Inverse Square Law

Objectives:

The experiment aims to achieve that the intensity of gamma rays is proportional to the square of the distance between the source and the point at which the measurement is made.

The tools and equipment used:

1- Geiger counter

2- electronic measurement system

3- high voltage source

4- radioactive sources

The theoretical part:

For a point source, the number of particles or photons emitted from it is n where

$n = 3.7 \times 10^4 \times S(\mu ci)$

where 3.7×10^4 called Curie's constant (from Madame Curie's radium experiment)

S: source efficacy (µci)

The effectiveness of the radioactive source at the time of the experiment can be extracted from the radioactive decay equation

$S=S_0 e^{-\lambda t}$

Where S_0 is the efficacy when manufacturing (fixed on the radioactive source box)

λ: the decay constant is correlated with the half-life through

$\lambda = \ln 2/ T_{1/2}$

$T_{1/2}$: half-life

$t = t_e - t_0$

t: time period from the date of manufacture of the source to the time of conducting the experiment

t_e : the date of the experiment

t_0 : production date

The stream of photons or particles spreads over the surface area of the sphere with radius d, where d represents the distance between the source and the detector, and the amount of photons received per centimeter

$$N= \frac{n}{4\pi d^2}$$

And the amount that enters the detector, which has the area A, and since the face of the detector is circular, then $A=\pi r^2$

So
$$N= \frac{n}{4\pi d^2} A$$

$$N= \frac{n}{4\pi d^2} \pi r^2$$

$$N= \frac{Sr^2}{4d^2} 3.7 \times 10^4$$

Note that N is the rate of counting per second, and S is constant when conducting the experiment, r is constant

So N will be

$$N= \text{constant} . \frac{1}{d^2}$$

$$N \alpha \frac{1}{d^2}$$

We note that the counting rate is inversely proportional to the square of the distance, and this is the content of the inverse square law.

practical part:

1- Set the operating voltage

2- Extracting the background reading

N_B= 50 count/100sec.

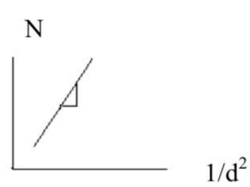
3- Fill in the following table

d	N1	N2	N3	Nav.	N= Nav. - N_B	$\frac{1}{d^2}$
1	889	893	891			
2	566	519	542.5			
3	427	359	393			
4	264	276	270			

4- Draw between N and $\frac{1}{d^2}$

5- Extract the practical exponent value of (S) and compare it with the theoretical value.

The reason for the difference is the assumption of a point source and we considered all the particles entering the detector to be recorded and from this experiment we conclude that moving away from the radioactive source reduces the damage.



Slope=Nd^2