Verification of inverse square law using radioactive source.

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1 Objective

To verify the inverse square law using radioactive source ^{133}Ba and ^{60}Co.

2 Theory

Any isotropic emission of radiation from the source the intensity varies inversely as square of the distance from the source. This statement is called the inverse square law.
Consider a point source situated in a vacuum. The radiation spreads in all directions about the source, and therefore when it is a distance x from the source it is spread over the surface of a sphere of radius x and area $4\pi x^2$. If E is the energy radiated per unit time by the source, the intensity (energy per unit time per unit area) is given by I

$$I = \frac{E}{4\pi x^2}$$

or simply as :

$$I \propto \frac{1}{x^2}$$

3 Apparatus and Materials Used

- Metre Scale
- Sticking Tape
- Radiation Monitor
- Radioactive Source ^{133}Ba and ^{60}Co

4 Procedure

a. Measure the background radiation without placing the source near the detector.

b. Keep the radioactive source at distance from detector.

c. Measure the distance between detector and source.

d. Measure the Gamma Radiation Dose and Photon Count Rate.

e. Move the source away from detector or vice-versa.

f. Repeat steps c,d and e until reading in detector reaches the level of background radiation.

5 Experimental Data

Distance (cm)	Gamma Radiation Dose ($\mu Sv/hr$)	Photon Count rate (Hz)
2	8.3	17200
5	3.22	6910
7	2.1	4540
10	1.31	2840
13	0.949	2000
15	0.794	1680
20	0.574	1170
30	0.389	745
35	0.354	647
45	0.295	519
60	0.262	444
70	0.25	409
95	0.233	385
120	0.227	349

Using ^{133}Ba with Background Radiation = 0.213 $\mu Sv/hr$ and Photon Count rate = 321 Hz

Distance (cm)	Gamma Radiation Dose ($\mu Sv/hr$)	Photon Count rate (Hz)
2	8.1	3100
10	1.34	785
7	2.11	1060
14	0.891	598
18	0.635	514
23	0.502	458
30	0.399	406
40	0.329	376
55	0.304	364
70	0.255	335
100	0.254	337

Using ^{60}Co with Background Radiation = 0.213 $\mu Sv/hr$ and Photon Count rate = 321 Hz

6 Graphs

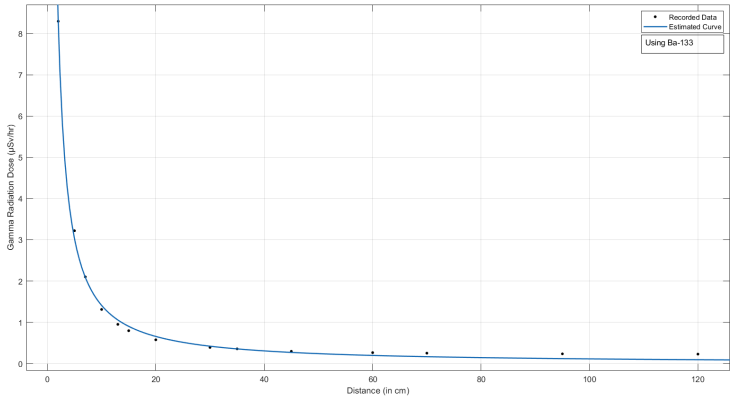


Figure 1: Distance vs Gamma Radiation Dose for Ba-133

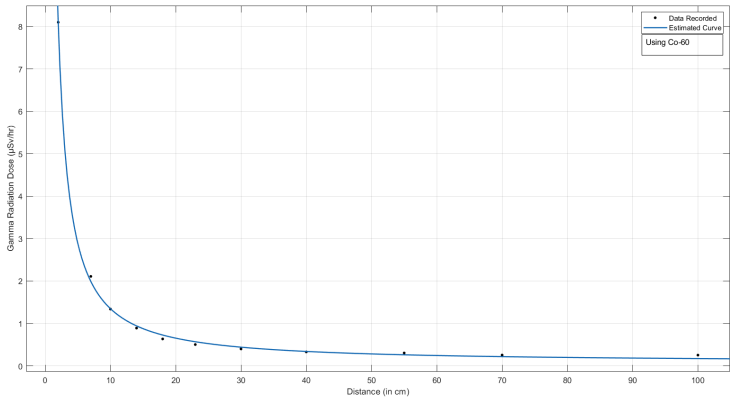
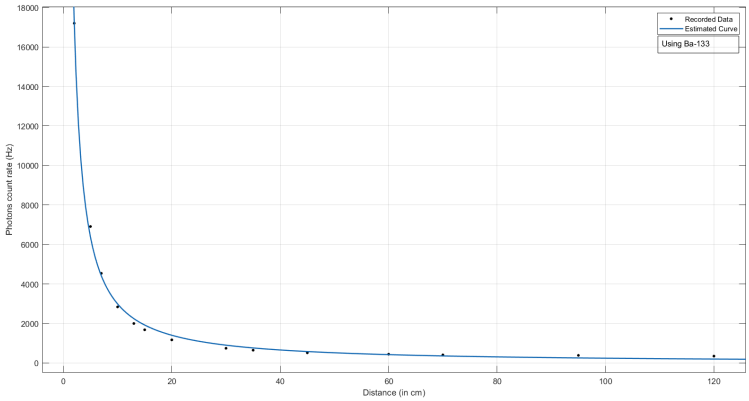
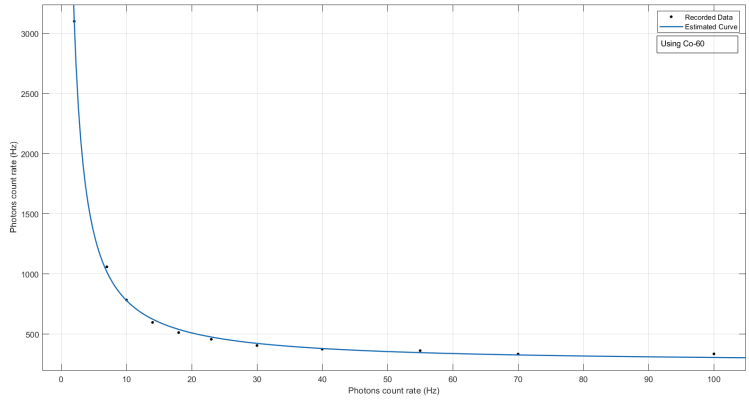


Figure 2: Distance vs Gamma Radiation Dose for Co-60



Distance vs Photons count Rate for Ba-133



Distance vs Photons count Rate for Co-60

7 Result and Conclusion

The shape of the graph shows that count rate decreases with distance. Using MATLAB curve fitting tool it is found that the data obtained follows inverse square law. There is small uncertainty in measurements due to systematic errors.

References

[1] Gamma radiation: inverse square law
`https://spark.iop.org/gamma-radiation-inverse-square-law`

[2] Nikolaos Voudoukis, and Sarantos Oikonomidis
[*Inverse Square Law for Light and Radiation: A Unifying Educational Approach*]. EJERS, European Journal of Engineering Research and Science Vol. 2, No. 11, November 2017