

# Virtual lab 4: Resolution of Gamma Ray Spectrometer

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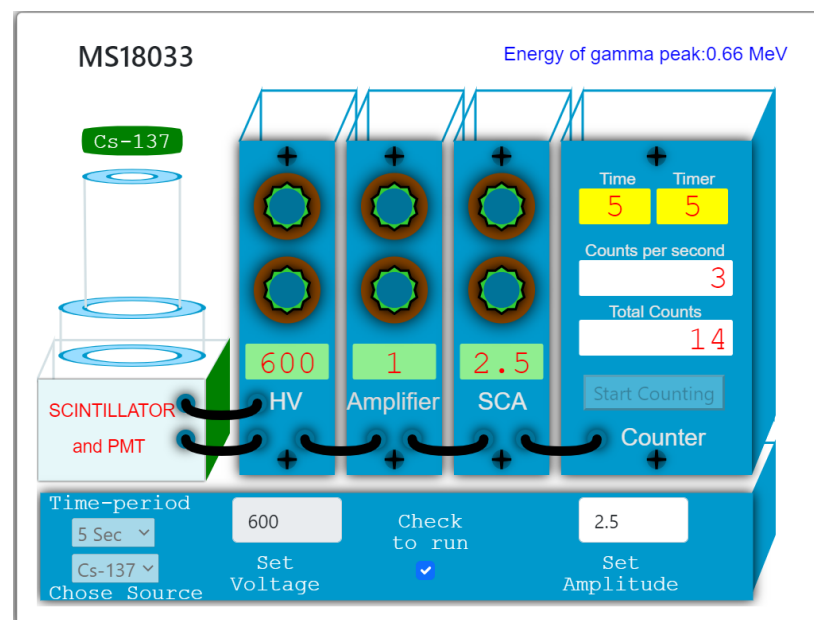
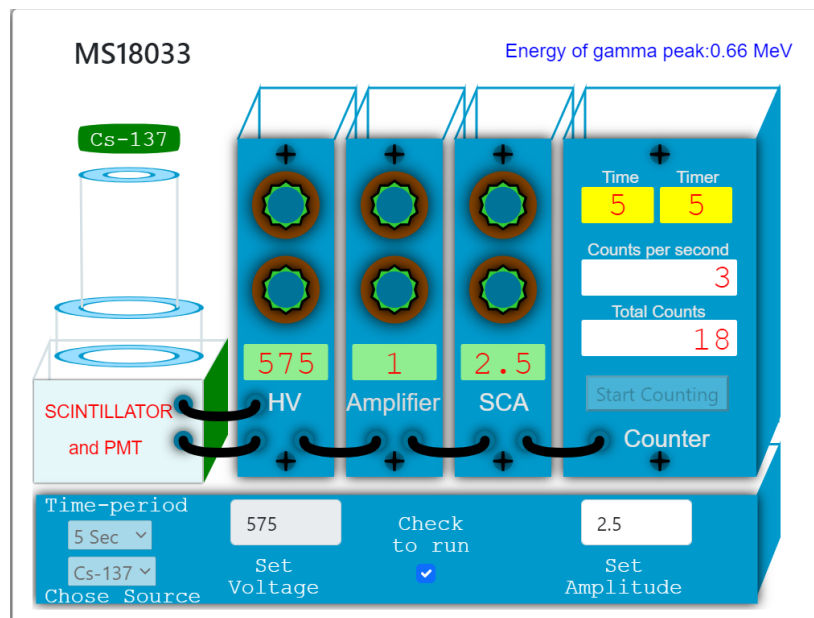
# 1 Aim

To Study the dependence of Energy Resolution on the Applied High Voltage and to determine the best Operating Voltage for our setup.

## 2 Data taken and Observations

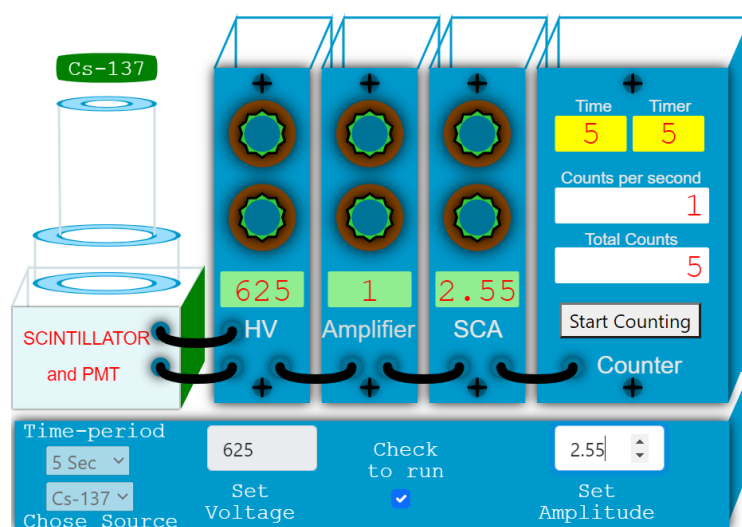
The counts vs LLD data for different PMT voltages between 575 to 725V is collected for Cs-137 Source with time period of counts set to 5s. The gain is set to 1.0, and is kept constant throughout the experiment.

### 2.1 Screenshots



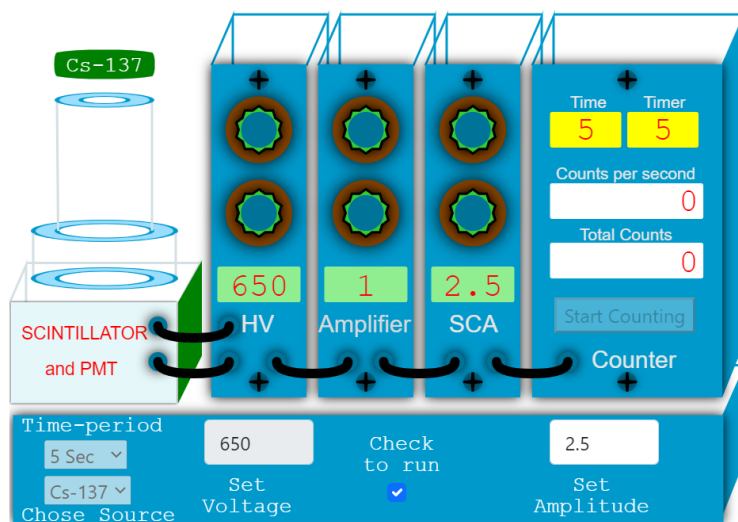
MS18033

Energy of gamma peak:0.66 MeV



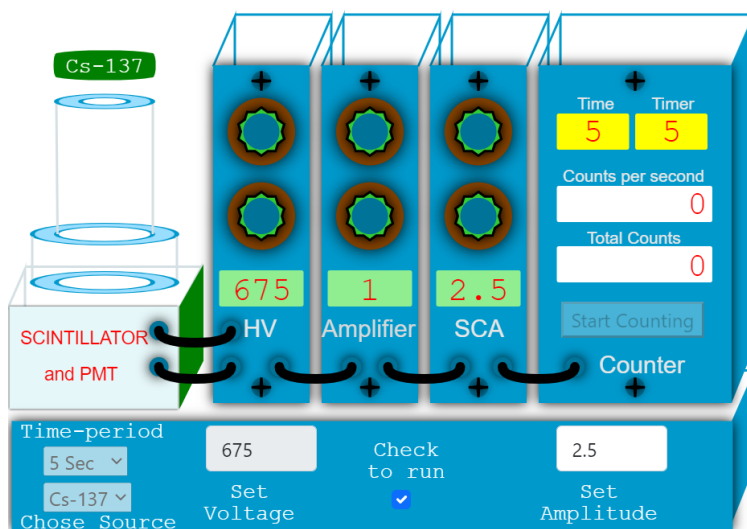
MS18033

Energy of gamma peak:0.66 MeV



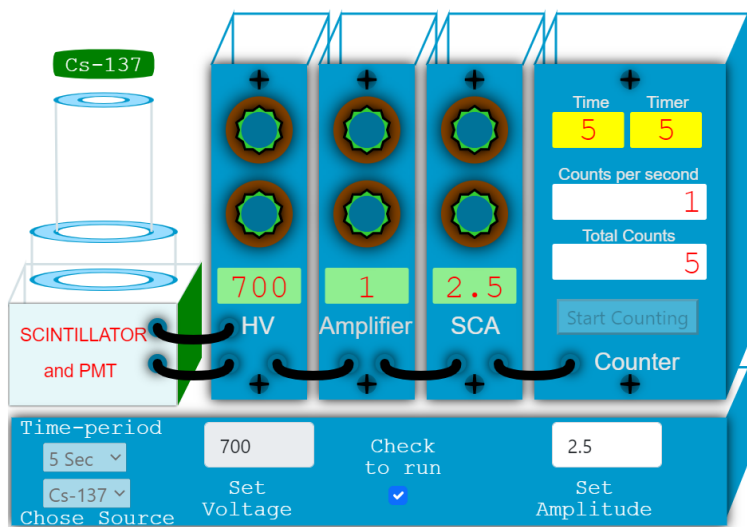
MS18033

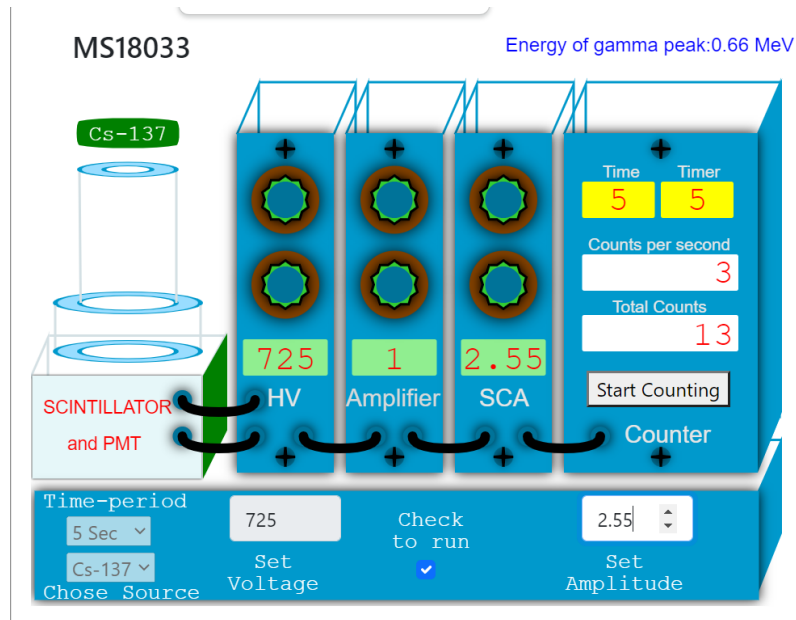
Energy of gamma peak:0.66 MeV



MS18033

Energy of gamma peak:0.66 MeV





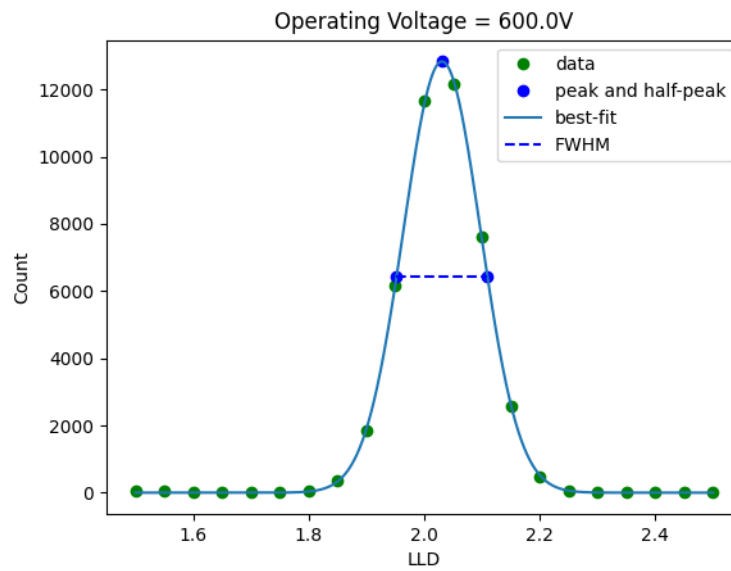
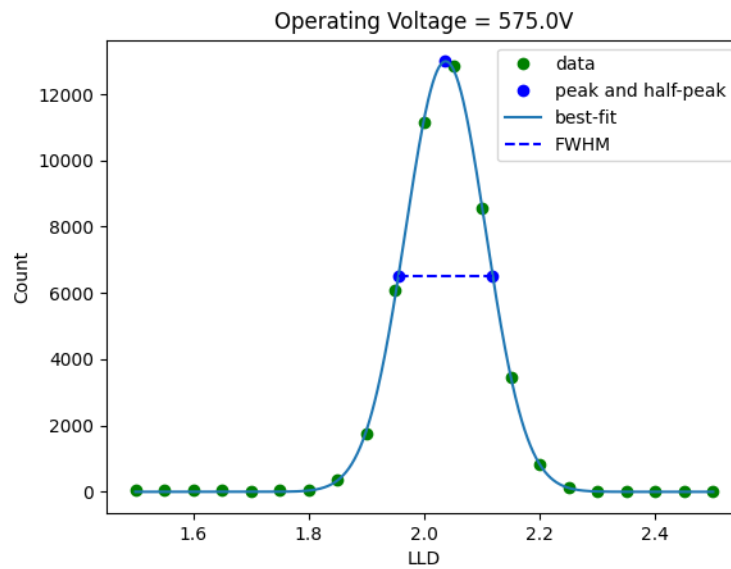
## 2.2 Data Taken

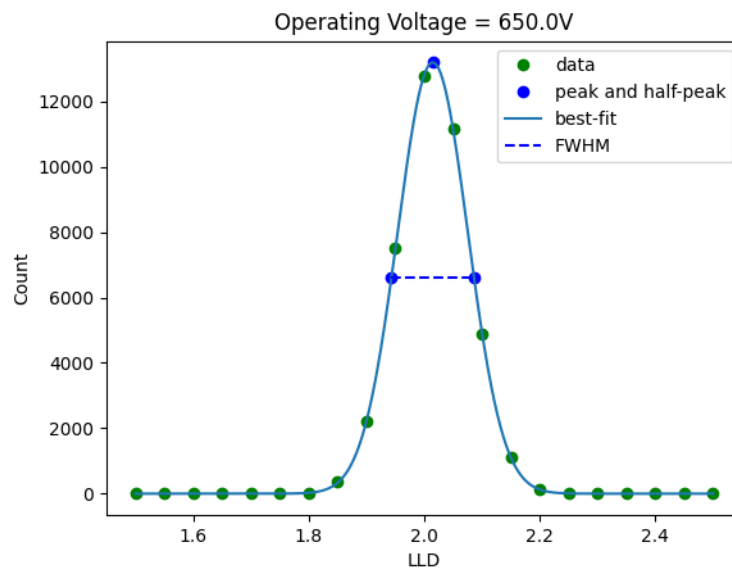
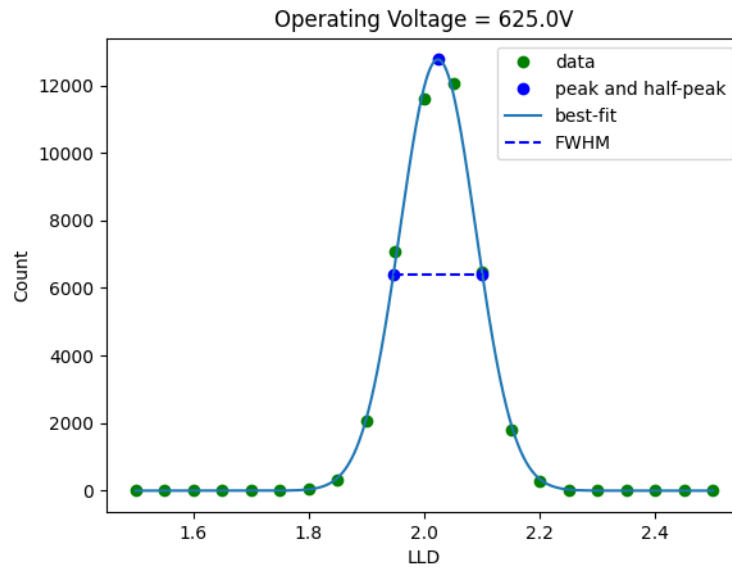
The total count vs LLD data obtained is given below.

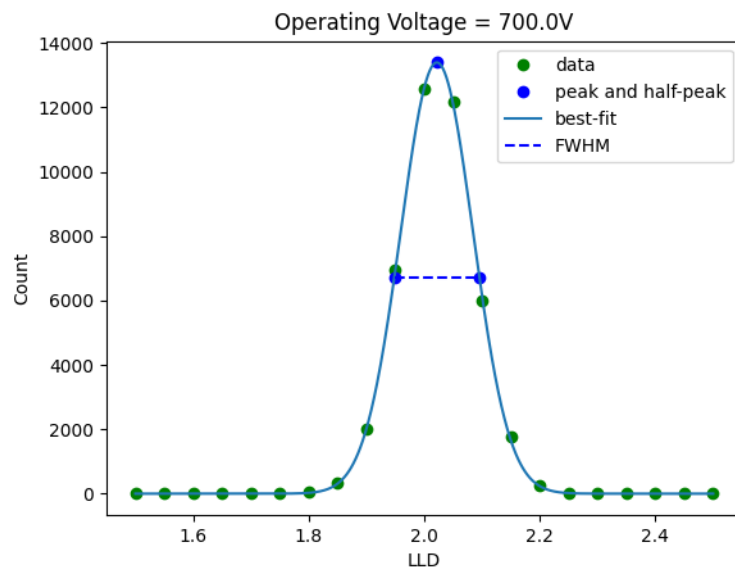
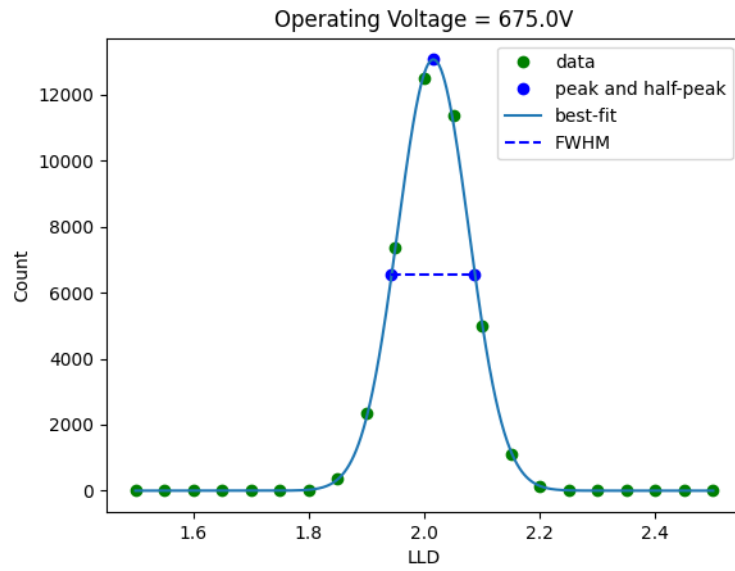
V = 575		V = 600		V = 625		V = 650		V = 675		V = 700		V = 725	
LLD	Count	LLD	Count	LLD	Count	LLD	Count	LLD	Count	LLD	Count	LLD	Count
1.5	351	1.5	252	1.5	150	1.5	50	1.5	45	1.5	152	1.5	237
1.55	243	1.55	182	1.55	113	1.55	33	1.55	32	1.55	106	1.55	167
1.6	209	1.6	151	1.6	90	1.6	30	1.6	27	1.6	85	1.6	144
1.65	187	1.65	130	1.65	78	1.65	27	1.65	24	1.65	78	1.65	130
1.7	146	1.7	106	1.7	63	1.7	20	1.7	19	1.7	59	1.7	104
1.75	183	1.75	134	1.75	75	1.75	30	1.75	28	1.75	79	1.75	133
1.8	352	1.8	279	1.8	229	1.8	168	1.8	165	1.8	230	1.8	286
1.85	1767	1.85	1709	1.85	1674	1.85	1782	1.85	1740	1.85	1688	1.85	1805
1.9	8718	1.9	9334	1.9	10410	1.9	11094	1.9	11767	1.9	10109	1.9	9976
1.95	30380	1.95	30865	1.95	35415	1.95	37463	1.95	36839	1.95	34809	1.95	32637
2	55766	2	58255	2	57940	2	63913	2	62511	2	62832	2	56649
2.05	64196	2.05	60892	2.05	60203	2.05	55863	2.05	56889	2.05	60980	2.05	64208
2.1	42892	2.1	38133	2.1	32356	2.1	24424	2.1	24874	2.1	30058	2.1	38035
2.15	17258	2.15	12855	2.15	8913	2.15	5654	2.15	5451	2.15	8911	2.15	12397
2.2	4155	2.2	2340	2.2	1376	2.2	652	2.2	633	2.2	1316	2.2	2486
2.25	583	2.25	271	2.25	125	2.25	43	2.25	39	2.25	104	2.25	256
2.3	70	2.3	31	2.3	14	2.3	5	2.3	0	2.3	11	2.3	30
2.35	18	2.35	13	2.35	5	2.35	0	2.35	0	2.35	5	2.35	11
2.4	20	2.4	14	2.4	5	2.4	0	2.4	0	2.4	5	2.4	13
2.45	13	2.45	10	2.45	5	2.45	0	2.45	0	2.45	5	2.45	10
2.5	18	2.5	14	2.5	5	2.5	0	2.5	0	2.5	5	2.5	13

## 2.3 Count vs LLD plots

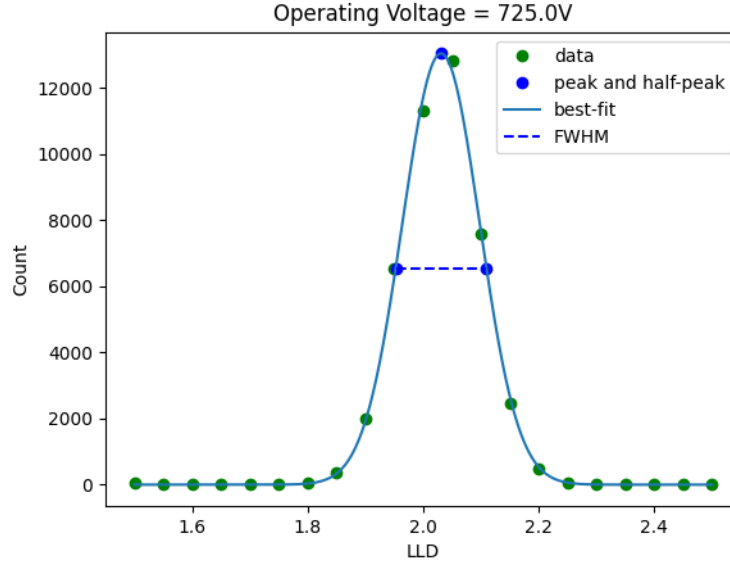
The average count vs LLD plots are as follows:











A Gaussian plot is obtained for each count vs LLD plot, as expected.

## 2.4 Calculation of resolution

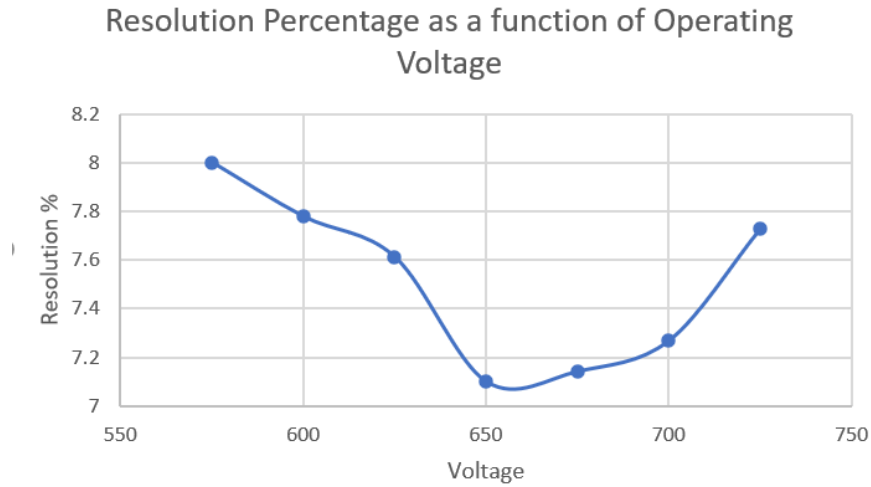
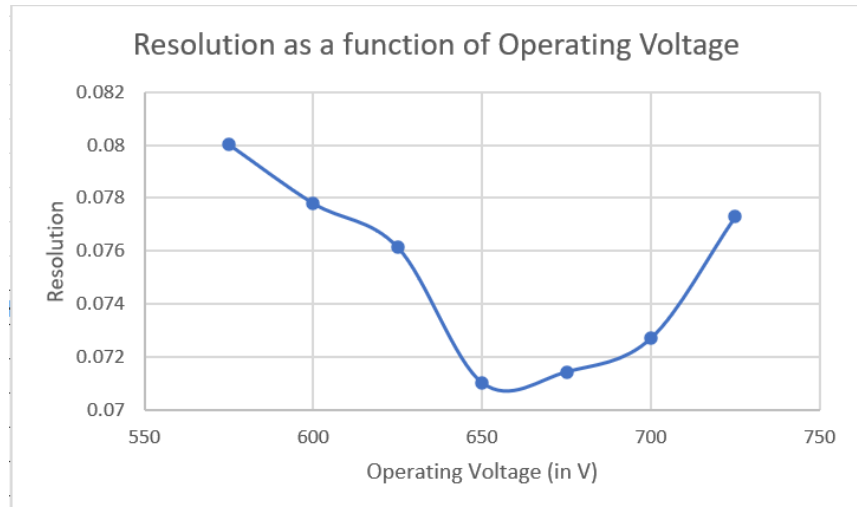
The Full Width at Half Maxima (FWHM) and the maximum LLD Amplitude height,  $A_{mh}$  are obtained from the Gaussian fit to the count vs LLD plots.

$$\text{Resolution } r = \frac{FWHM}{A_{mh}}$$

$$\text{Percentage resolution } r_p = 100r\%$$

Operating Voltage	Amh	FWHM	r	rp
575	2.037	0.163	0.080019637	8.001964
600	2.031	0.158	0.07779419	7.779419
625	2.023	0.154	0.076124567	7.612457
650	2.014	0.143	0.071002979	7.100298
675	2.016	0.144	0.071428571	7.142857
700	2.022	0.147	0.072700297	7.27003
725	2.031	0.157	0.077301822	7.730182

## 2.5 Plot of $r$ and $r_p$ as a function of PMT Voltages



The PMT voltage in the data set with the minimum resolution is 650V.

## 3 Result

The best operating voltage for this setup is obtained to be 650 V.