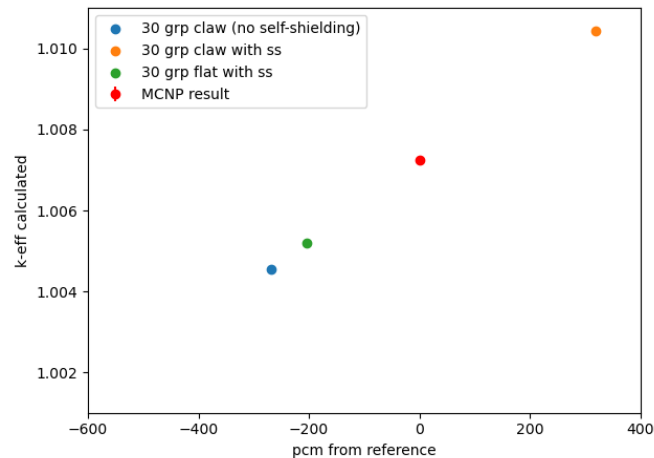
Plutonium core
Beryllium reflector



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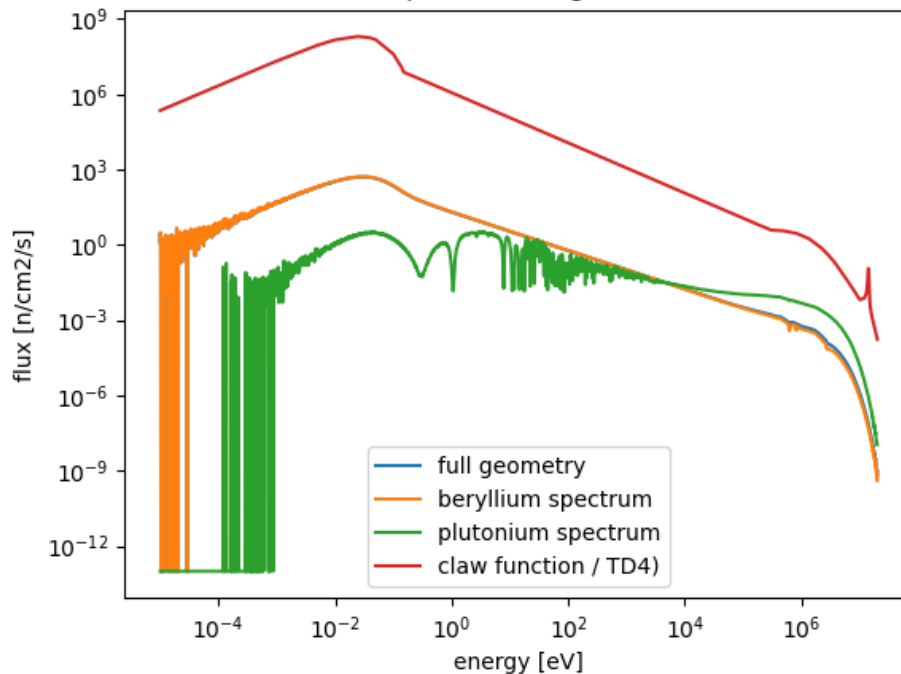
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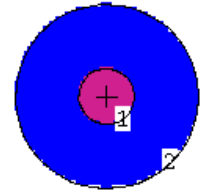
PMF038 (BeRP)

Plutonium core
Beryllium reflector

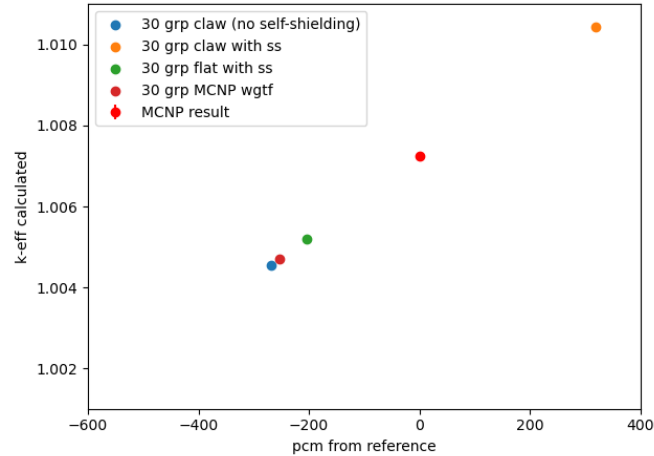
PMF038 possible weight functions



How do they behave?



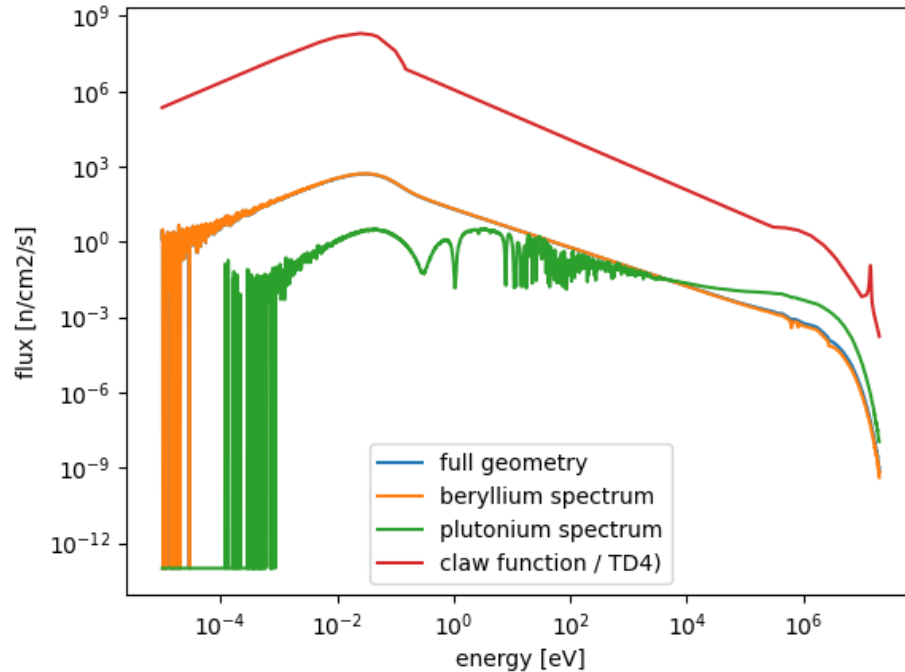
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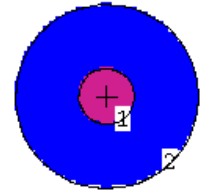
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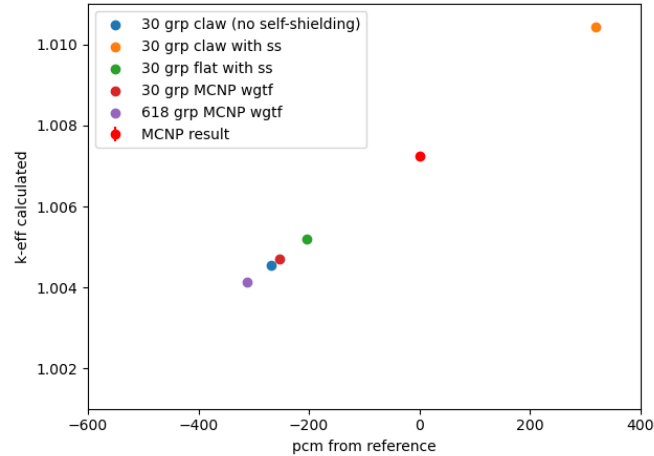
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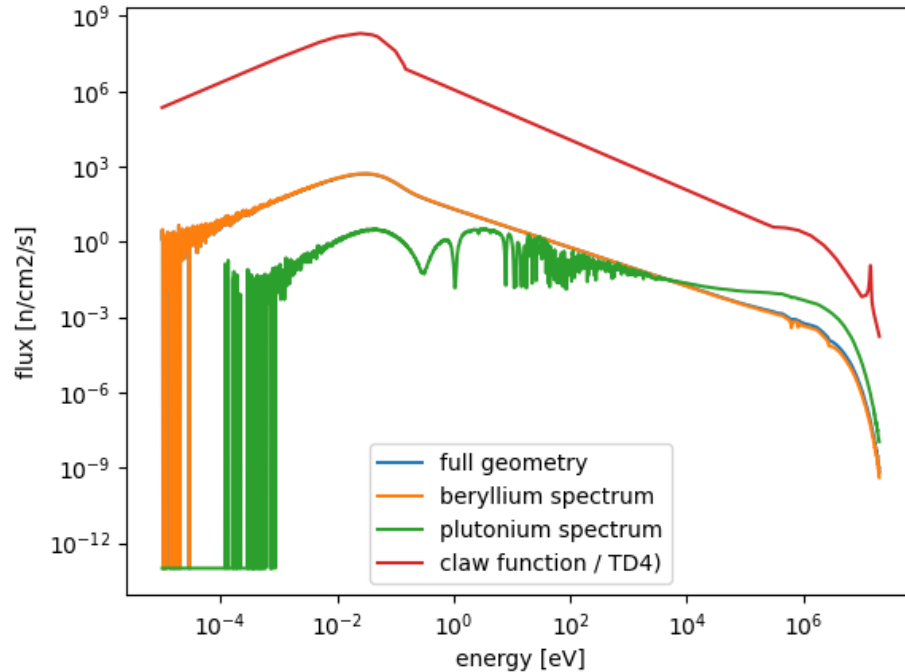
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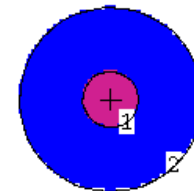
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Beryllium reflector

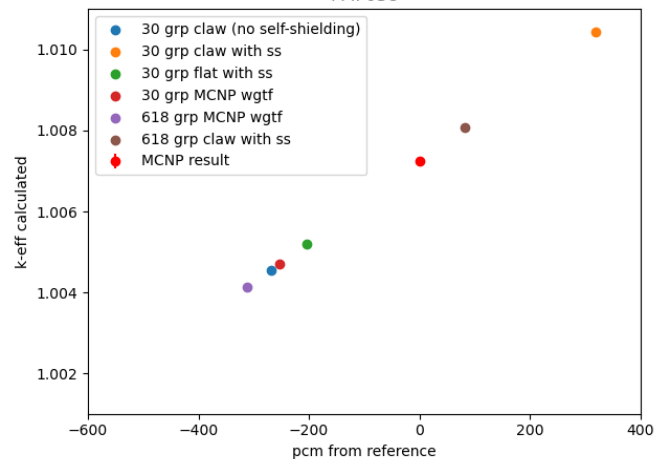
PMF038 possible weight functions



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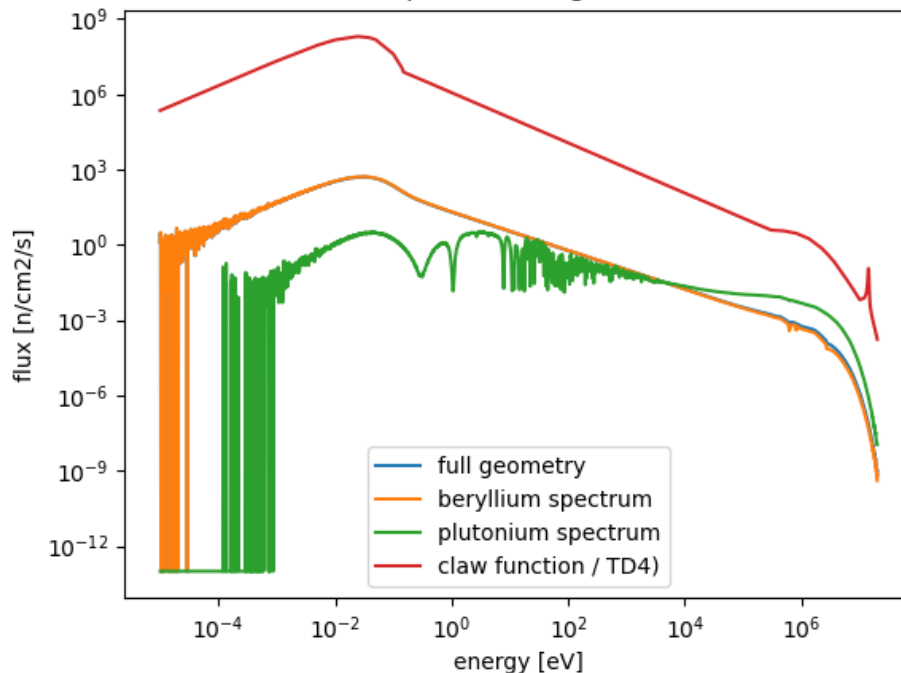
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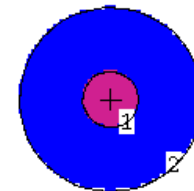
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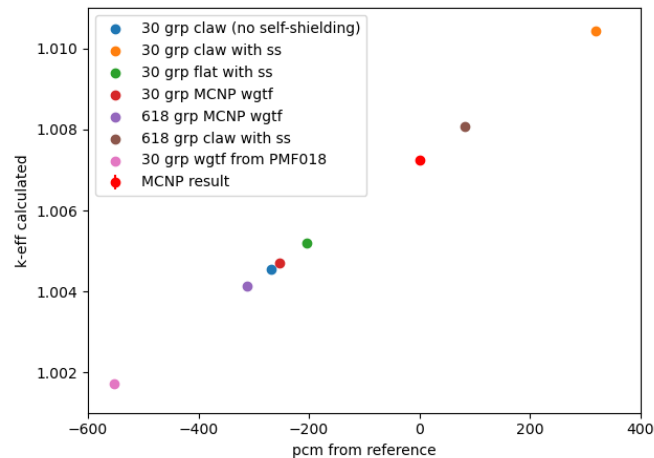
PMF038 possible weight functions



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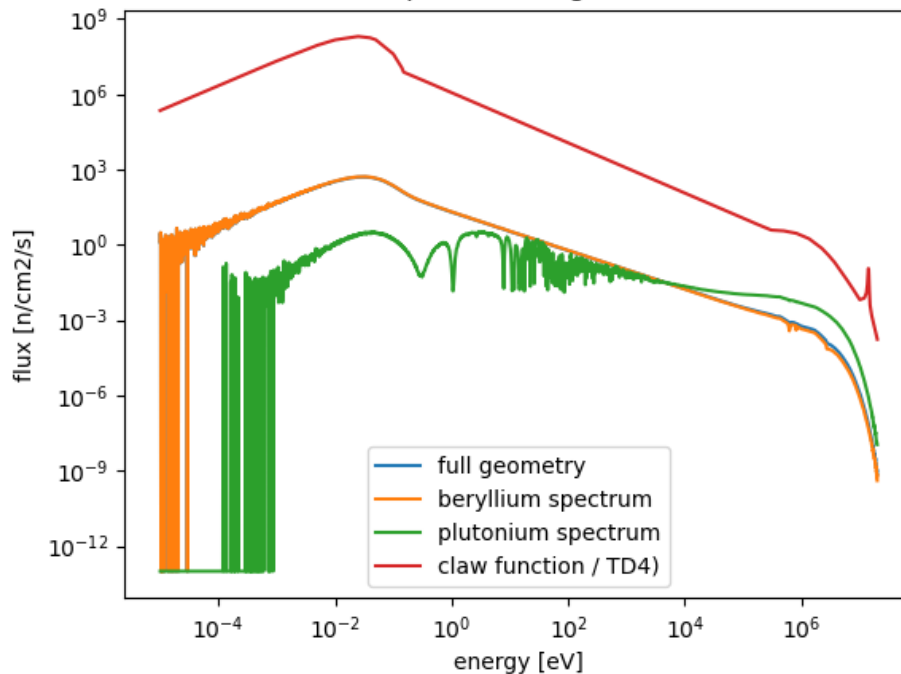
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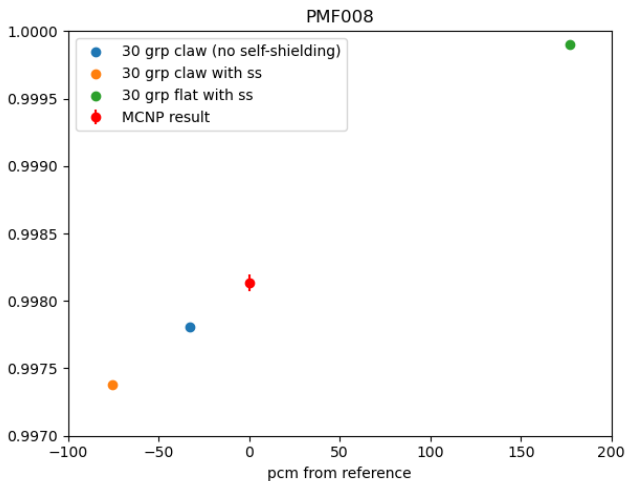
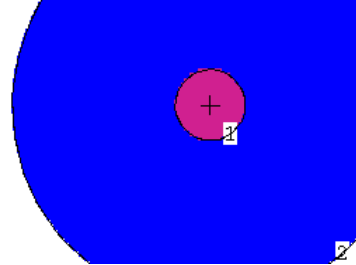
PMF038 (BeRP)

Plutonium core
Beryllium reflector

PMF038 possible weight functions

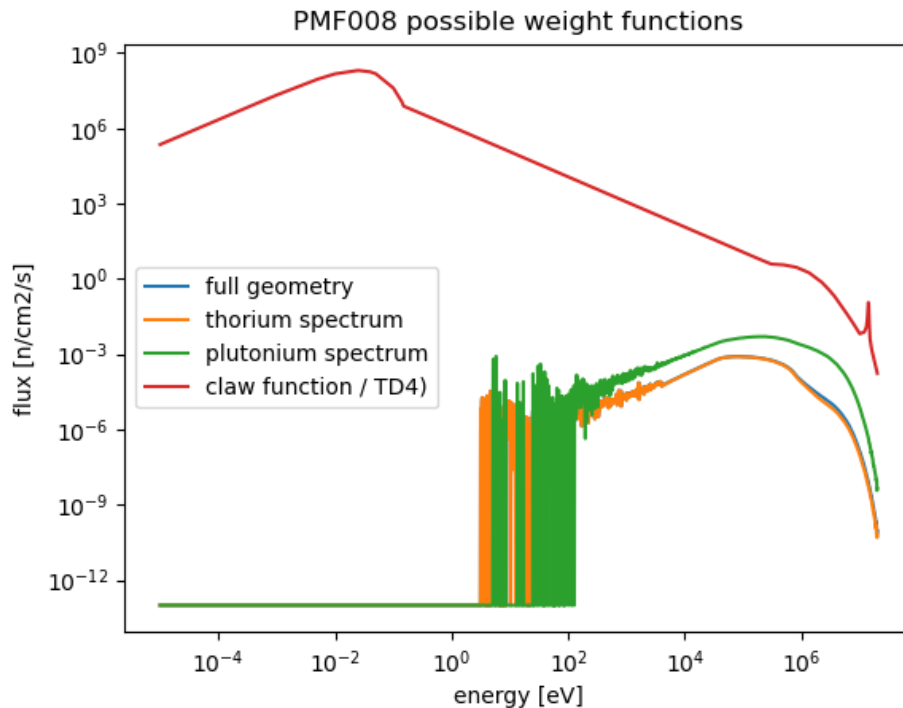


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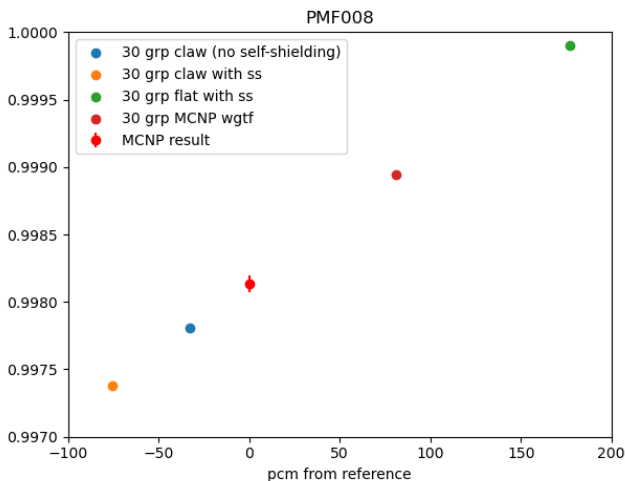
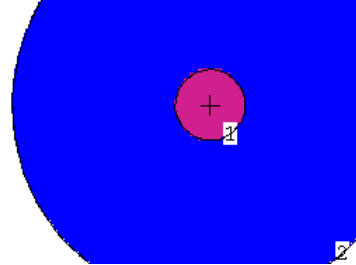


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Plutonium core
Thorium reflector

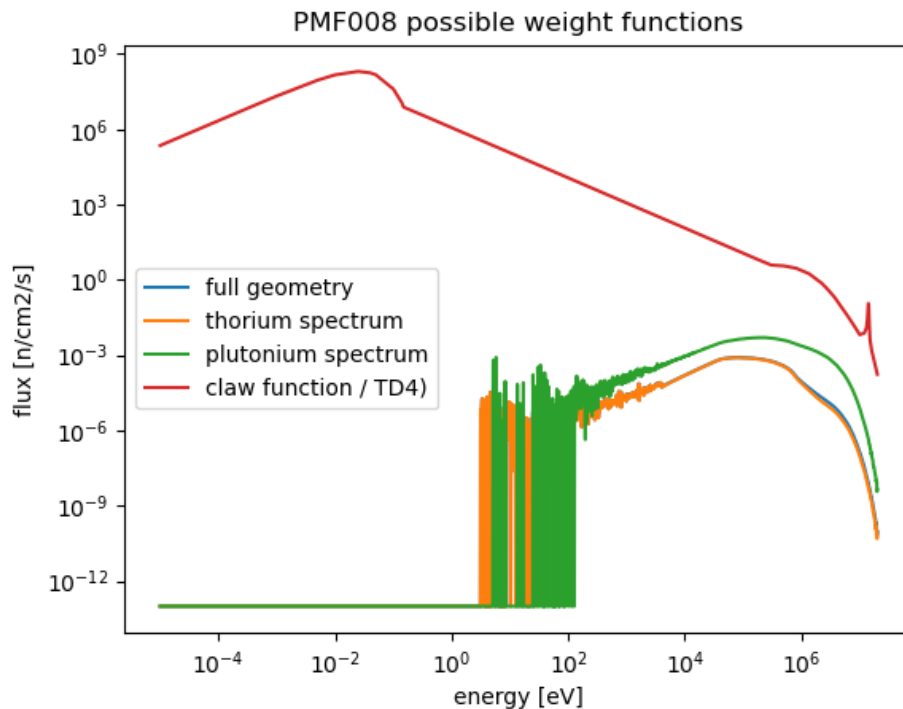


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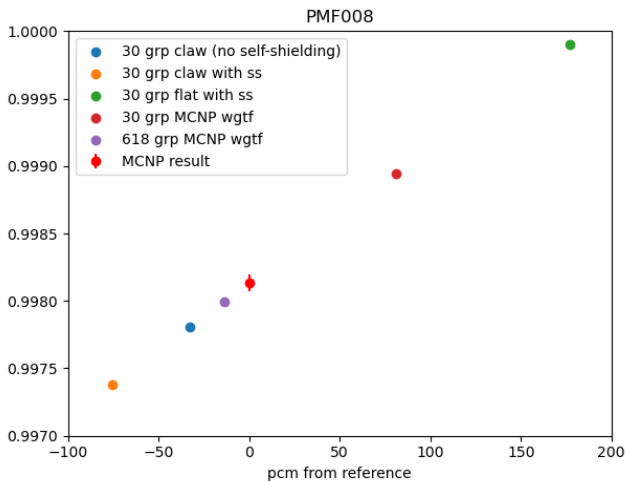
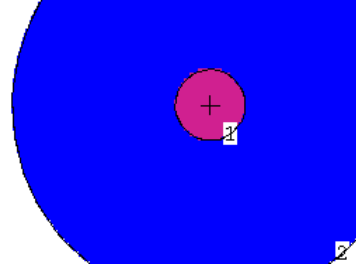


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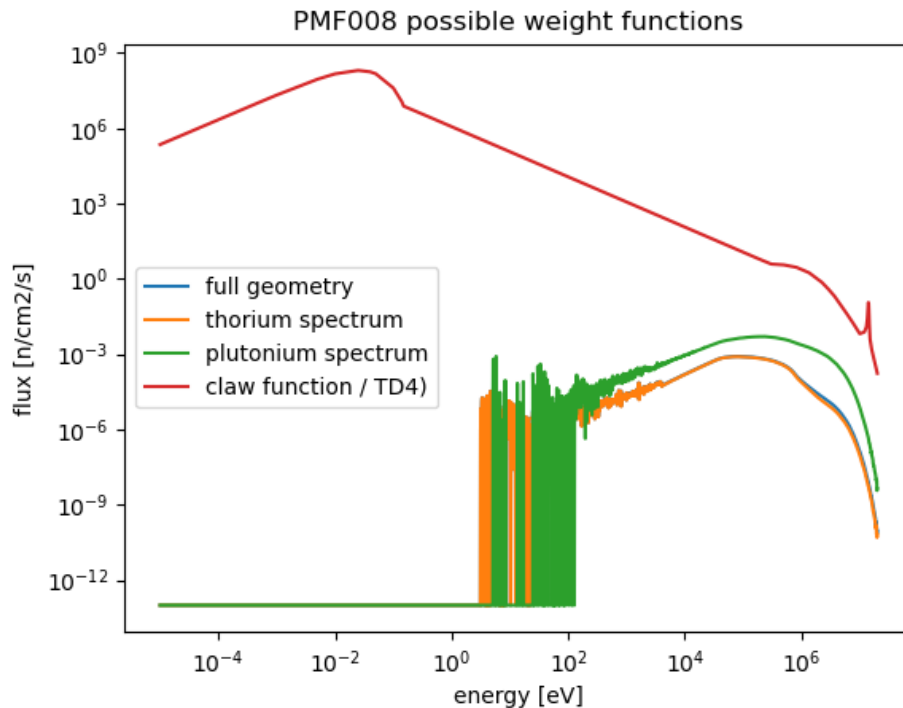


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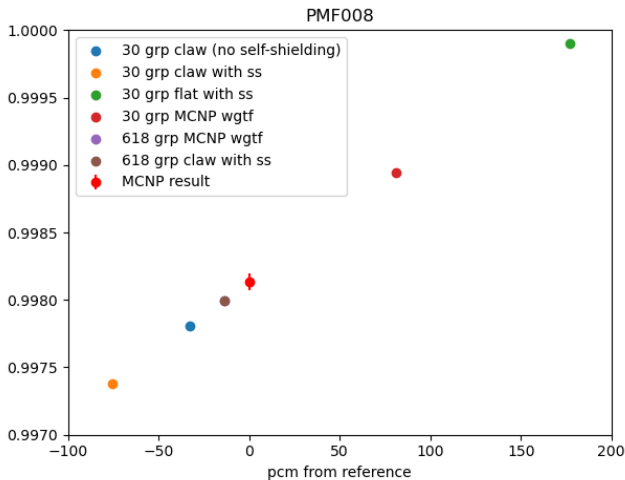
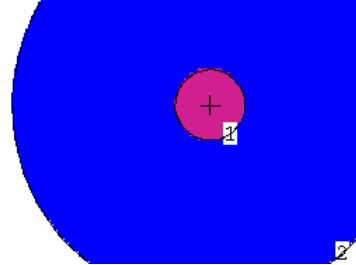


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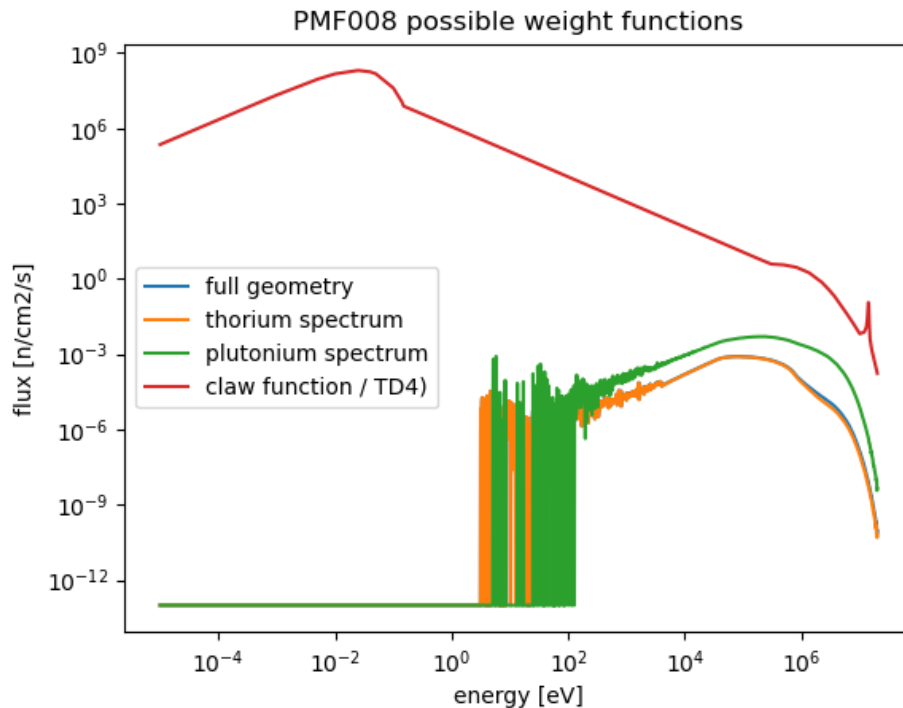


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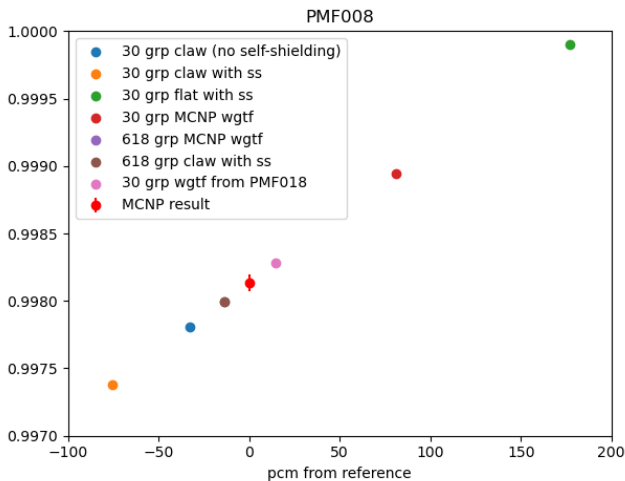
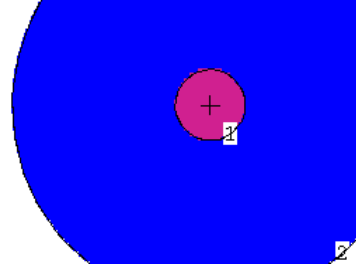


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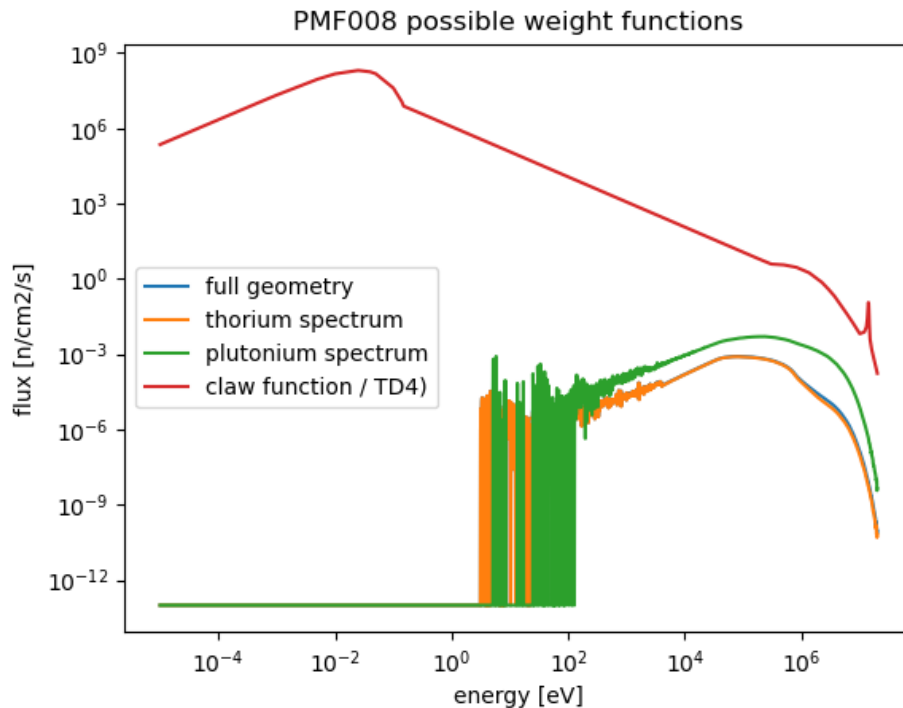


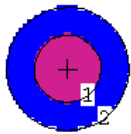
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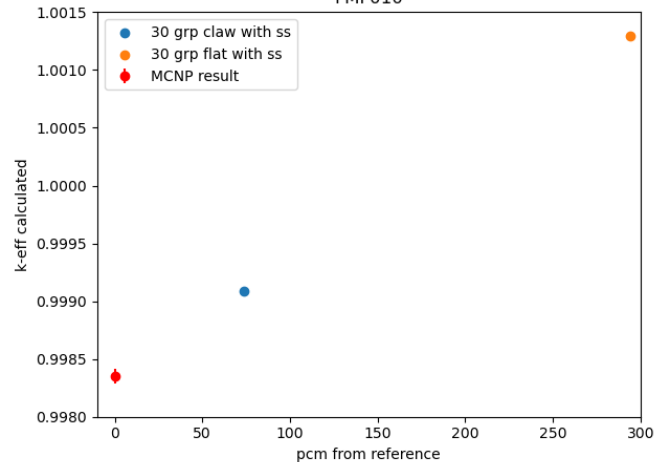
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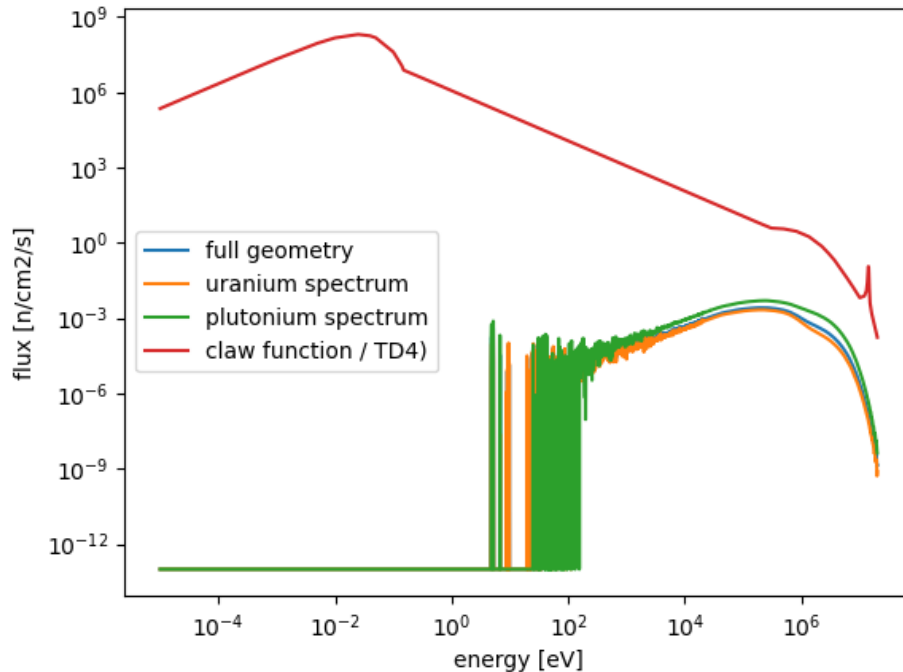
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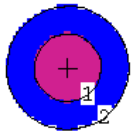


PMF010

Plutonium core
Natural Uranium reflector

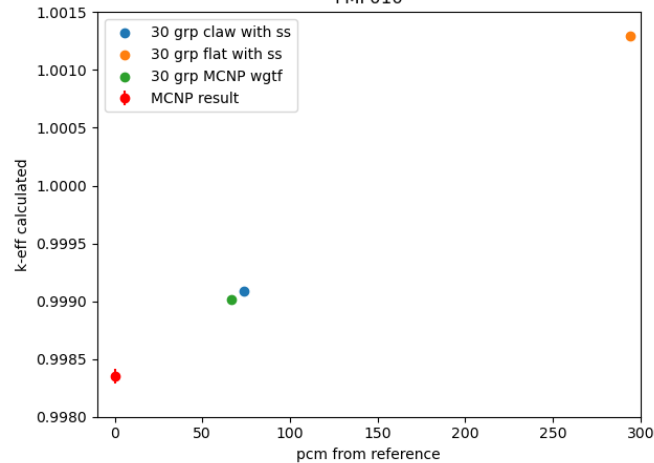
PMF010 possible weight functions





How do they behave?

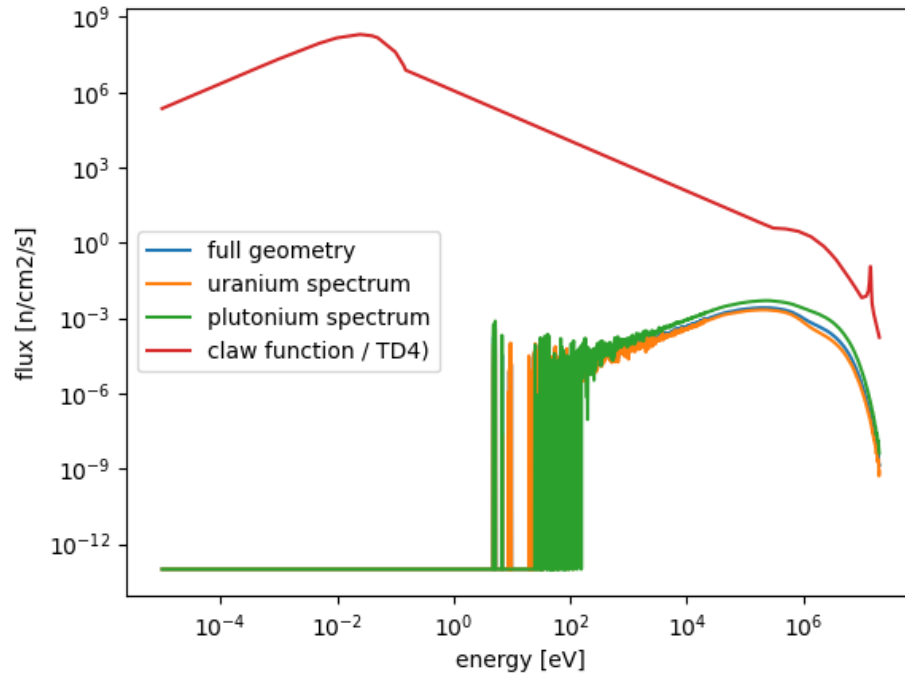
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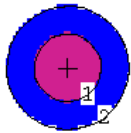


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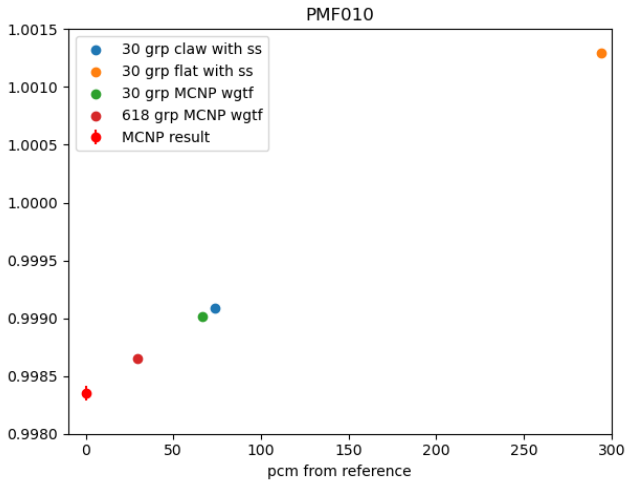
Plutonium core
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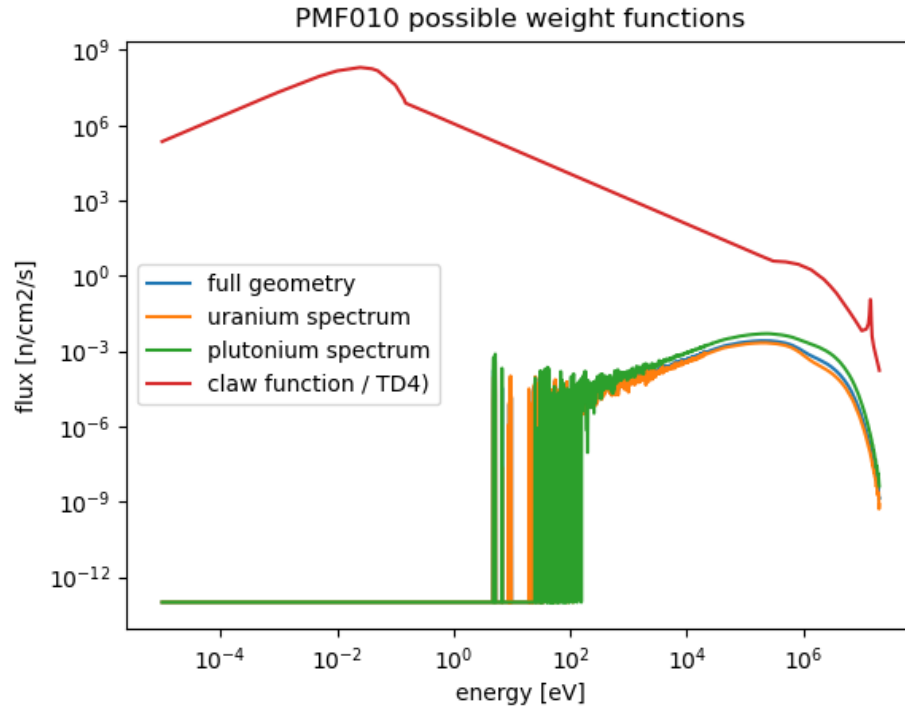


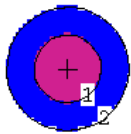
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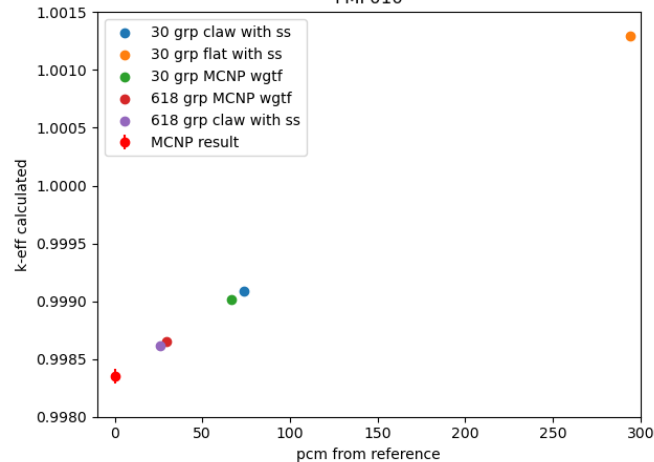
Plutonium core
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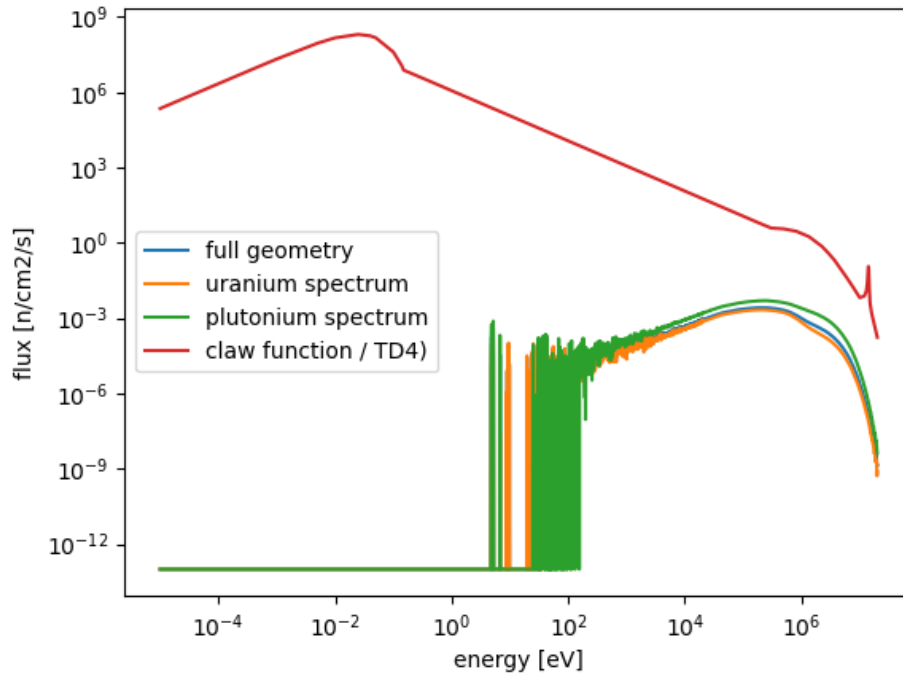
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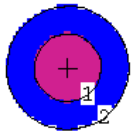


PMF010

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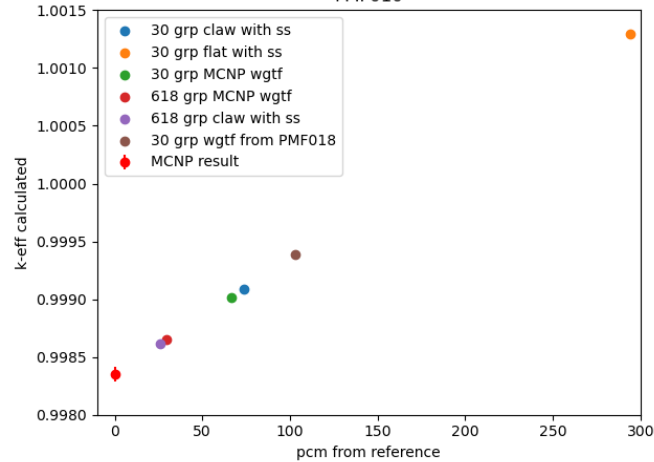
PMF010 possible weight functions





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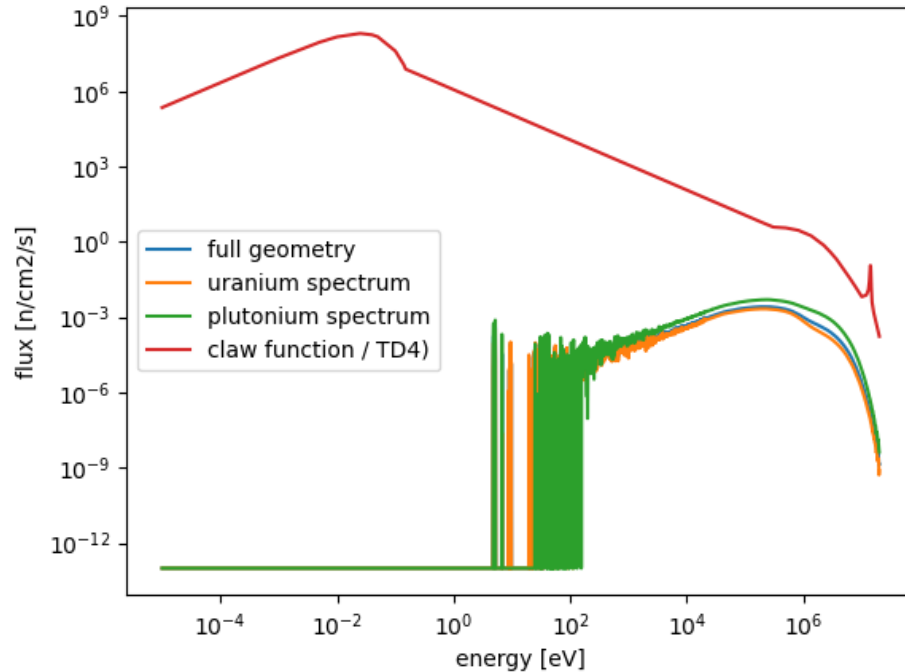
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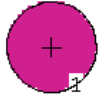
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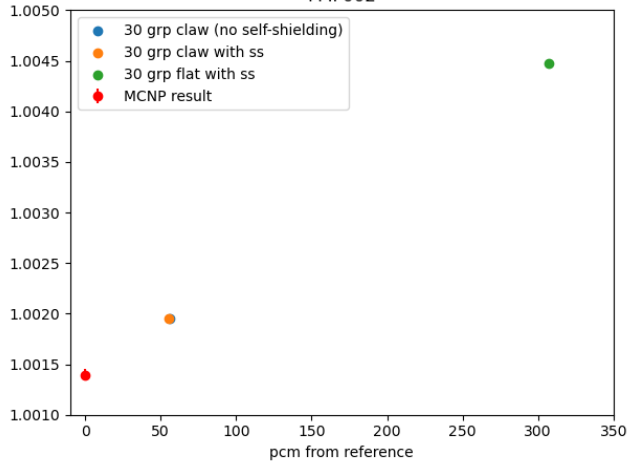
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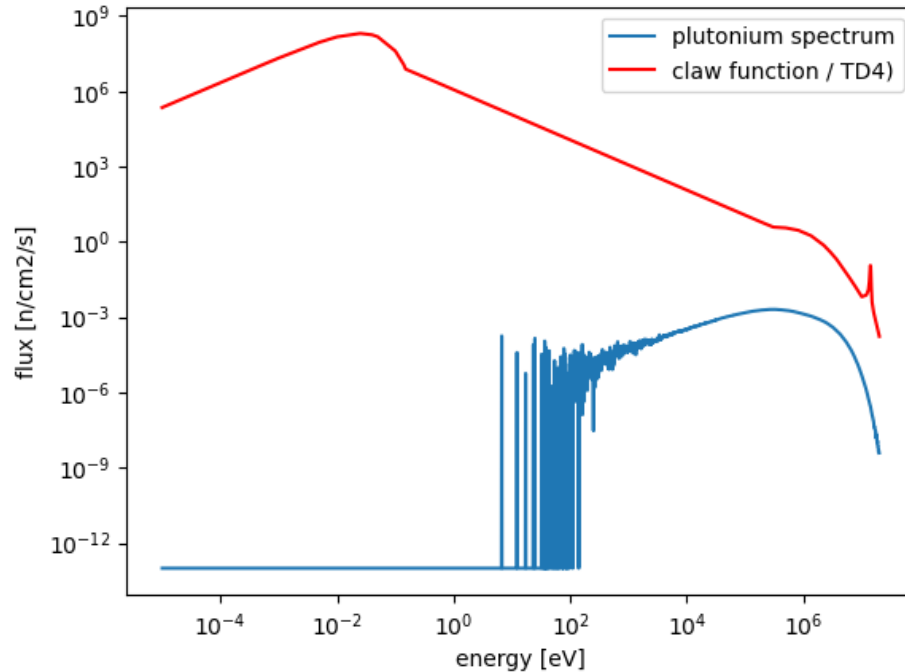
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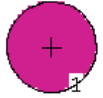
PMF002

Bare plutonium

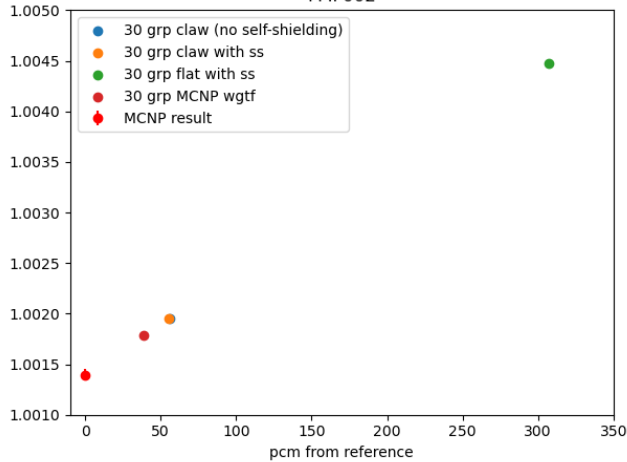
PMF002 possible weight functions



How do they behave?



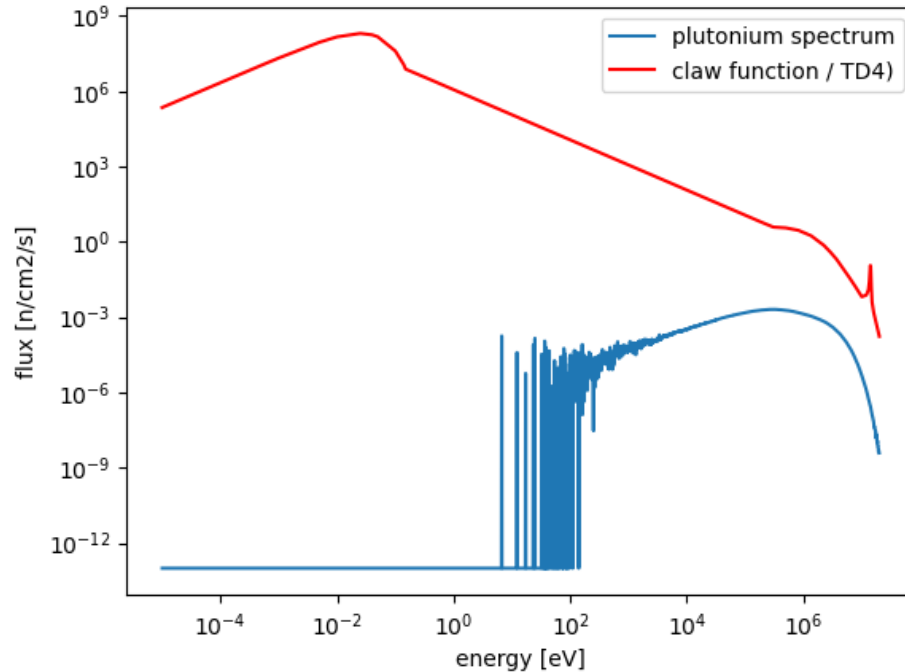
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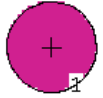
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Bare plutonium

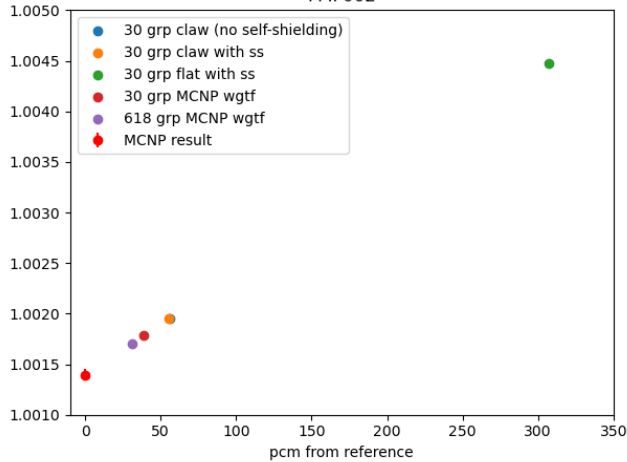
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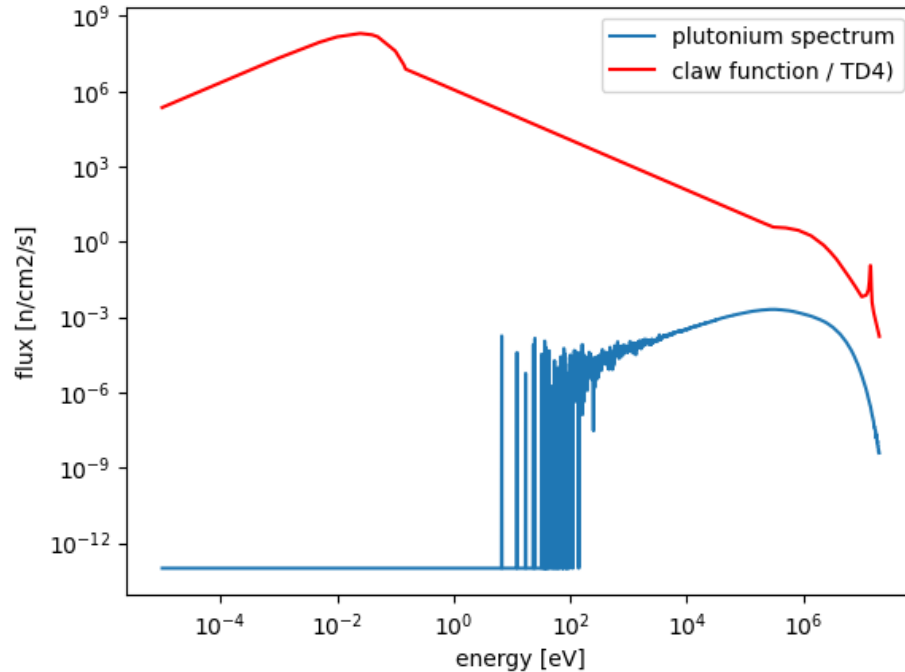
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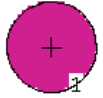
PMF002

Bare plutonium

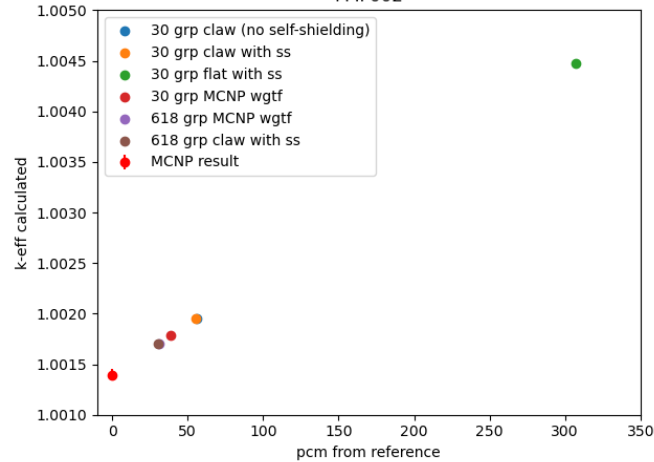
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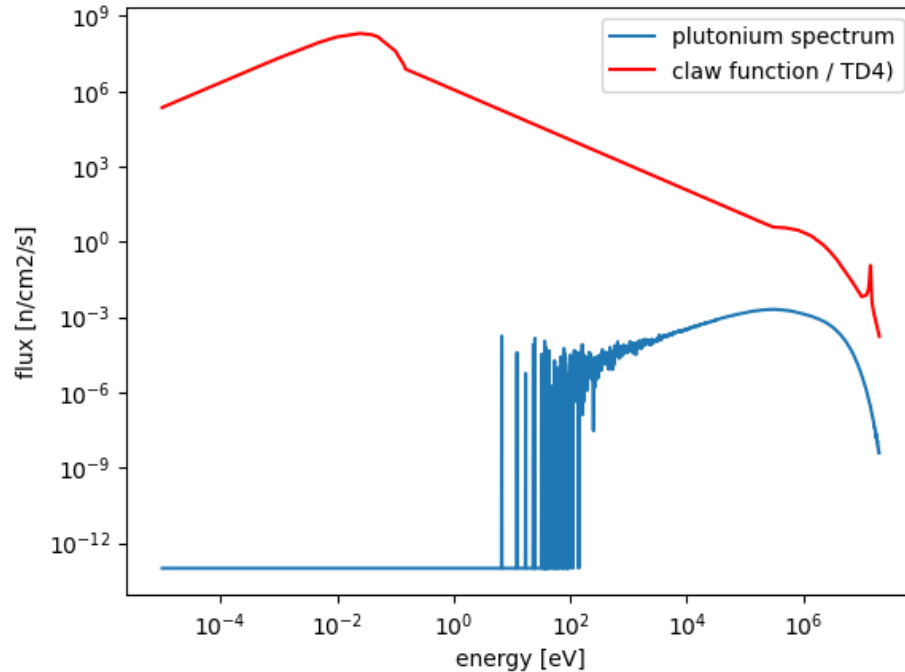
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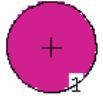
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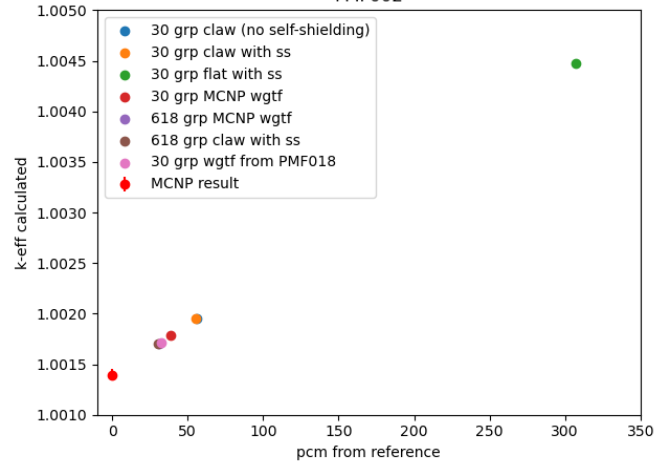
PMF002 possible weight functions



How do they behave?



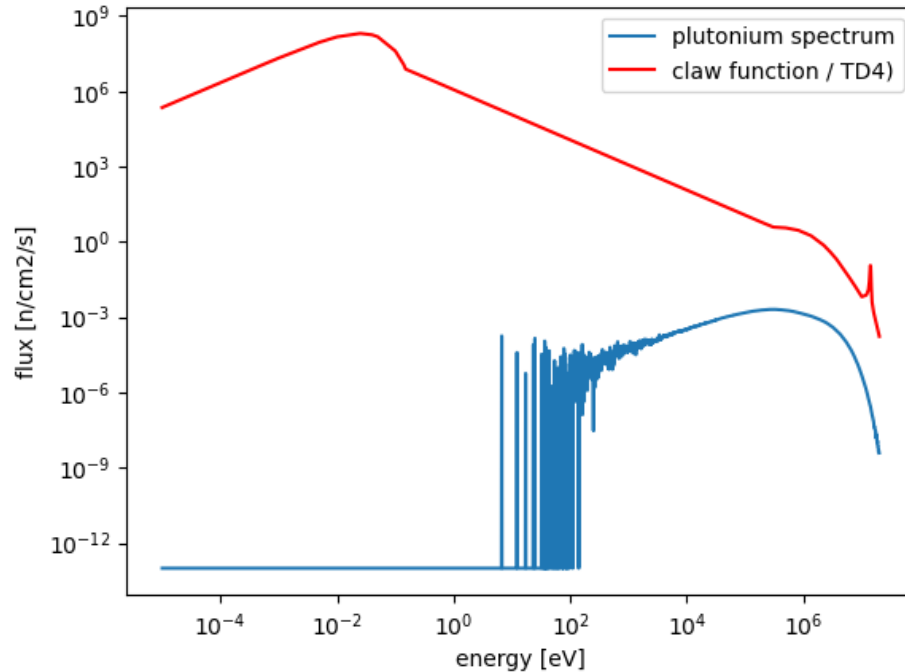
PMF002



PMF002

Bare plutonium

PMF002 possible weight functions



Key take-aways:

- The weight function used to generate multi-group data is important.
- MCNP-generated data is not always feasible.
- CLAW/TD4 weight function often behaves the same or better.
- More research is required to study *why* this weight function and group structure combination is so successful for fast systems.

Key take-aways: LANL-30 & claw work really well together

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