

LYSO CERN Beam Test Material Effect and Energy Dependence

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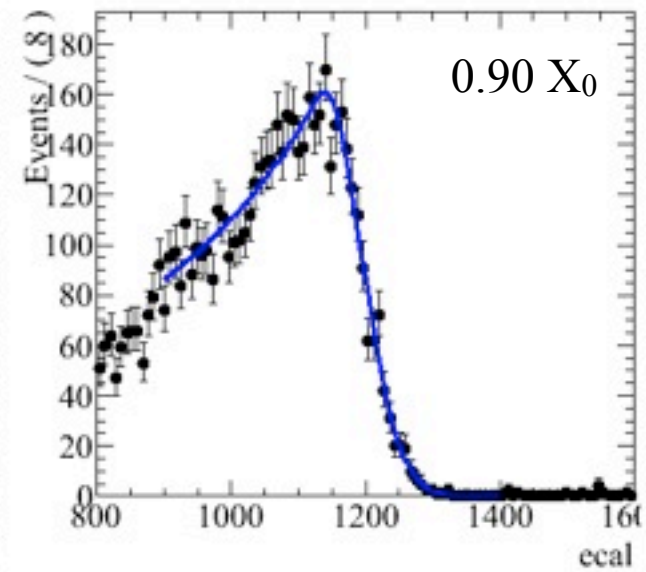
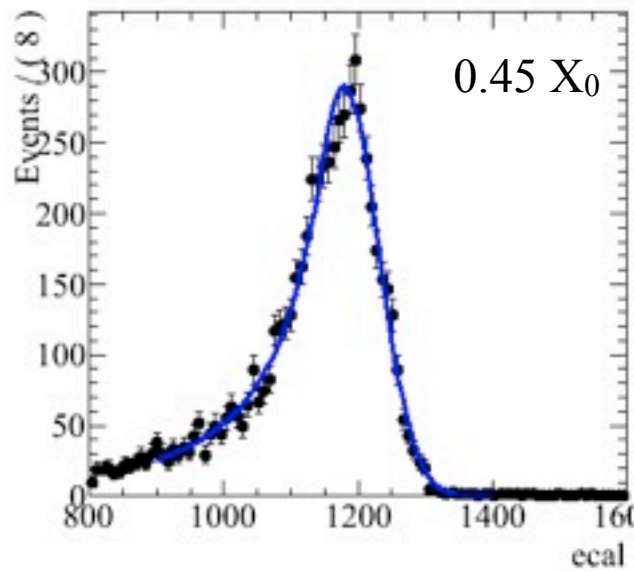
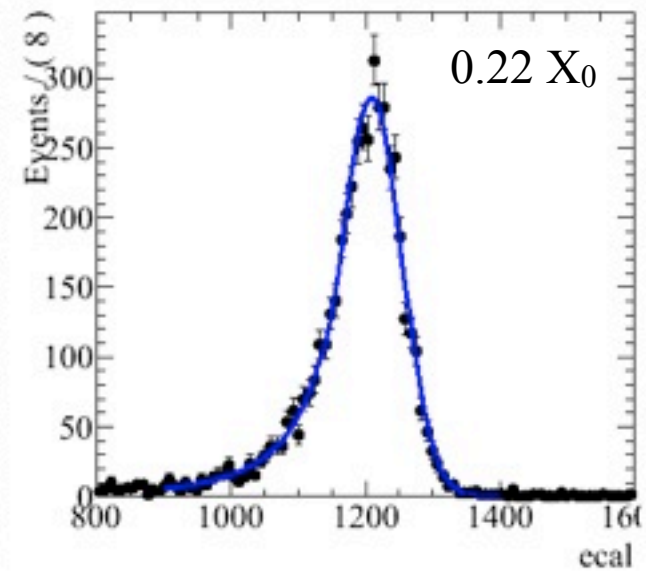
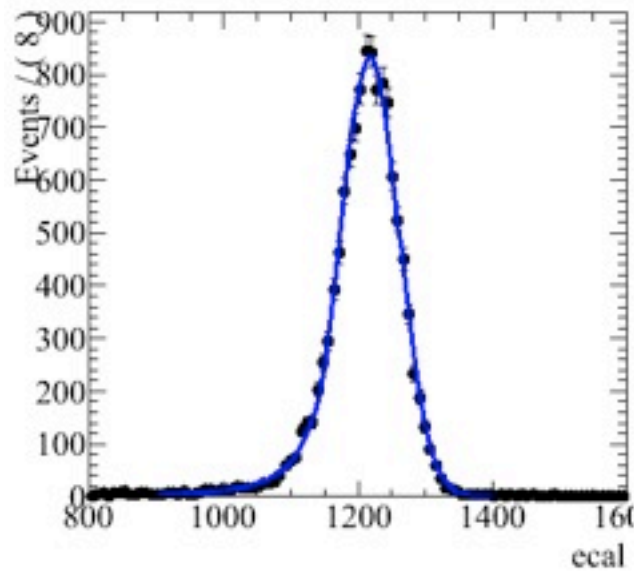
Material

Aluminum blocks (~3feet? away)		
run	thickness	X0
350	0	0
393	20 mm	0.22
395	2×20 mm	0.45
392	4×20 mm	0.90

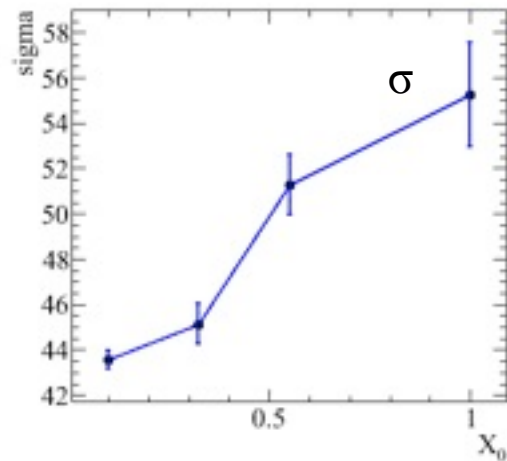
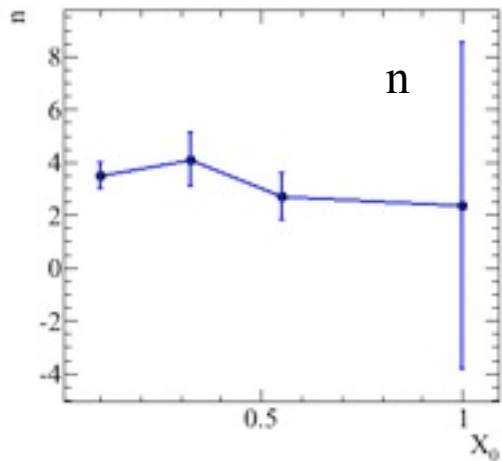
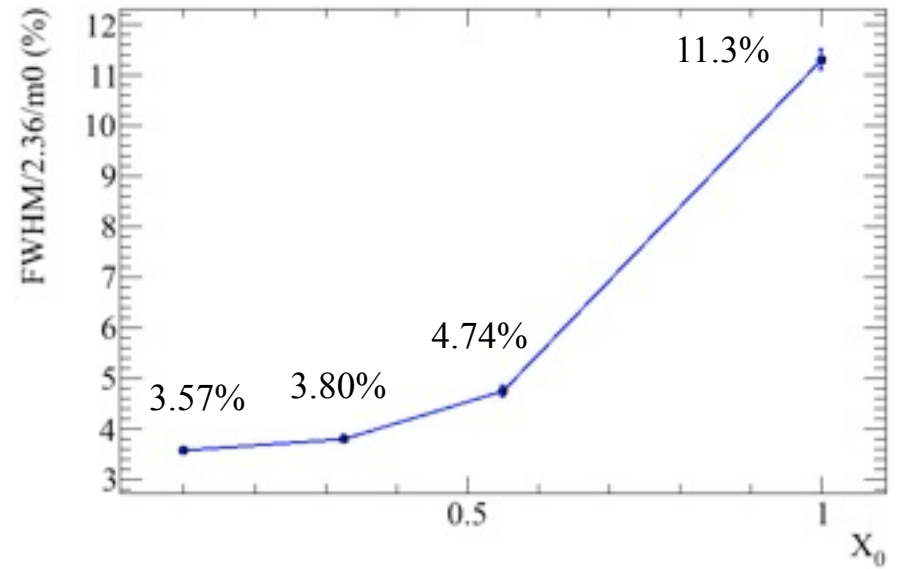
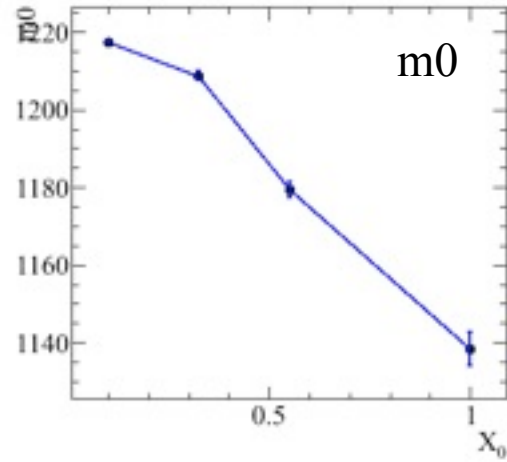
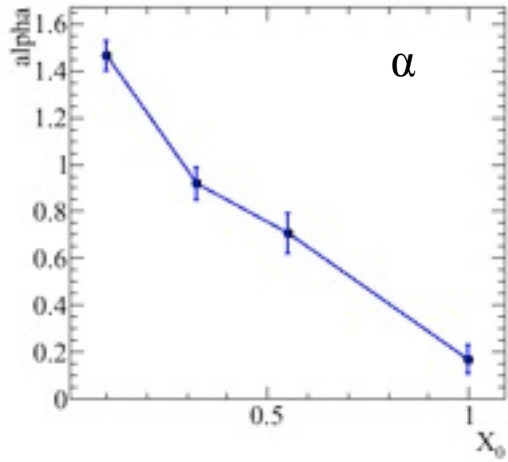
Quartz plates (close to the box)		
run	thickness	X0
407	0	0
405	5 mm	0.041
404	15 mm	0.122
403	30 mm	0.244

- 1-GeV beam
- High APD gain
- Temperature correction: $-2\%/^{\circ}\text{C}$
 - ▶ Use sensor #0
- Fit Crystal Ball function
- Also calculate FWHM using the fitted curve.

Aluminum blocks

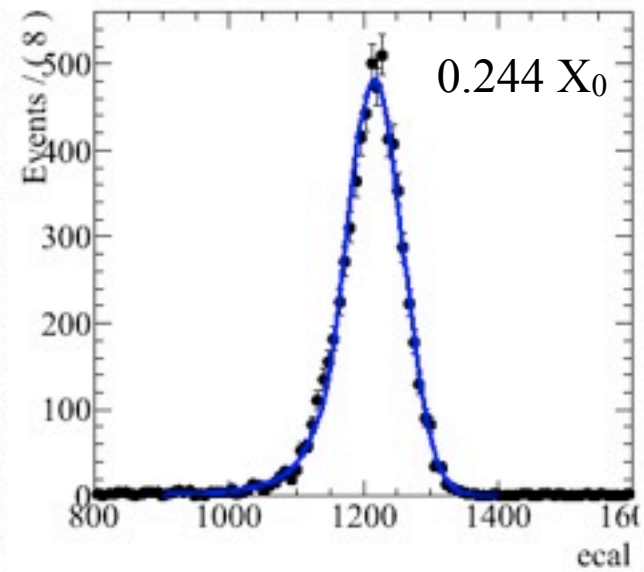
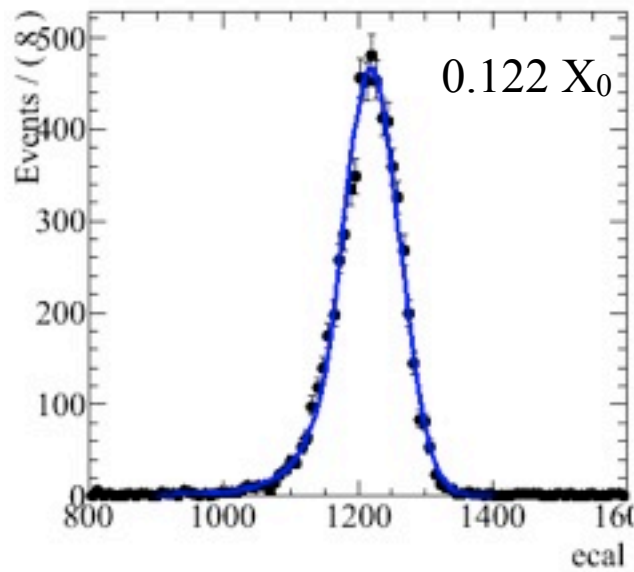
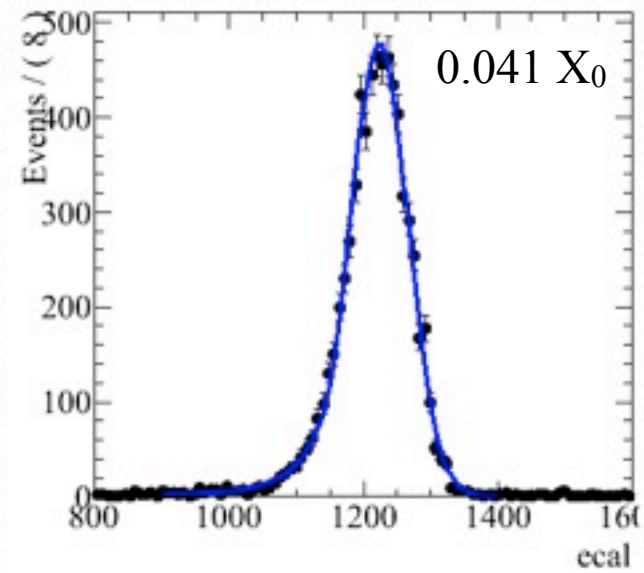
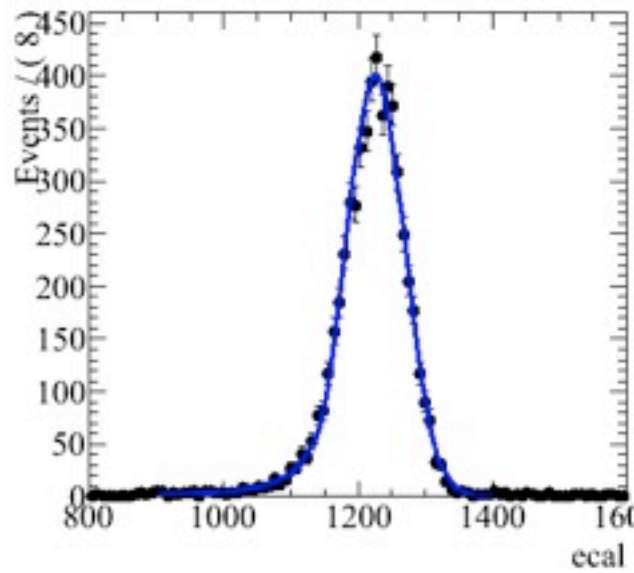


Dependence

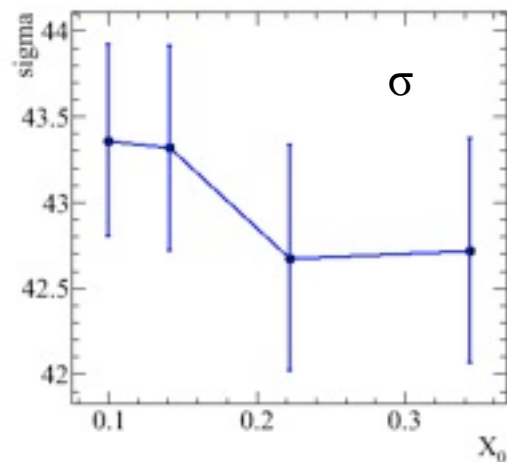
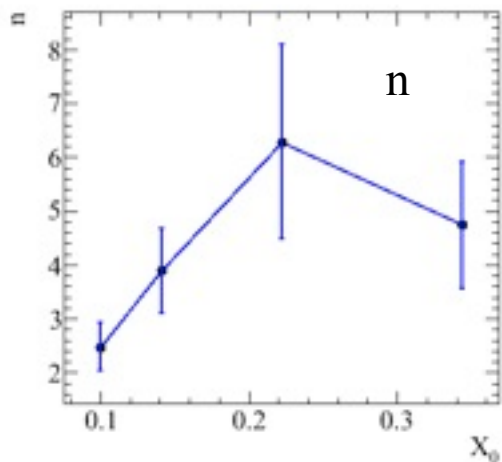
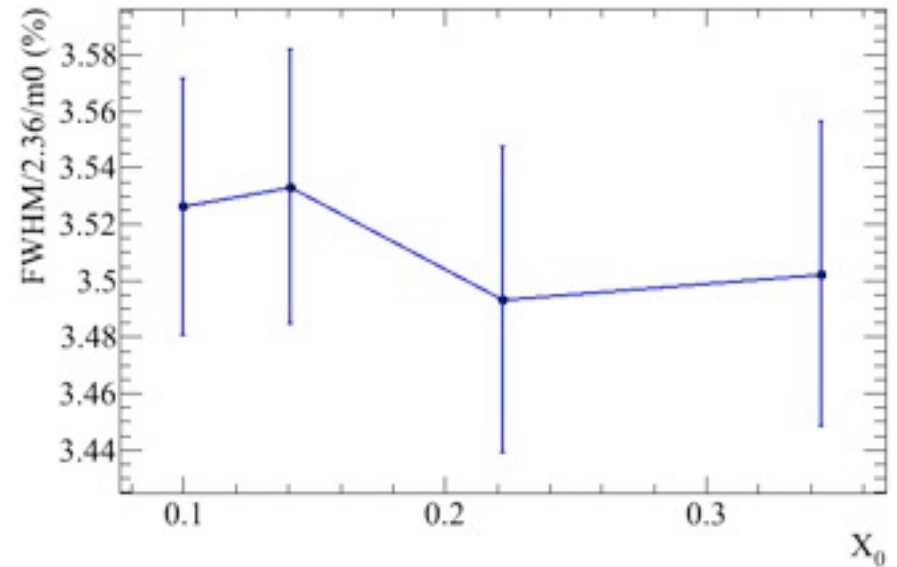
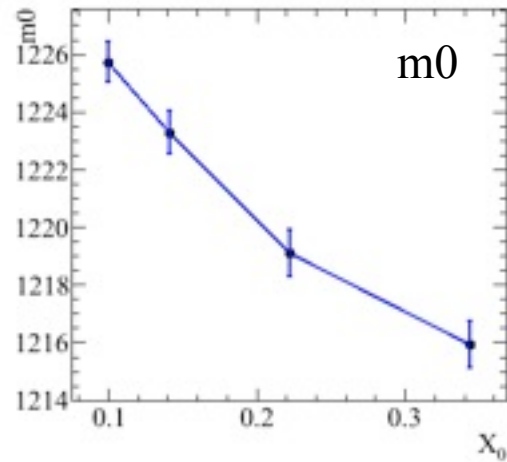
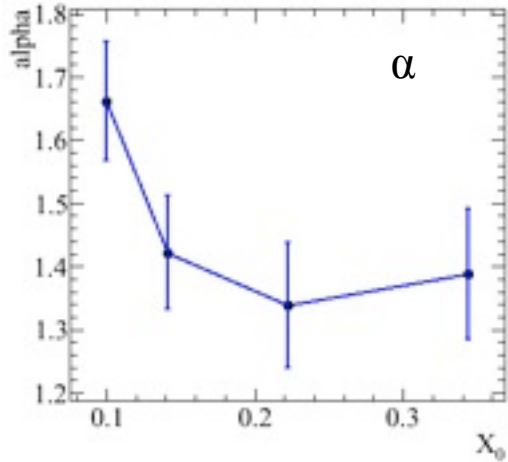


X-axis shifted by 0.1 X_0

Quartz plates



Dependence

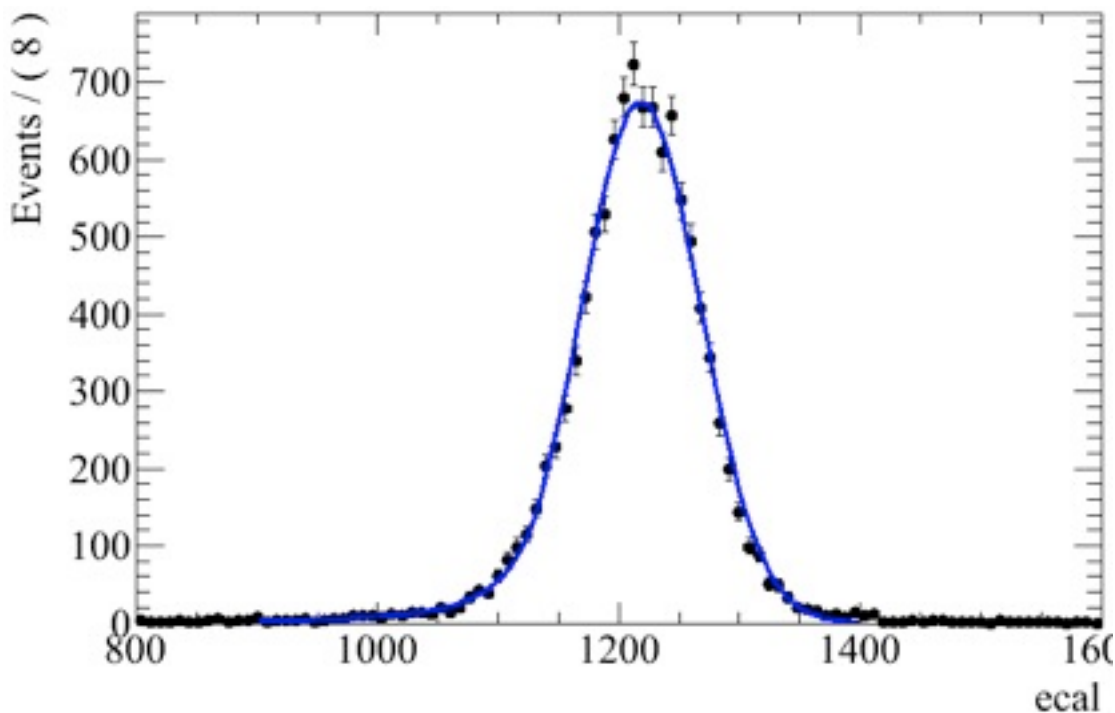


X-axis shifted by $0.1 X_0$

Effect of quartz not visible.

Active quartz bar

- Run 447. Radiation length?



Floating Parameter	FinalValue	+/-	Error
alpha	1.7777e+00	+/-	8.79e-02
m0	1.2184e+03	+/-	5.56e-01
n	2.9399e+00	+/-	5.68e-01
sigma	4.9504e+01	+/-	4.48e-01

Core resolution= 4.06 +/- 0.04 %
FWHM/2.36 = 49.36
FWHM/2.36/mean= 4.05 %

Worse than 0.22 X₀ Al block

Energy dependence

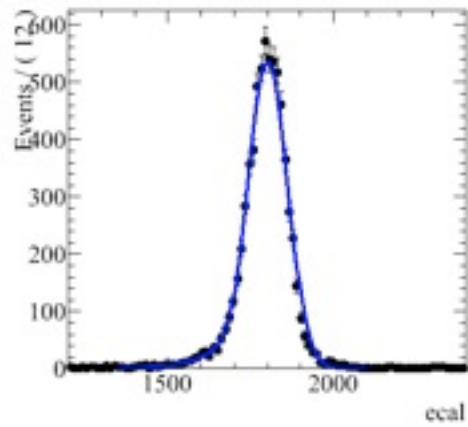
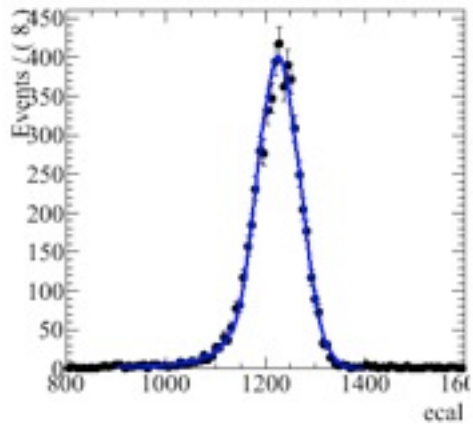
High APD Gain	
run	Energy
407	1 GeV
437	1.5 GeV
429	2 GeV

Low APD Gain	
run	Energy
448	1 GeV
456	1.5 GeV
442	2 GeV
455	3 GeV

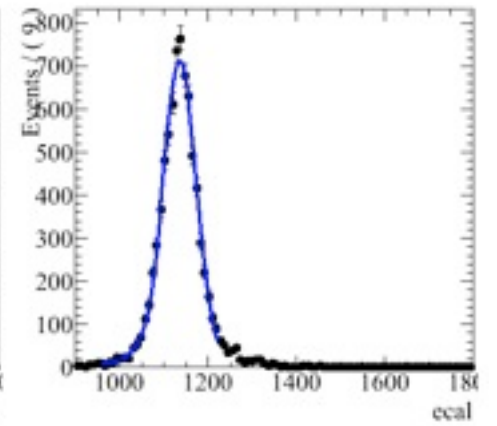
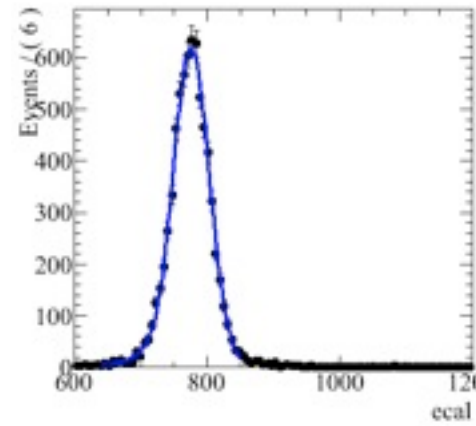
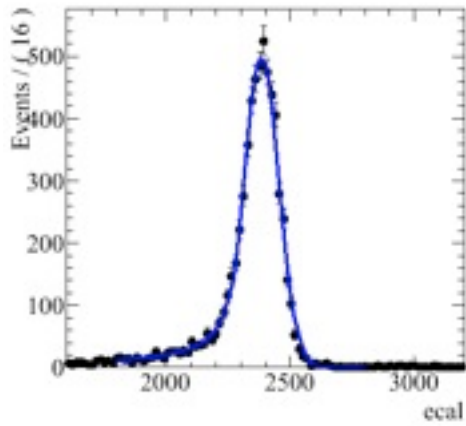
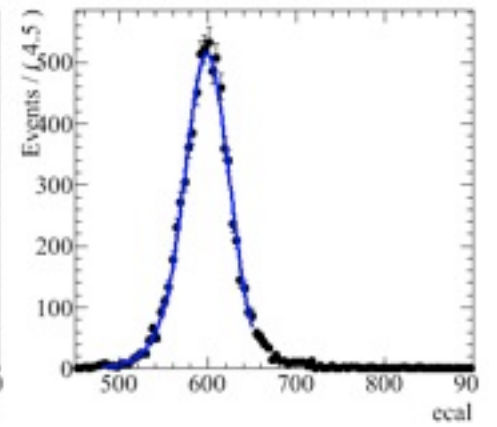
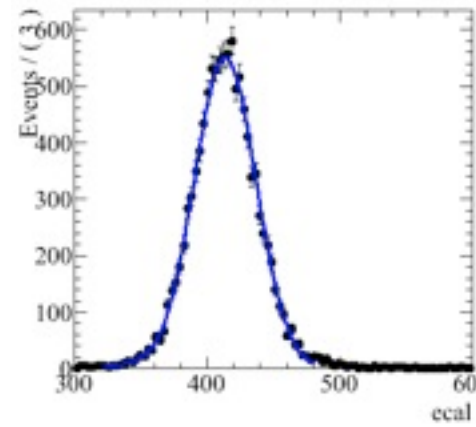
- Temperature correction: $-2\%/^{\circ}\text{C}$ for high gain, $-1\%/^{\circ}\text{C}$ for low gain.
- Fit Crystal Ball function
- Also calculate FWHM using the fitted curve.

Fits

high gain

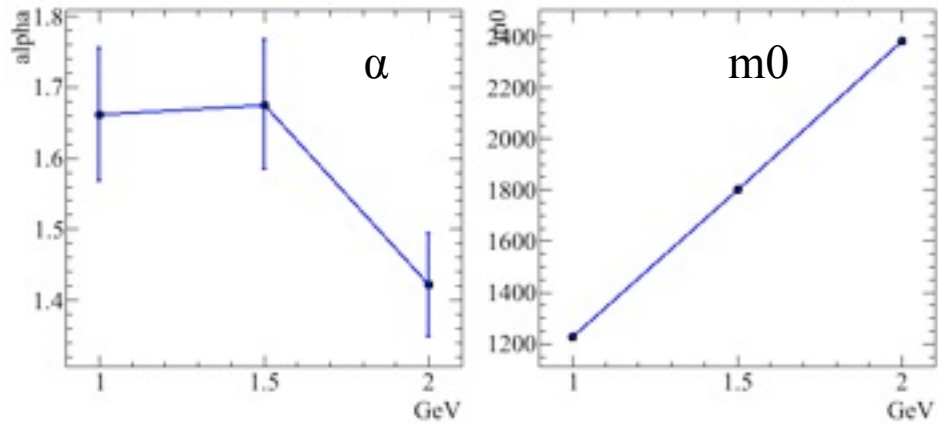


low gain

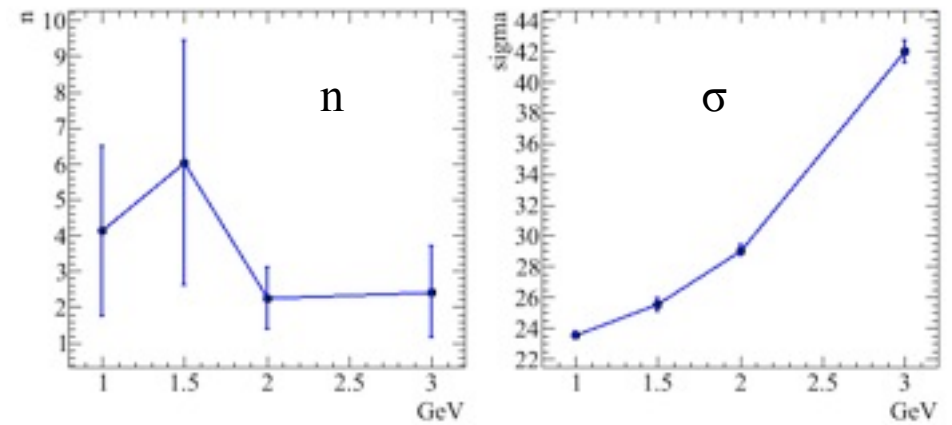
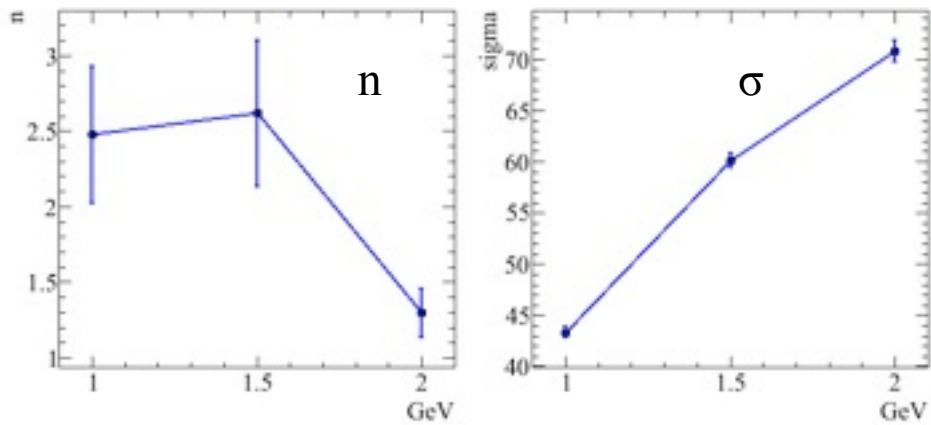
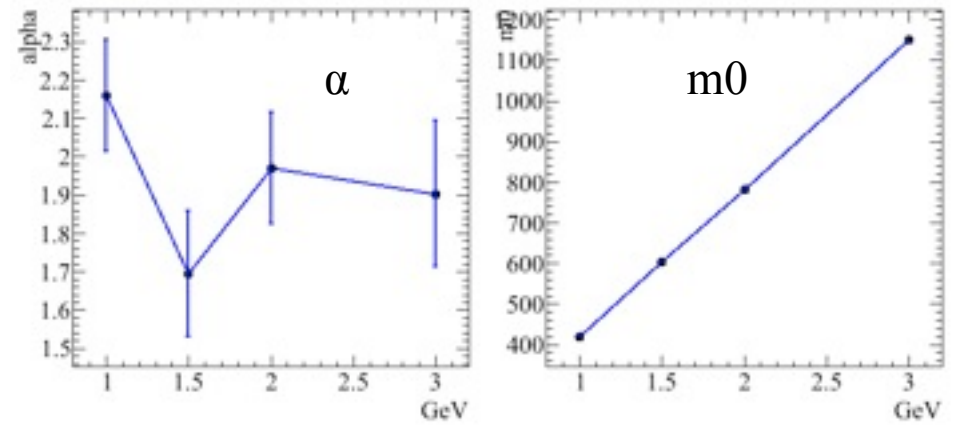


Parameters

high gain

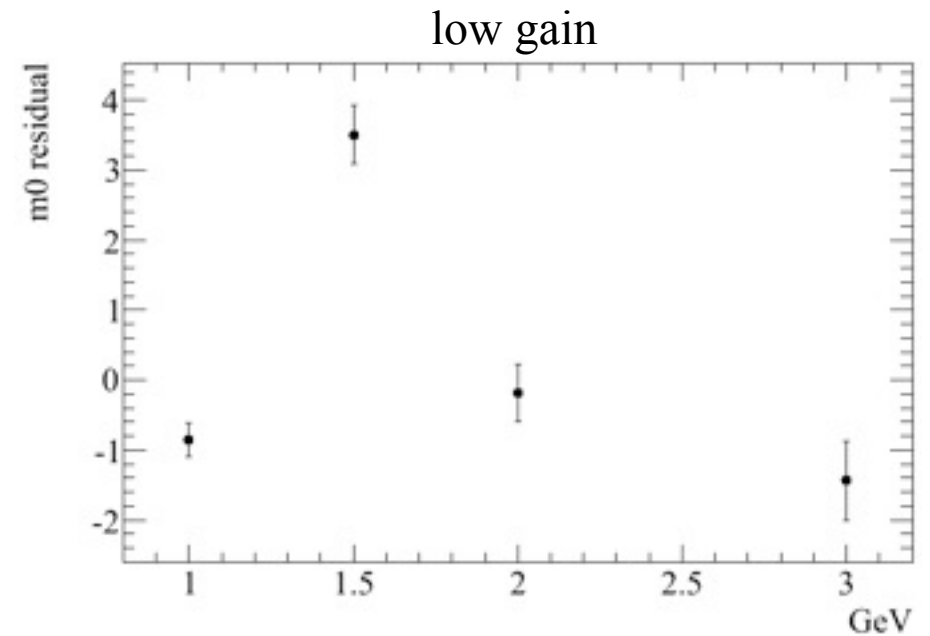
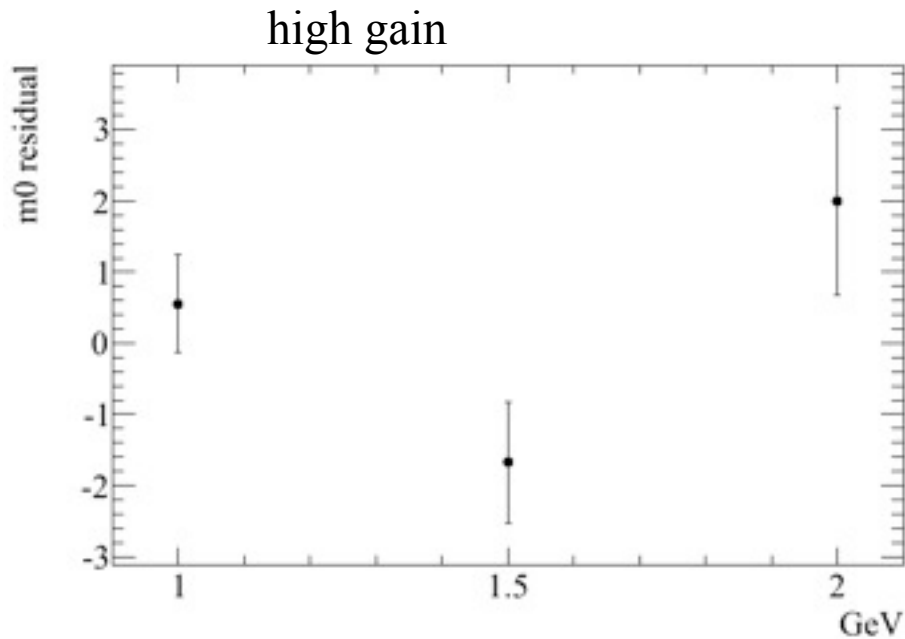


low gain



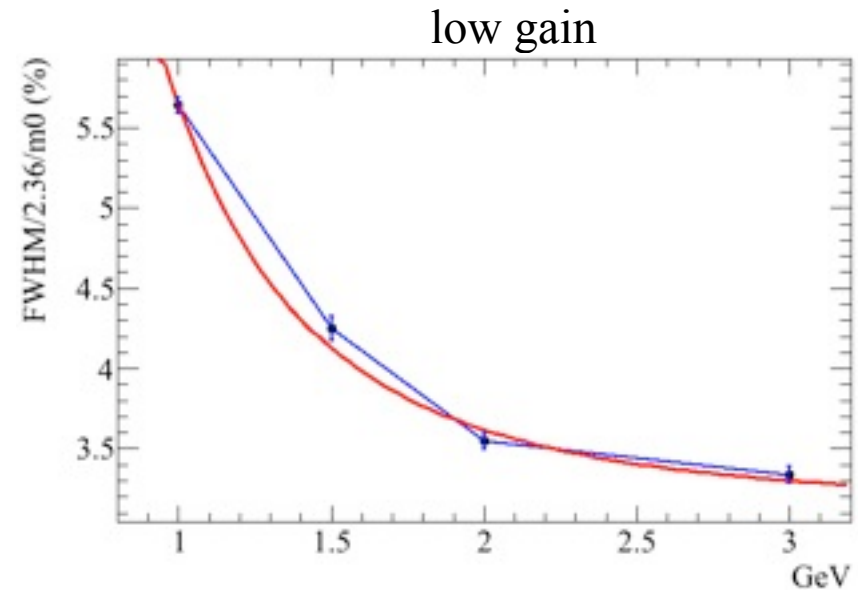
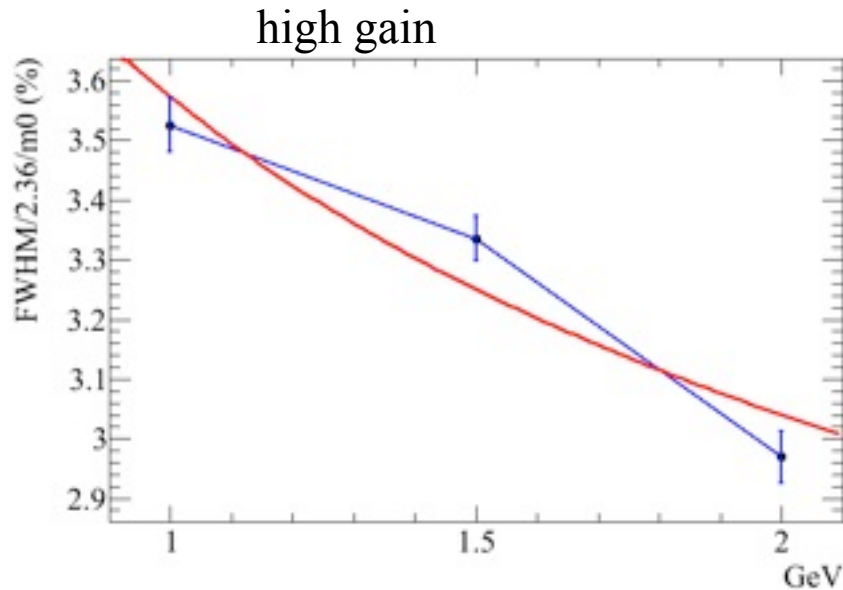
Linearity

- Fit m_0 to a line. Plot residual.



	high gain	low gain
offset	69.5 ± 1.9	52.9 ± 0.4
slope	1155.7 ± 1.4	361.4 ± 0.3

Resolution dependence on energy



- Fit to $\frac{b}{E^p} \oplus a$

$$\begin{aligned} a &= 0.0 \pm 2.1 \\ b &= 3.57 \pm 0.04 \\ p &= 0.23 \pm 0.03 \end{aligned}$$

$$\begin{aligned} a &= 3.14 \pm 0.09 \\ b &= 4.70 \pm 0.08 \\ p &= 1.38 \pm 0.13 \end{aligned}$$

Conclusions

- Have investigated material effect (Al blocks and quartz plates) and energy dependence.
- Large effect from Al blocks from some distance away.
- No effect from quartz plates (up to $1/4 X_0$) right in front of the crystal box.
- Fit to energy dependence shows very different behaviors between low and high gain runs.