Demystifying neutron lethargy
Ocean Wong
2019-03-18

When attempting to find the solution to the following question: " How can the average number of collisions necessary to thermalise a fission neutron (slow it down from 2 MeV to 1 eV) in deuterium be calculated? " Several fellow students has stubled across the following misconception.

1 Incorrect method

An intutive method is to do the following:

$$\overline{E_f} = E_i \frac{(\alpha + 1)}{2} = \int P(E) E dE \tag{1}$$

$$\overline{\Delta u} = ln \left(\frac{E_i}{\overline{E_f}} \right) \tag{2}$$

$$N = (\Delta u()) \left(\overline{\Delta u} \right) \tag{3}$$

Which corresponds to the procedure as follows:

1. Find the average energy lost $\bar{E}$
2. Calculate the lethargy change associated with it
3. Find the number of collisions (each with energy $\bar{E}$ lost) required to slow it down.

In a single equation, this is represented as:

$$N = \frac{\Delta u(\,)}{\Delta u \left(\int P(E) E dE \right)} \tag{4}$$

2 Correct method

However, this isn't correct. We know that the size of the

3 Explanation

One small excursion to the left will contribute a much larger increment in lethargy gain than a small excursion to the right. This means that a collision losing slightly more than $\bar{E}$ requires multiple collision losing slightly less energy than $\bar{E}$ to counter its effect.

3.1 Arithmatic mean Geometric mean

Why geometric mean should be applied

4 Acknowledgement

Thank you for Sam Dyson from 2018-19 class of PTNR