Experiment: 04

Objective: To determine the absorption coefficients of Aluminum and Copper using G-M counter.

Apparatus:

- Geiger-Müller tube
- Shelf stand
- High voltage supply
- Scalar, counter and timer setup
- Radioactive source
- Source holder
- Absorber kit (Aluminum and Copper foils)

Theoretical Background

When gamma rays pass through a foil a certain fraction of them is removed from the primary Cbeam. If N_o is the number of gamma rays which enter a medium, the number that emerge through thickness x is

$$N = N_o e^{-\mu x} \quad \ldots (6)$$

where μ is called as the absorption coefficient of the medium.

The probability of interaction is given in terms of the total cross-section σ which is the summation of individual cross-sections related to the photoelectric effect, the Compton effect and the pair production and is written as

$$\sigma = \sigma_{PE} + Z\sigma_C + \sigma_{PP} \quad \ldots (7)$$

The factor Z in the second term embodies the assumption that all the atomic electrons contribute individually to Compton scattering. For gamma ray energies above K-shell ionization energy of the atom, the Compton effect is more dominant and for the purpose of the present experiment the first and the third terms of Eq. (7) can be neglected.

From Eq. (6), we have

$$\ln N = -\mu x + \ln N_o \quad \ldots (8)$$

Procedure:

1. Set the G-M detector at the operating voltage.
2. Place a ^{137}Cs source at a distance such that the count rate is about 1000.
3. Place a Aluminum foil of smallest thickness in between the detector and source and take the counts for 200 seconds thrice.
4. Repeat step-3 for different thicknesses of Aluminum foils.
5. Repeat steps-3 and 4 for copper foils.

Table-3:

Source and its activity:

Absorber:

Background counts =

Preset time =

Thickness 'x' (mm)	Counts	Corrected count rate 'N'	ln N

Data Analysis

A plot of ln N versus x is thus a straight line where the slope gives μ. Find μ for Al and Cu using ^{137}Cs source. Compare your results with those reported in the literature.

Results:

Absorption coefficient of Aluminum =

Absorption coefficient of Copper =