

27.03.2019



Beam Test @CNAO 10.03.19



FOOT Meeting

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Where were we ..

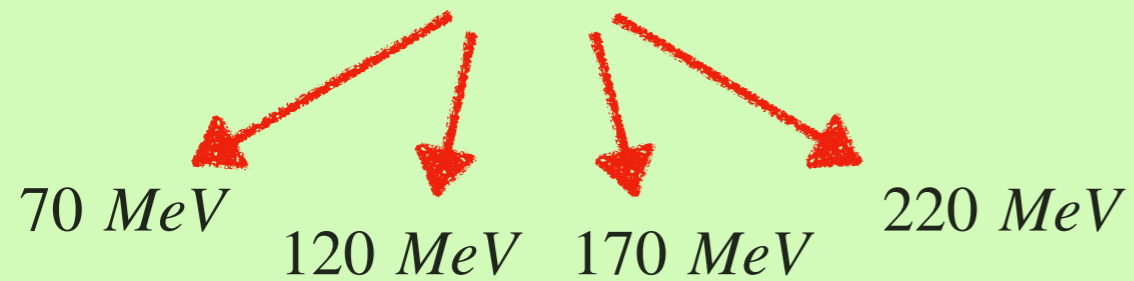


	October	March
Tile	15, 20, 30 μm	15, 20 μm
Wrapping	Alluminium	Reflective Paint
Board	V0	V1
Digitizer	1 GHz $V_{pp} = 1\text{V}$ 12 bits	62.5 MHz $V_{pp} = 10\text{V}$ 12 bits
Trigger	Self-Trigger	External
Fan IN/OUT		

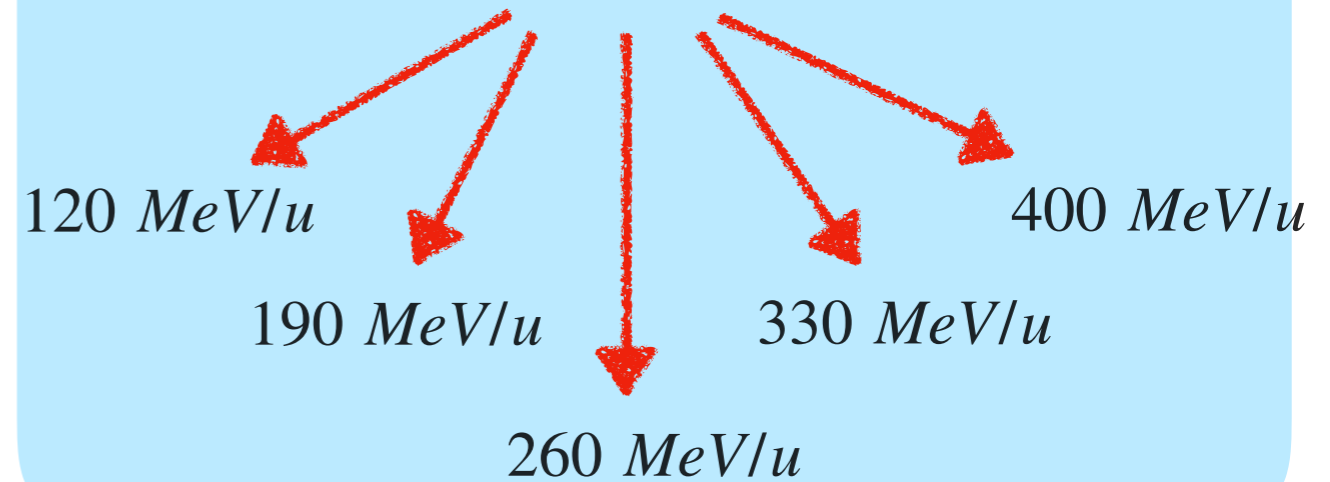
Beam Test Overview



Proton Beam:



Carbon Beam:



15 μm
20 μm

coupled to



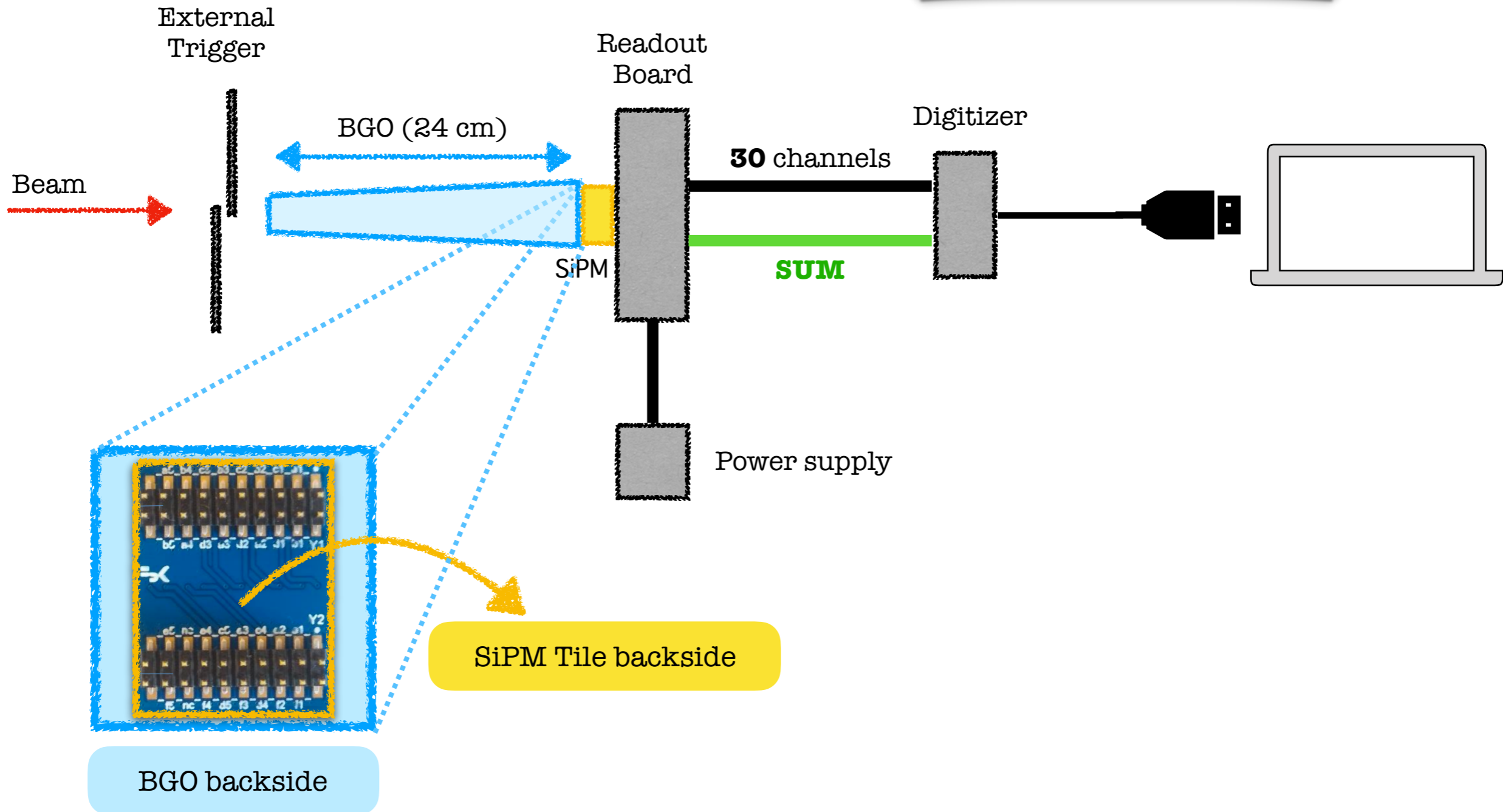
BGO with black tape
+ Reflective Paint



Experimental Setup



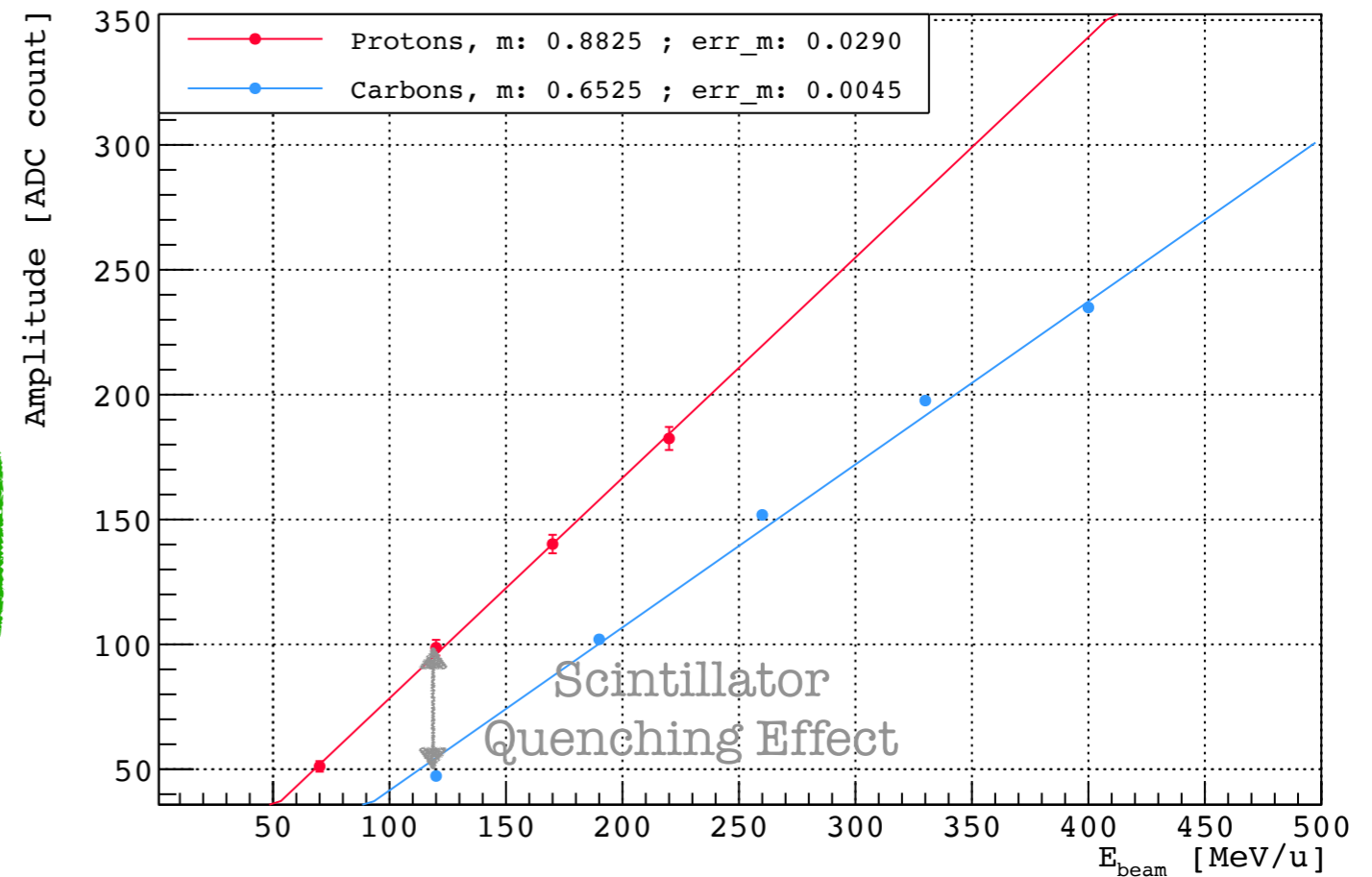
SiPM Tile from FBK
pitch: 15-20 μm
breakdown voltage: 28 V
bias voltage: 34 V



Linearity

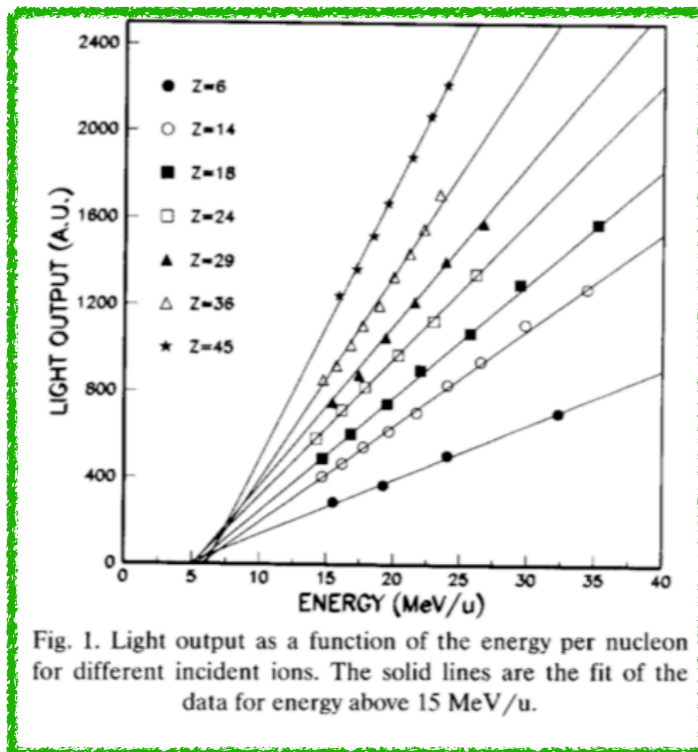


Linearity - **Amplitude** Analysis - 15 μm SiPM array



15 μm

“Calibration of CsI(Tl) scintillators for heavy ions ($3 \leq Z \leq 54$) in a wide energy range ($E/u \leq 60 \text{ MeV/u}$)”,
P. Mastinu, P. Milazzo, M. Bruno, M. D’Agostino, L.Manduci



Birks Formula

$$dL/dx = cost \cdot \frac{dE/dx}{1 + kB \cdot dE/dx}$$

where:

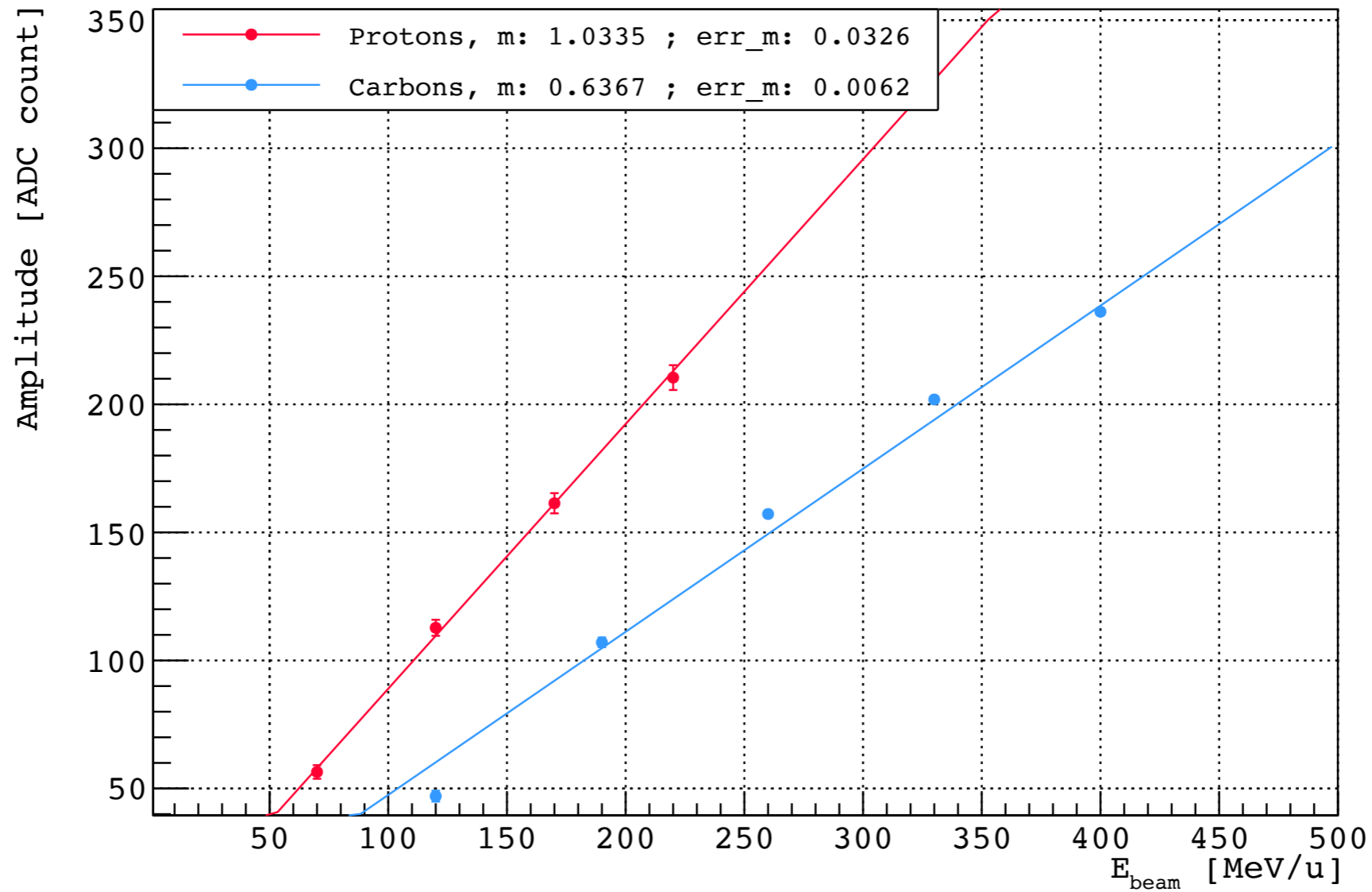
- **k** is the Quenching Parameter
- **BdE/dx** is the density of quenching centres per unit distance

Linearity



20 μm

Linearity - **Amplitude** Analysis - 20 μm SiPM array

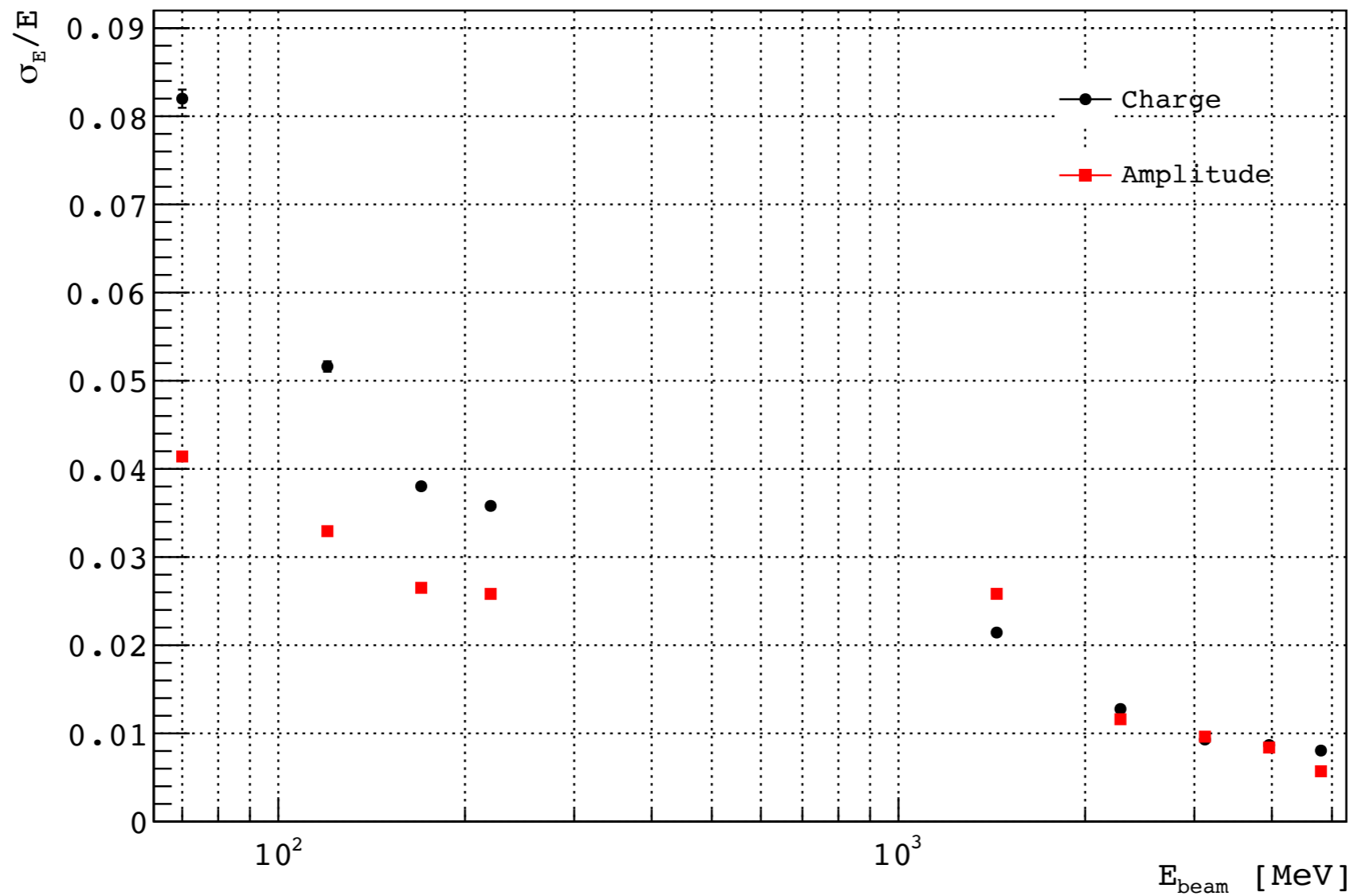


Energy Resolution

15 μm

Comparison between Amplitude & Charge Analysis:

Energy Resolution - **Amplitude & Charge** Analysis - 15 μm SiPM arrays

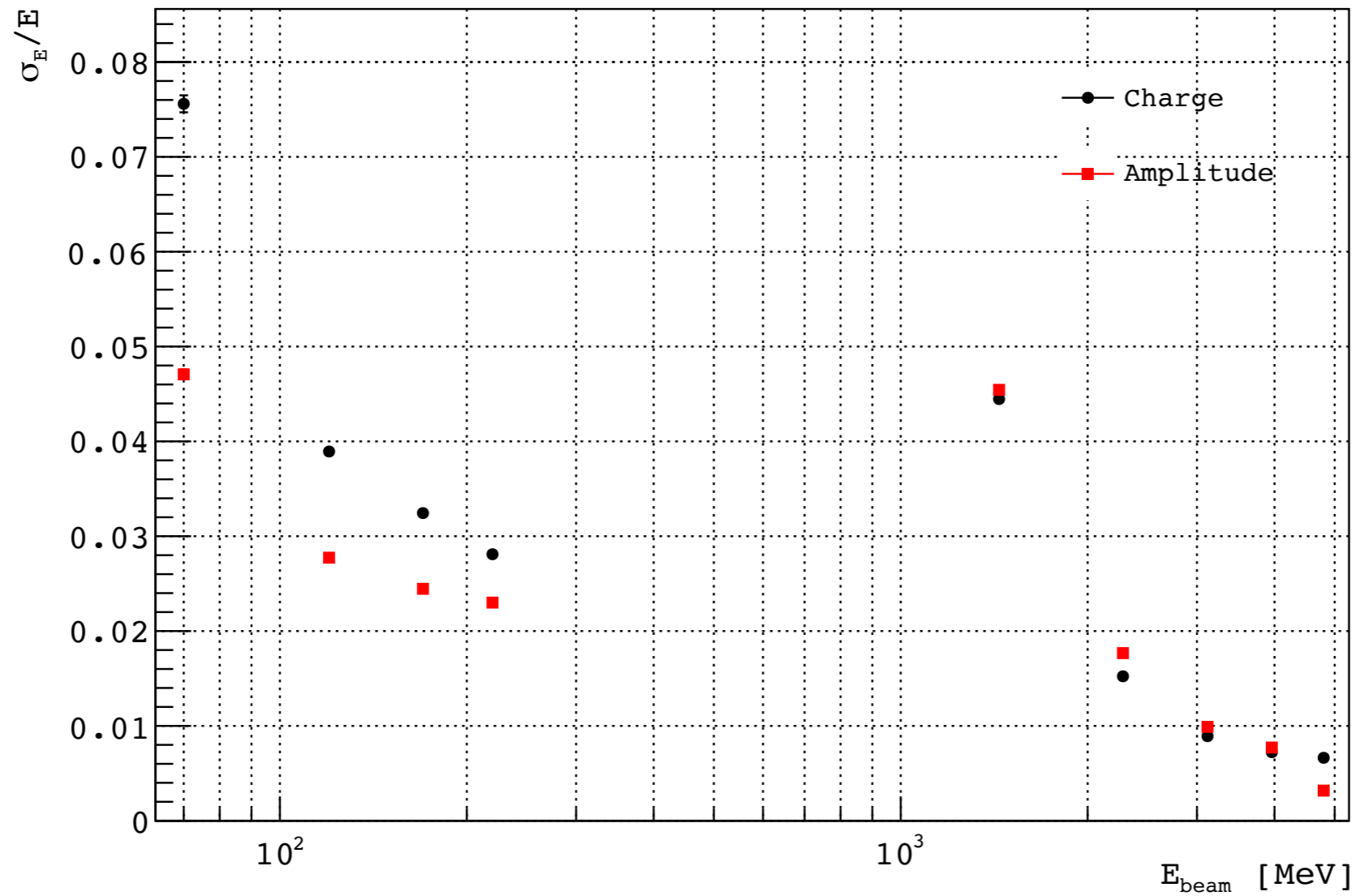


Energy Resolution

20 μm

Comparison between Amplitude & Charge Analysis:

Energy Resolution - **Amplitude & Charge** Analysis - 20 μm SiPM arrays





BackUp Slides

Energy Resolution

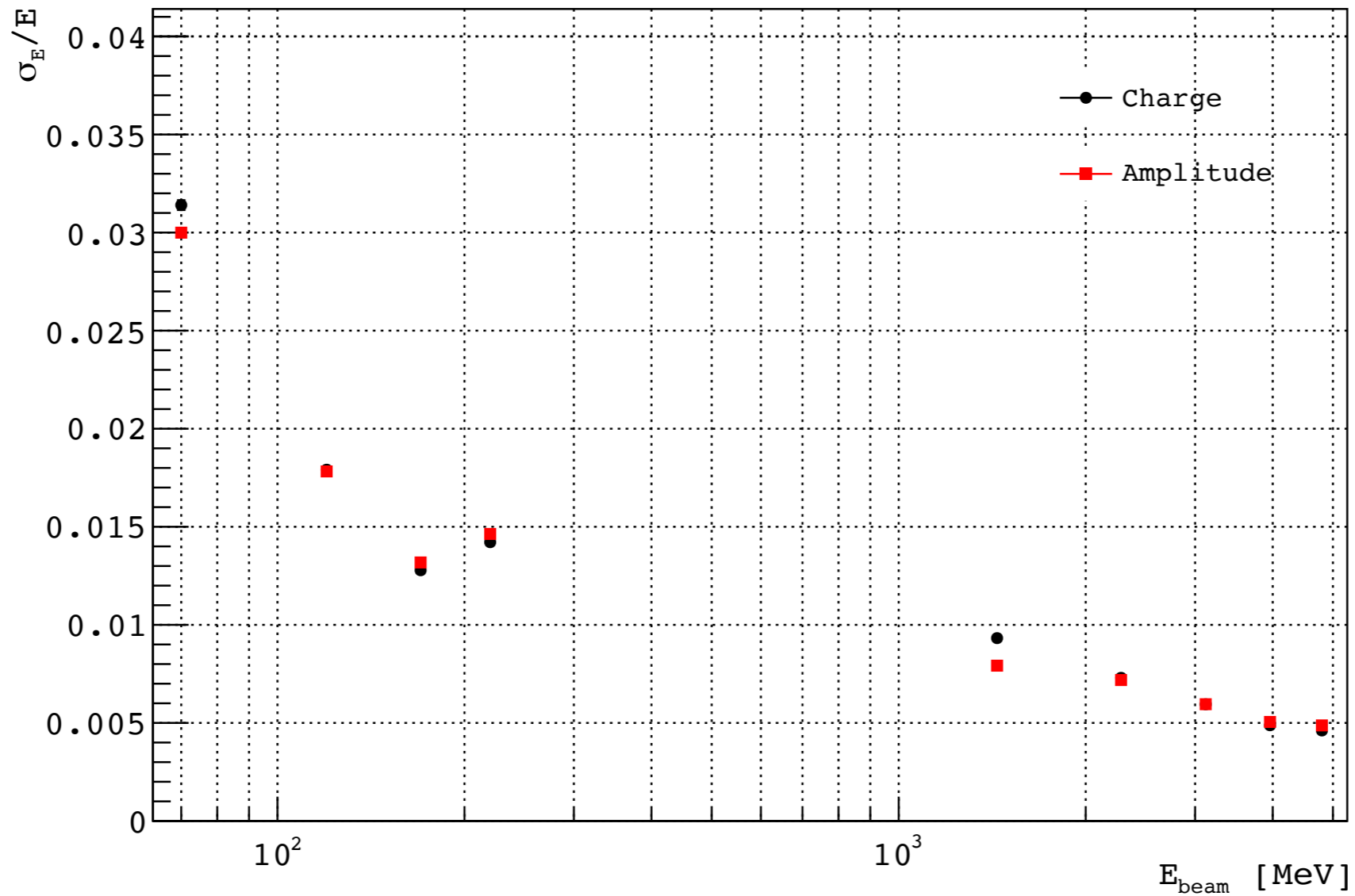


15 μm

Comparison between Amplitude & Charge Analysis:

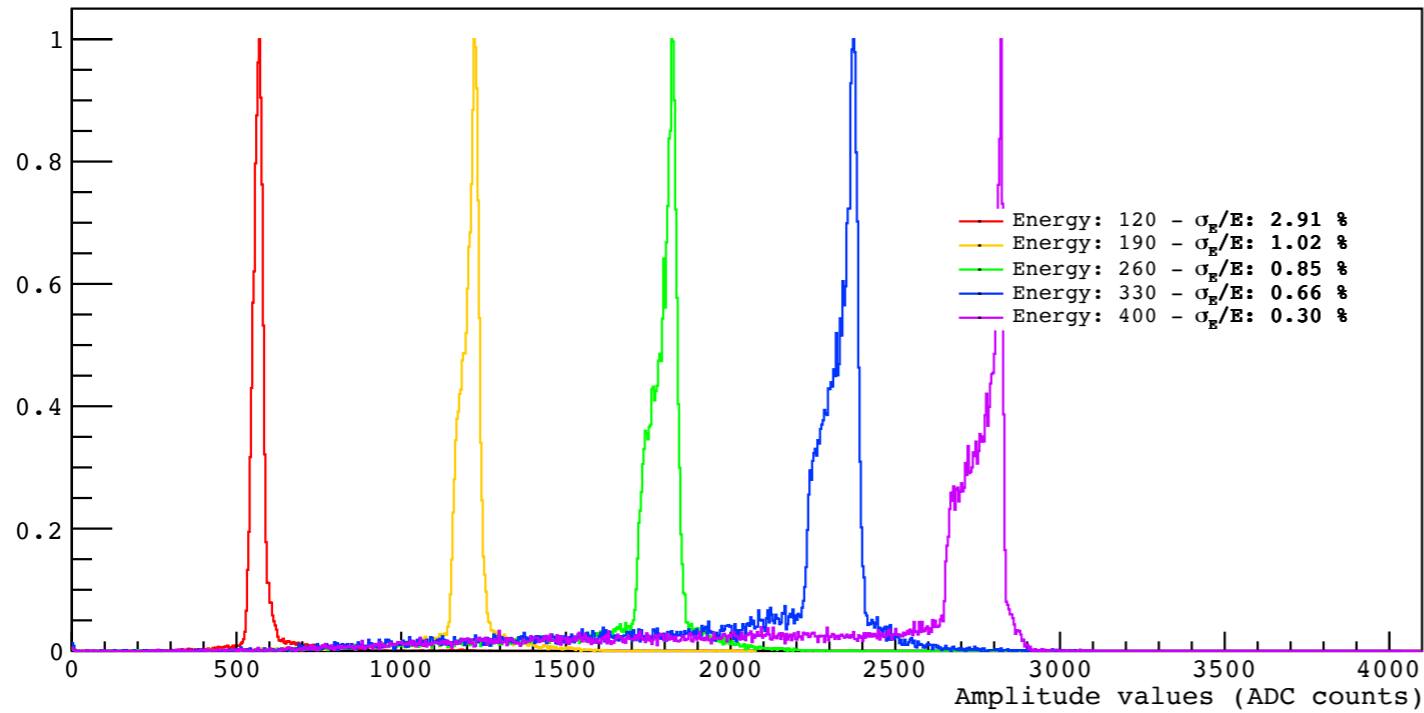
October

Energy Resolution - **Amplitude & Charge** Analysis - 15 μm SiPM arrays



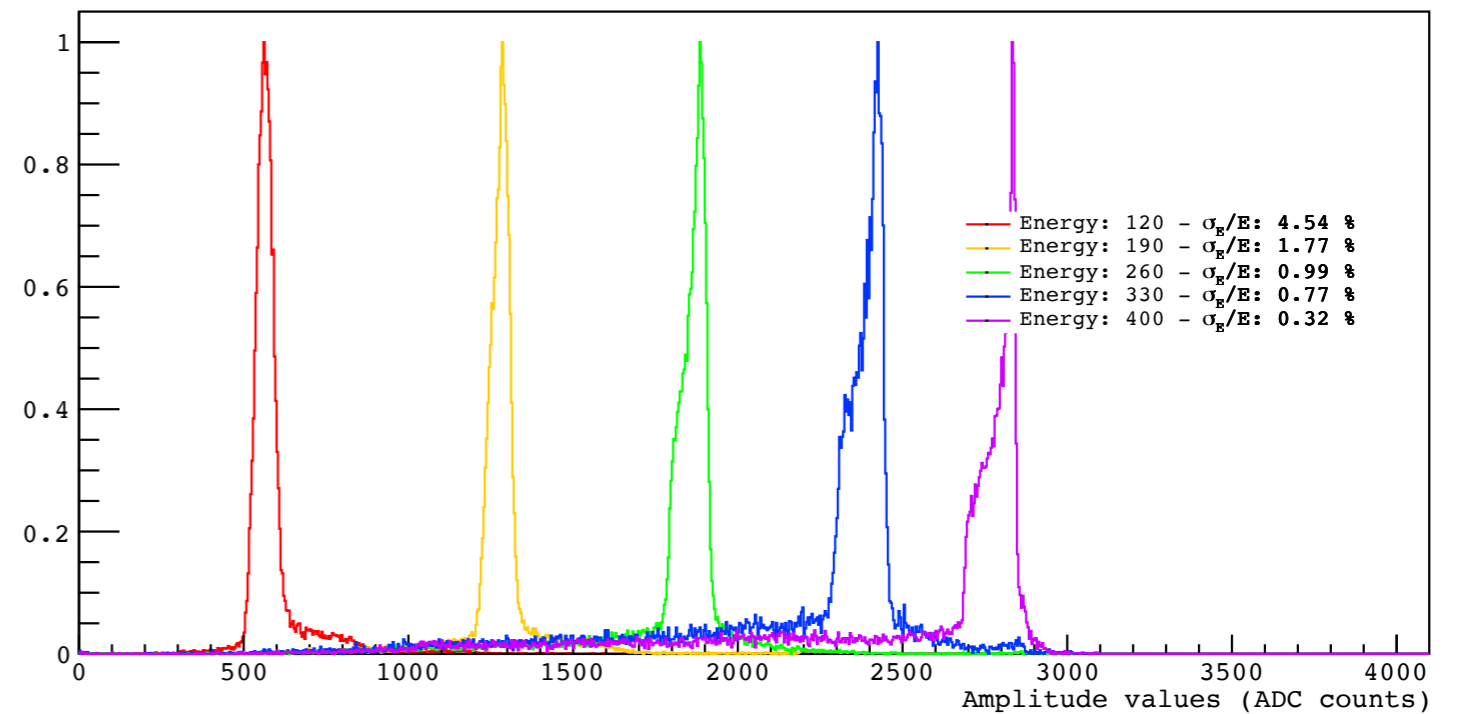
Amplitude Analysis - Carbon

Amplitude Analysis - 15 μm SiPM arrays



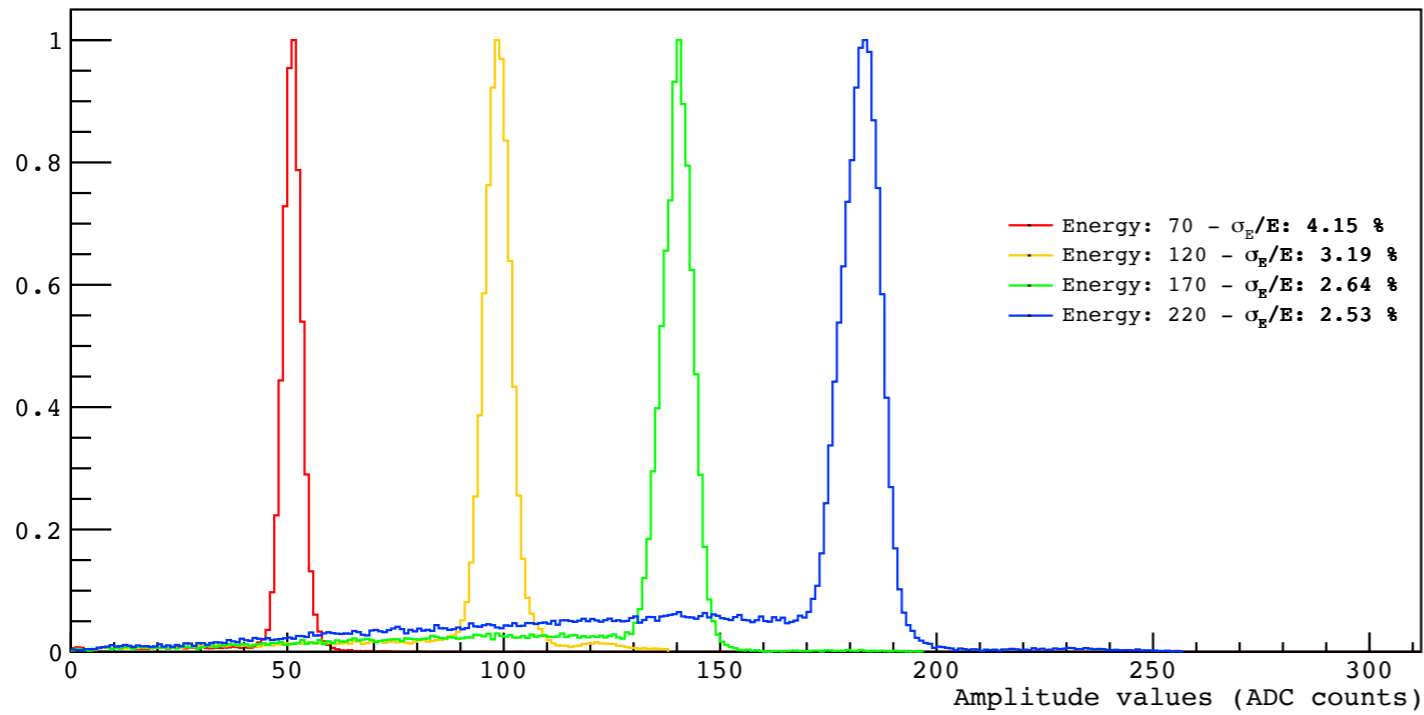
March

Amplitude Analysis - 20 μm SiPM arrays



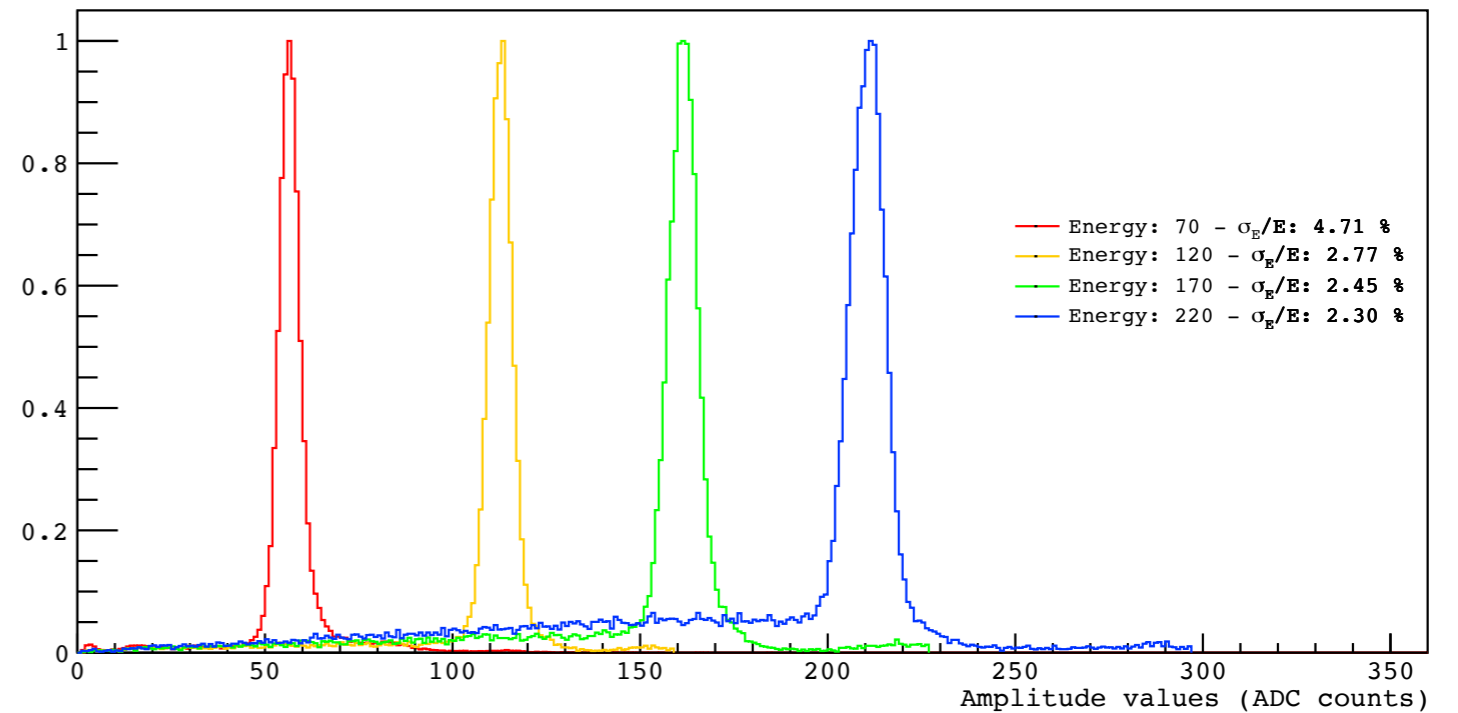
Amplitude Analysis - Proton

Amplitude Analysis - 15 μm SiPM arrays



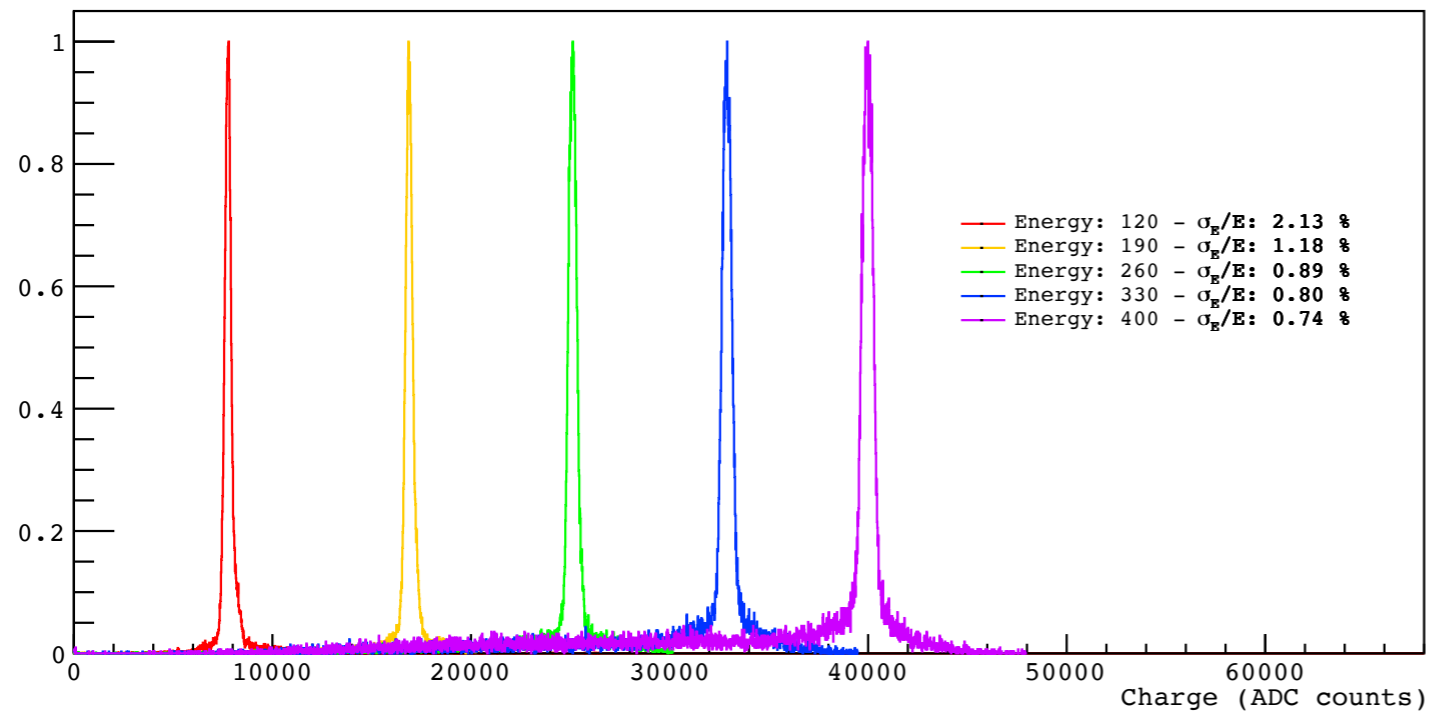
March

Amplitude Analysis - 15 μm SiPM arrays



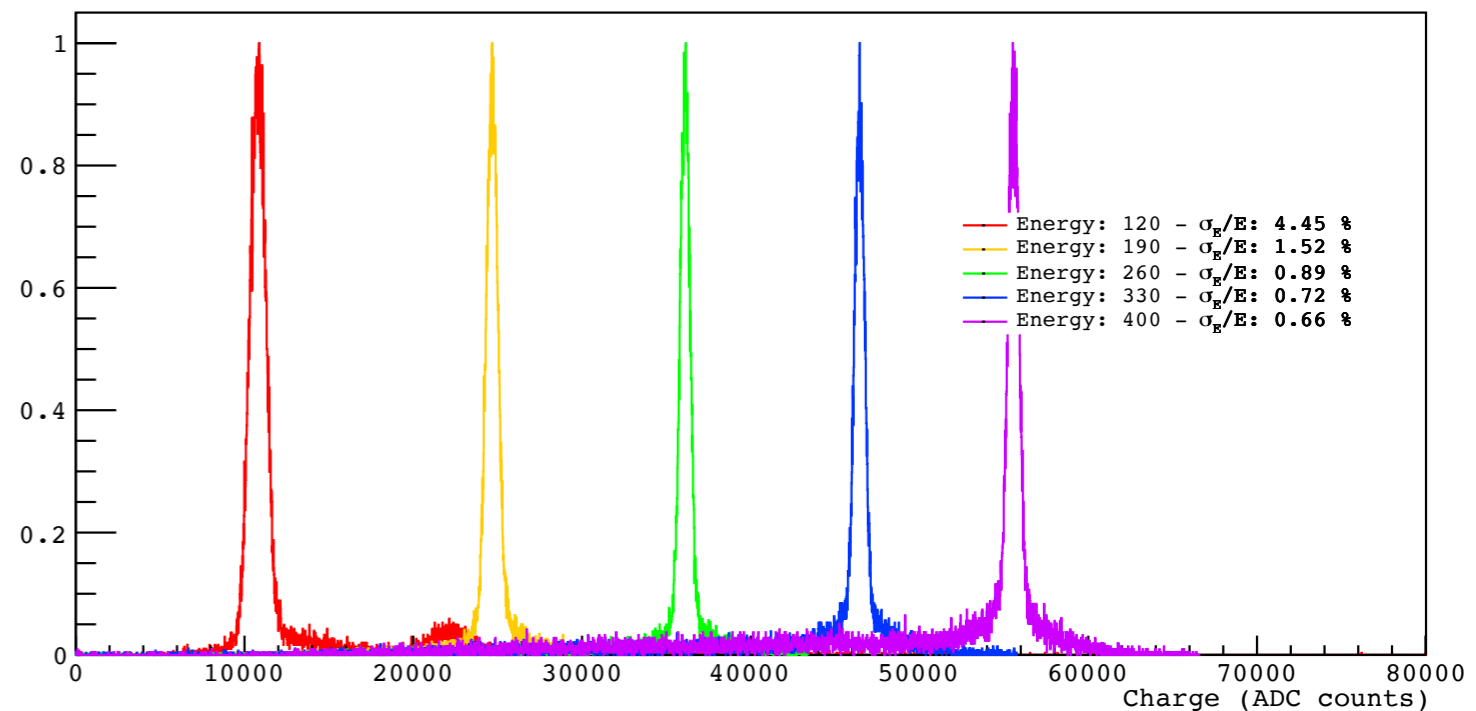
Charge Analysis - Carbon

Charge Analysis - 15 μm SiPM arrays



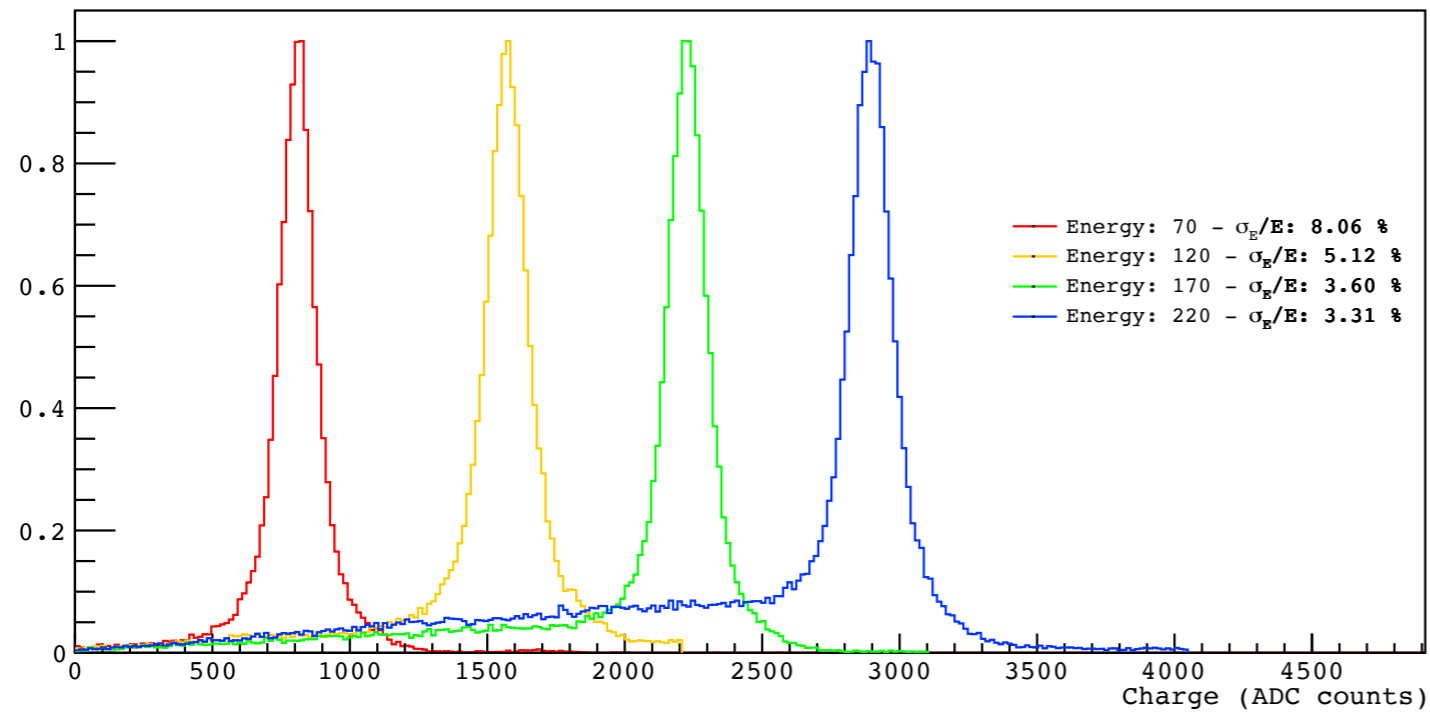
March

Charge Analysis - 20 μm SiPM arrays



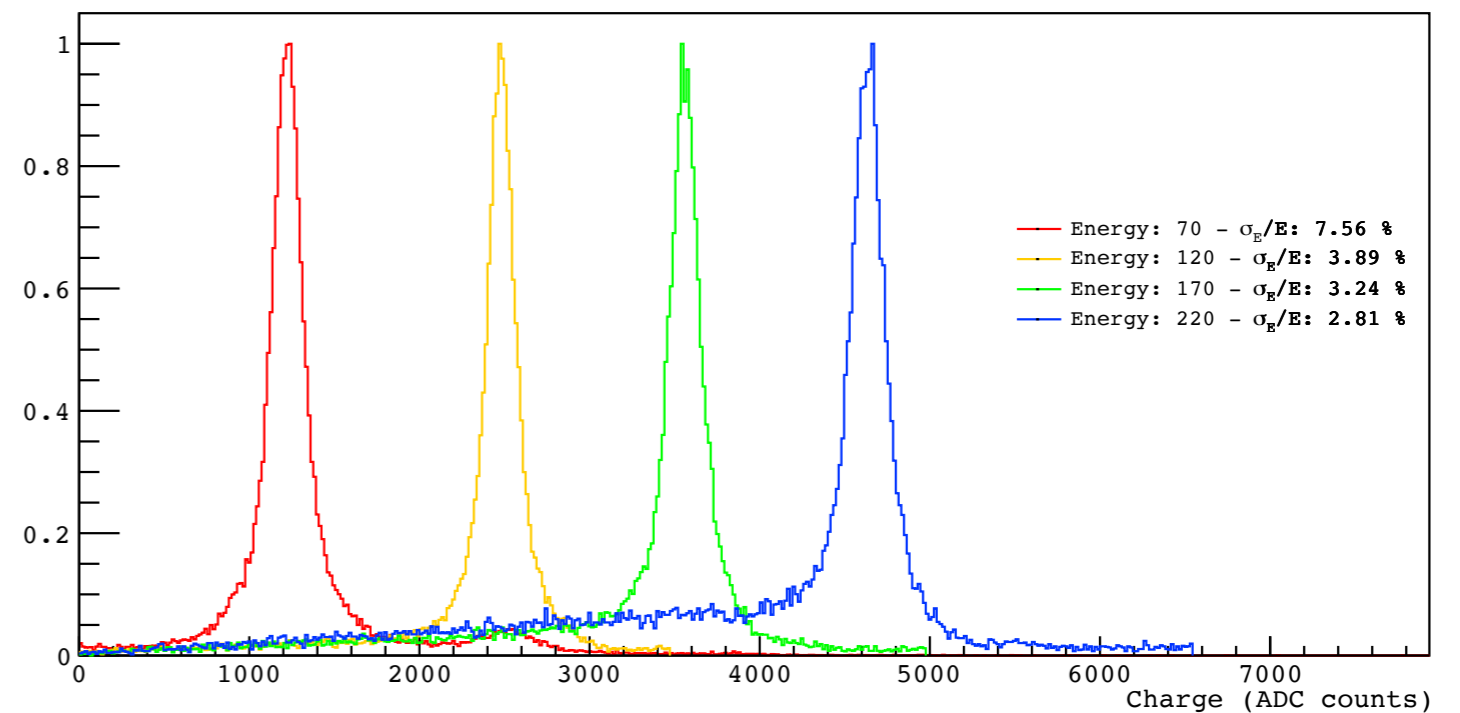
Charge Analysis - Proton

Charge Analysis - 15 μm SiPM arrays



March

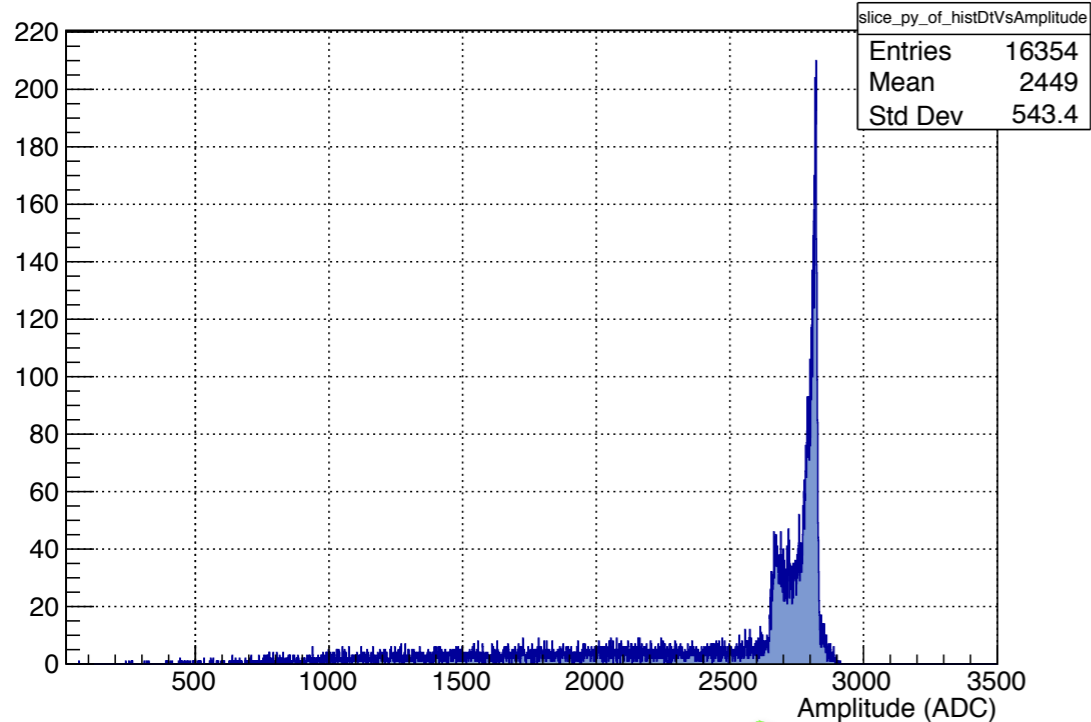
Charge Analysis - 20 μm SiPM arrays



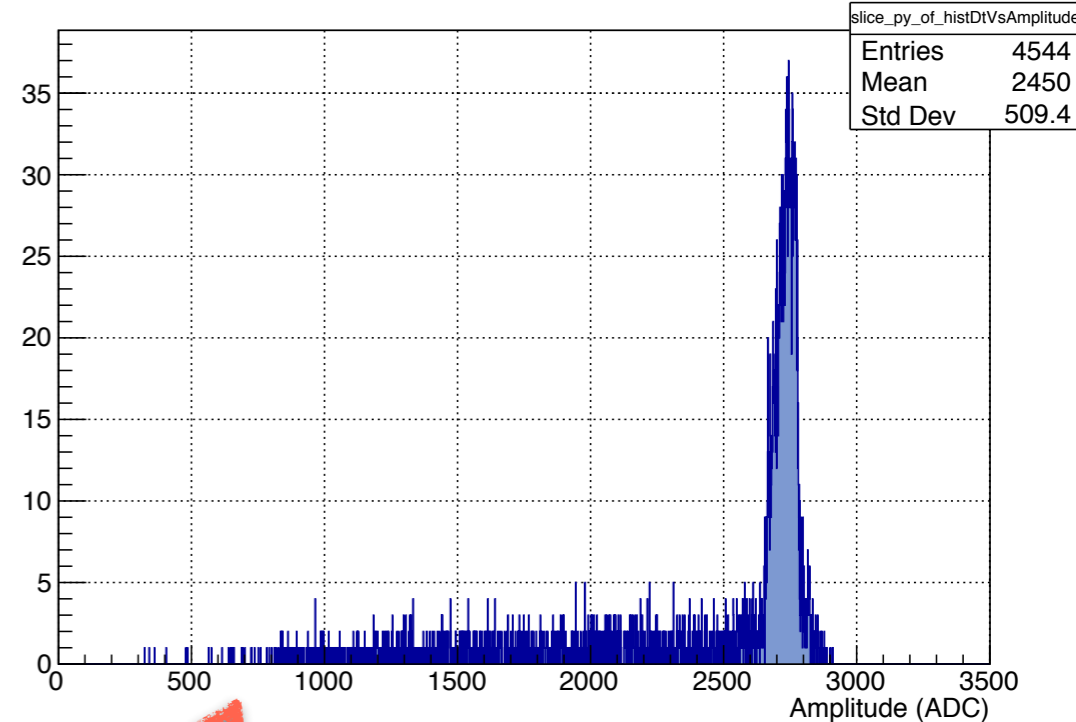


dT versus Amplitude

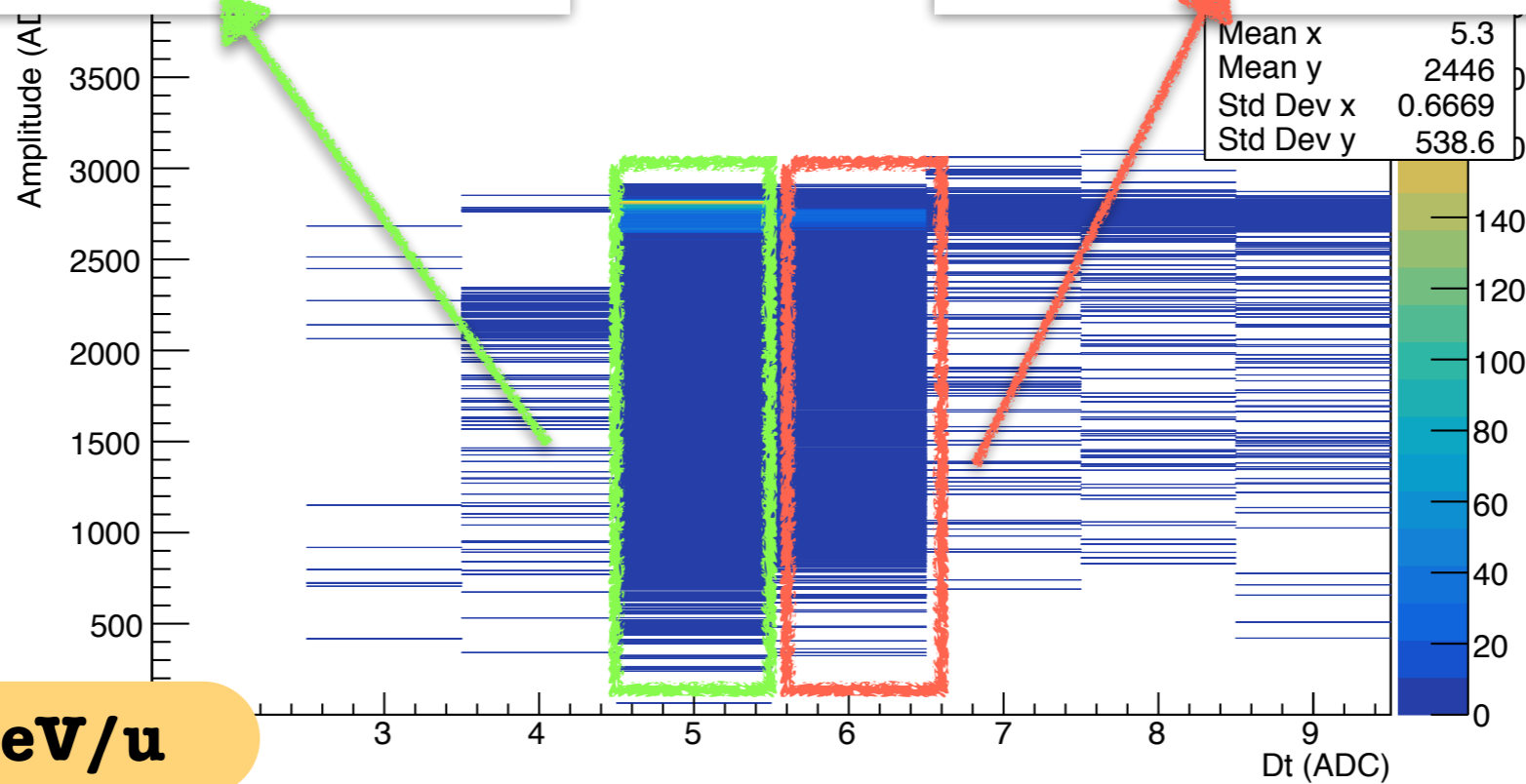
ProjectionY of binx=6 [x=4.5..5.5]



ProjectionY of binx=7 [x=5.5..6.5]



histDtVsAmplitude



Carbon 400 MeV/u

Present:



Digitizer **V1742** CAEN

12 bits

1 Ghz

1024 samplings

$V_{pp} = 1\text{ V}$

Future:



Digitizer **V1740** CAEN

12 bits

62.5 Mhz

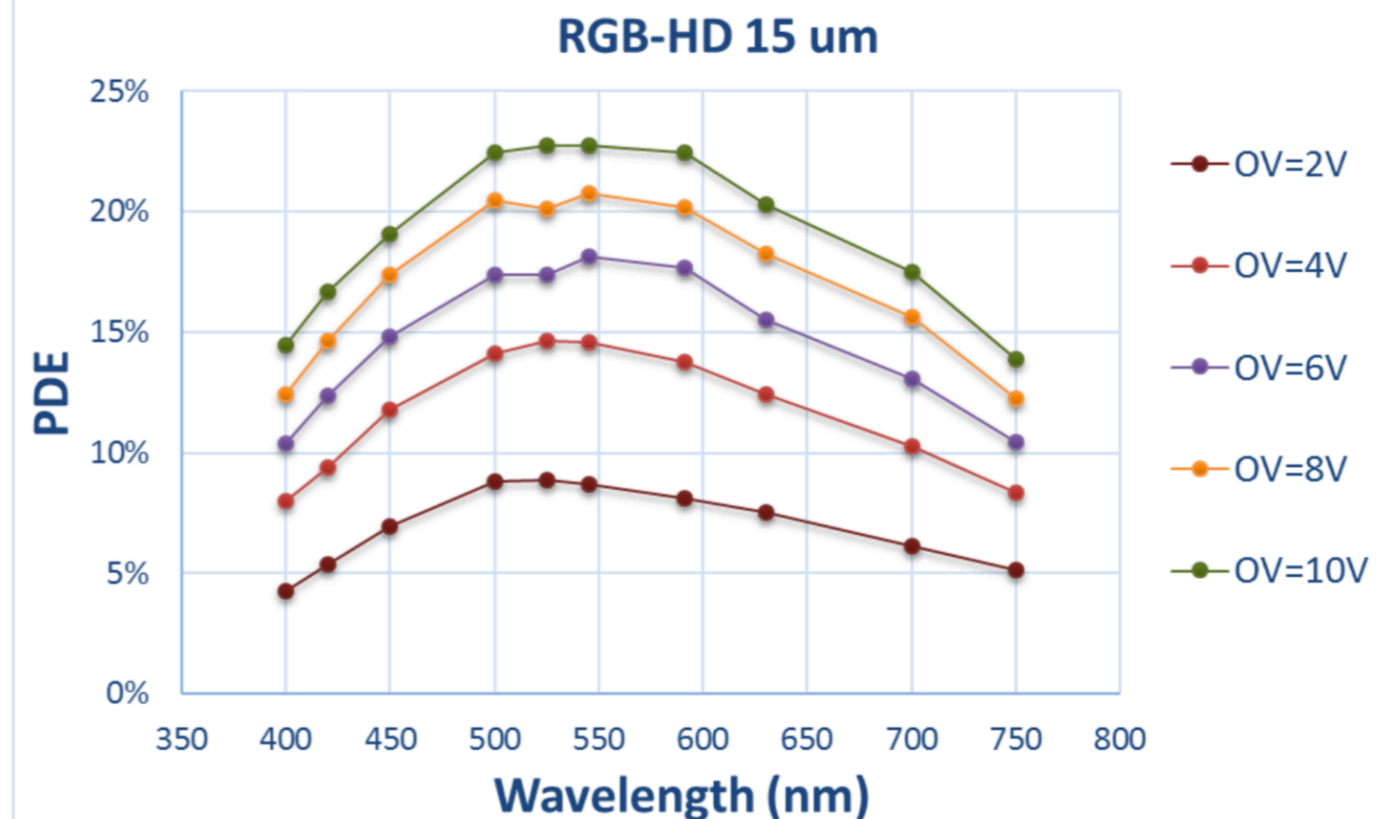
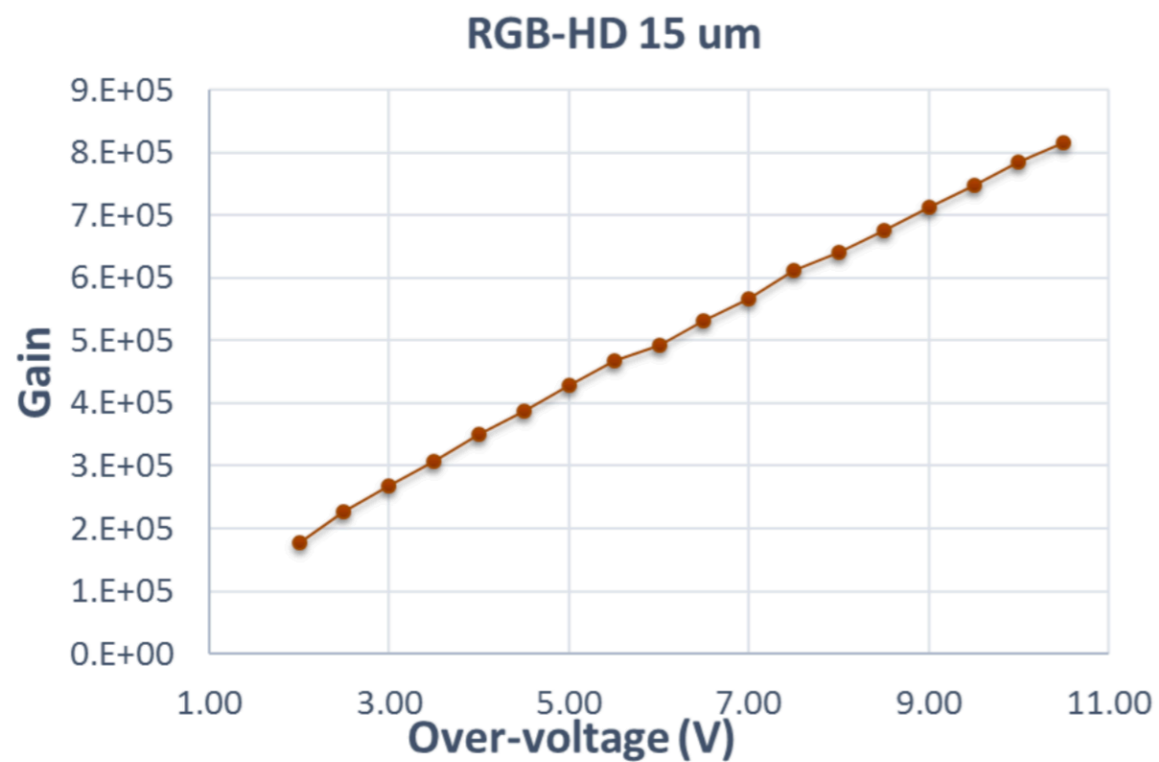
1024 samplings

$V_{pp} = 10\text{ V}$

SiPMs parameters



SiPM Type			# SPADs		Fill Factor (%)		Capacitance (≈)	
Technology	Cell size (μm)	SiPM size (mm ²)	1 mm ²	SiPM	Single SPAD	SiPM	pF/mm ²	SiPM (pF)
RGB-HD	15	16	3832	61314	54	52	40	620
RGB-HD	20	16	2158	34532	65	60	40	620
NUV-HD	30	36	1122	40410	77	71	35	1260

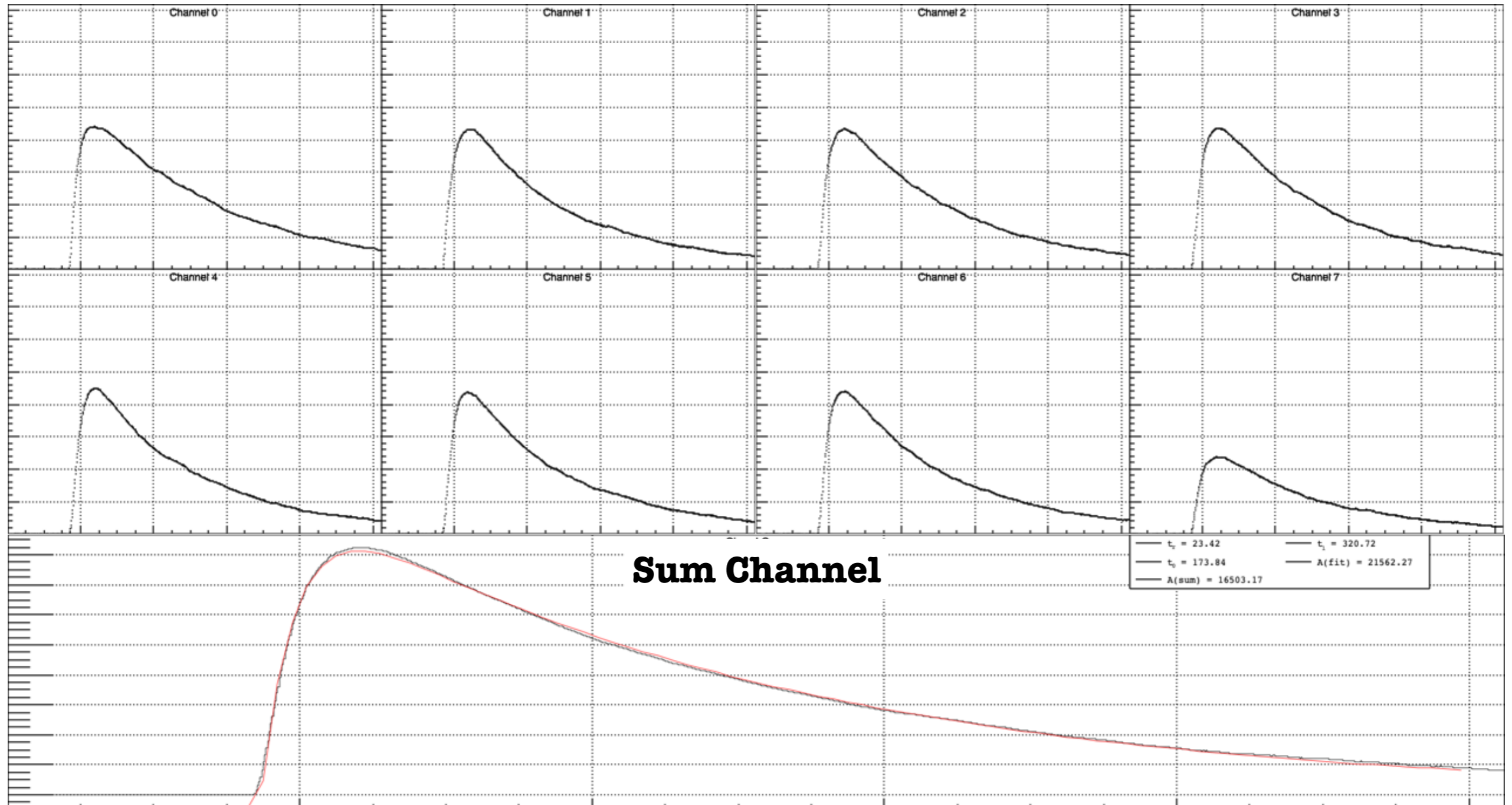


Signal with board_v0

Carbon 400 MeV/u

October

Signals from FAN OUT

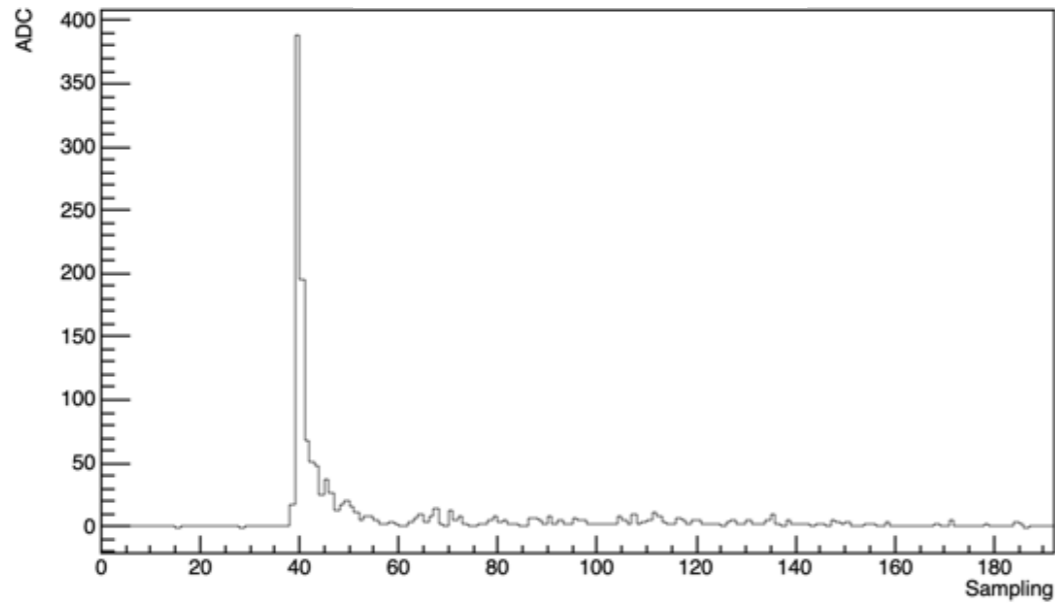


Signal with board_V1

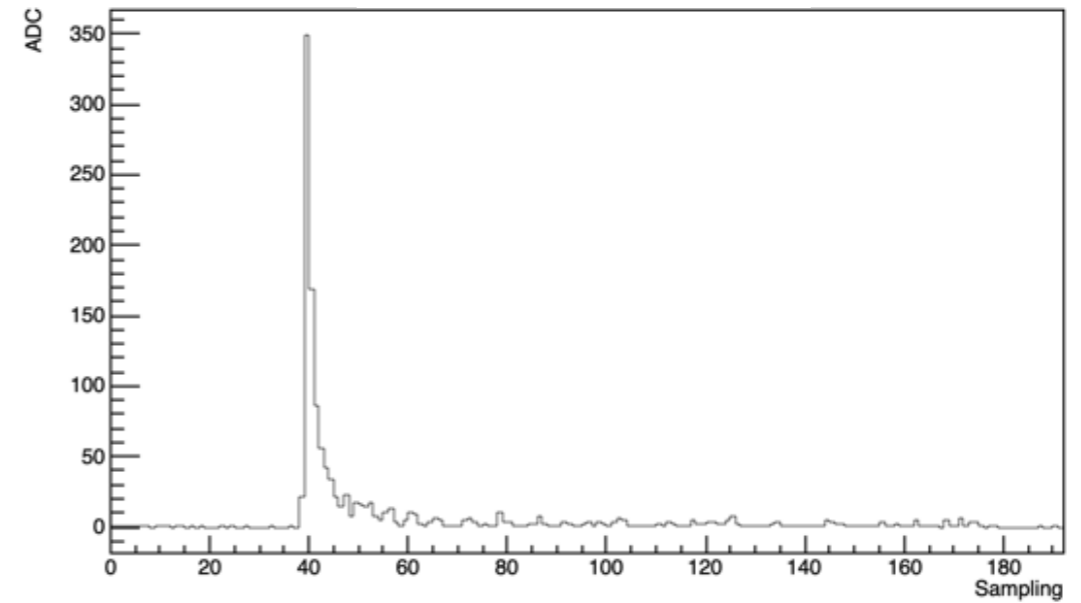
Carbon 400 MeV/u

March

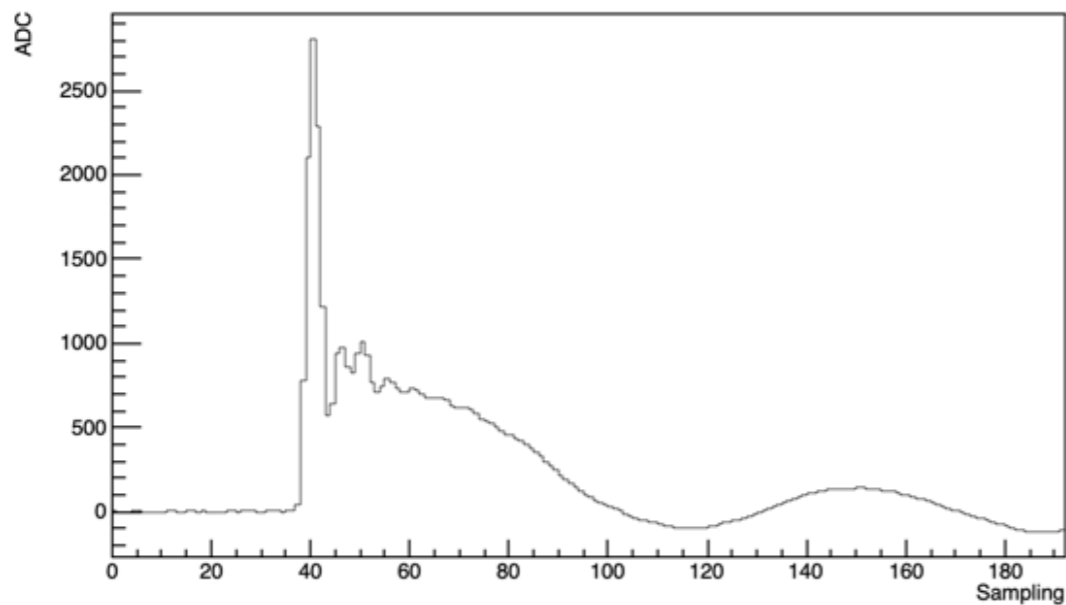
Scintillator 1



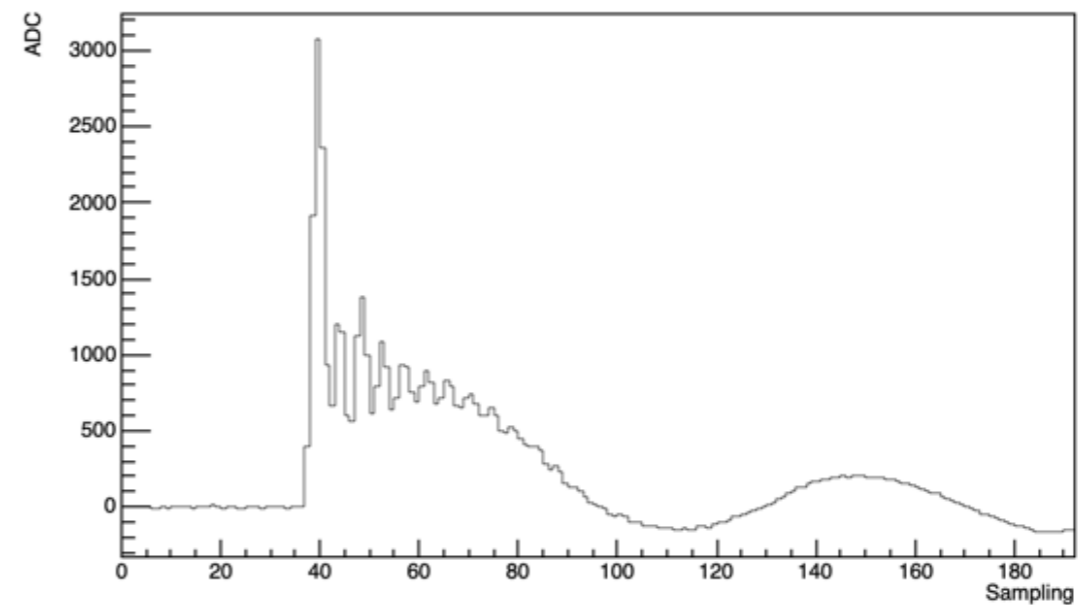
Scintillator 2



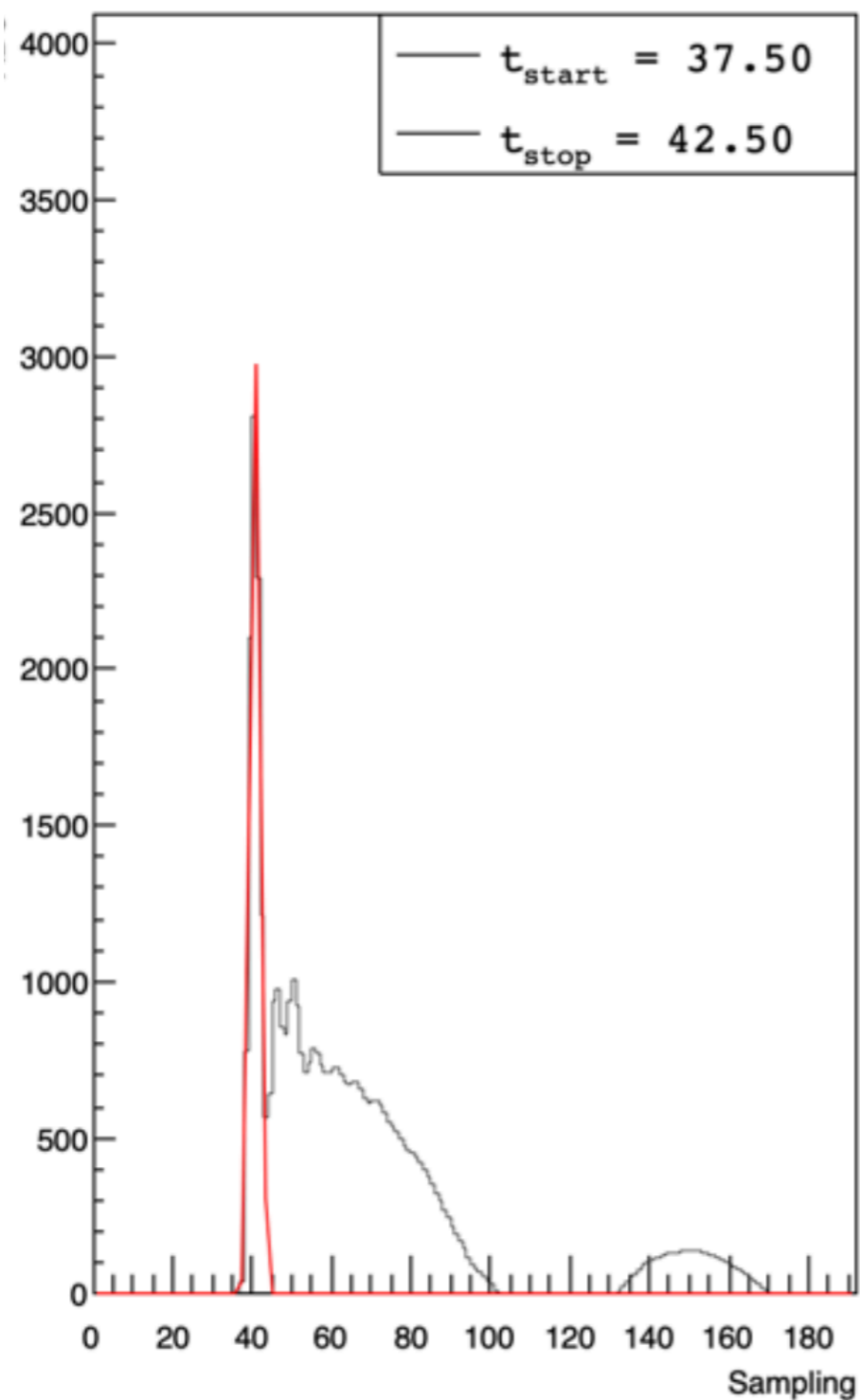
Sum Channel



Sum of 30 single channels



SiPMs parameters



$$dT = t_{stop} - t_{start}$$