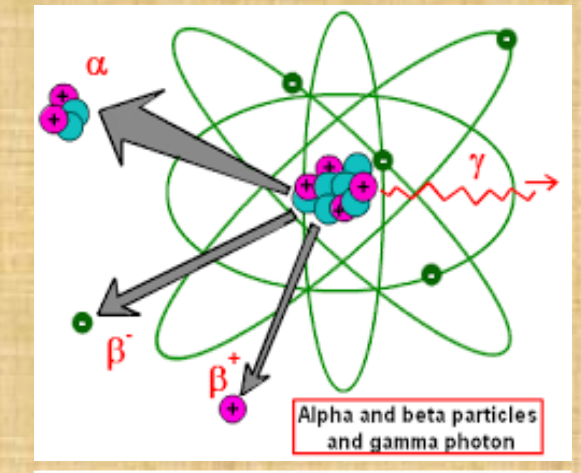
Measurement of the Change in Lifetime of 5/2+ Yrast State of ^{133}Cs Isomer due to Gamma Resonance Effect using a System of Mixed Scintillation Detectors

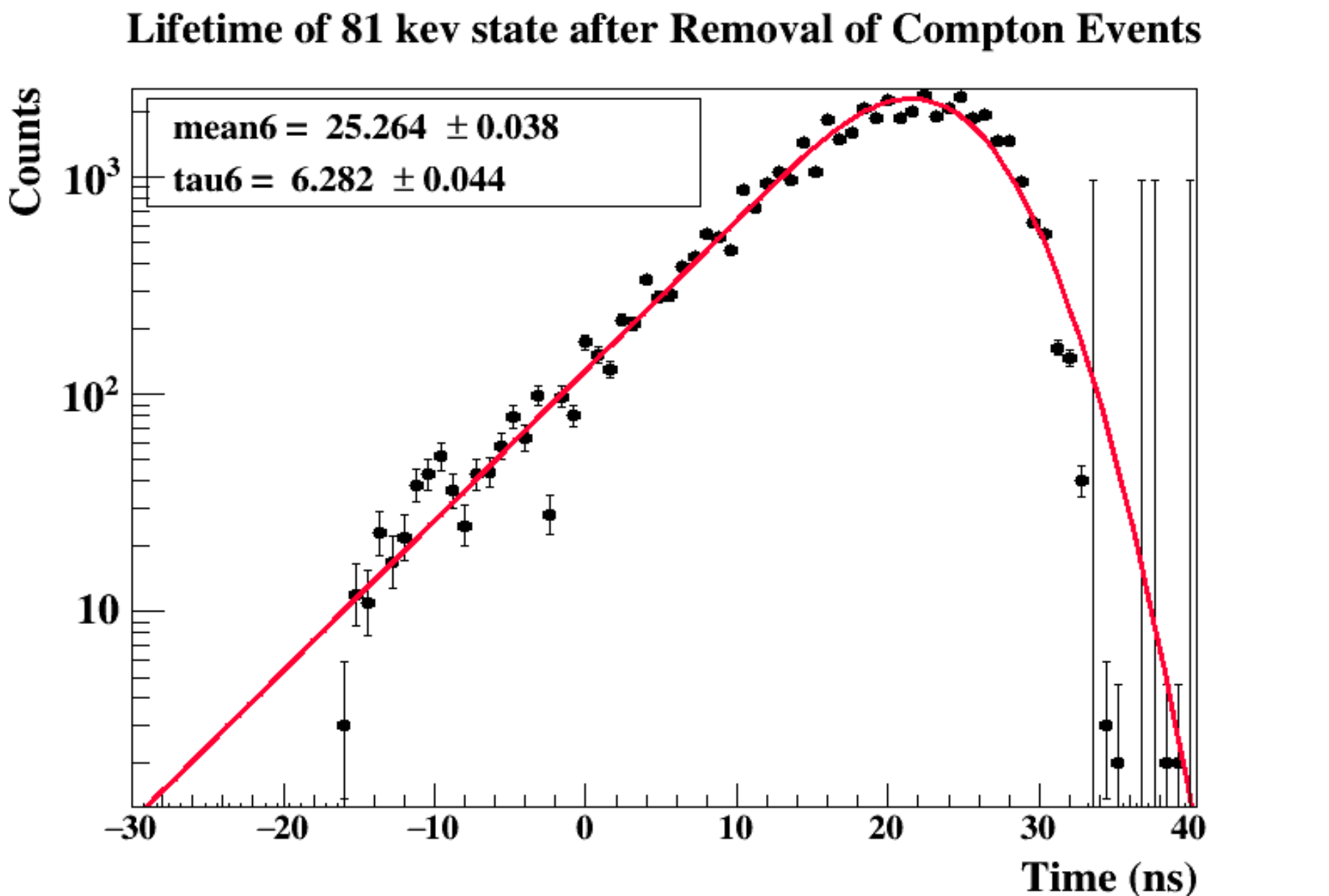


I.J Lugendo

Korea University

Lab Meeting, 19/07/2016

Results from Previous Experiment



Systematic Uncertainty Budget

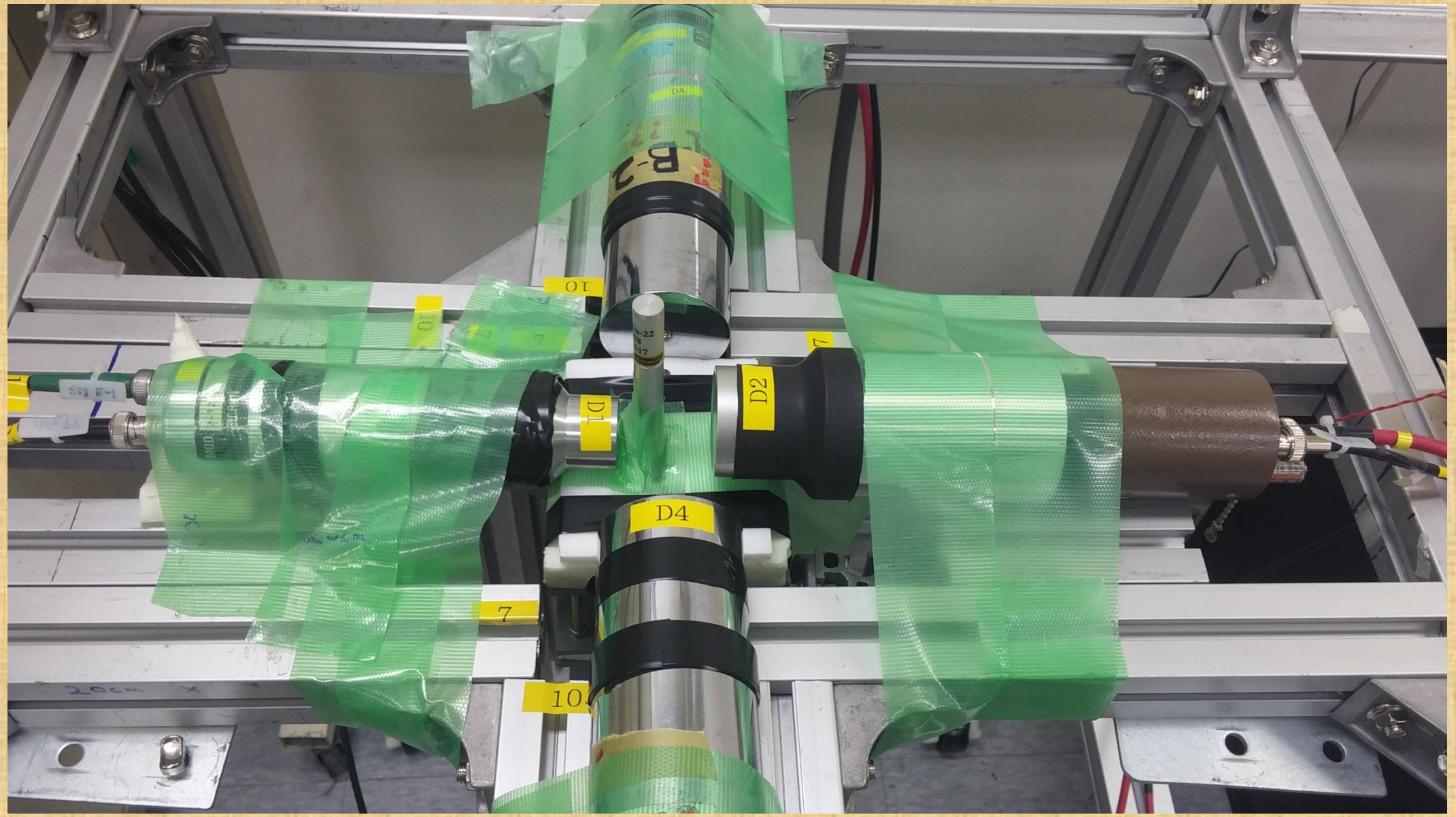
Source of Uncertainty	±Δ τ (ns)	±Δ τ (%)
Background Effect	0.001	0.016
Compton Scattering Effect	0.002	0.032
Uncertainty in Time Resolution	0.017	0.271
Choice of Gamma Cascade	0.006	0.095
Counting Statistics	0.015	0.247
TOTAL	0.024	0.380

$\tau = (6.282 \pm 0.024)$ ns

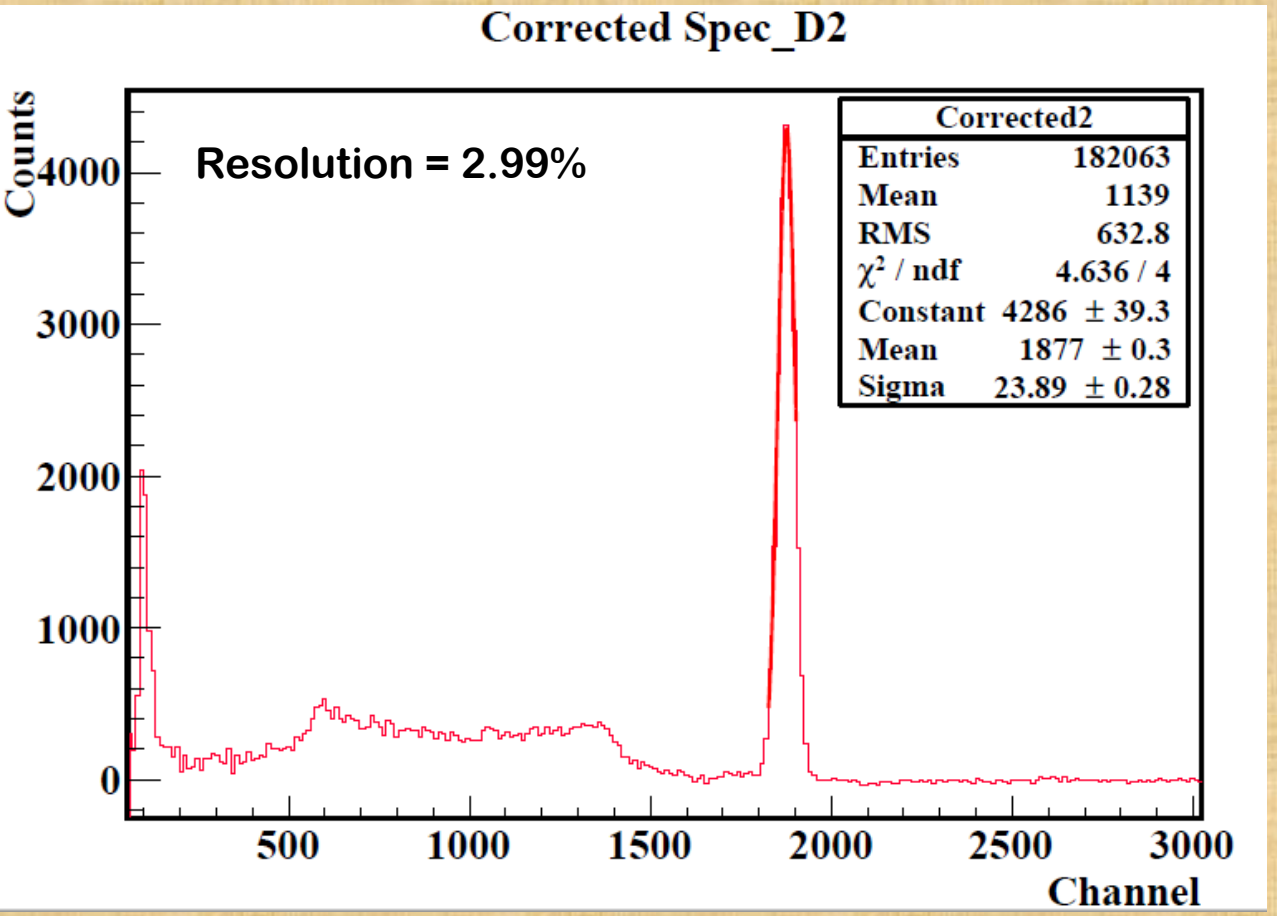
Search for Better Scintillators?

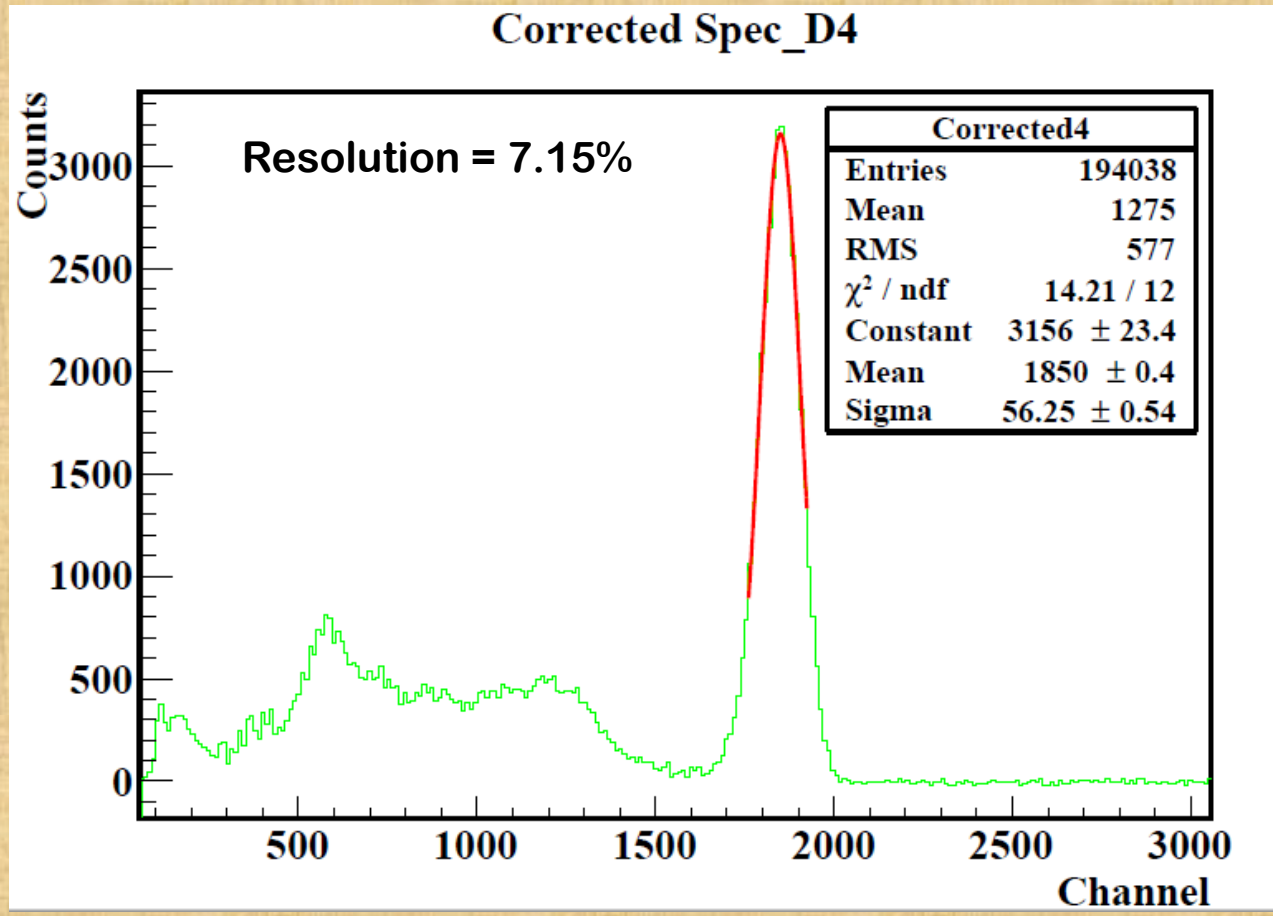
Parameter	NaI(Tl)	CsI(Pure)	$LaBr_3$	BaF_2	CsI(Tl)	$PbWo_4$
Resolution (%)	6 – 7	17 –185	3 – 4	12	4 – 5	
Decay Time (ns)	250	35 (s), 6 (f)	16	0.6 – 0.8 (f) 630 (s)	1000	6
Light Yield (Photons/Mev)	40,000	2000	63,000	1800 (f), 10000 (s)	54,000	200
Wavelength (nm)	415	315	380	180 – 240 (f) 310 (s)	565	420
Density (g/cm^3)	3.67	4.51	5.29	4.88	4.5	8.3

Four Detectors Setup

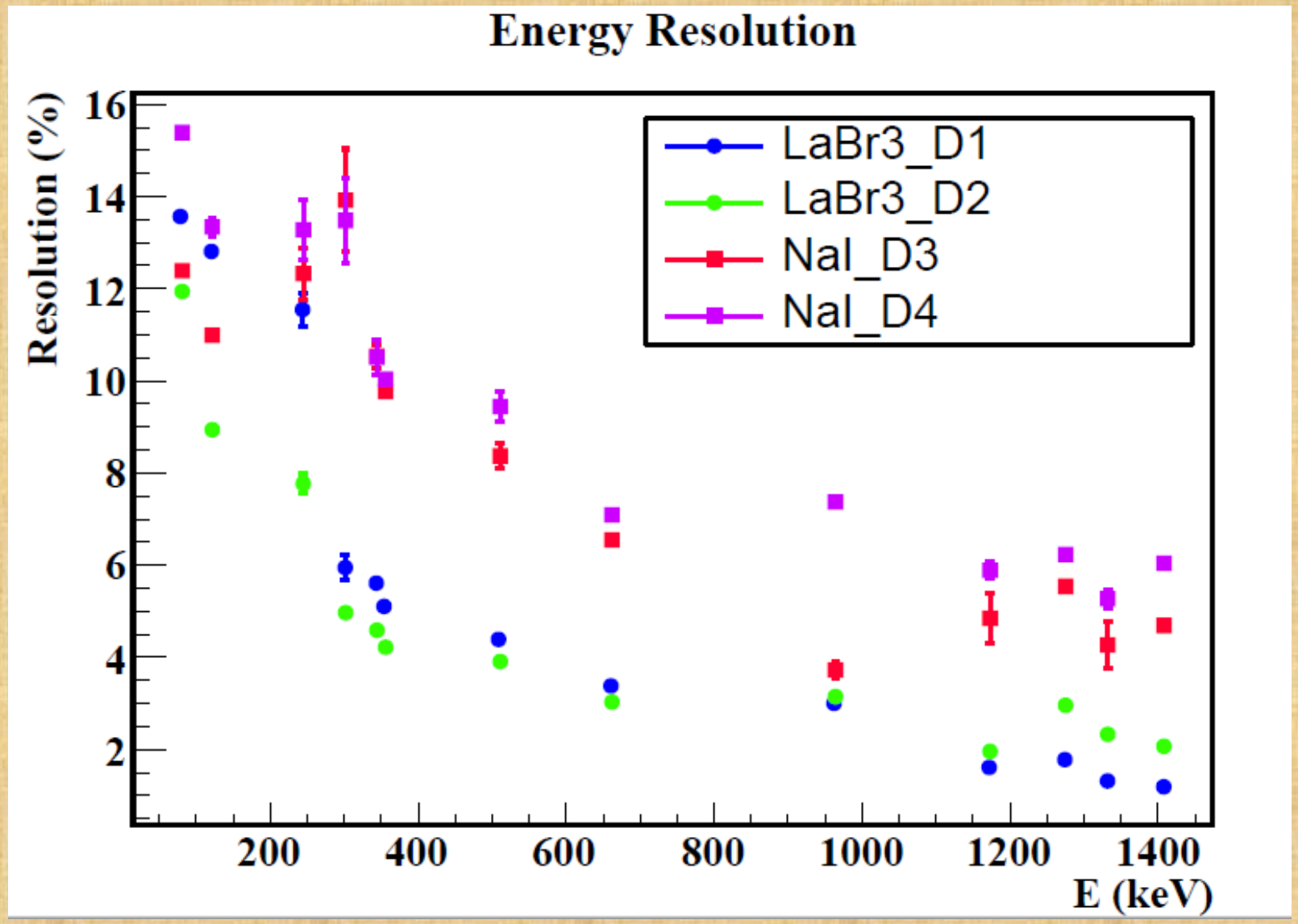


Energy Resolution Comparison

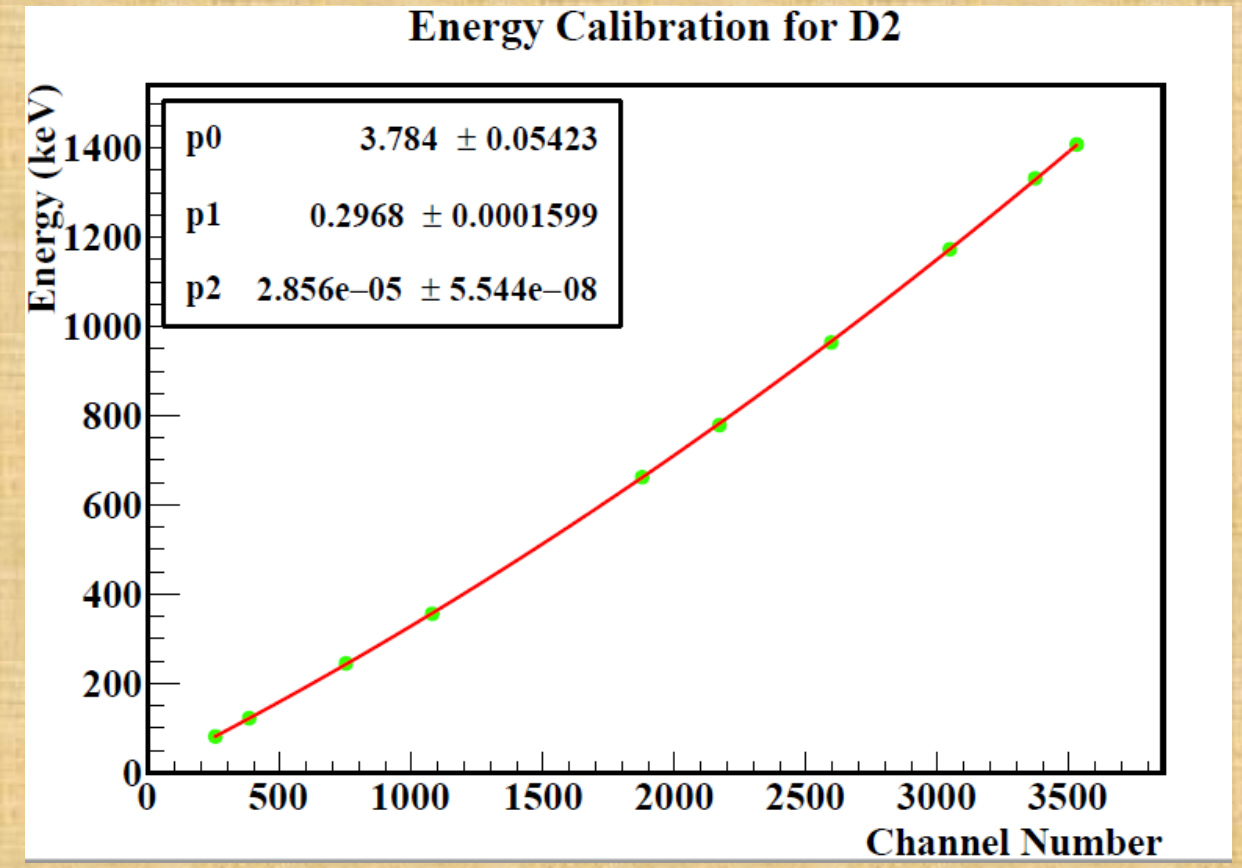




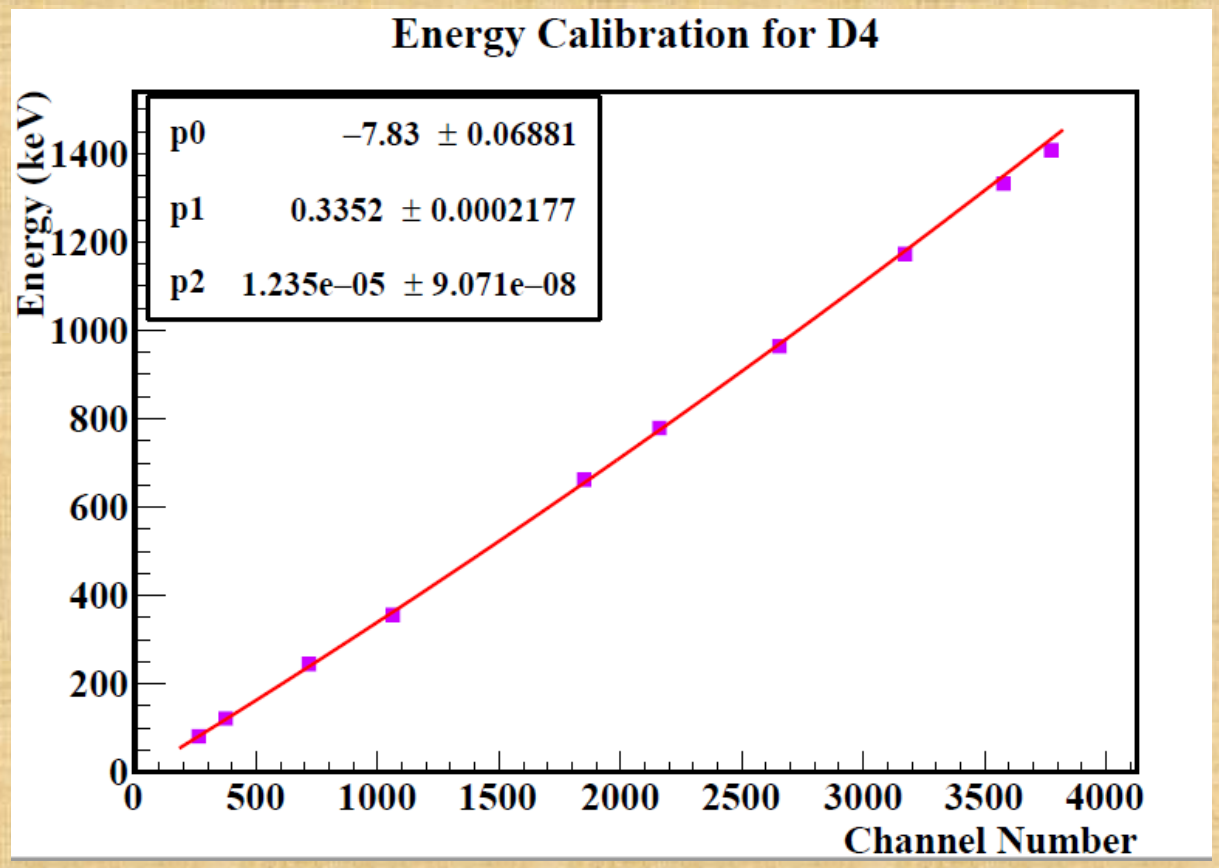
Energy Resolution Comparison



Energy Calibration

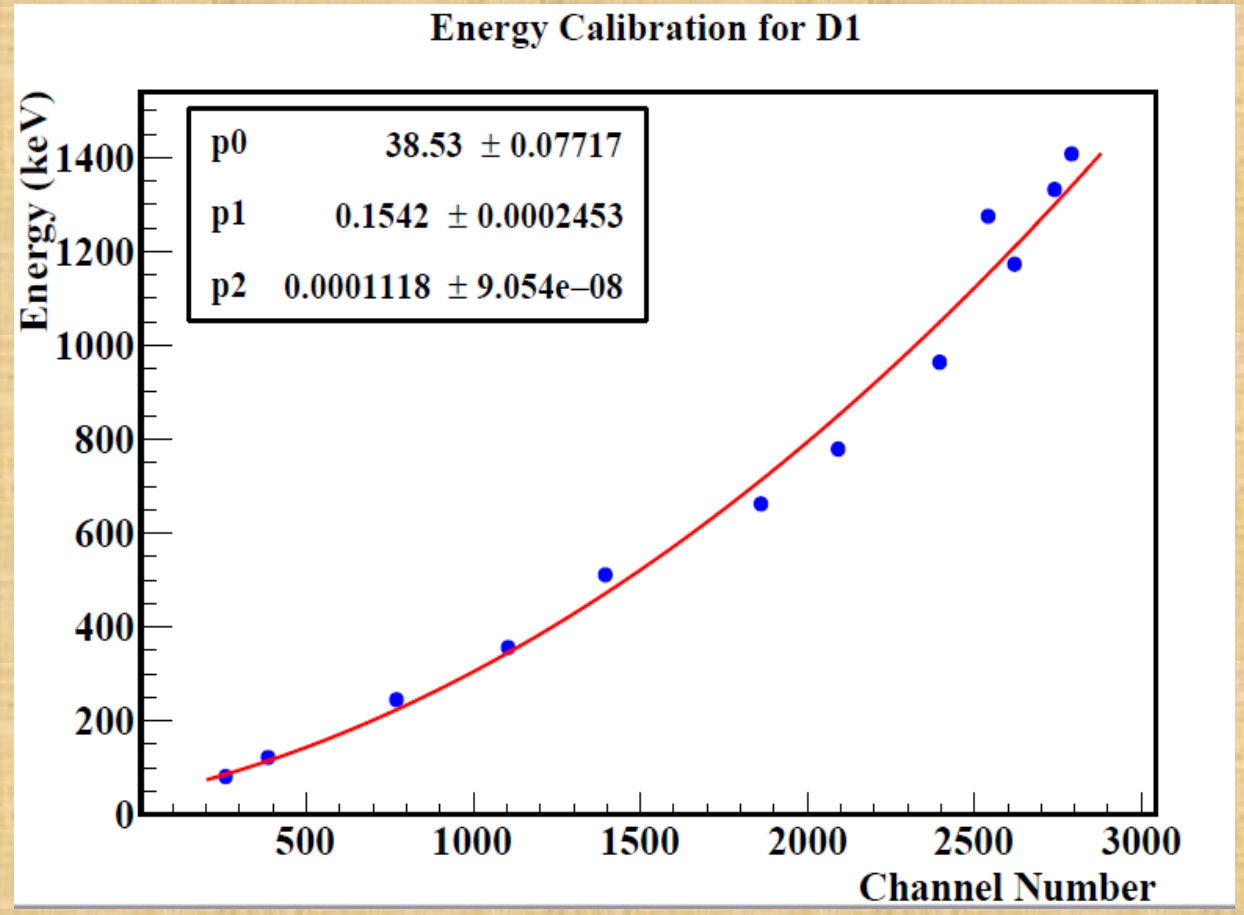


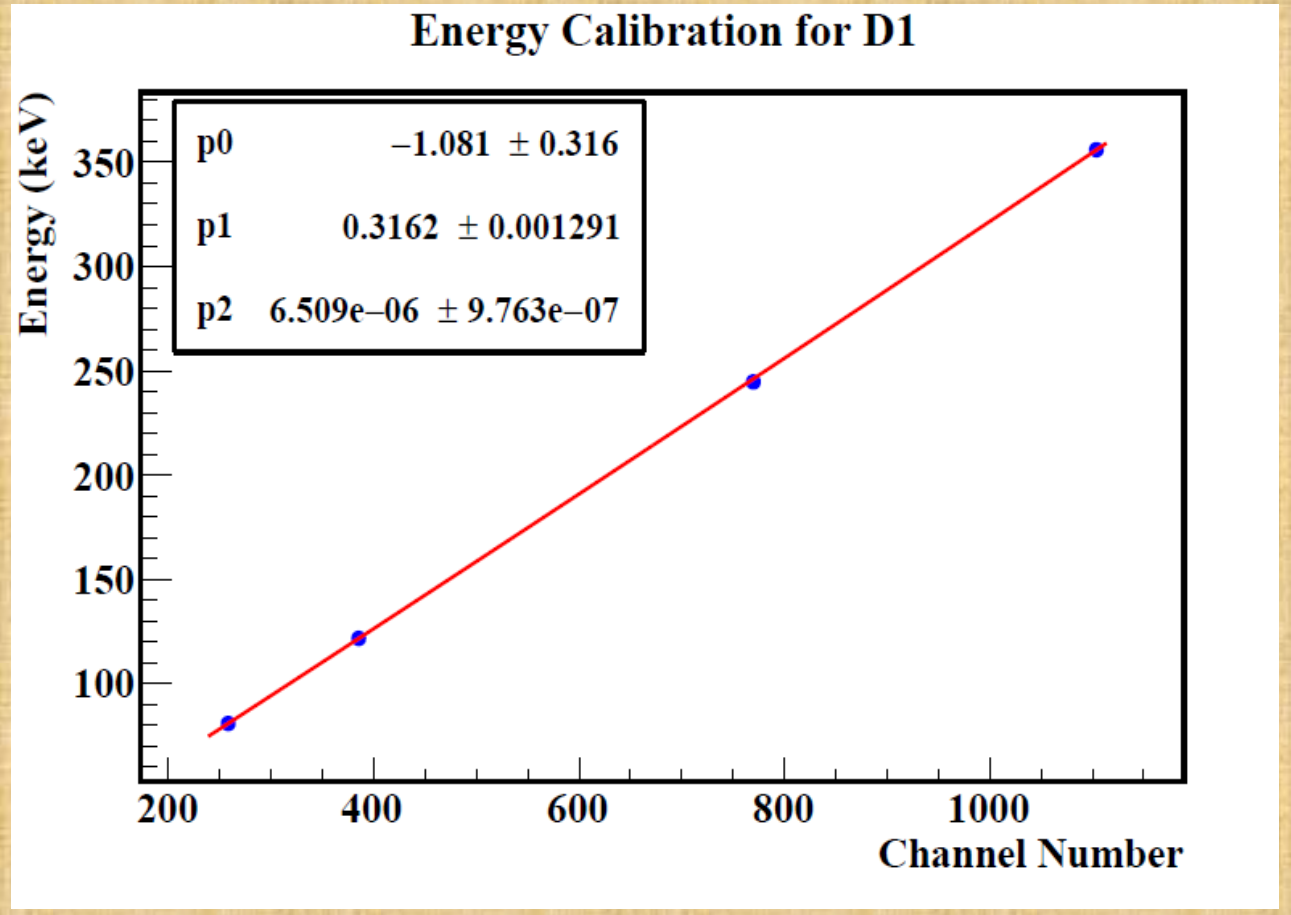
Large LaBr3



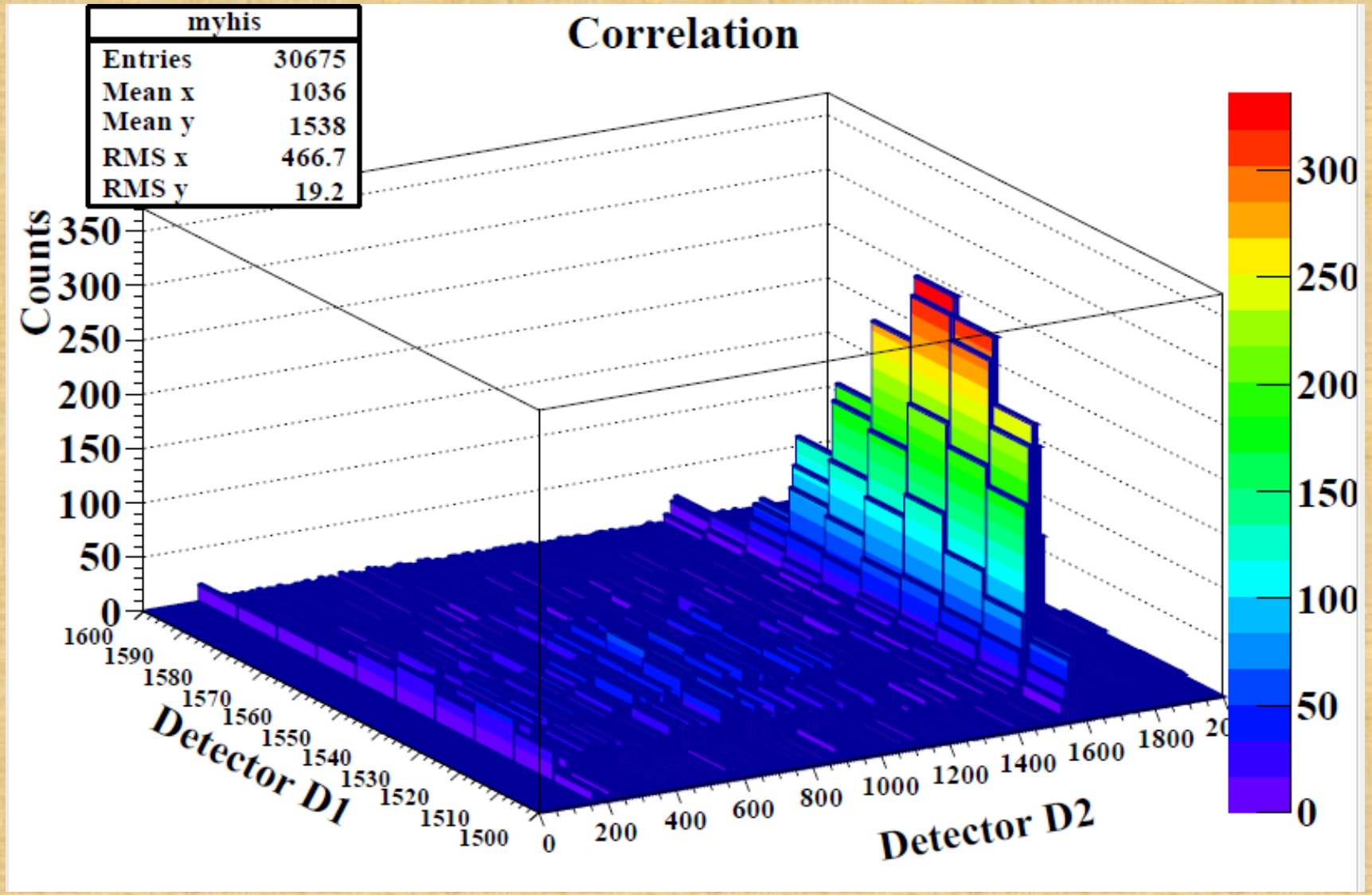
NaI(Tl)

Energy Calibration for Small LaBr3

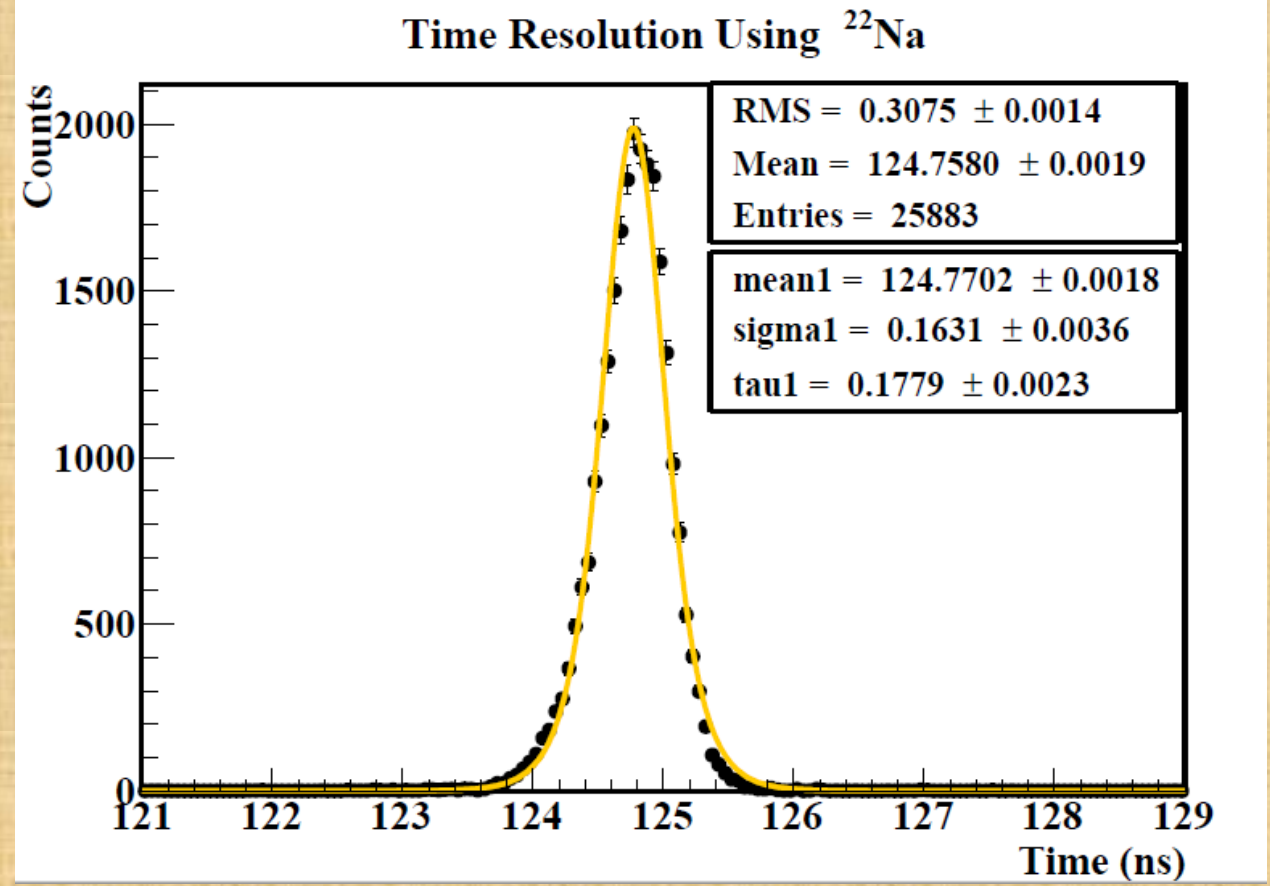




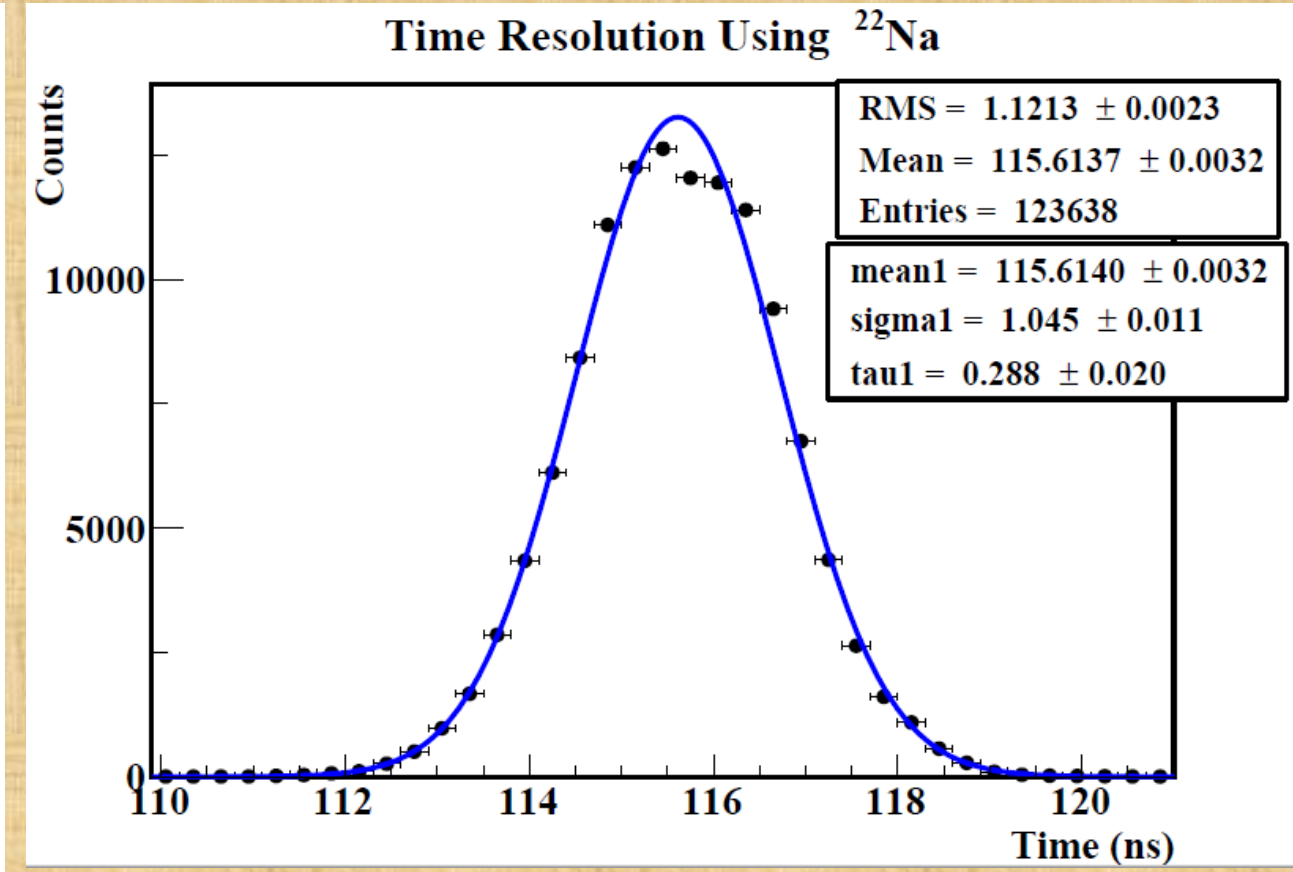
Selection of Coincident Events



Time Resolution



Time Resolution using LaBr3 Detectors

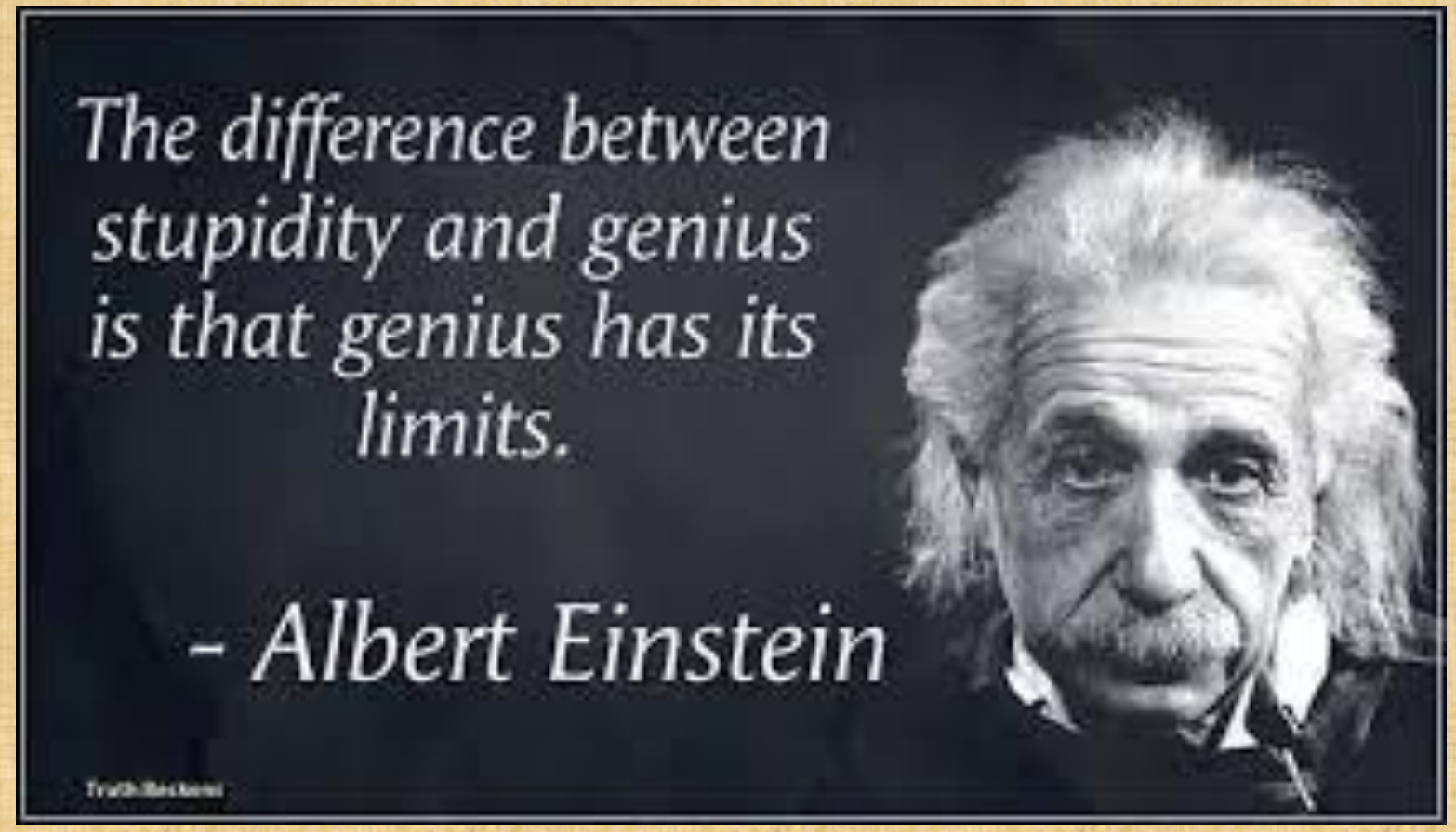


Time Resolution using NaI(Tl) Detectors

Summary and Forward Works

- Time Resolution of the system can indeed be improved by the use of LaBr3 detectors which have faster decay time.
- Low count rate and poor linearity of the small LaBr3 poses some difficulties in the experiment. I plan to replace it by a small square NaI(Tl) detector.
- Currently, an experiment is running to measure the Lifetime of 81 keV state of 133Cs.
- Further Data Analysis will be carried out to determine measurement uncertainties which could include Time Walk effect, Background Contribution, Compton Scattering events etc.
- Correction of these effects could lead to a better System Time Resolution.

THANK YOU FOR LISTENING!!



JAH BLESS YOU!!

Backup

Accidental Coincidence and Selection of Peak Region

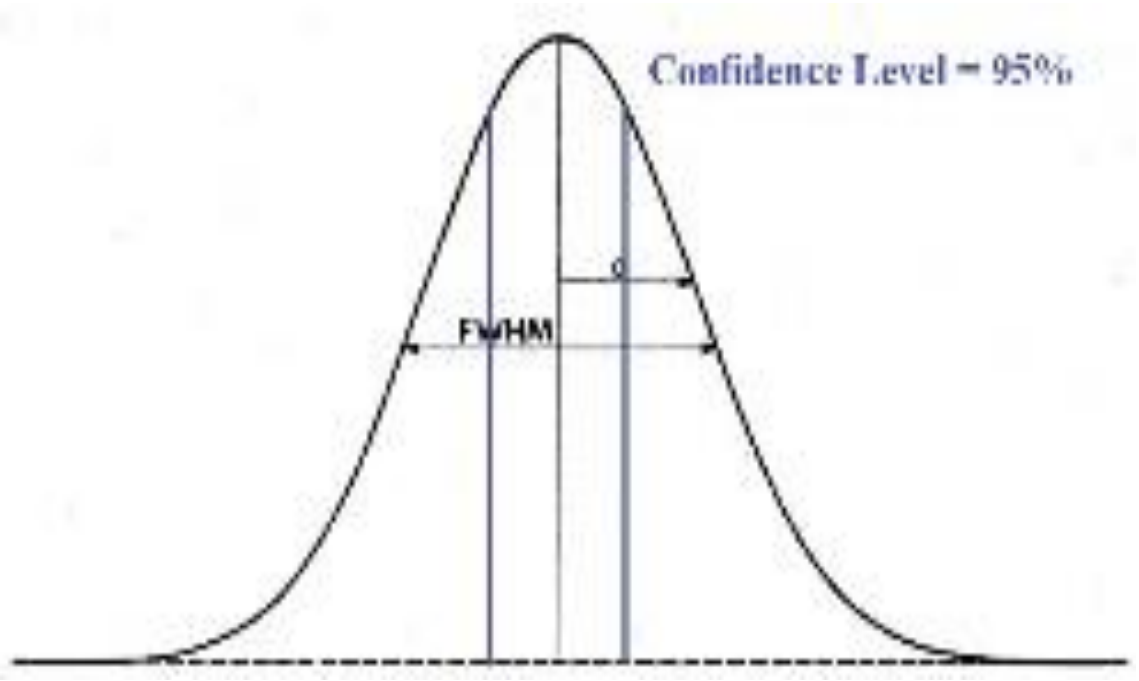
The ratio of True coincident events to Accidental coincident events is calculated as;

$$N_0 = 7955Bq$$
$$\tau = 107ns$$

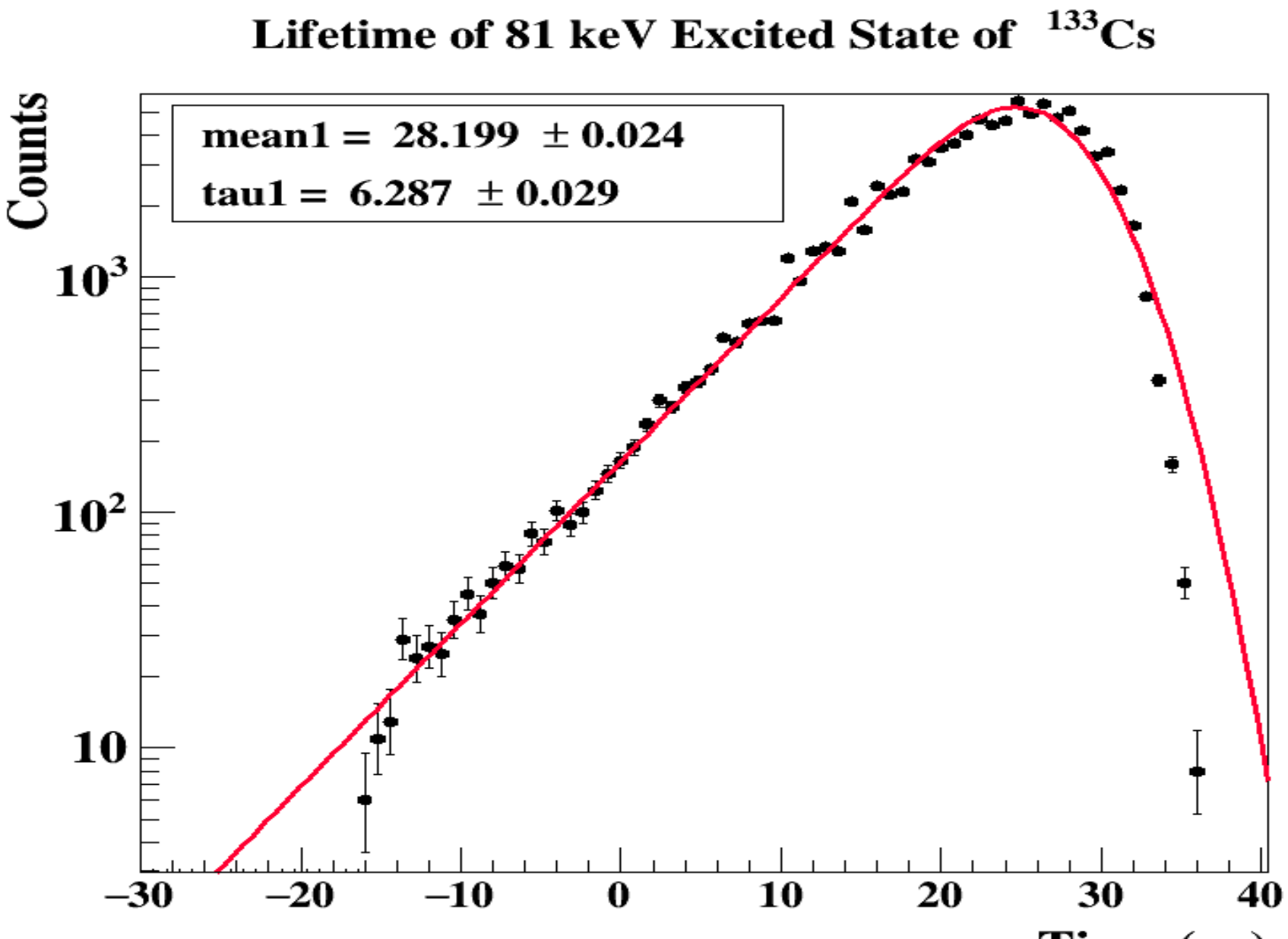
$$\frac{N_C}{N_A} = \frac{1}{2N_0\tau} = 587$$

Offline selection of coincident peaks is done using the following range,

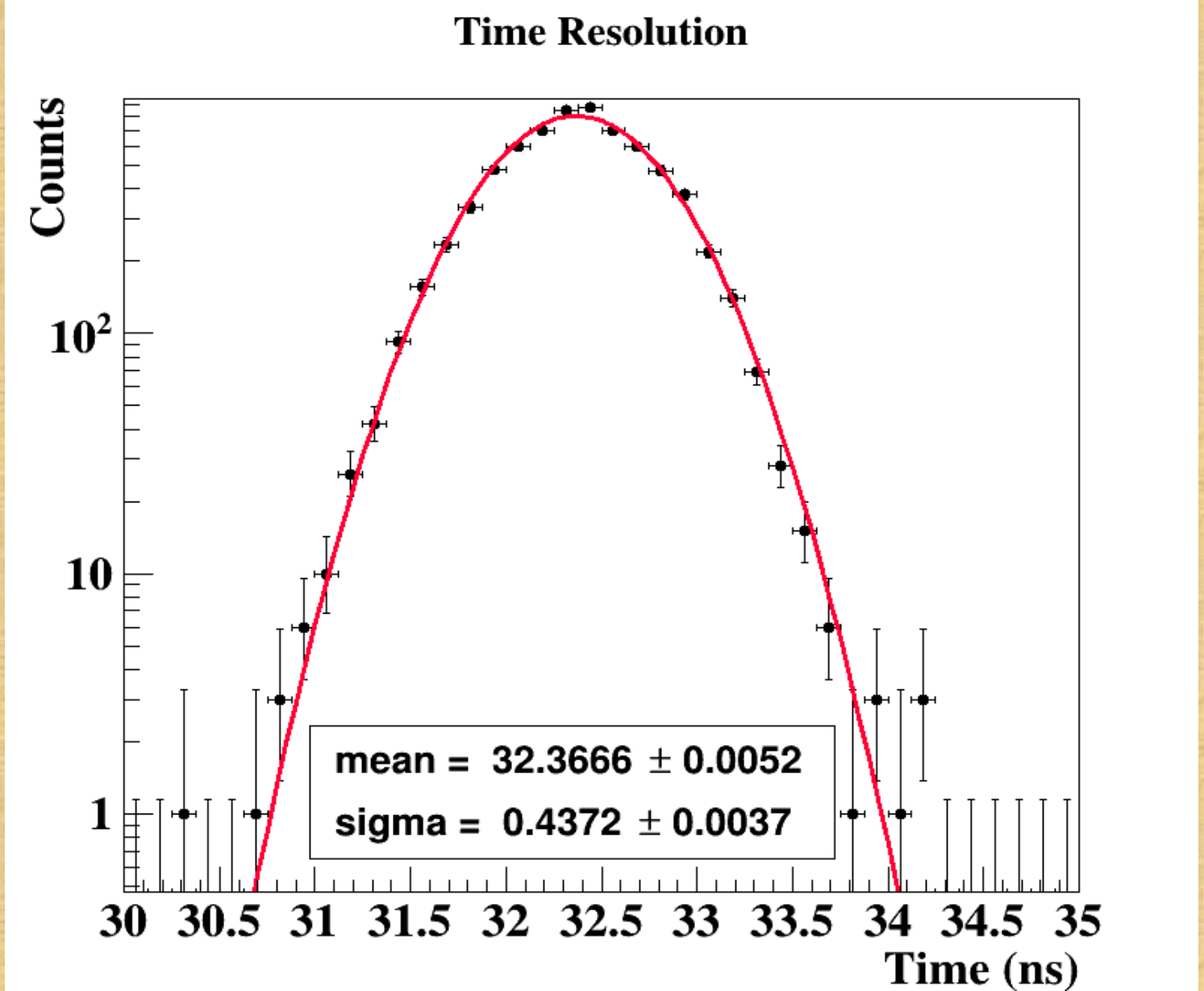
$$R = (\mu - 1.645\sigma, \mu + 1.645\sigma)$$



Lifetime of 81 keV state using 2nd Transition



Time Resolution of the System



- An advantage is taken of the fact that the lifetime of the 1173 keV state of Co-60 is very short.

- With the results shown in the picture on the left,

Resolution = FWHM = 1.03ns