Radiation Protection and the Safety of Radiation Sources

- JINR University Centre
- Wave 5 (27 September - 5 November, 2021)
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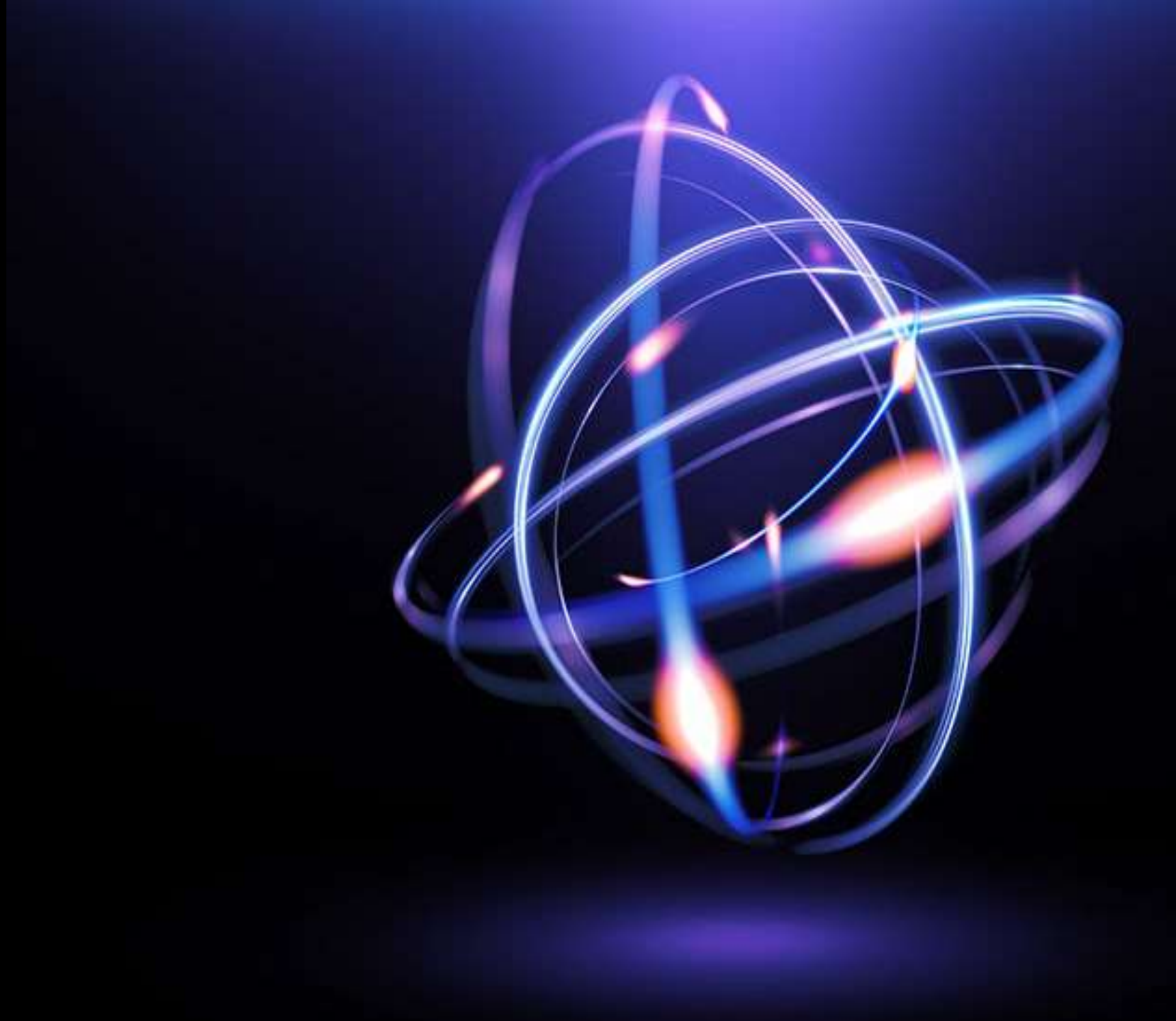
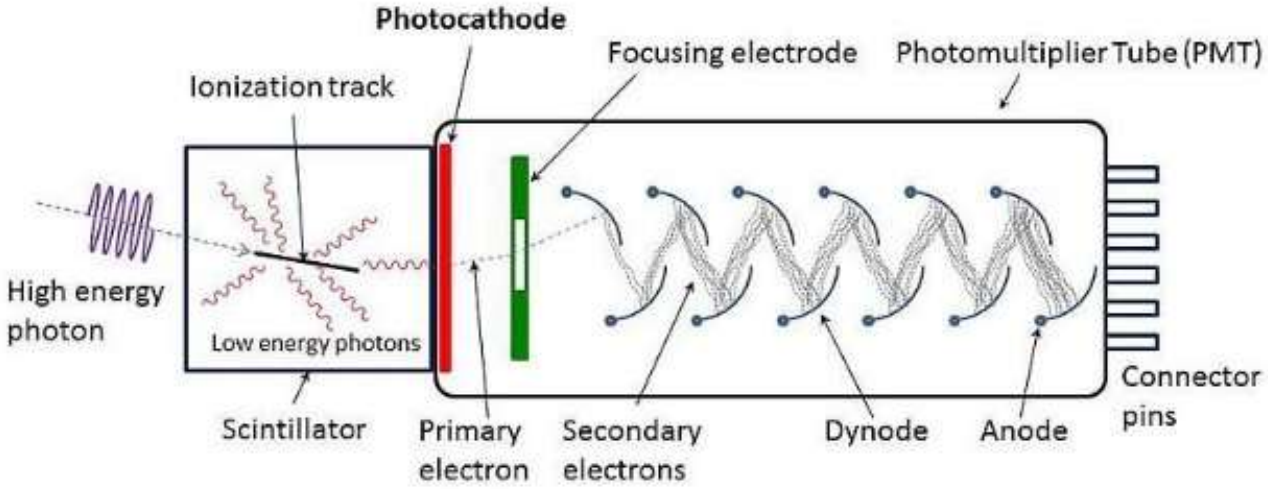
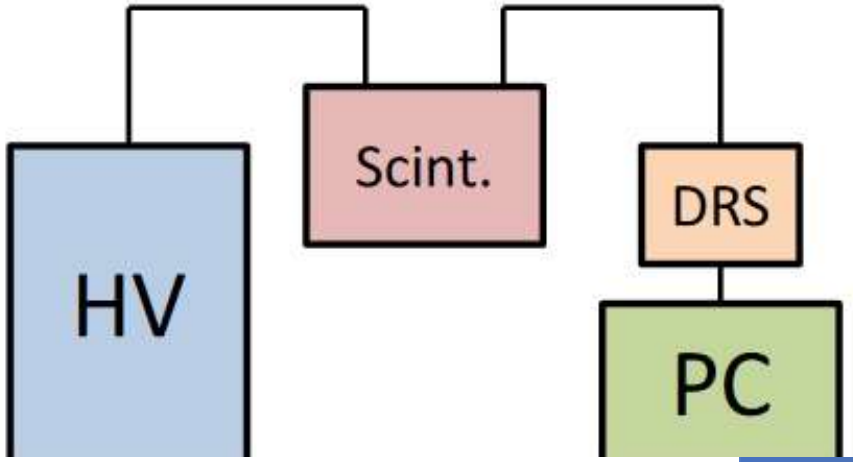
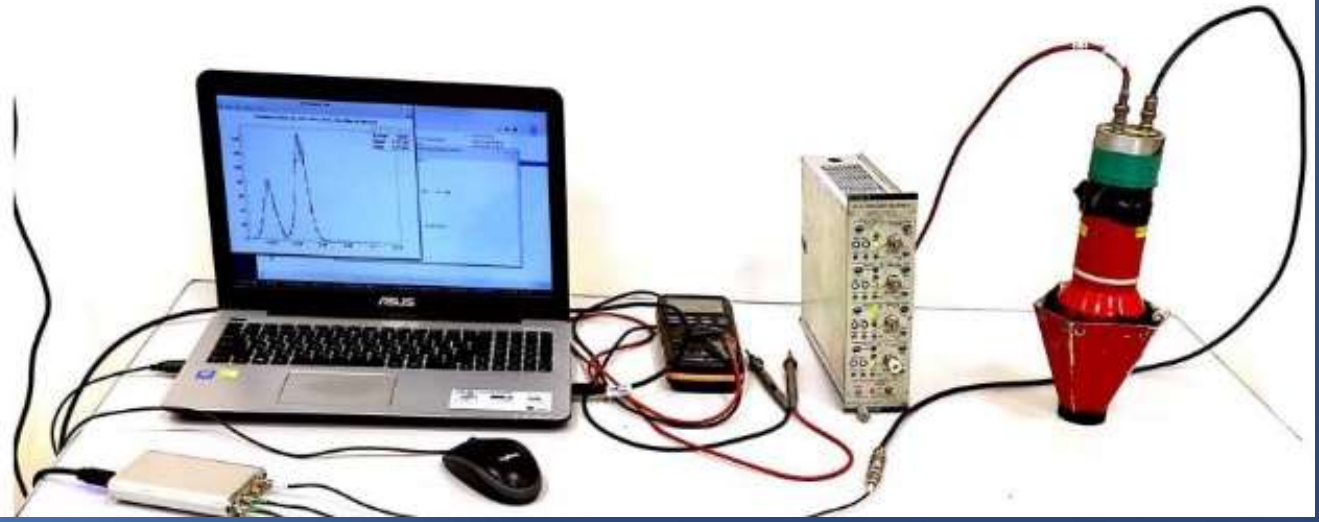
- Student: Baresis Ioannis, Physics Department, Aristotle University of Thessaloniki



Scintillation detectors and experimental set-up

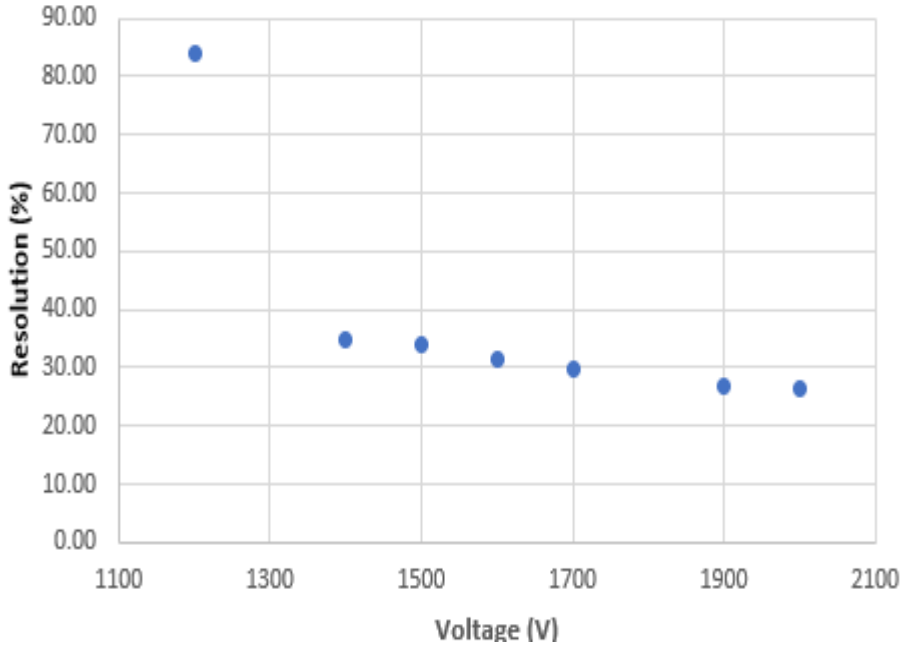






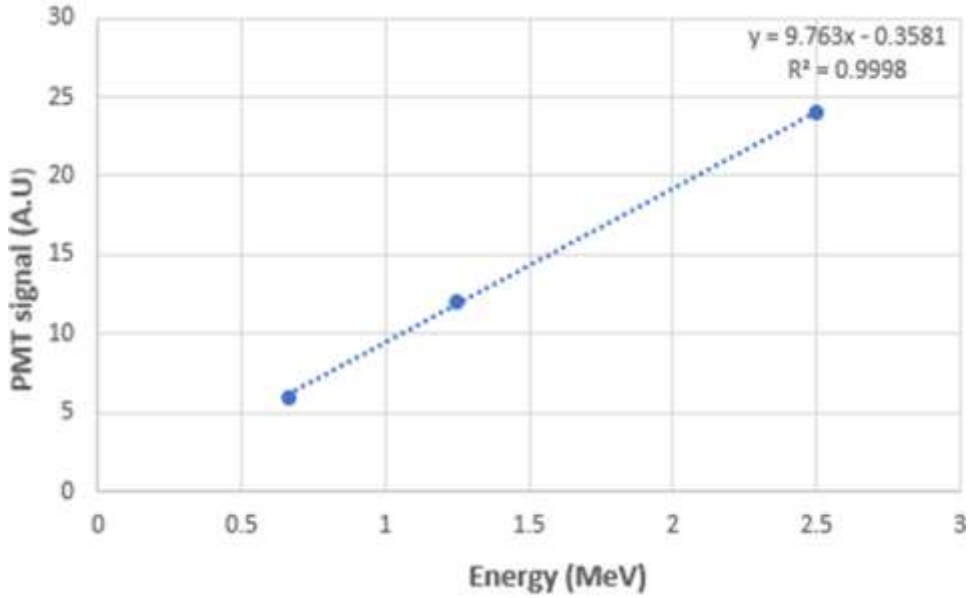
Resolution of a BGO detector

No	Volts	σ	Mean	Resolution
12	1200	0.511741	1.4291	84.15
14	1400	0.285063	1.92446	34.81
15	1500	0.433111	2.98483	34.10
16	1600	0.589787	4.40051	31.50
17	1700	0.774765	6.10679	29.81
19	1900	1.22482	10.6951	26.91
20	2000	1.53509	13.6689	26.39



$$R = \frac{\sigma}{mean} \times 2.35$$

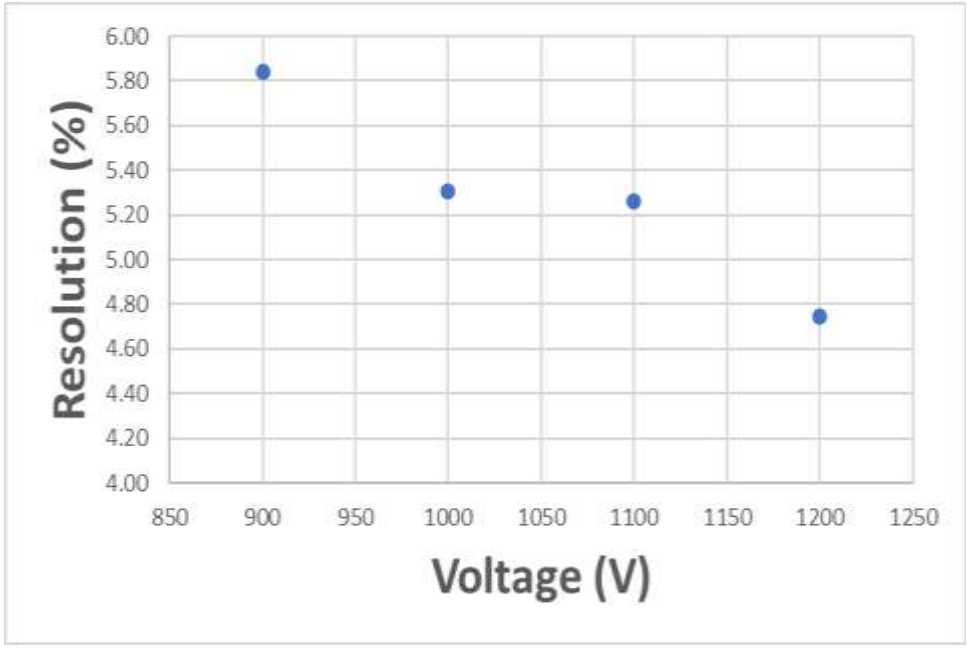
Energy calibration for BGO detector



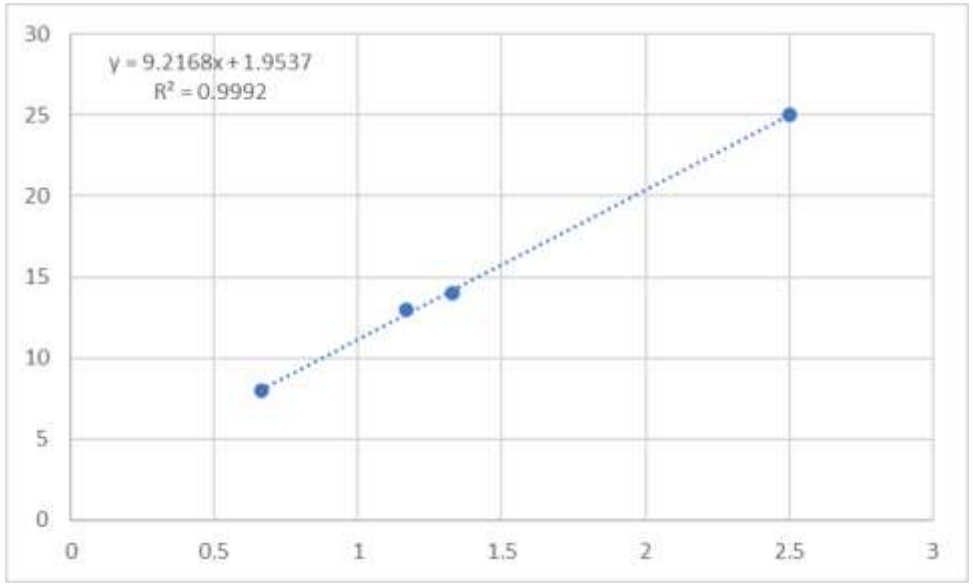
Resolution of a NaI detector

No	Volts	σ	Mean	Resolution
2	900	0.588898	23.6915	5.84
3	1000	0.918586	40.6869	5.31
4	1100	1.48273	66.2498	5.26
5	1200	1.99527	98.7663	4.75

$$R = \frac{\sigma}{mean} \times 2.35$$



Energy calibration for NaI detector



Identification of unknown sources

Assuming a spectrum of an unknown source is given to us:

- First, we apply Gauss fitting in curve to find out the mean.
- Then, we know mean is the PMT signal A.U (y) for our energy peak.
- We use the equation of calibration of NaI detector and we solve in respect of x, which is the energy of the unknown source.

Attenuation coefficient

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

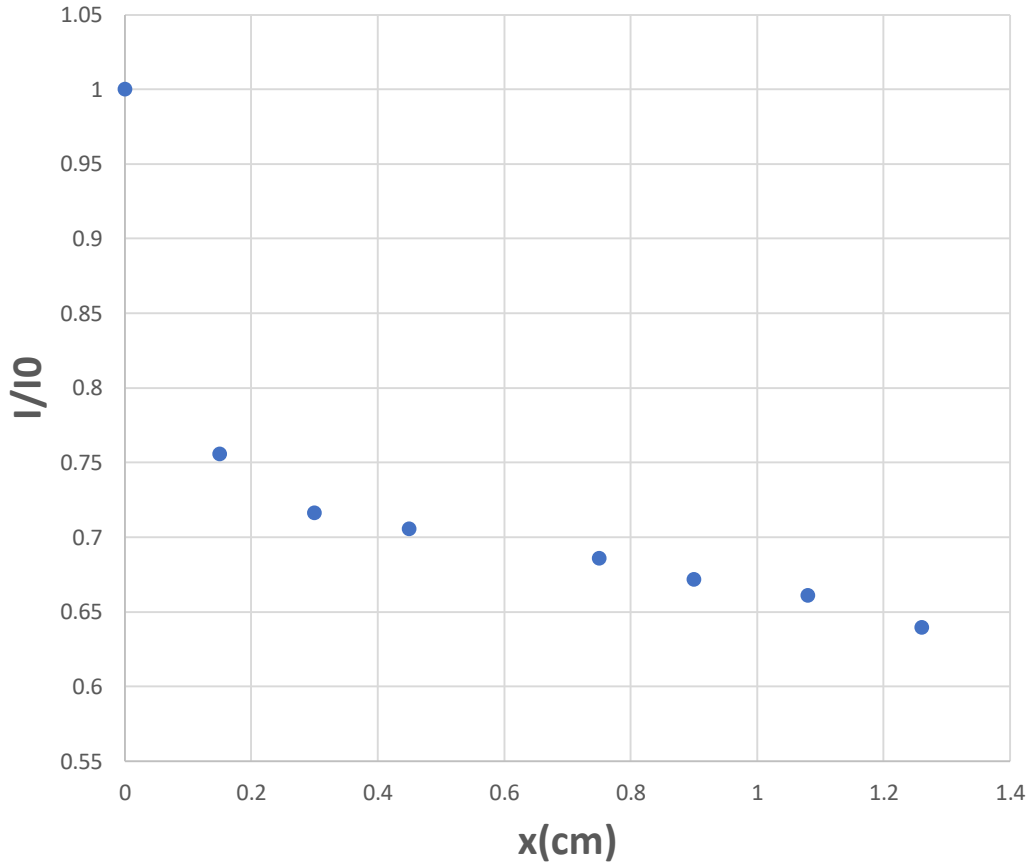
- I is the intensity of the beam
- I_0 is the initial intensity
- μ is the attenuation coefficient
- x is the thickness of the absorber

Determination of attenuation coefficient for Al

x(cm)	I/I0
0	1
0.15	0.75573
0.3	0.71623
0.45	0.70569
0.75	0.68596
0.9	0.67155
1.08	0.66103
1.26	0.63939

After exponential decay fitting,

we find μ=0,24.

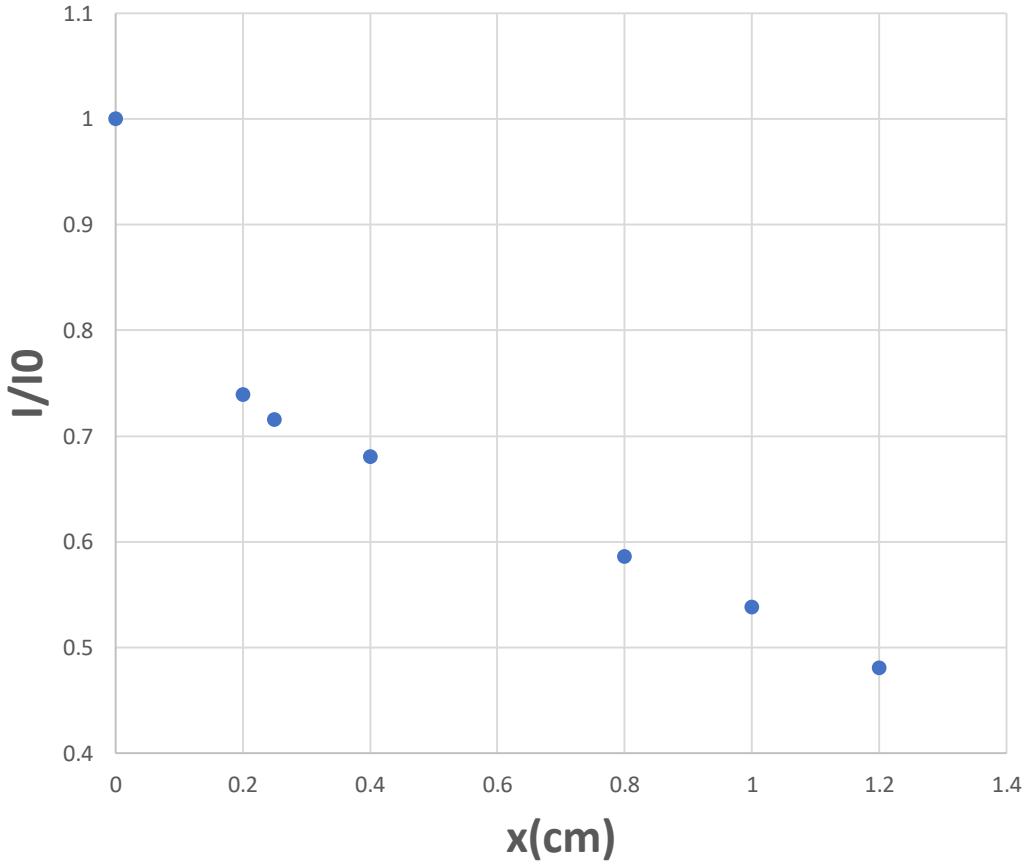


Determination of attenuation coefficient for Cu

x(cm)	I/I0
0	1
0.2	0.73931
0.25	0.7157
0.4	0.68065
0.8	0.58611
1	0.53827
1.2	0.48042

After exponential decay fitting,

we find μ=0,65.



Conclusion

This one-month journey taught us:

- How to calculate resolution of a scintillation detector
- How to calibrate a scintillation detector
- How to identify an unknown source
- How to determine the attenuation coefficient
- Basic knowledge of alpha particles range in air and pixel detectors