Gamma Absorbtion

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1 Introduction

When gamma radiation passes through matter, it undergoes absorption primarily by Compton, photoelectric, and pair-production interactions. The intensity of the radiation is thus decreased as a function of distance in the absorbing medium. The purpose of this experiment is to measure the attenuation of the intensity with absorber thickness and to derive the half-thickness and the attenuation coefficient.

We will these equations:

$$I = I_0\theta^{-\mu x} \leftrightarrow \ln(I/I_0) = -\mu x \tag{1}$$

$$x_{1/2} = \frac{\ln 2}{\mu} \tag{2}$$

where I is the transmitted intensity, I_0 is the incident intensity, and μ is the linear absorption coefficient for the absorber's medium, x is the thickness of the absorber and $x_{1/2}$ is the half-thickness.

2 Experimental Setup & Procedure

We first turn on the detector with an operating voltage of 1180 V. Then we placed a cesium source 30 cm away from the detector.

Then, we took 10 reading for each absorber, 5 for Lead and 5 for Aluminium. Each reading was averaged out of a five trials with a time interval of 10 s.

3 Data & Analysis

3.1 Counts Vs. Absorber's Thickness

Number (thickness)	thickness (cm)	Reading 1 (no./ 10s)	Reading 2 (no./ 10s)	Reading 3 (no./ 10s)	Reading 4 (no./ 10s)	Reading 5 (no./ 10s)	Average no. readings
-	0	2788	2740	2749.00	2781	2856	2782.8
1088.2	0.403037037	2746	2822	2759.00	2664	2713	2740.8
1213.7	0.449518519	2674	2660	2780.00	2612	2800	2705.2
1372.5	0.508333333	2678	2738	2722.00	2656	2681	2695
1493.2	0.553037037	2665	2663	2637.00	2656	2757	2675.6
1605.4	0.594592593	2612	2694	2595.00	2555	2748	2640.8
926.4	0.819823009	2192	2185	2214.00	2272	2273	2227.2
1821.6	1.612035398	1864	1909	1966.00	1877	1985	1920.2
2648.1	2.343451327	1818	1777	1770	1789	1738	1778.4
4491.7	3.974955752	1596	1521	1578.00	1537	1556	1557.6
7143.6	6.321769912	1293	1367	1332.00	1290	1340	1324.4

Table 1. Experimental data, blue ones are for Aluminium source and red ones are for lead source.

Concentraiting on the lead absorber, we will plot the thickness vs. $\ln(I/I_0)$, which from Eq. (1) we know that the slope is going to equal to -μ

Thickness (cm)	Average no. readings	ln(N avg)
0.819823009	2856	7.931212894
1.612035398	2713	7.916005128
2.343451327	2800	7.902931126
3.974955752	2681	7.899153483
6.321769912	2757	7.891928933

Table 2. Lead absorbers Vs I and $\ln(I/I_0)$.

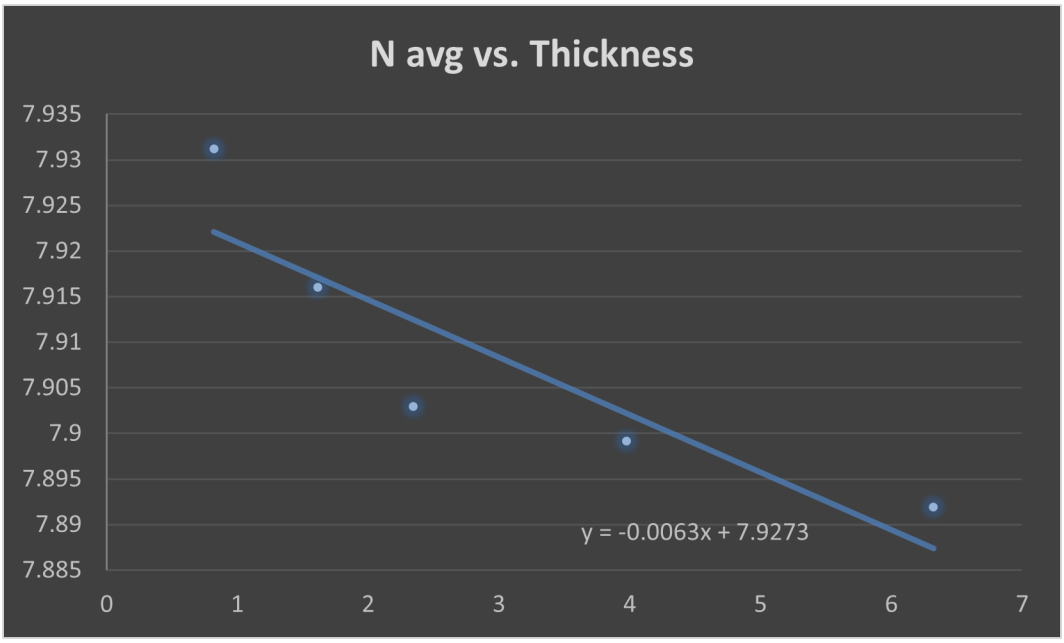

Figure 1. Thickness Vs $\ln(I/I_0)$

We can see here that the slope is equal to -0.0063 cm which equals to -μ, and also we can conclude that I_0, which is the y-intercept, is equal to 7.93 .

After finding μ we can now get the value of $x_{1/2}$ using Eq. 2, and we calculated it to be 110.02 cm

4 Conclusion

In this experiment we have seen how absorbers can block the gamma radiation based on thier thicknesses, and how effective lead is for protecting from gamma radiation. Moreover, we calculated the value of μ which is the linear absorption coefficient for the absorber's medium by fitting the data linearly and find the slope of the fitting.