<u>Neutron Time of Flight and Neutron Energy Distribution Calculations</u>

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For these simulations we assumed the fission source and two detectors A and B, placed at the distances r_a and r_b from the fission source, respectively (Fig.1)

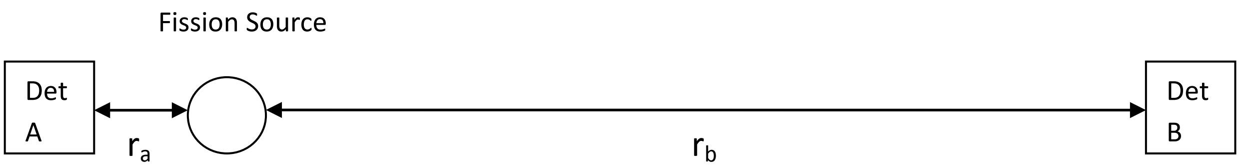

Figure 1. Simulation setup

For the simulations I assumed r_a to be equal to one centimeter, and r_b to be one meter. Neutron energy distribution was considered to be the following (Figure 2):

$$f(E) = \sqrt{E} \cdot e^{\frac{-E}{1.29}}$$

where E is the neutron energy in MeV.

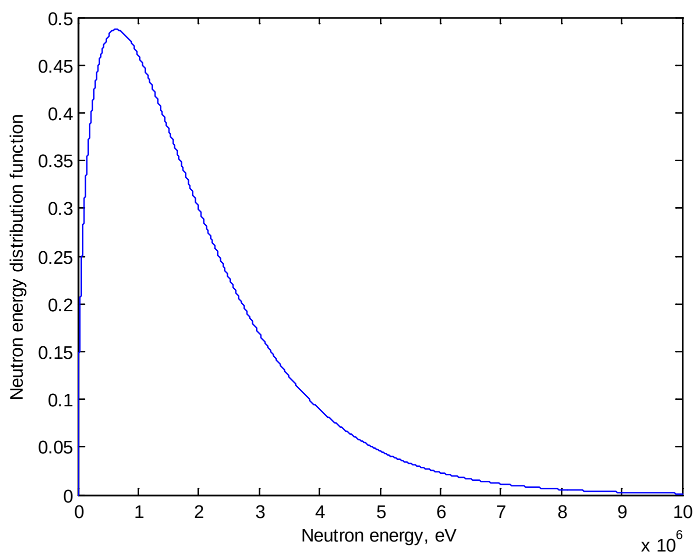

Figure 2. Neutron energy distribution.

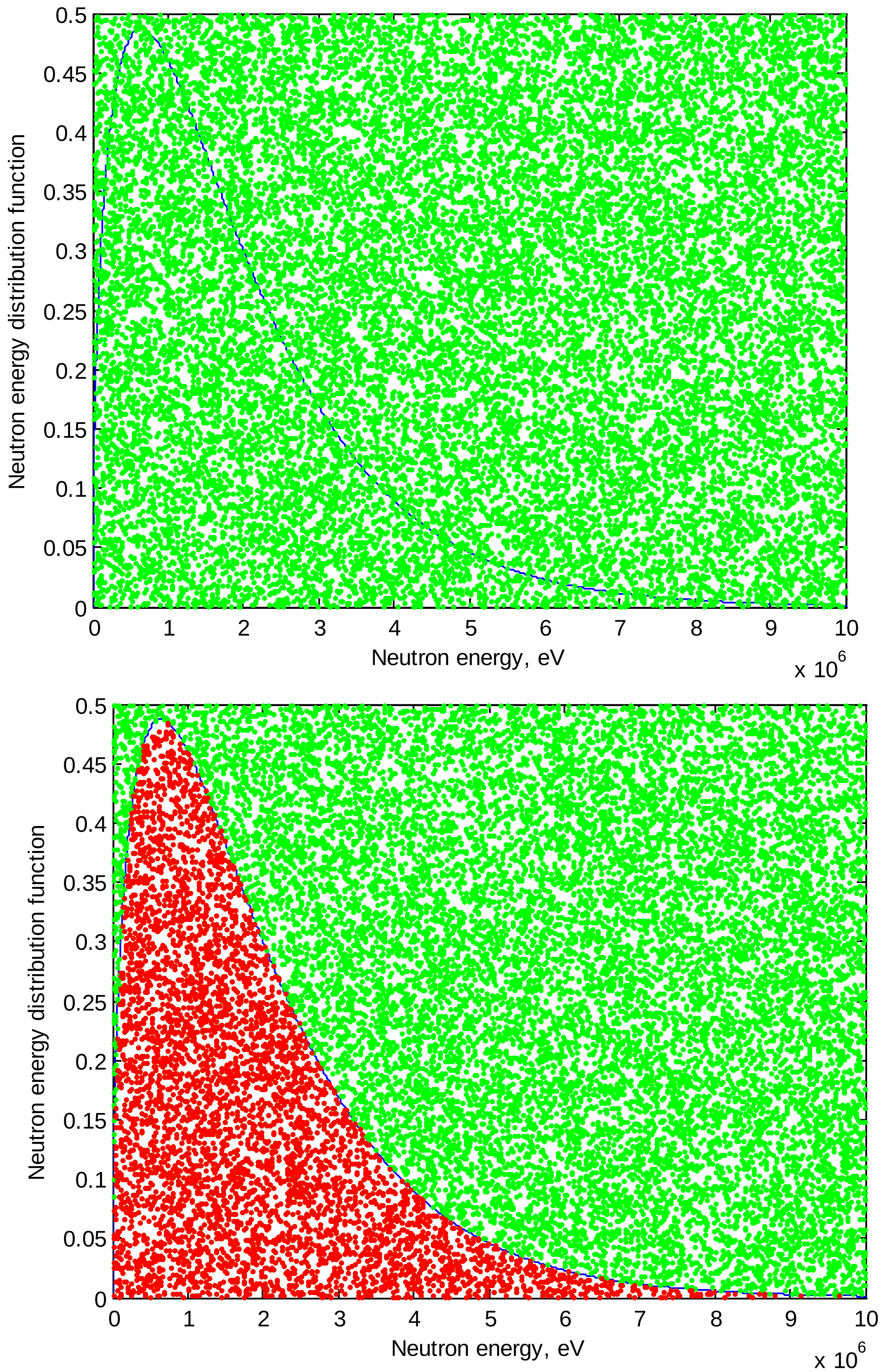

Figure 3. "Darts shots" – sampling the neutrons. I kept the red ones and threw away the green ones.

At first I just attempted to graph the function, as shown above. After that was successful, I began to "shoot darts", as shown on Figure 3 (top). I used random number generator to make x- and y-coordinates of these darts. After those dart shots, I singled out the ones from above and below the line. The points below the line are red (these are the neutrons I kept for calculations), and the ones above are blue(I threw them away) – see Figure 3 (bottom).

Then, I calculated time of flight from the fission source to the detectors A and B using the formulae:

$$E_A = \frac{1}{2} m V_A{}^2 = \frac{1}{2} m (\frac{r_A}{t_A})^2$$

$$E_B = \frac{1}{2} m V_B{}^2 = \frac{1}{2} m (\frac{r_B}{t_B})^2$$

where m is the mass of neutron. Thus from the energy distributions I got time distributions and plotted histograms of the time of flight for each detector, A and B, and their difference delta t (Fig. 4)

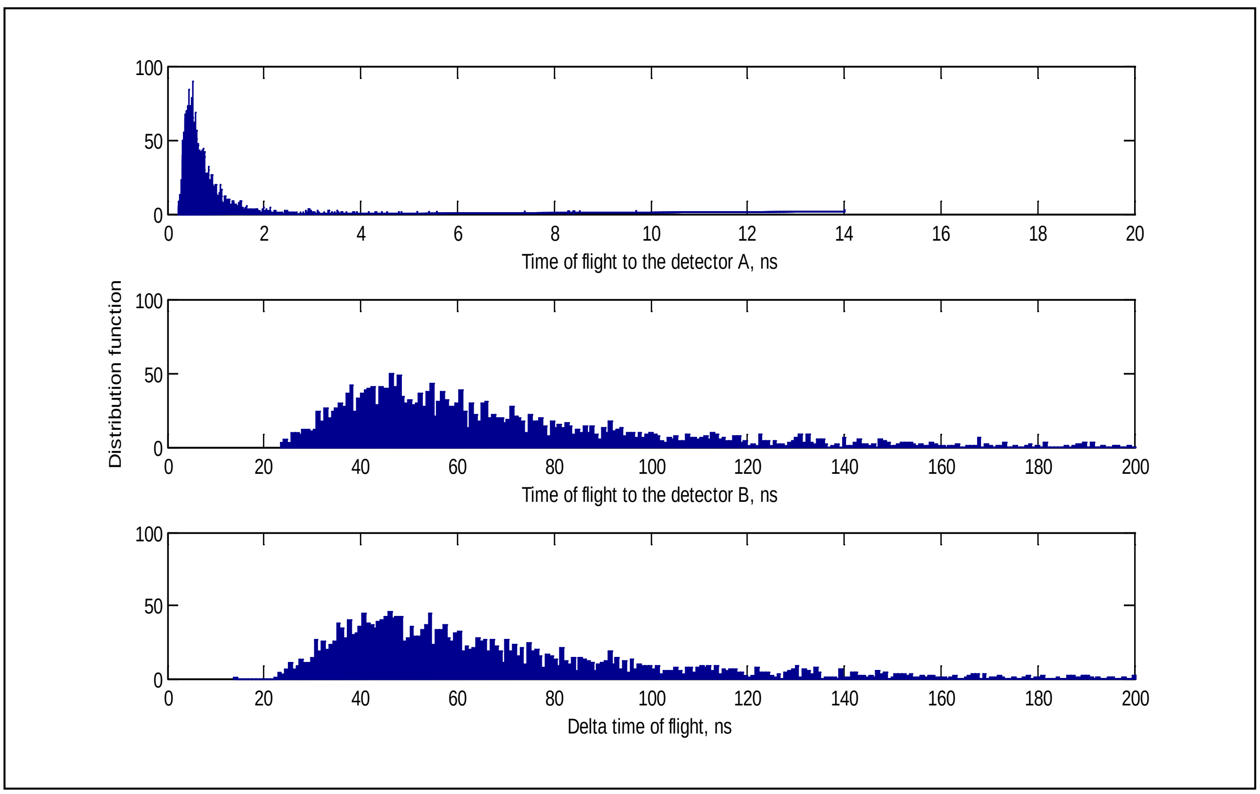

Figure 4. Time of flight histograms.

Finally, I calculated the neutron energy from the difference of time of flight, delta t and compared it to the energy measured by the detector B – from the time t_B. I considered three different values for t_A:

1. t_A=0 (infinitely large energy)
2. t_A corresponds to the peak energy (about 0.8 MeV)
3. t_A corresponds to the mean energy (about 1.9 MeV)

The scatter plot is shown below. There is not much difference between mean energy and peak energy.

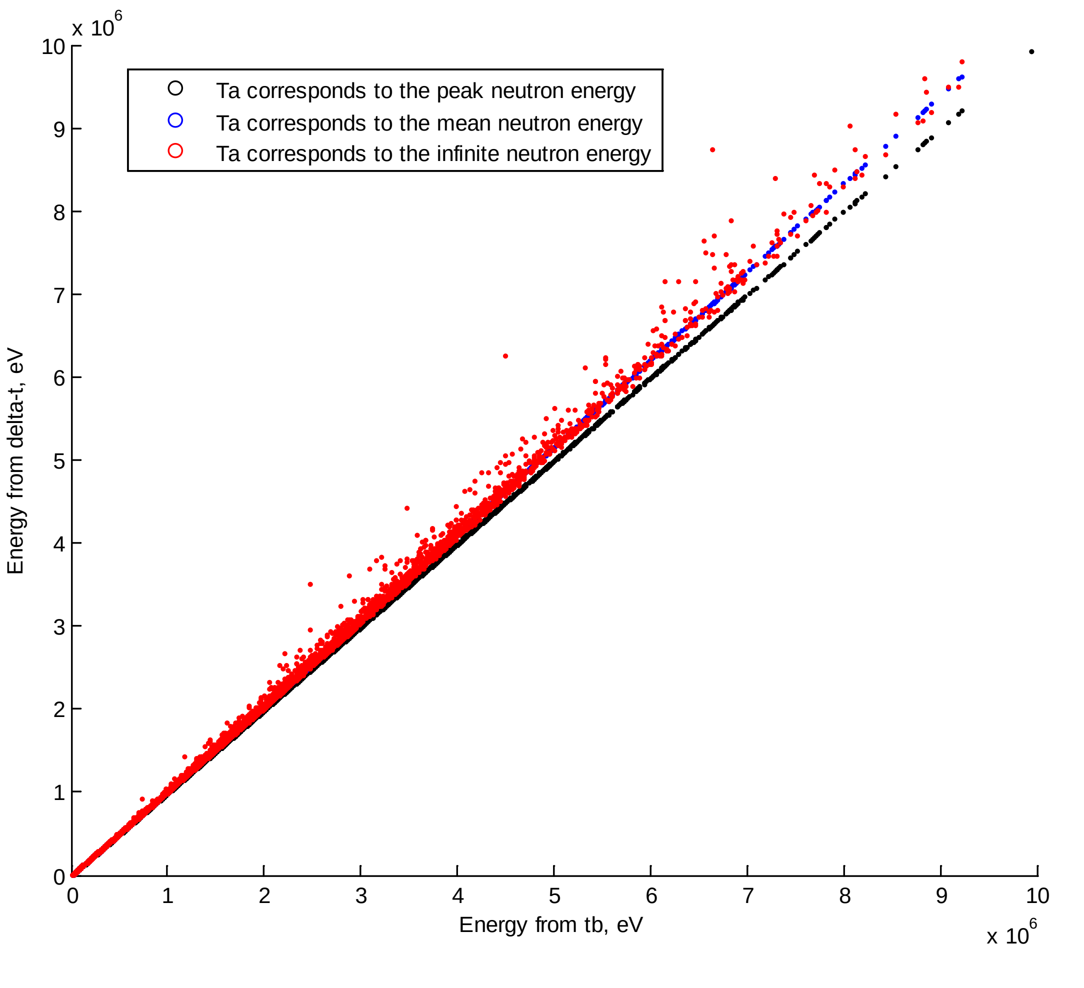

Figure 5. Scatter plot for the neutron energy from delta-t and t_B.