<div align="center">

Physics eExp

Absorption of β-radiation in aluminum

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A. *Objective*:   To study the absorption of β-radiation in aluminum (Al).

B. *Safety* [<mark>ref.</mark>]

Use a lifting tool to handle the radioactive source. Never touch a source with bare fingers. After finishing the experiment, place the radioactive source back in the container and wash your hands thoroughly.

C. *Theory* (Ref. Section R-2.2)

α-radiation can be stopped by a paper sheet, or air around 5 cm thick. β-radiation can be stopped by a Al sheet of around 5 mm thick. γ-radiation is much more difficult to be stopped (Fig. 1). I_o and I are the intensities of the incident radiation and that after passing through an absorbing material with a distance x. μ is the linear attenuation coefficient (Fig. 2).

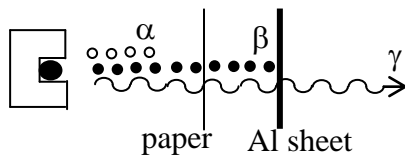$$I(x) = I_o\, e^{-\mu x} \tag{1}$$

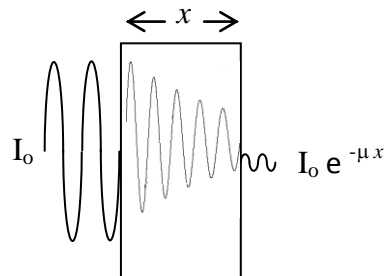Fig. 1 Penetration power of α, β and γ-radiation.

Fig. 2 Attenuation of radiation in a material of thickness *x*.

D. *Experiment*

D.1 *Safety assessment*

A survey meter show readings of _____ (mR hr^{-1}) or _____ (mSv hr^{-1}) for a source 30 cm from it. Compare the result with the data given in the document "Radiation units and safety". Hence, assess the risk.

D.2 Radiation absorption

- Place a thin Al foil under the Geiger Muller (GM) tube in the setup shown in Fig. 3. Most of the α-radiation is absorbed. γ-radiation is hardly detected by the GM tube. Therefore, the counts detected by the detector is mainly due to β-radiation.
- Turn on the setup by applying 400 volts to the GM tube.
- The number of counts from the background is collected for 300 s.
- Place a radium (Ra-) 226 isotope at the base plate of the setup. By successively increasing the thickness of the Al sheets, record the numbers of counts for 300 s for each thickness. Subtract the background counts from the data and complete Table 1.
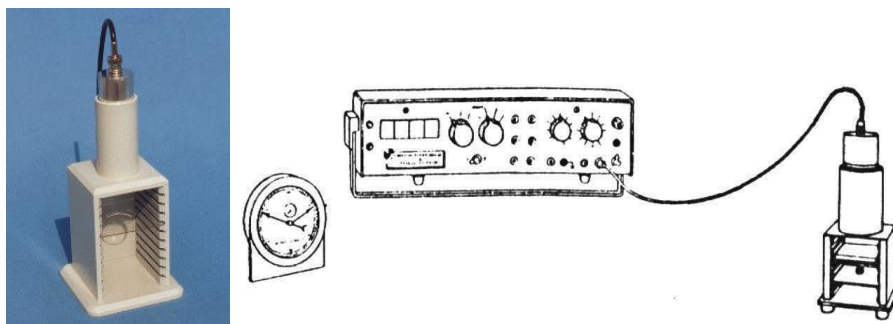- Plot the net count rate against the thickness of Al.

Fig. 3 Setup for the measurements.

Table 1 Results of counts and count rates. Each measurement lasts for 300 s.

Thickness of absorber (mm)	0.00	0.212	0.371	0.602	1.21	2.12	3.14
Background counts (in 300 s)							
Background count rate (/s)							
Counts (in 300 s)							
Count rate (/s)							
Net count rate = Count rate – Background count rate (/s)							

E. Analysis

- Determine the value of μ for β-radiation absorption in Al from Eq.(1).

- According to the maximum annual effective exposure, discuss whether an Al container can be used to store a radioactive isotope emitting β-radiation.