Radiation Protection and the Safety of the Radiation Sources

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JINR, Dubna

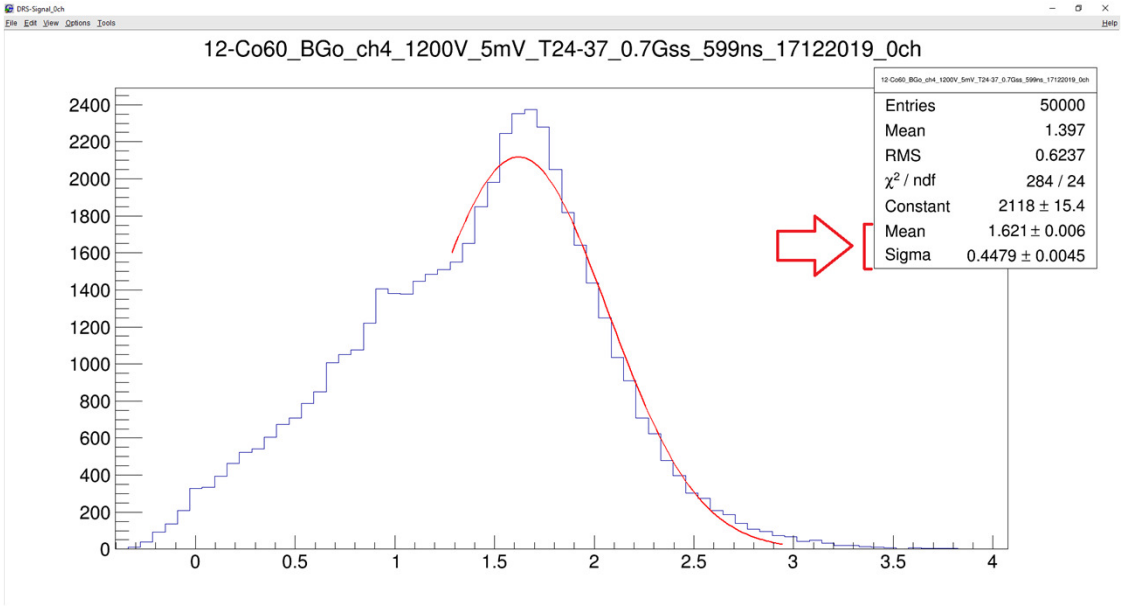
INTEREST – INTErnational Remote Student Training
Wave 3

Task 1 – BGO detector The relation between the resolution and applied Voltage

$$R = \frac{Sigma}{Mean} \cdot 2.35$$

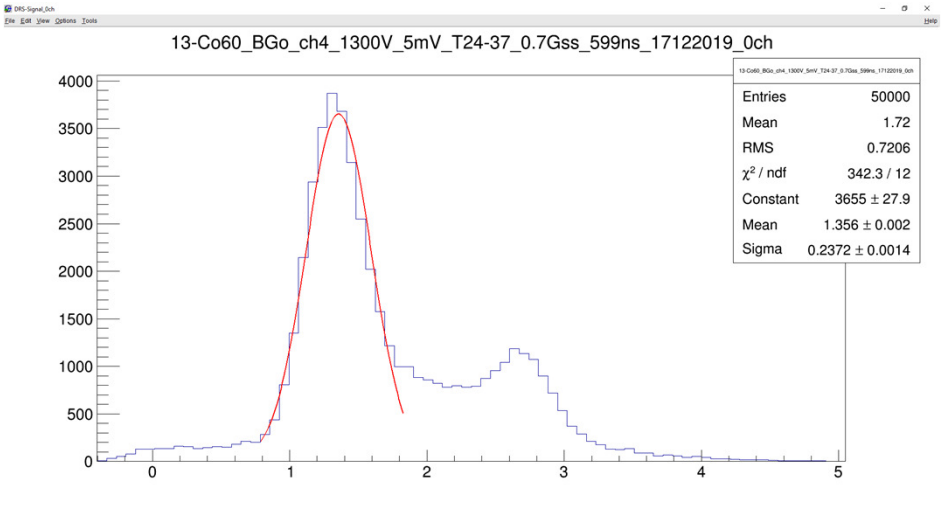
$$R = \frac{1.621}{0.4479} \cdot 2.35$$

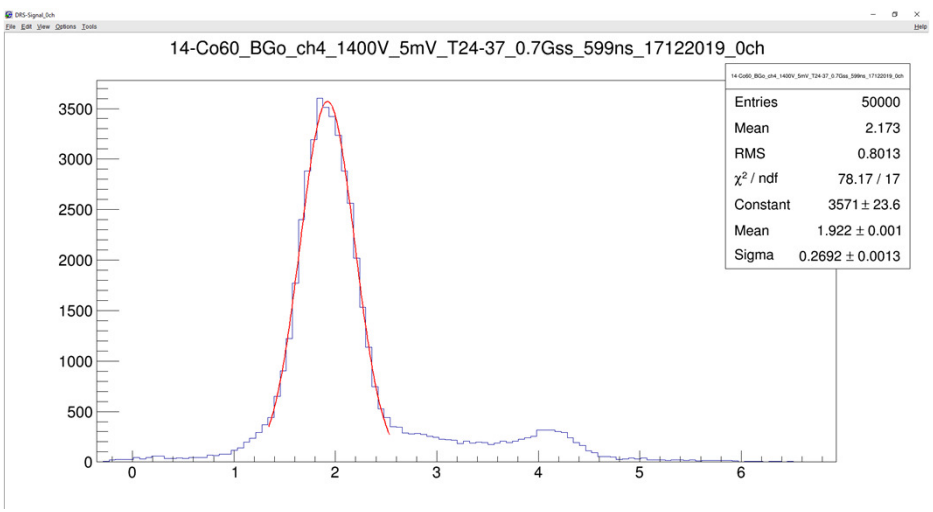
$$R = 64.933\ \%$$

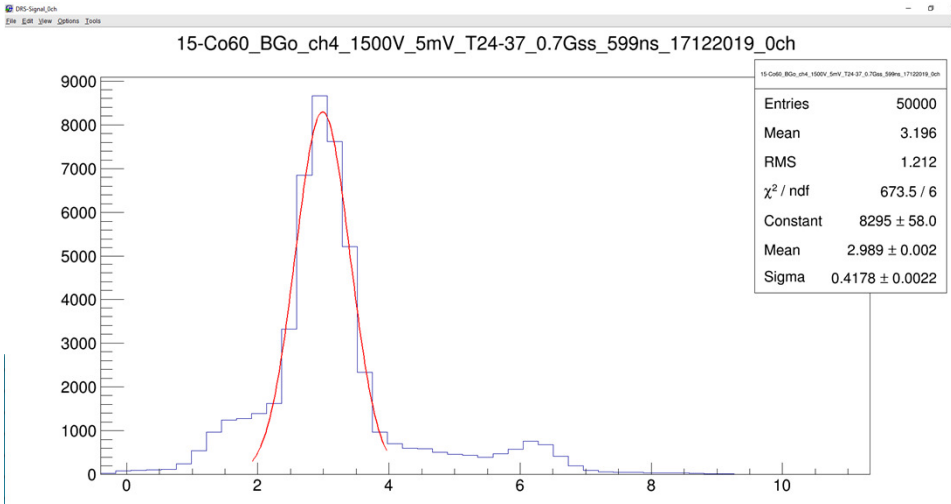


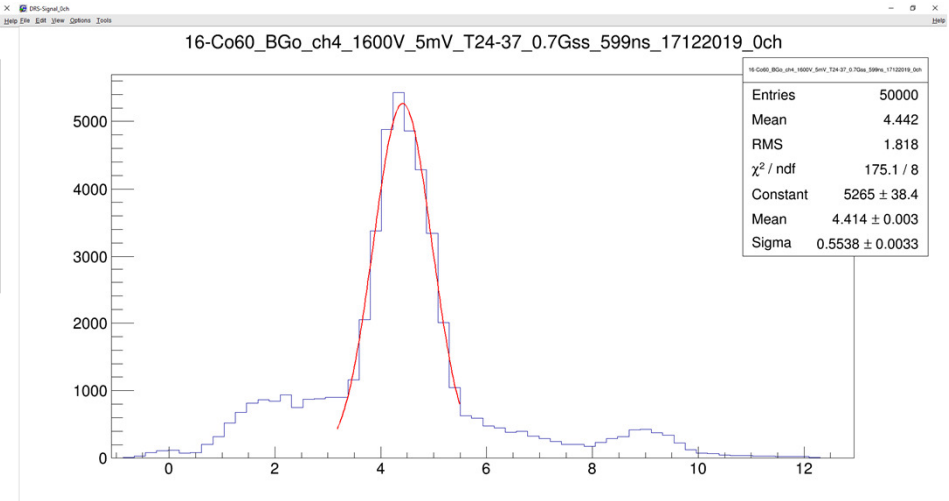
Task 1 – BGO detector The relation between the resolution and applied Voltage

FIT – for all graphs



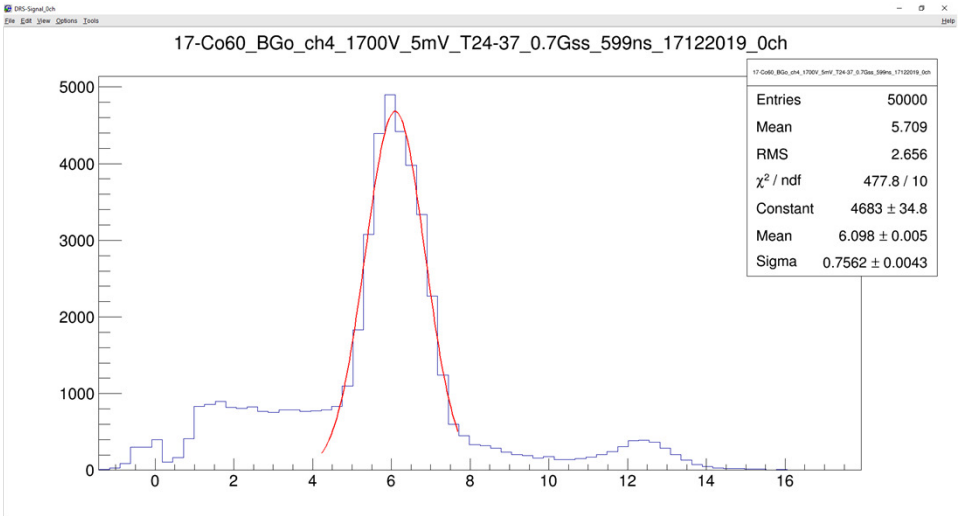


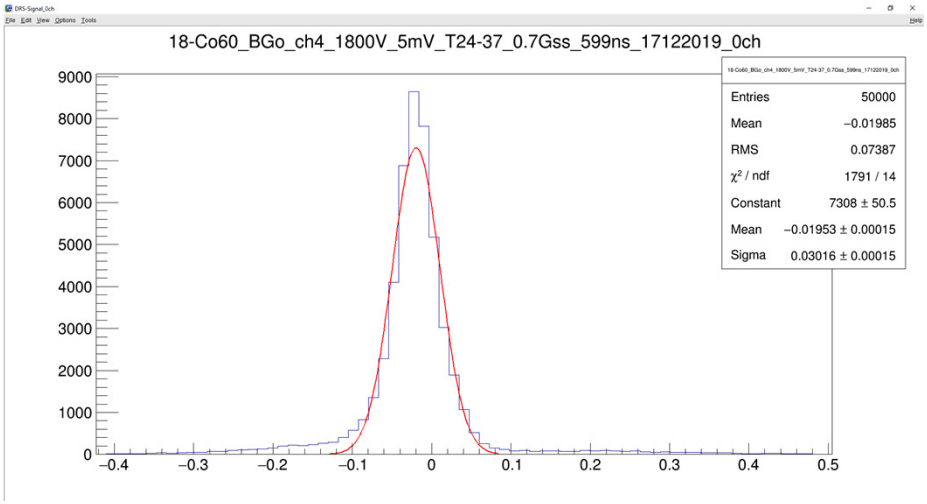


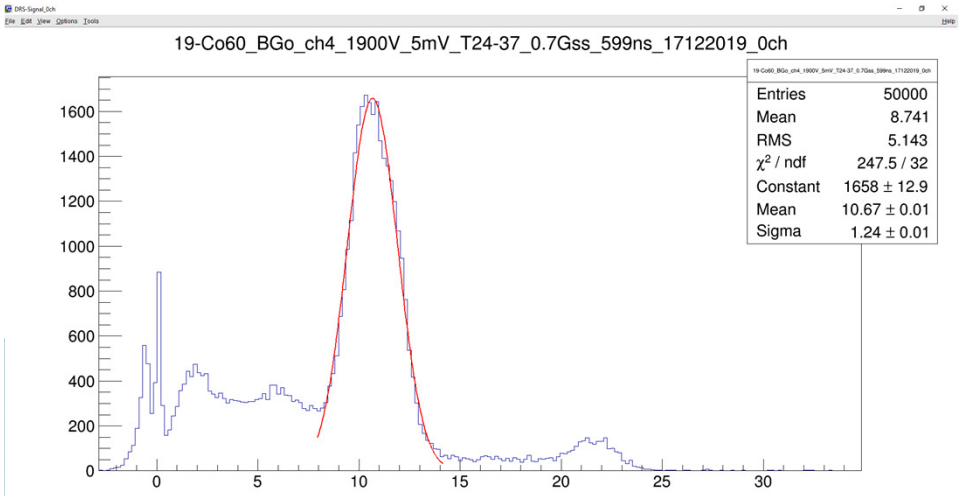


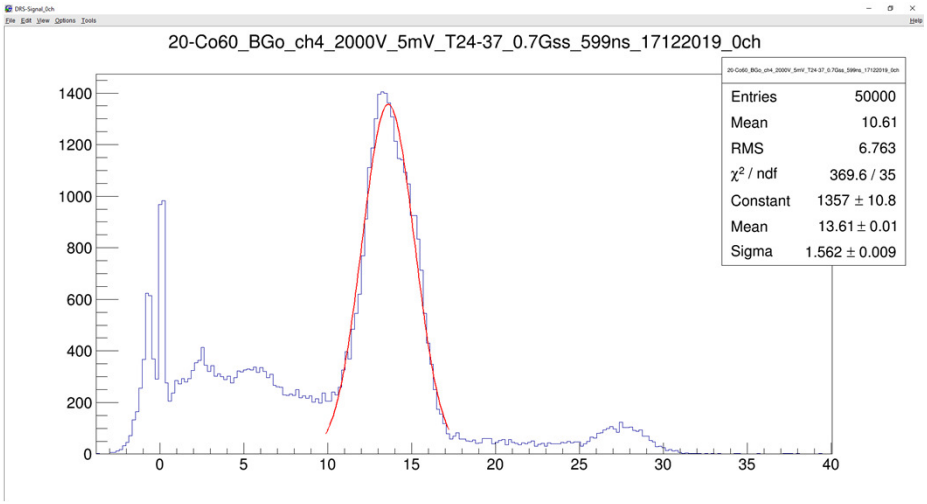
Task 1 – BGO detector The relation between the resolution and applied Voltage

FIT – for all graphs





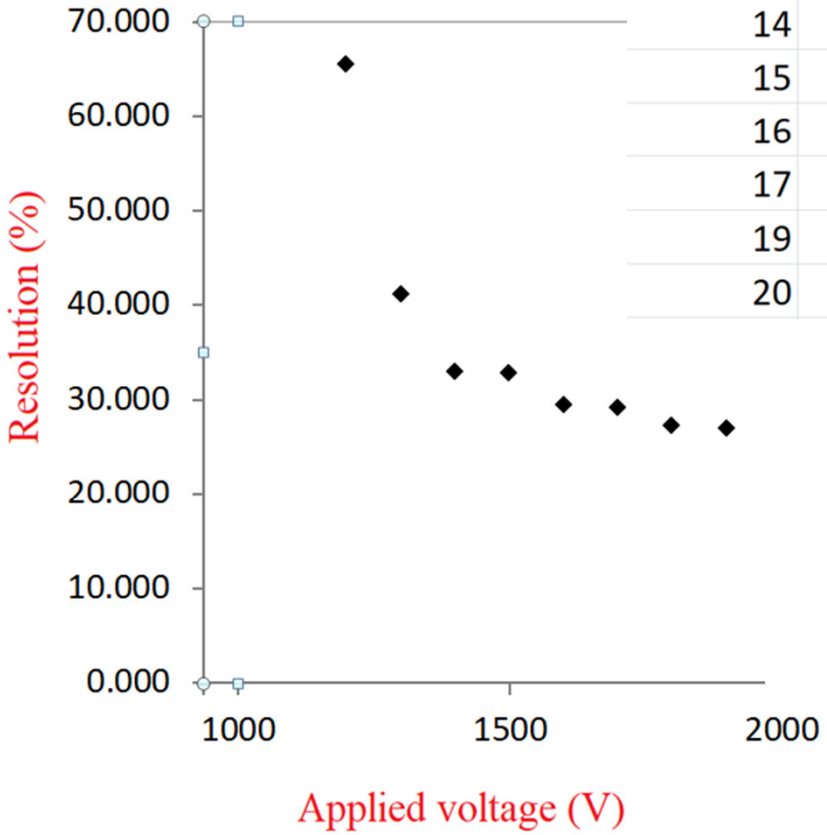




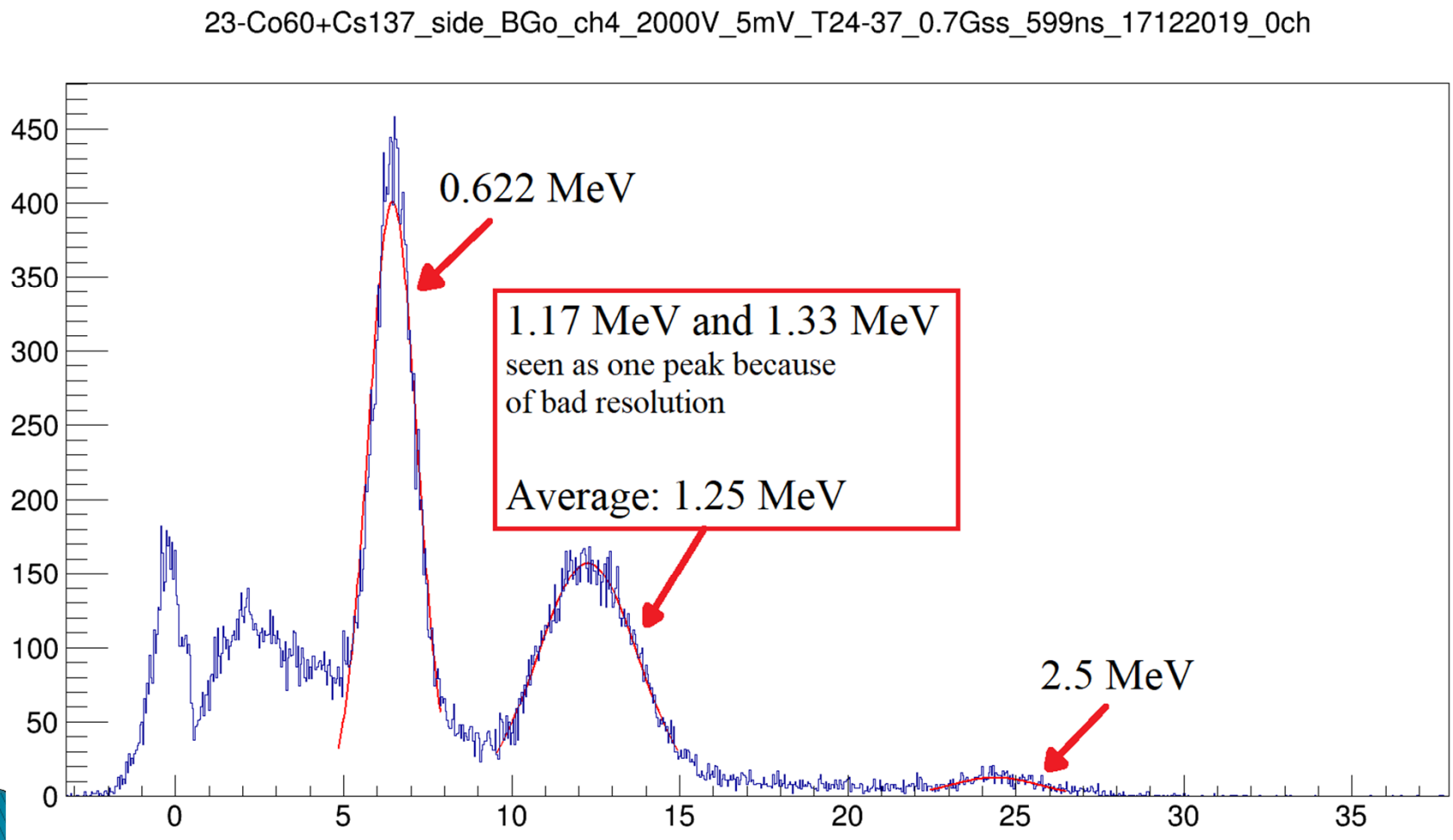
Task 1 – BGO detector The relation between the resolution and applied Voltage

Graph: Resolution – Applied Voltage

Nr.	Mean	Sigma	R (=resolution) (%)	Applied Voltage (V)
12	1.621	0.4519	**65.513**	**1200**
13	1.356	0.237	**41.073**	**1300**
14	1.922	0.2692	**32.915**	**1400**
15	2.989	0.4178	**32.848**	**1500**
16	4.414	0.5538	**29.484**	**1600**
17	6.098	0.7562	**29.142**	**1700**
19	10.67	1.24	**27.310**	**1900**
20	13.61	1.562	**26.971**	**2000**

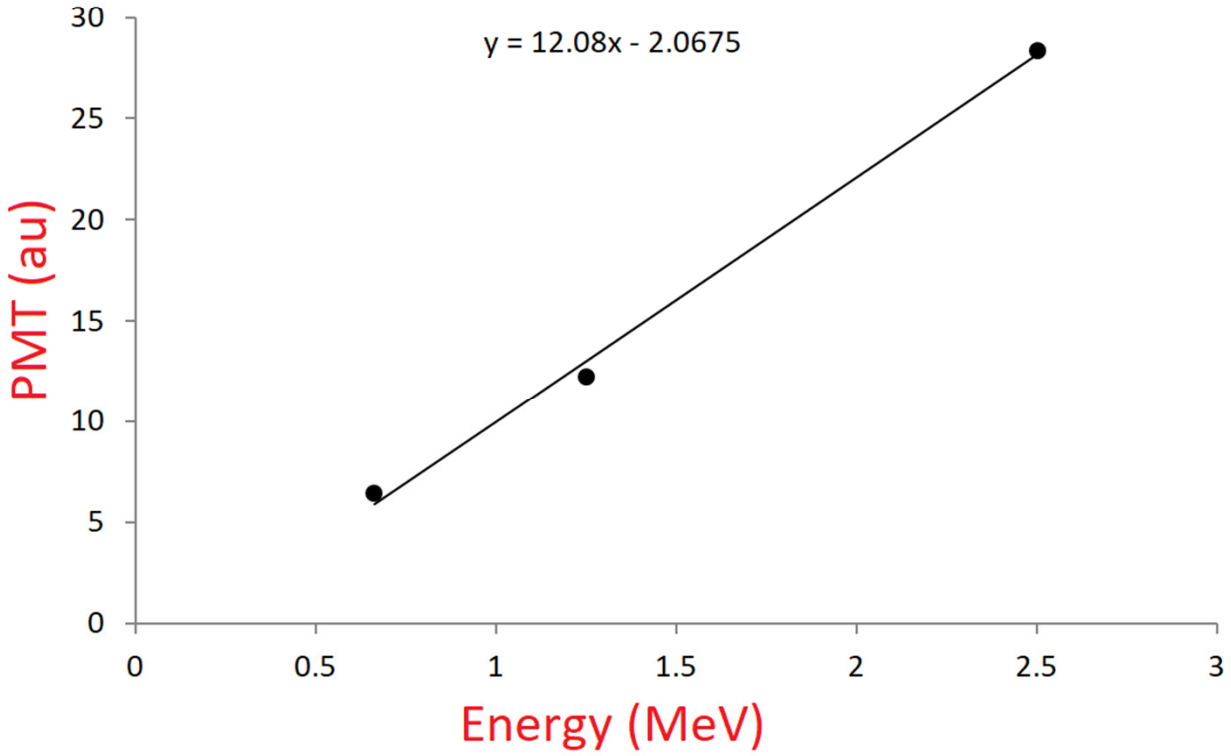


Task 2 –BGO detector – Calibration
Gaus FIT

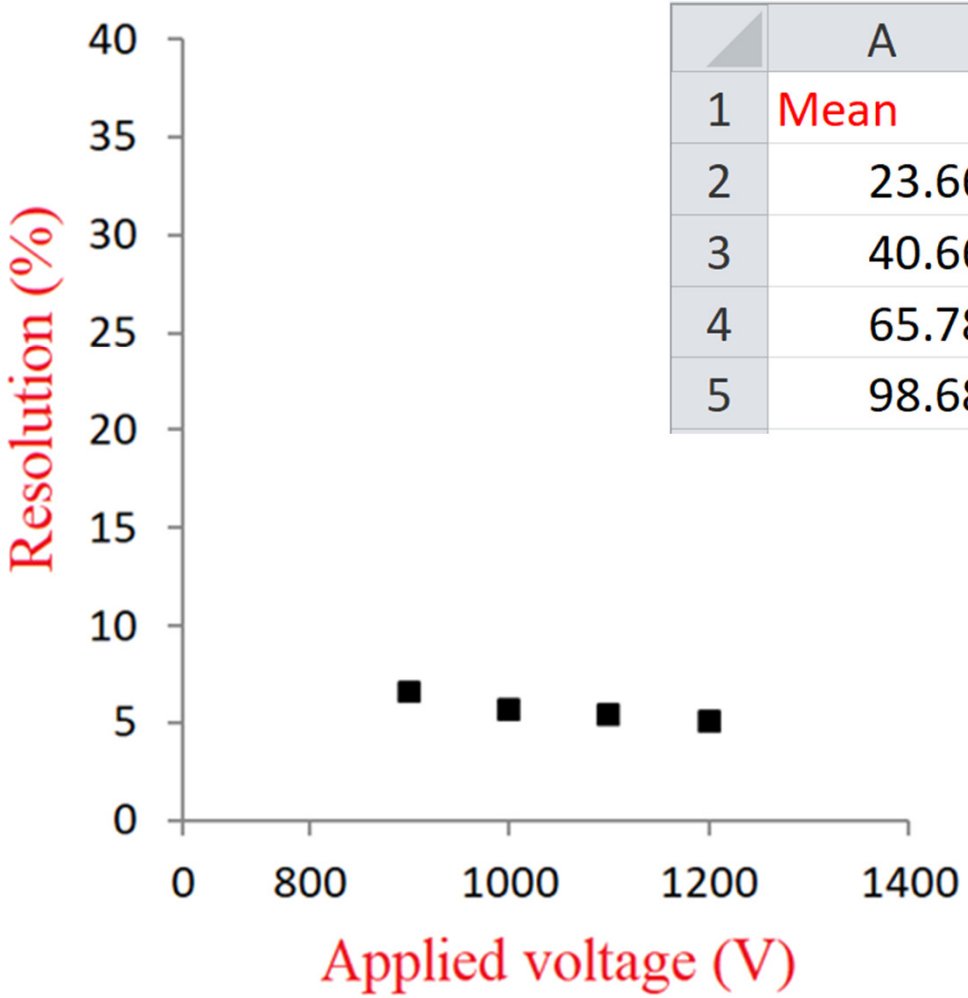


Task 2 –BGO detector – Calibration
Graph + liniar FIT

Energy (MeV)	PMT (au)
0.662	6.455
1.25	12.26
2.5	28.38



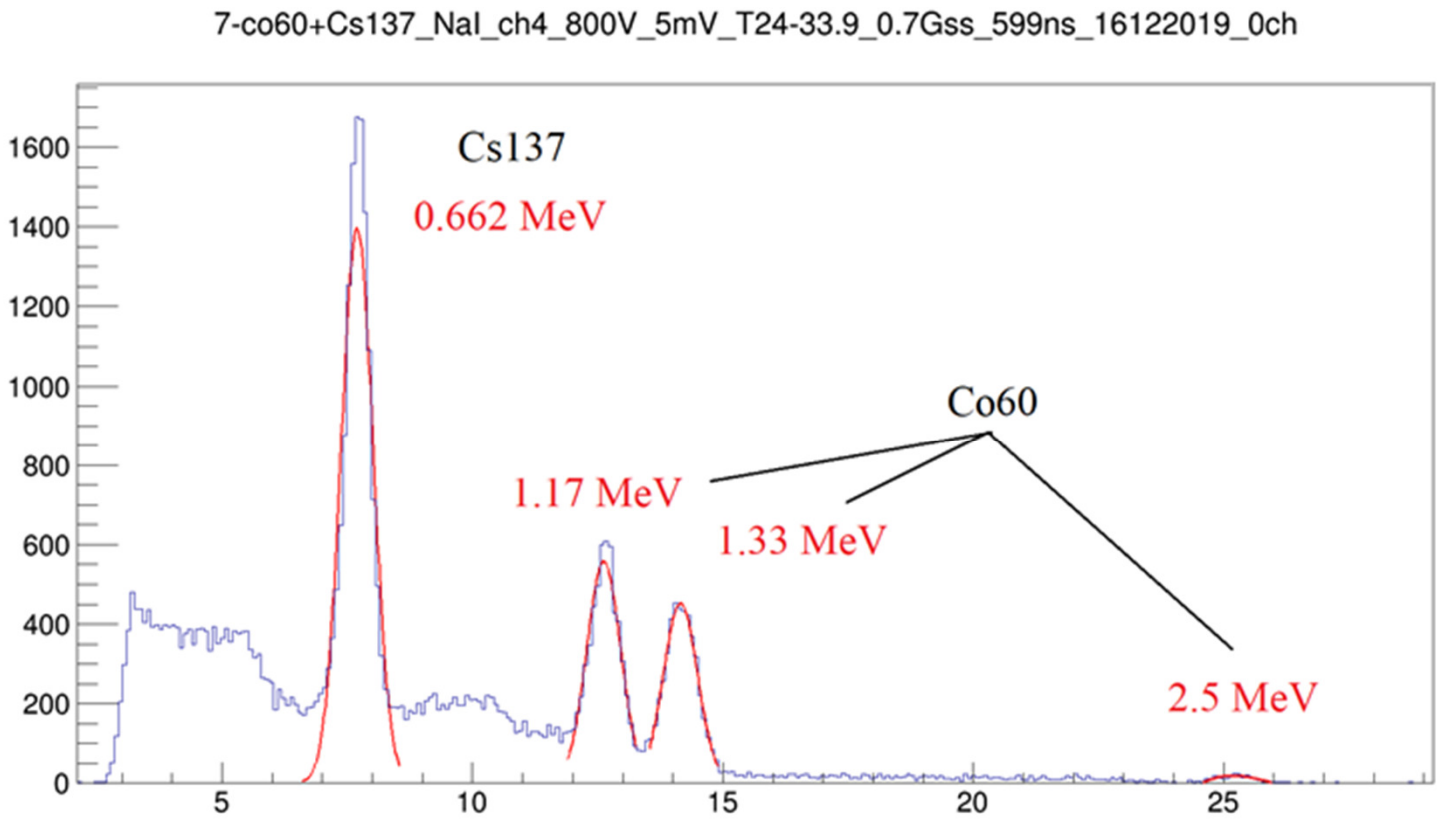
Task 3 – NaI detector
RESOLUTION



	A	B	C	D
1	Mean	Sigma	R(%)	Applied Voltage
2	23.66	0.663	6.58516	900
3	40.66	0.9722	5.61896	1000
4	65.78	1.516	5.41593	1100
5	98.68	2.114	5.03435	1200

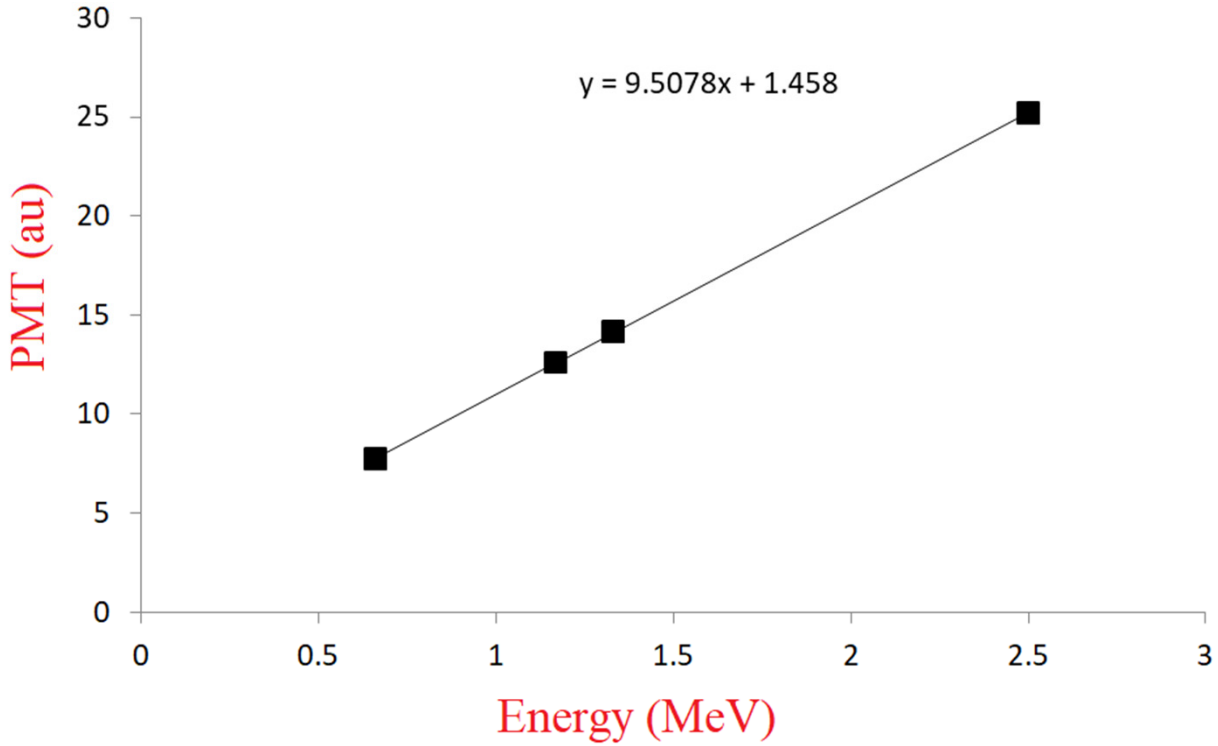
$$R = \frac{Sigma}{Mean} \cdot 2.35$$

Task 3 – NaI detector
CALIBRATION

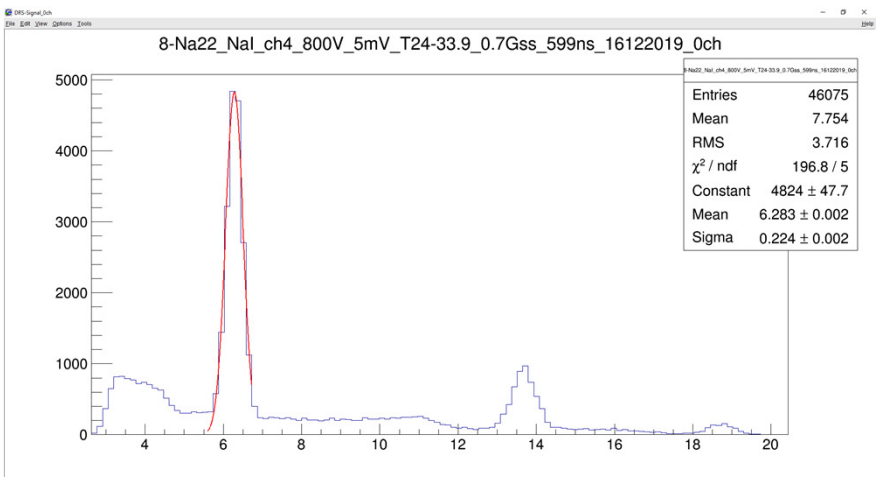


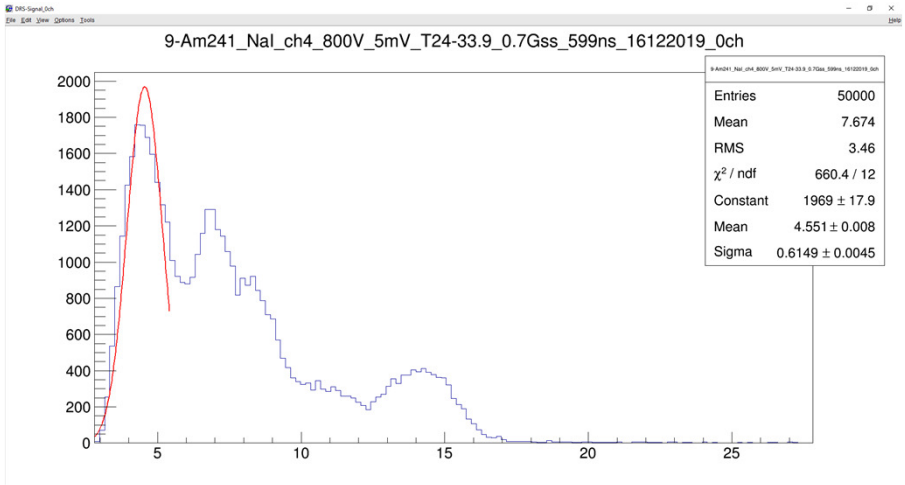
Task 3 – NaI detector CALIBRATION

	A	B
1	Energy (MeV)	PMT (au)
2	0.662	7.695
3	1.17	12.62
4	1.33	14.15
5	2.5	25.2



Task 3 – NaI detector
Unknown source





Mean = y = 6.283

y=9.5078x + 1.458

$$\Rightarrow x = \frac{y-1.458}{9.5078}$$

$$x = \frac{6.283 - 1.458}{9.5078}$$

x = 0.507

E = 0.507 MeV **Na22**

Mean = y =4.55

y=9.5078x + 1.458

$$\Rightarrow x = \frac{y-1.458}{9.5078}$$

$$x = \frac{4.55 - 1.458}{9.5078}$$

x = 0.507

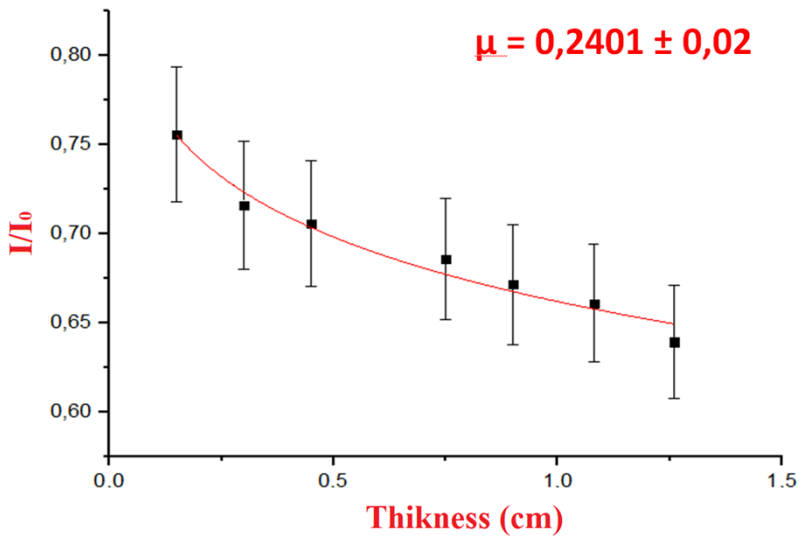
E = 0.325 MeV **Sn-125m**

Task 4 – Attenuation Coefficient

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

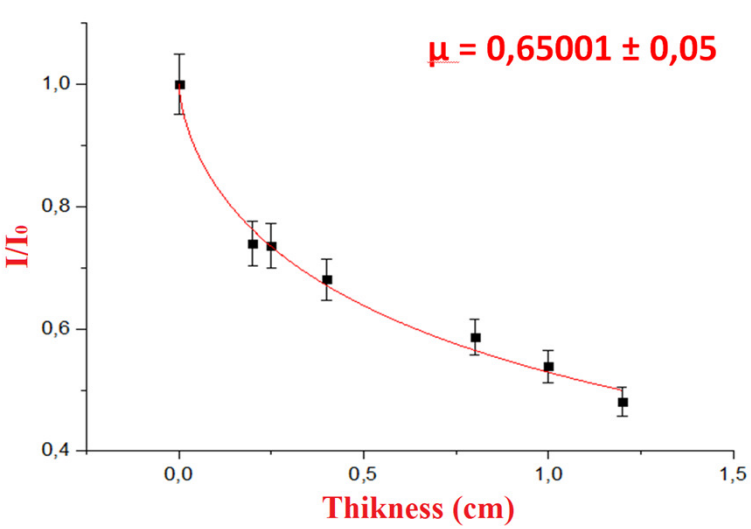
Al

I/I0	Thikness (cm)
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



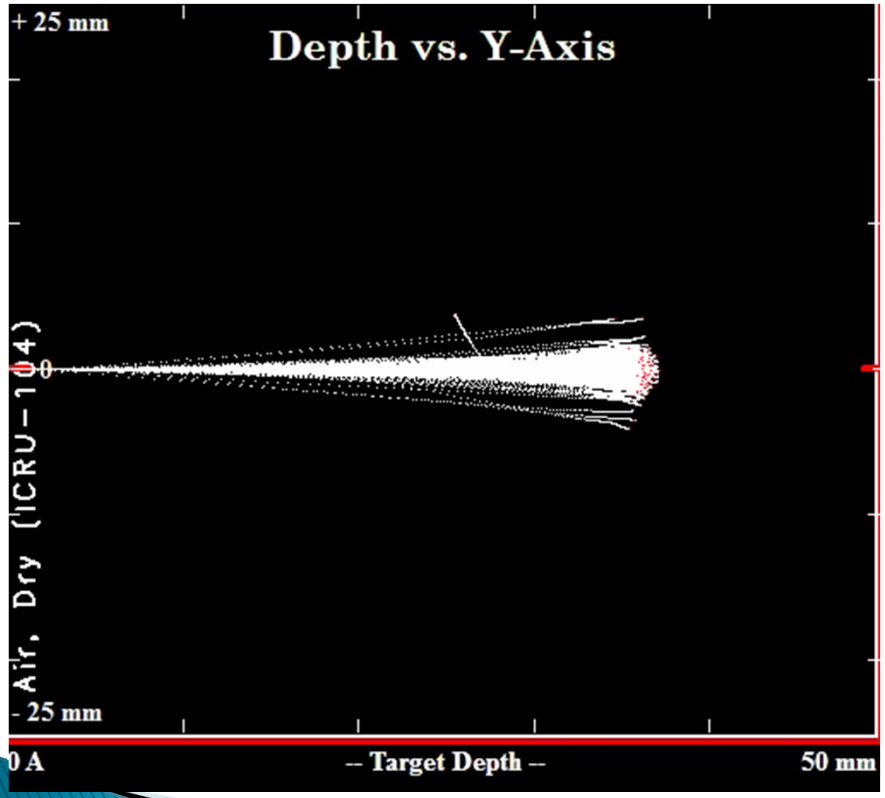
Cu

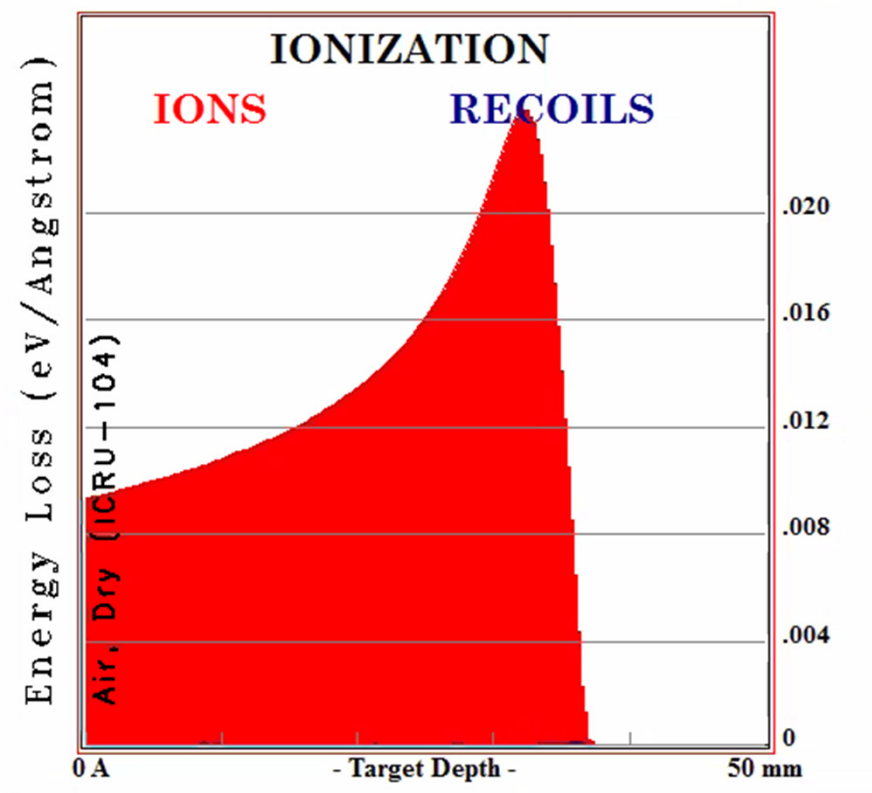
I/I0	Thikness (cm)
0	1
0.2	0.73931
0.25	0.7357
0.4	0.68065
0.8	0.58611
1	0.53827
1.2	0.48042



Task 5 – SRIM Program – simulation

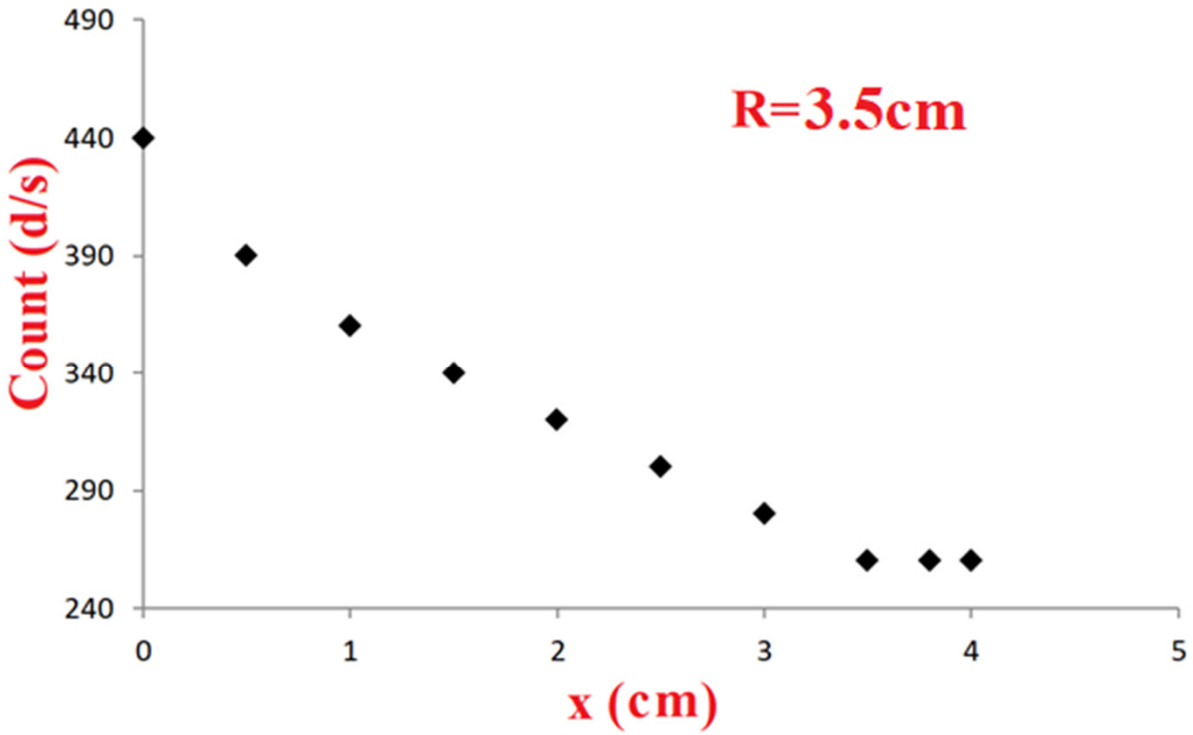
We use plastic detector to calculate the α particle range in air using Plutonium 239 and the Energy of α is 5MeV.





Task 5 – α RANGE in air

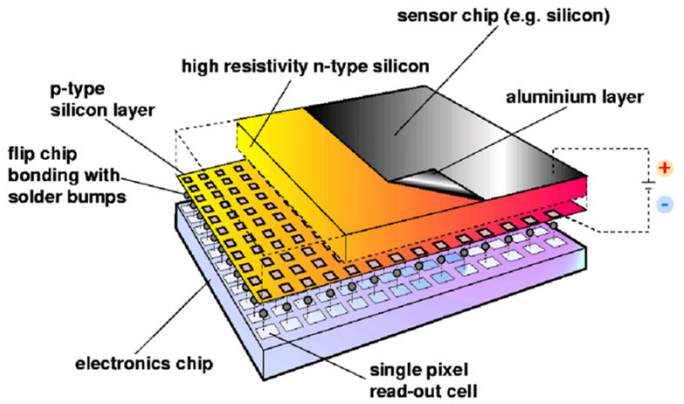
	A	B
1	Counts (d/s)	x (cm)
2	440	0
3	390	0.5
4	360	1
5	340	1.5
6	320	2
7	300	2.5
8	280	3
9	260	3.5
10	260	3.8
11	260	4

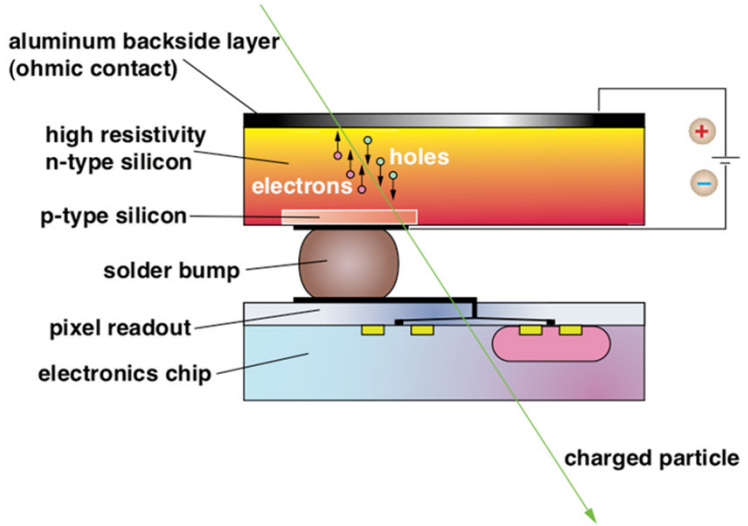


Task 6 – Pixel Detector

- Is an advanced detector with high resolution

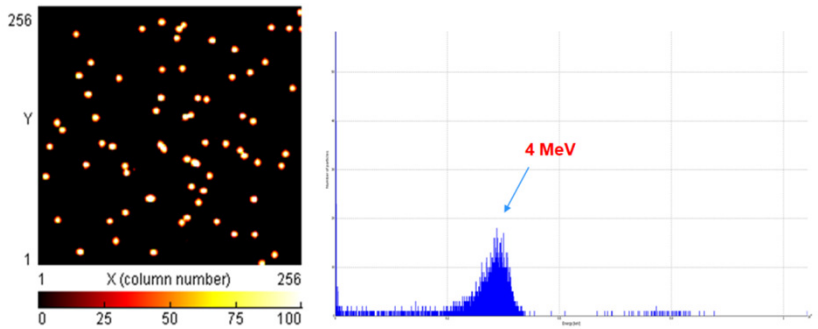
- It has 3 parts:
  - Sensor
  - Electronic cip
  - Usb



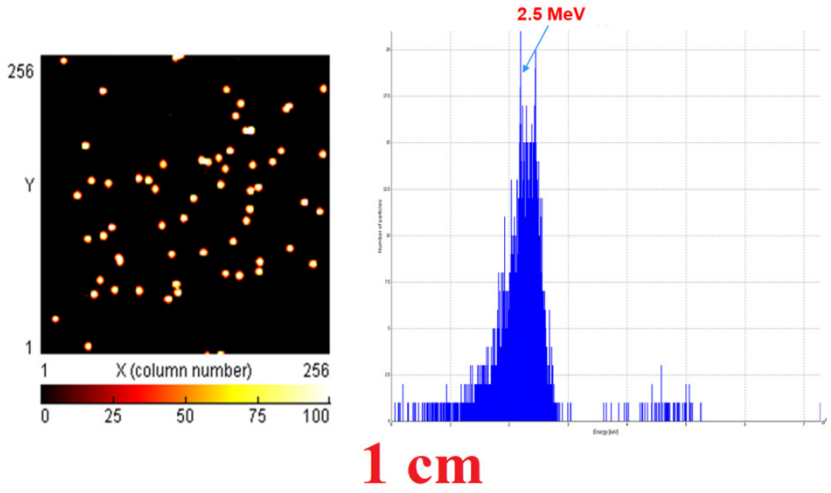


Task 6 – Pixel Detector

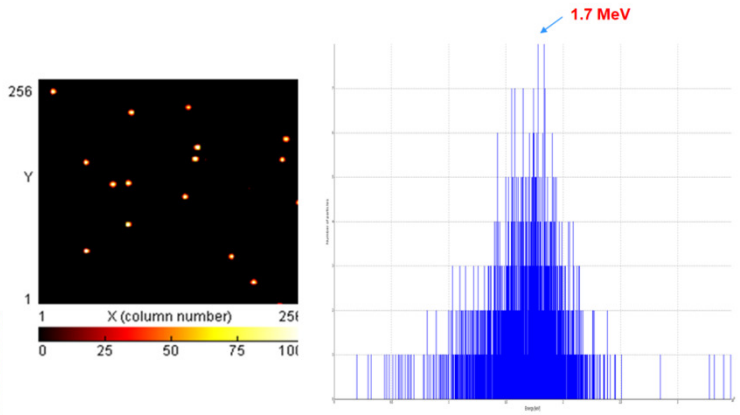
- Determination the range of Alpha partcles with (Am-241) energy about 4 MeV in air using pixel detector



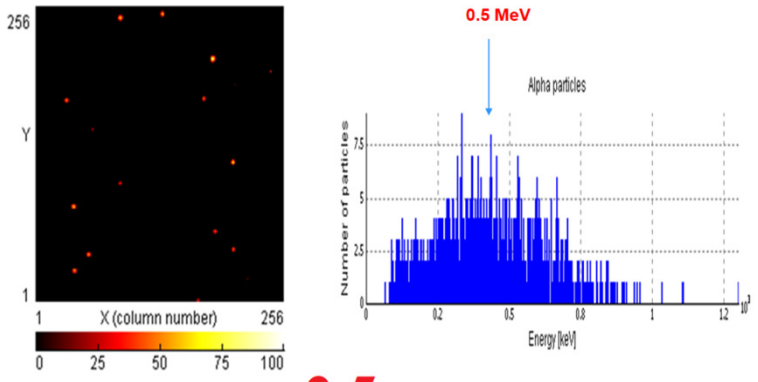
0 cm



1 cm



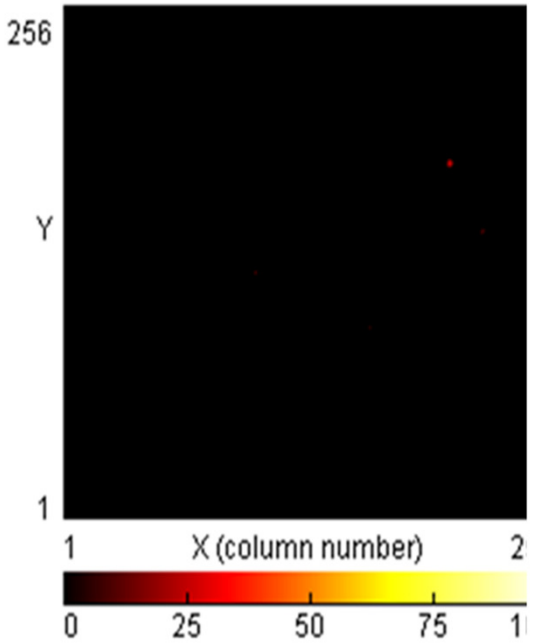
2 cm



2.5 cm

Task 6 – Pixel Detector

- Maximum of α-particle range is 3cm
- R= 3cm



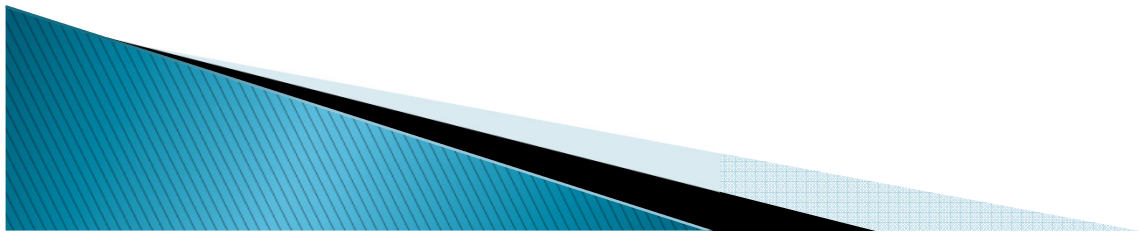
3 cm

no alpha particles are detected
The range is 3cm

Conclusion

This practice helped us to gain experience in:

- Different types of radiation sources, and detection of radiation.
- Radioactivity and naturally occurring radioactive materials NORM.
- Energy calibration of some scintillation detectors by using Standard sources.
- Identify of unknown source by using energy calibration curve.
- Calculation of Resolution diffrent scintillation detectors.
- Determination of alpha range in air using Pixel and Plastic detectors.
- Determination of Attenuation coefficient for different materials .
- Assessment the ranges and energy of alpha particles using Monto Carlo simulation SIRM software.



References

- Cember, H., Introduction to Health Physics, 3rd Edition, McGraw-Hill, New York (2000)
- Attix, F.H., Introduction to Radiological Physics and Radiation Dosimetry, Wiley, New York (1986)
- Martin J.E., Physics for Radiation Protection, Wiley-VCH Verlag Gmbh; Co KGaA, Weinheim (2013)