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Title: Benchmarking of Fusion Data with Pulsed Sphere Experiments

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Benchmarking of Fusion Data with Pulsed Sphere Experiments

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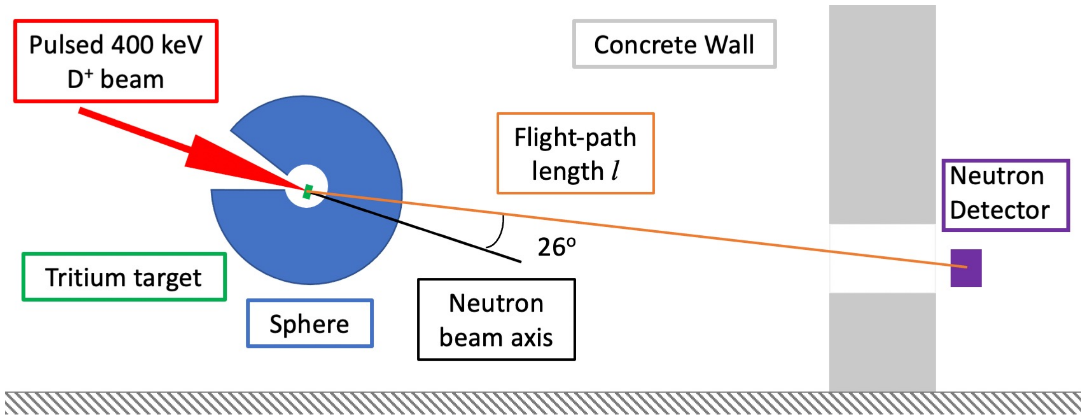
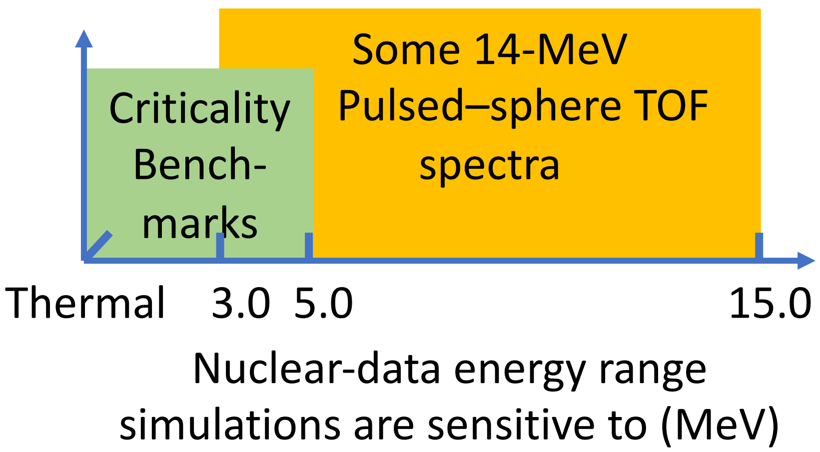
LLNL pulsed spheres allow us to validate nuclear data from 3-15 MeV of several isotopes of interest for fusion research.

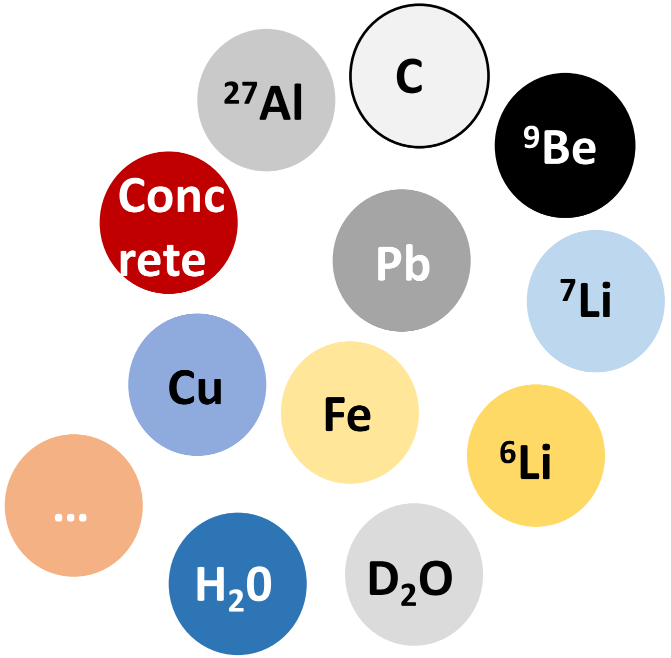
Querying nuclear data from 3-15 MeV





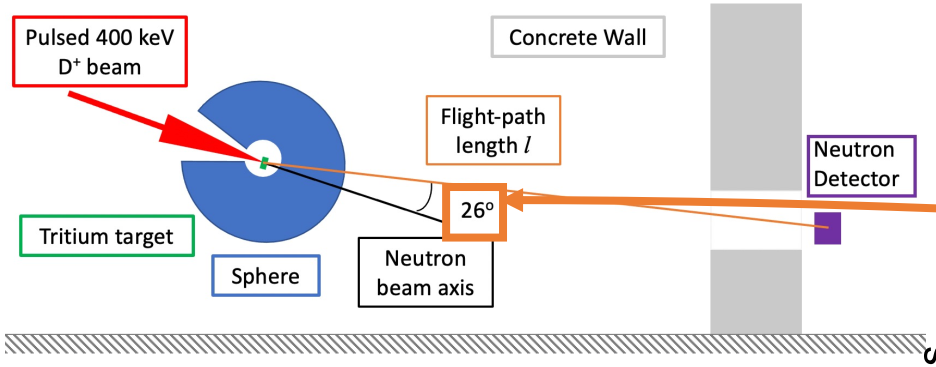
Experiments: Wong et al., UCRL-51144, UCRL-ID-91774, Webster et al. UCID-17332.

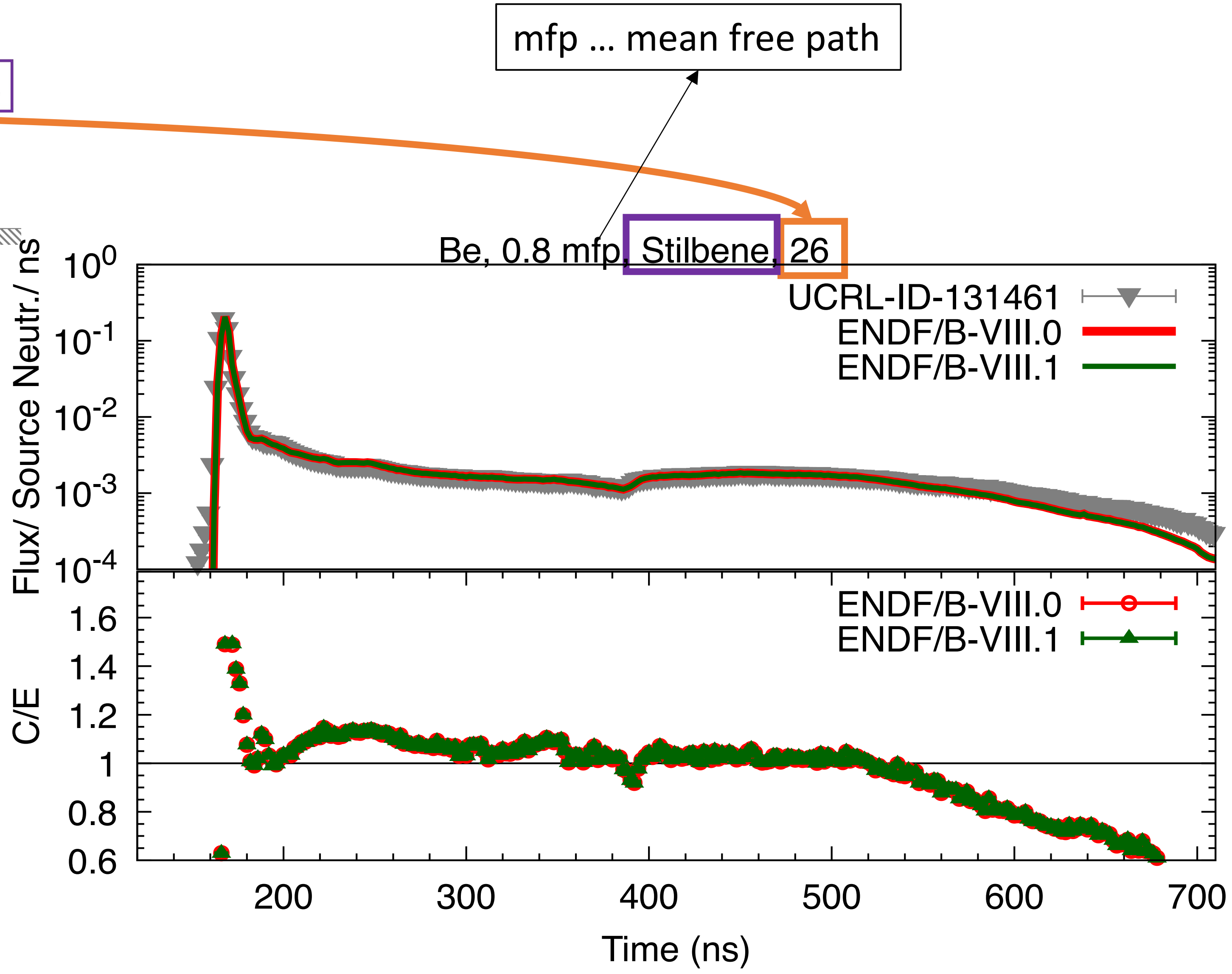
Several materials of interest for fusion



Neudecker et al., Annals of Nuclear Energy 159, 108345: "Issues could be in ^{6}Li, ^{12}C, ^{16}O, $^{24-26}$Mg, ^{27}Al, ^{48}Ti, ^{56}Fe, and ^{208}Pb nuclear data. Good agreement is found with ^{1,2}H, ^{7}Li, ^{9}Be, ^{14}N, ^{235,238}U, and ^{239}Pu nuclear data."

LLNL pulsed spheres allow us to validate elastic, inelastic and (n,2n) nuclear data of interest for fusion research.

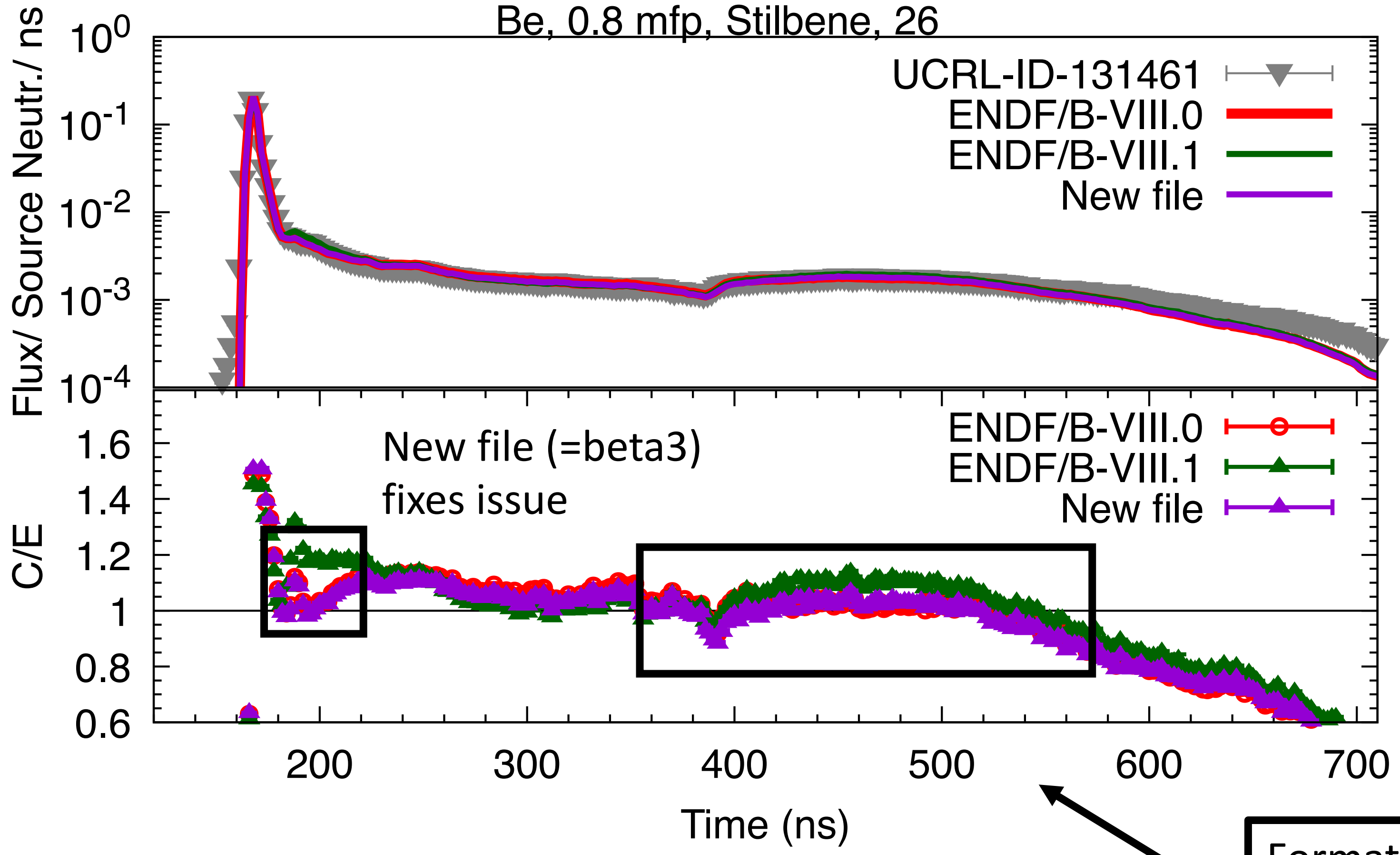




<u>Pulsed spheres query:</u>

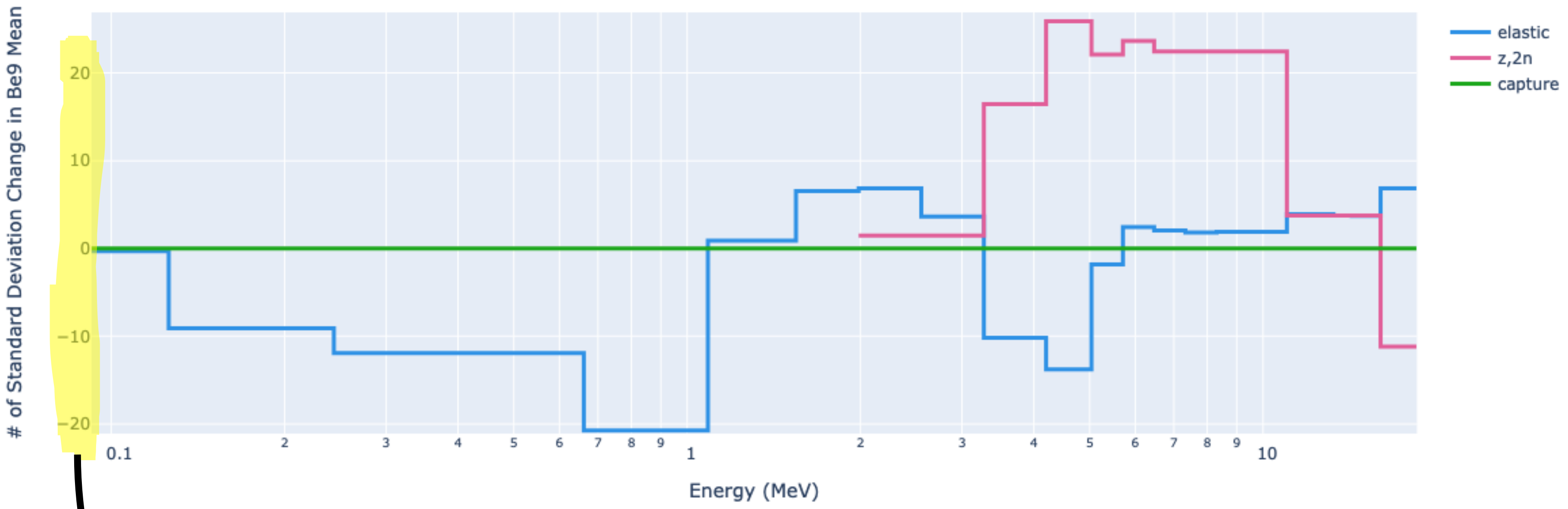
- Light elements: elastic, inelastic discrete levels, maybe (n,2n); cross sections and angular distributions;
- Ti, Fe, Pb, etc.: + inelastic continuum cross sections and angular distributions;
- Actinides: + fission cross section + PFNS.

The resulting spectra are an excellent diagnostic tool to find issues in nuclear data that might have eluded us otherwise …



Formatting issue in $^{9}Be(n,2n)$ VIII.1beta2 (green) was spotted thanks to deviation in LPS spectra!

… but they are fairly uncertain with poorly quantified uncertainties. “Blind” adjustment with these data is perilous at best.



Issues preventing good adjustment:

- Missing angular distribution sensitivities,
- Missing angular distribution covariances for some isotopes,
- Poorly quantified experimental uncertainties,
- Systematic issues in the experiment that cannot be recovered.

The blindly adjusted cross sections change by 20(!!) sigma compared to ENDF/B-VIII.0!*

* If we model bias and add uncertainties according to known effects, the adjusted cross sections change within 2 sigma.

Adjustment with EAT (``EUCLID Adjustment Tool” by Mike Grosskopf (LANL)).

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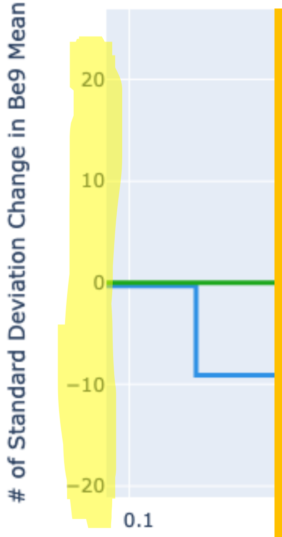

In a nutshell: LLNL Pulsed sphere experiments are very helpful for validating nuclear data of interest for fusion, BUT It might be worth re-measuring them with careful analysis of experimental uncertainties.
We need angular distribution covariances and sensitivities of their spectra to these nuclear data to harvest their full effect.

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