Islamic University / Najaf
College of Medical Technology
Department of Radiology Techniques

Radiation Physics Lab/second stage

# Absorption of X-ray And Gamma -ray

## Lecture 4

## By

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## The aim of this study:

1-calculate Linear and mass absorption coefficients forgamma ray.

2- Study of the X-ray attenuation as a function of the absorbent material

## device used in this measurement:

1. An x-ray device

2. Giger counter

3. Multi-thickness absorbent material

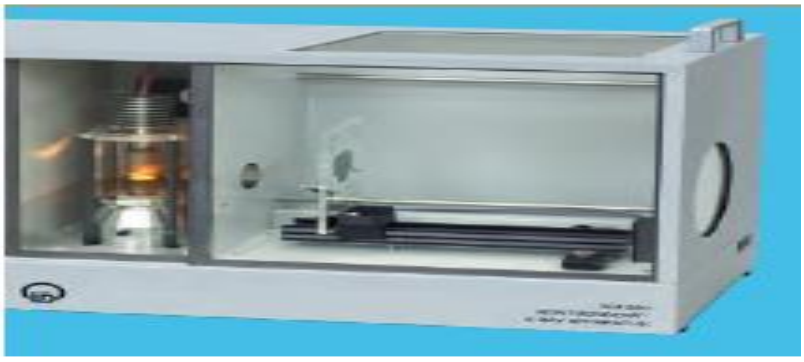
4- Vernier

## Theory:

We are mean by attenuation of x-rays is the decrease in their intensity as they pass through matter. This attenuation occurs for two reasons: scattering and absorption.

The scattering of x-ray quanta at the atoms of the attenuator causes a change in the direction of part of the radiation. This reduces the intensity in its original direction. This scattering can be elastic or require energy loss or wavelength deviation (inelastic scattering).

In absorption, the entire amount of X-ray energy is transmitted to the atoms or molecules of the X-rayed substance in the form of excitation or ionizing energy.



In the attenuation of gamma-rays depends not only on the energy of the incident gamma photon, but also on the effective atomic number, the density of the elements of the shielding material and the thickness of such shield.

**The linear absorption coefficient:** is a measurement looking at how far radiation can go through material before it gets absorbed, the absorption coefficient measures how far a beam of radiation can go through the material before getting absorbed. If the material is thinner than the absorption coefficient, then the radiation will be transmitted through the material.

The following equation can then describe the attenuation of gamma radiation

$$\mathbf{I=I_0.e^{-\mu x}}$$

**The mass absorption coefficient**: is defined as the ratio of the linear attenuation coefficient and absorber density ($\mu/\rho$).

*Hint: $\rho$= 2.733 gm/cm$^3$

## Calculation:

first step: find the background measurement of the GM (without isotopes) for three times, then calculate the average of it.

$$I_{Bg}(\text{count/sec}) = [I_1+I_2+I_3]/3$$

$$I_0\,(\text{count/sec}) = [I_{01}+I_{02}+I_{03}]/3$$

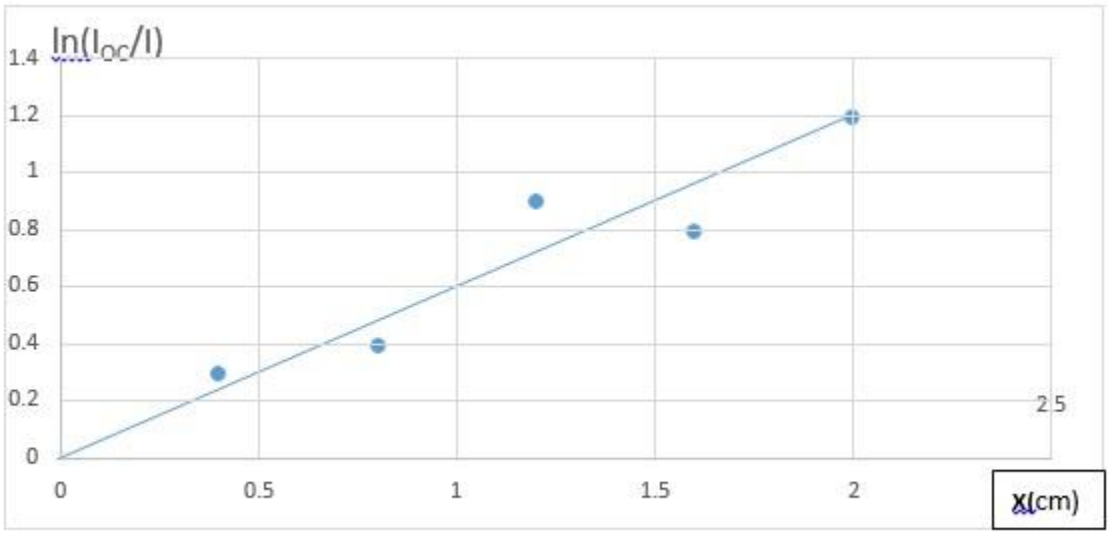
Where $I_0$ represented the original radiation intensity$I_{0c}\,(\text{count/sec}) = [I_0-I_{Bg}\ ]$

Where $I_{0c}$ represented the original radiation minus the background intensity

Second: follow the below table

| $x_{cm}$ | $I_{(count/sec)}$ | | | $I_{av}$ (count/sec) | $I = I_{av} - I_{Bg}$ (count/sec) | $I_{OC} / I$ | Ln ($I_{OC} / I$) |
|---|---|---|---|---|---|---|---|
| | $I_1$ | $I_2$ | $I_3$ | | | | |
| 0.4 | 64 | 65 | 66 | | | | |
| 0.8 | 56 | 56 | 57 | | | | |
| 1.2 | 37 | 37 | 40 | | | | |
| 1.6 | 39 | 39 | 44 | | | | |
| 2 | 29 | 30 | 31 | | | | |

Third: paint the slope as the following diagram between Ln ($I_{OC} / I$ )And X (cm) :




Forth: find the slope from the diagram to calculate the following:

The linear absorption coefficient

$\mu_y$ = slope ($cm^{-1}$)

The mass absorption coefficient

$\mu_m = \mu_y / \rho$ ($cm^2/gm$)