NUCL 510 HMWK 9

1. HMWK #6 of Ch. 5
   1. Natural-uranium fueled graphite reactor where number of carbon atoms to uranium is 500

Assuming :

Dividing through by :

Using Values from table 4-II:

* 1. Natural-uranium fueled light water reactor where number of water atoms to uranium is 5

Assuming :

Dividing through by :

Using Values from table 4-II:

1. HMWK #7 of Ch. 5

The resonance integral can be given as (from problem 6 (#1 on this assignment):

For heterogeneous case specified, the number density will double:

With all other thing equal (scattering occurring in moderator even in the fuel region):

This is a gross underestimate because of the numerous assumptions made when performing this calculation. The first assumption is that the given approximation for the resonance integral is valid for both a heterogeneous case and a homogenous. The second approximation is that scattering will only occur in the moderator throughout the reactor, which will slightly decrease the scattering source. The final assumption is that the change of number density of half of the reactor will not affect the final solution. Because the final two assumptions decrease the scattering source and the absorption of resonance respectively, the final heterogeneous resonance integral is a much decreased approximation to real values.

1. HMWK #8 of Ch. 5

The resonance integrals shown above assume the S/M ratios to be calculated using one fuel pin in a large moderator, widely spaced throughout the lattice. This will be much different for when the lattice is closely packed. The fuel pins usually sit almost directly on top of each other, and the rods are close enough that they can be considered closely packed. This will cause an increase in energy for the average neutron within the closely packed lattice (as it will have less moderator to decrease its energy as it travels through). The escape cross section in the widely packed lattice is going to be much higher because the reflected boundaries are assumed to be further away (increasing the ). Several further corrections will be needed to create an estimation for resonance absorption in closely packed lattice of fuel rods made up of pellets.

1. HMWK #9 of Ch. 5

The area under a Doppler broadened cross section is broadened by averaging against a Maxwellian distribution. This averaging will not change the integral (ie the area under the resonance). The following chart shows the Maxwellian function averaging the function . This shows the difference in shape, but the following values for the integral show that the integral does not change at all.

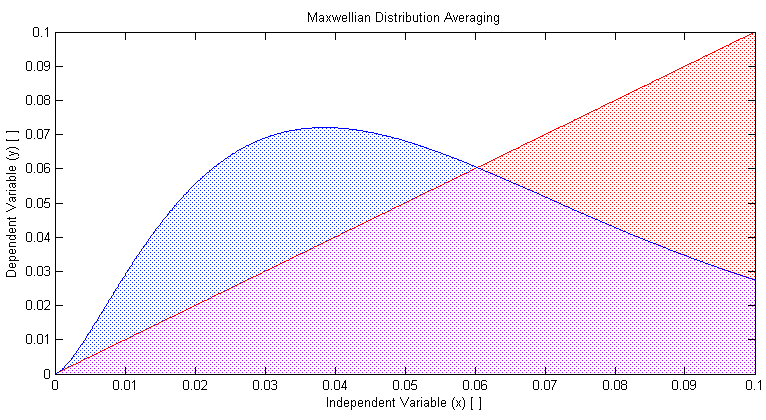


Figure Maxwellian Averaging

This result is smaller than the result without averaging because part of the distribution has been cut off. If you could do this with increasing upper end of energy, it would converge to the same value.

1. HMWK #10 of Ch. 5

The normalized Gaussian function will decrease with increasing width. This can be shown mathematically using the following steps: