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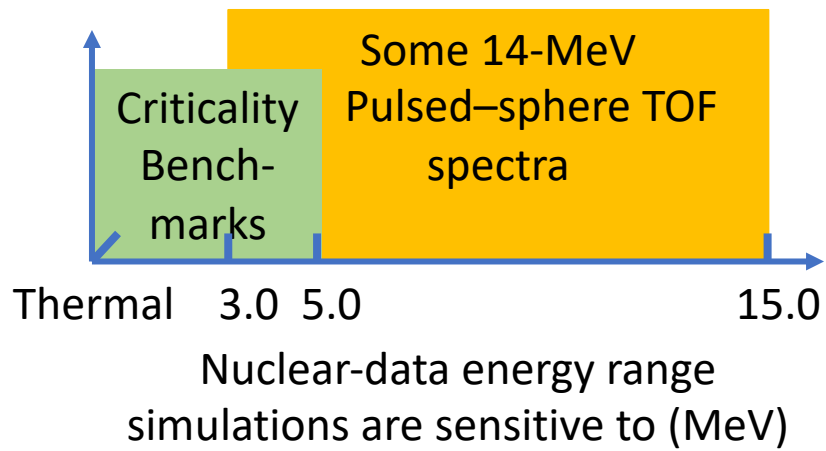
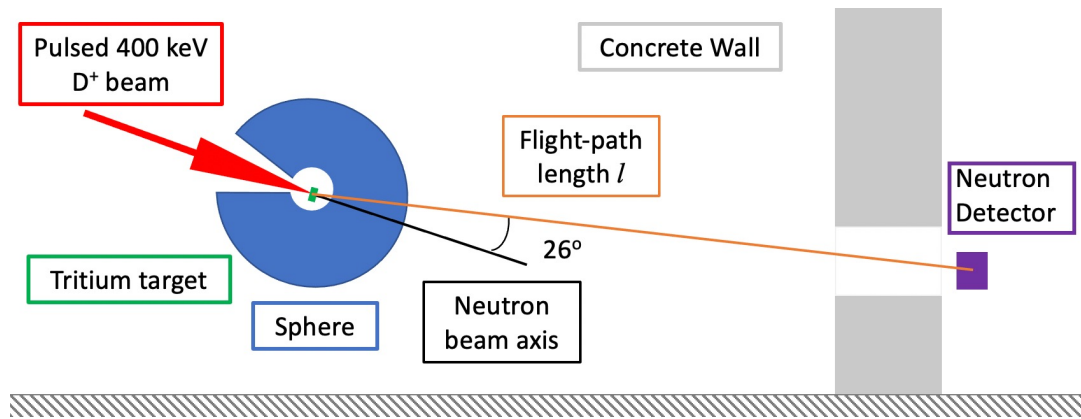
# Benchmarking of Fusion Data with Pulsed Sphere Experiments

Denise Neudecker, Robert Casperson  
WANDA2024, 2/26-29/2024

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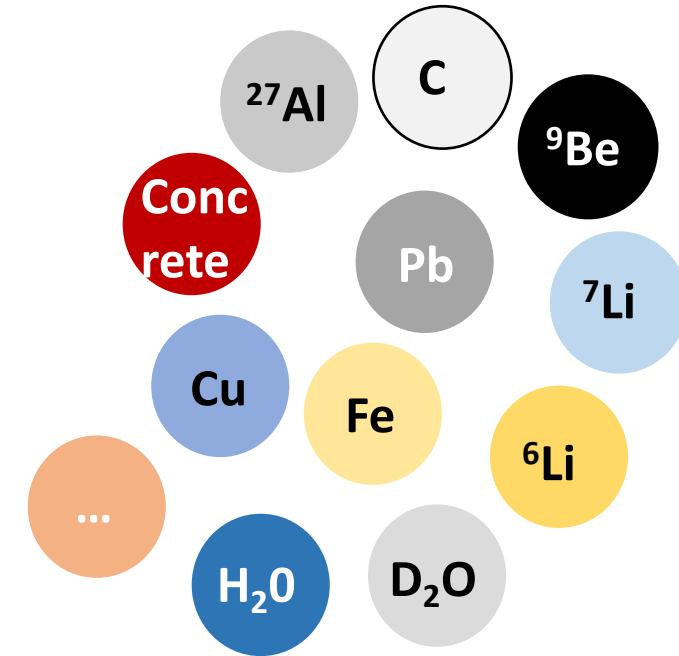
# LLNL pulsed spheres allow us to validate nuclear data from 3-15 MeV of several isotopes of interest for fusion research.

## Querying nuclear data from 3-15 MeV



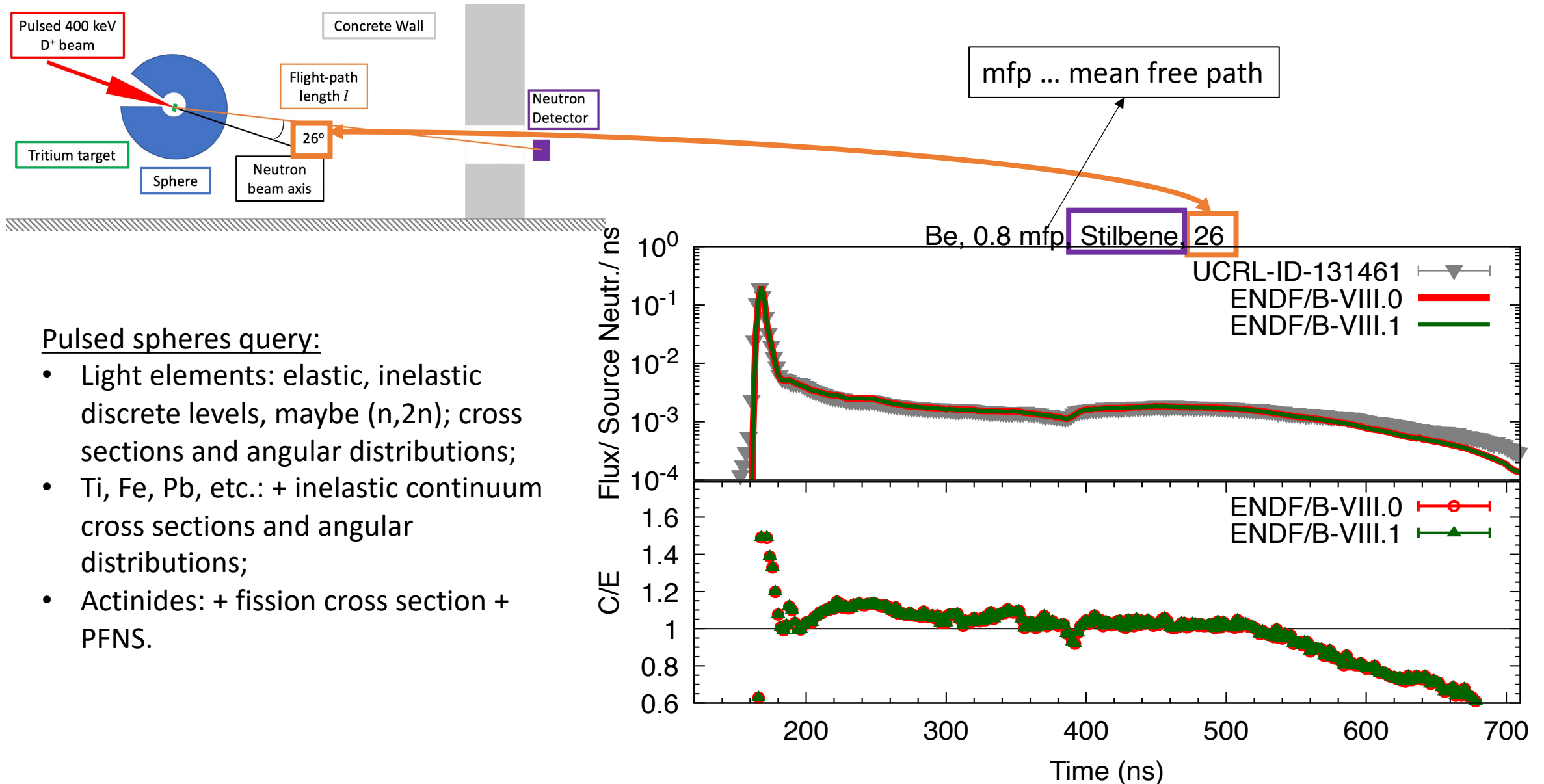
Experiments: Wong et al., UCRL-51144, UCRL-ID-91774, Webster et al. UCID-17332.

## Several materials of interest for fusion

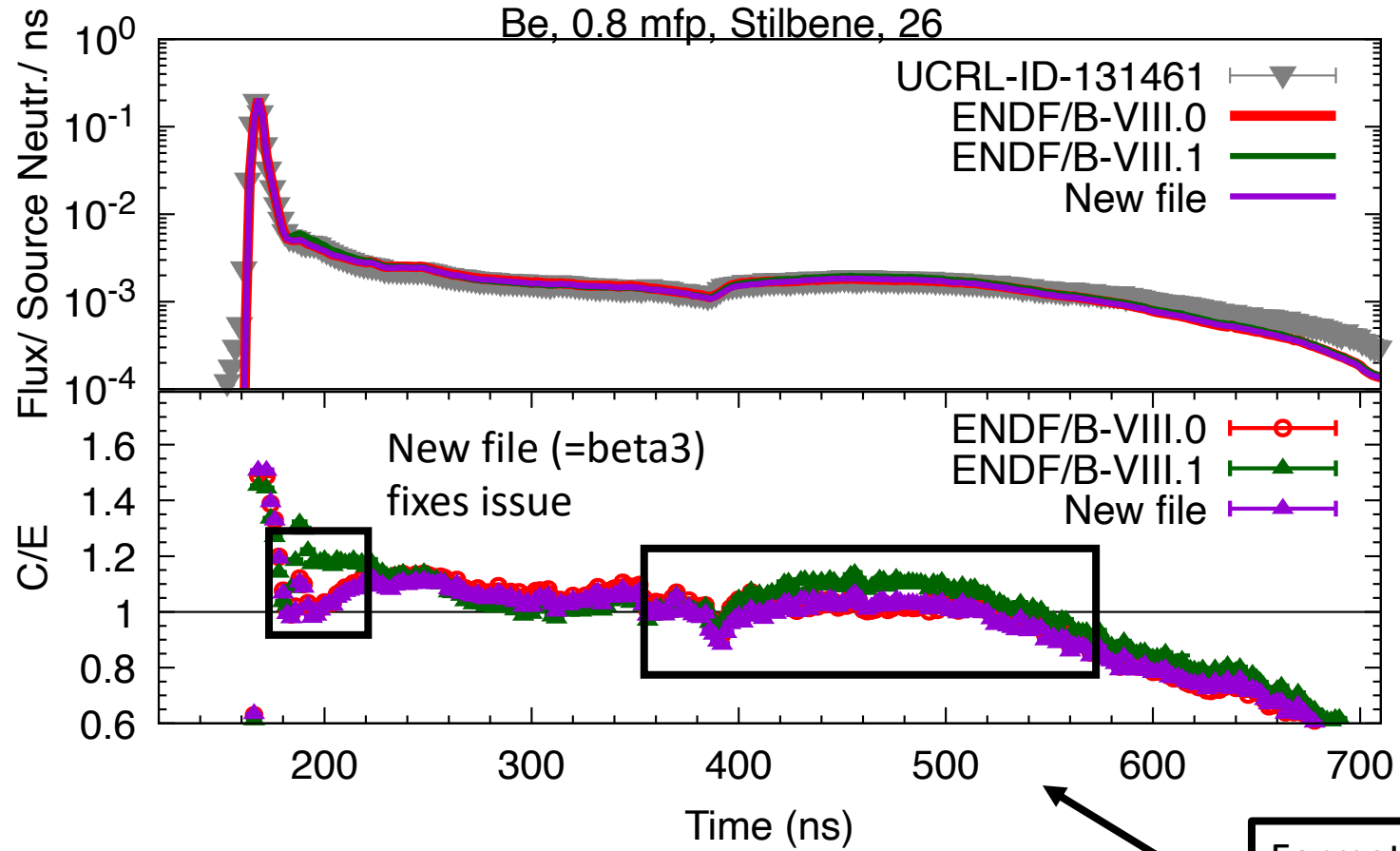


Neudecker et al., Annals of Nuclear Energy 159, 108345: “Issues could be in  ${}^6\text{Li}$ ,  ${}^{12}\text{C}$ ,  ${}^{16}\text{O}$ ,  ${}^{24-26}\text{Mg}$ ,  ${}^{27}\text{Al}$ ,  ${}^{48}\text{Ti}$ ,  ${}^{56}\text{Fe}$ , and  ${}^{208}\text{Pb}$  nuclear data. Good agreement is found with  ${}^1,2\text{H}$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

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

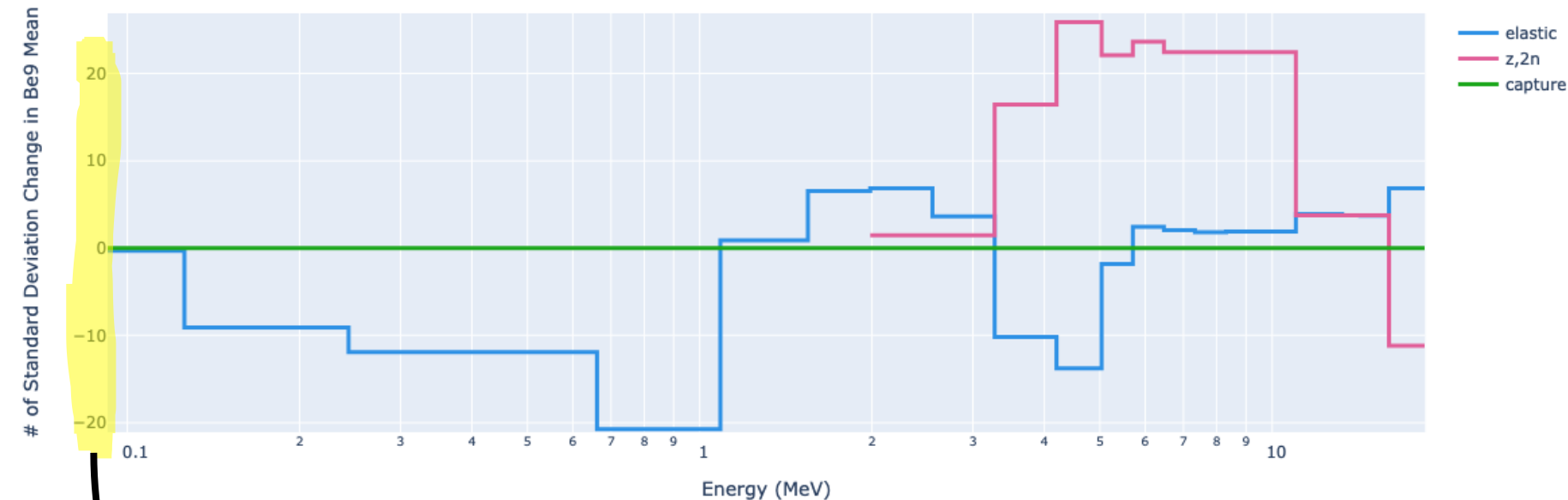


# The resulting spectra are an excellent diagnostic tool to find issues in nuclear data that might have eluded us otherwise ...



Formatting issue in  ${}^9\text{Be}(n,2n)$   
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:

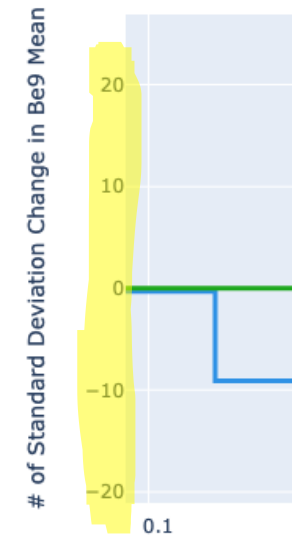
- Missing angular distribution sensitivities,
- Missing angular distribution covariances for some isotopes,
- Poorly quantified experimental uncertainties,
- Systematic issues in the experiment that cannot be recovered.

*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)).

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



**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.**

good  
r distribution  
r distribution  
some  
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uncertainties!  
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Adjustment with EAT (“EUCLID Adjustment Tool” by Mike Grosskopf (LANL) ).