Experiment: 05

Objective: To study the inverse square law using a G-M counter.

Apparatus:

- Geiger-Müller tube
- Shelf stand
- High voltage supply
- Scalar, counter and timer setup
- Radioactive source
- Source holder

Theoretical Background

Radioactive sources are isotropic in nature. This means that gammas (for a gamma source) are given off equally in all directions. There are some sources, however, where there is a correlation of one gamma relative to the other that is not isotropic. This angular correlation allows predicting some properties of the nuclear states that are involved in the decay of these isotopes. In the case of an isotropic source, it is a well known fact that the intensity of the source falls off as $1/R^2$. In this experiment, this $1/R^2$ relationship for a ^{137}Cs source will be verified.

Procedure:

1. Set the G-M detector at the operating voltage. Determine the background counting rate.
2. For this experiment, use a ^{137}Cs source. The betas from the source must be attenuated out, since air absorption of the betas will modify the results. This can be done by placing a thin piece (1/16") of almost any material between the source and the window. Place the ^{137}Cs source at a distance of 1 cm from the window and take the counts for 200 seconds. Record this uncorrected counting rate in Table-4.
3. Move the source to the 2 cm position and count for a period of time long enough to get reasonable statistics. Record the uncorrected counting rate in Table-2. Continue for the other distances in the table. It should be obvious that the counting time will have to be increased for the longer distances to get good statistics

Table-4:

Source and its activity:

Background counts =   Preset time =

Separation between source and detector	Uncorrected counts	Corrected count rate

Data Analysis:

Plot the corrected count rate versus distance. From the 3 cm data point, obtain the constant K as follows:

$$I = \frac{K}{R^2} \quad \dots (9)$$

On the same curve, plot eq. (9) with the other values of R. Use the value of K that was found above. What we have done is normalize the data to the 3 cm measurement. How do the two curves compare?

References:

1. Radiation Detection and Measurement by *G. F. Knoll*
2. Techniques for Nuclear and Particle Physics Experiments by *William R. Leo*
3. Introduction to Nuclear Physics by *H. Enge*
4. Nuclear Radiation Detection by *W. J. Price*
5. Nuclear Physics by W. E. Burcham