Beam test results on PHOSWICH configuration

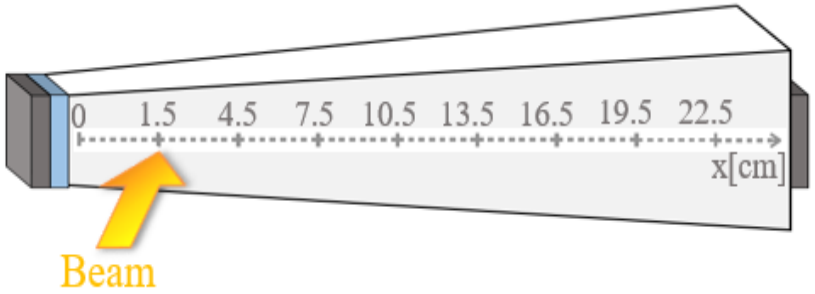
Francesca Borgia

Experimental set-up

- Single crystal “modified” with a fast scintillator on front face and two SiPMs coupled to the front and rear BGO face.
- Testbeam goal: test for the first time a new BGO prototype and try to discriminate BGO from plastic scintillator signal

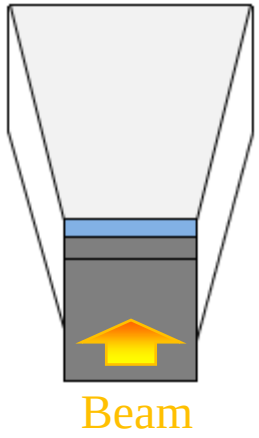
Lateral scan

- Beam energies: p70 MeV and C115 MeV/u
- Different beam positions
  (1.5, 4.5, 7.5, 10.5, 13.5, 16.5, 19.5, 22.5) cm
- Beam hits the lateral face of the BGO crystal



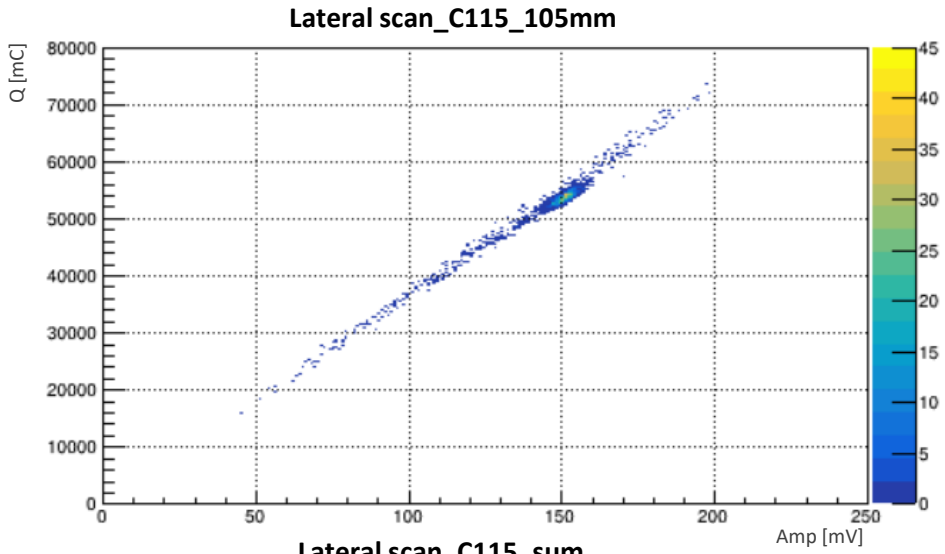
Frontal scan

- Beam energies: p70-220 MeV and C115-400 MeV/u
- Beam crosses before the plastic scintillator and then the BGO crystal

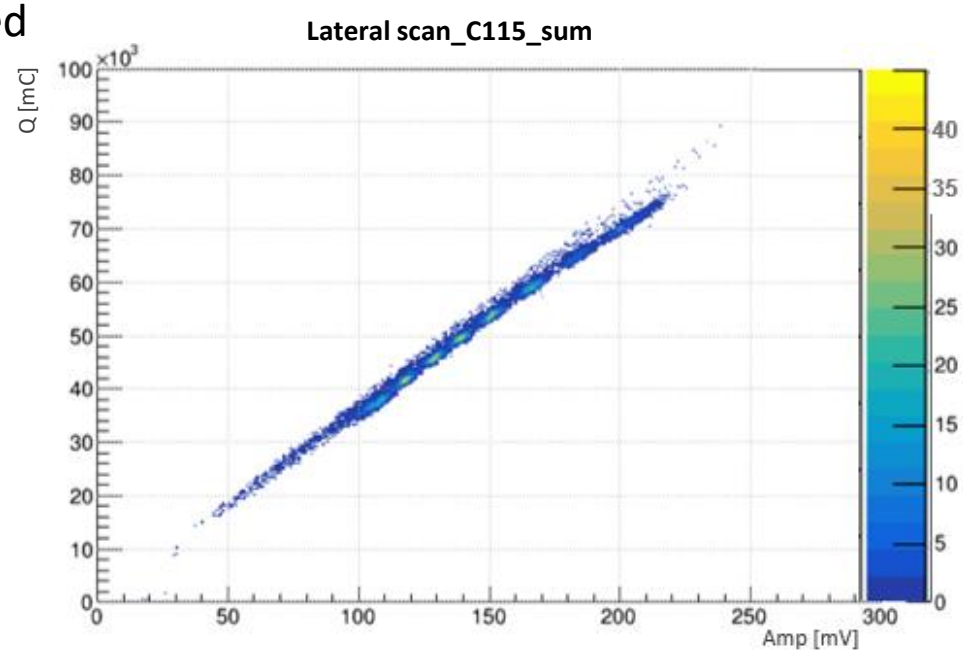


Energy p [MeV]	Energy C [MeV/u]
70	115
120	190
170	260
227	330
	400

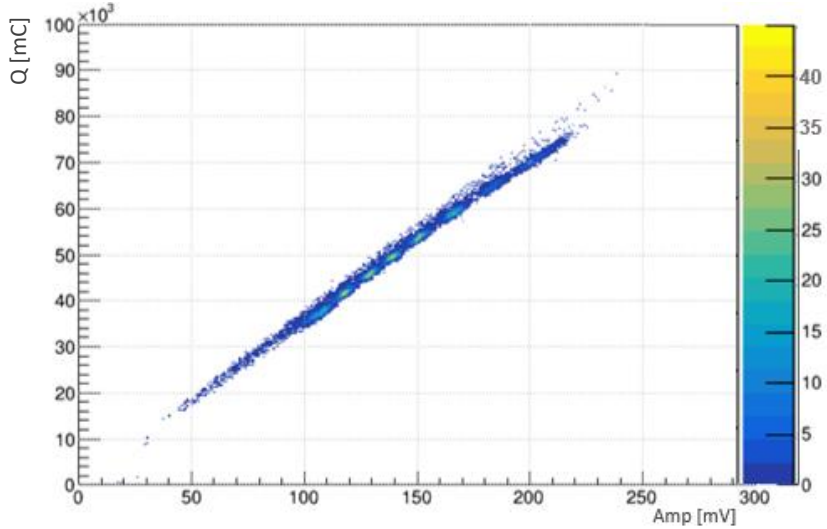
Lateral scan

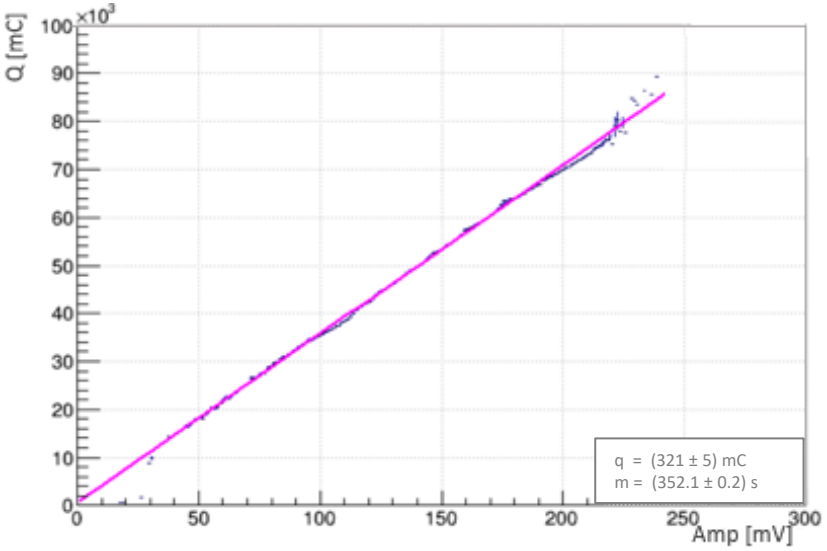


- Analysis on Charge Vs Amplitude scatter plots
- NUV SiPM signals
- A direct proportionality between charge and amplitude in BGO signals is expected
- Summing all the scatter plots with different positions a distribution over the full range of charge and amplitude is obtained

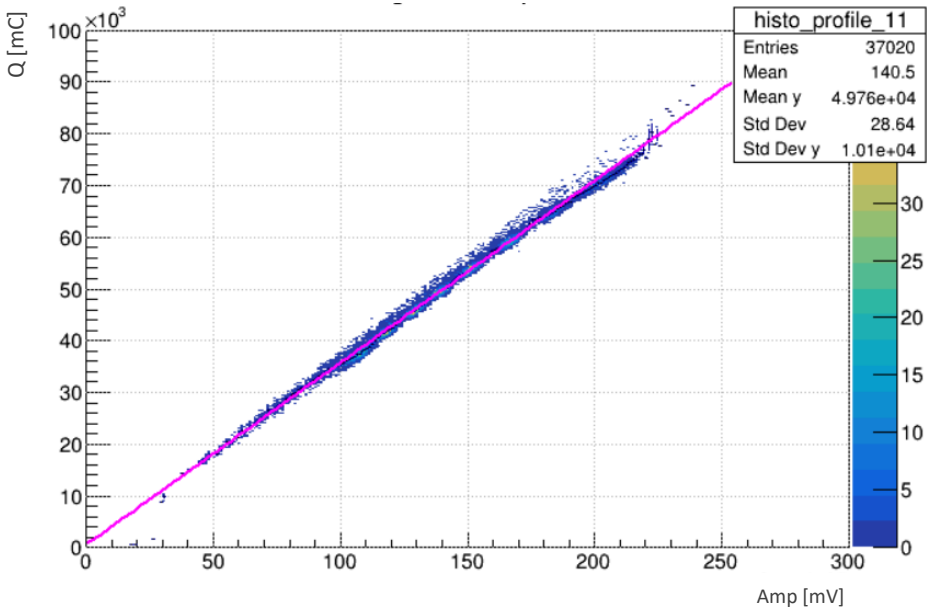


Lateral scan



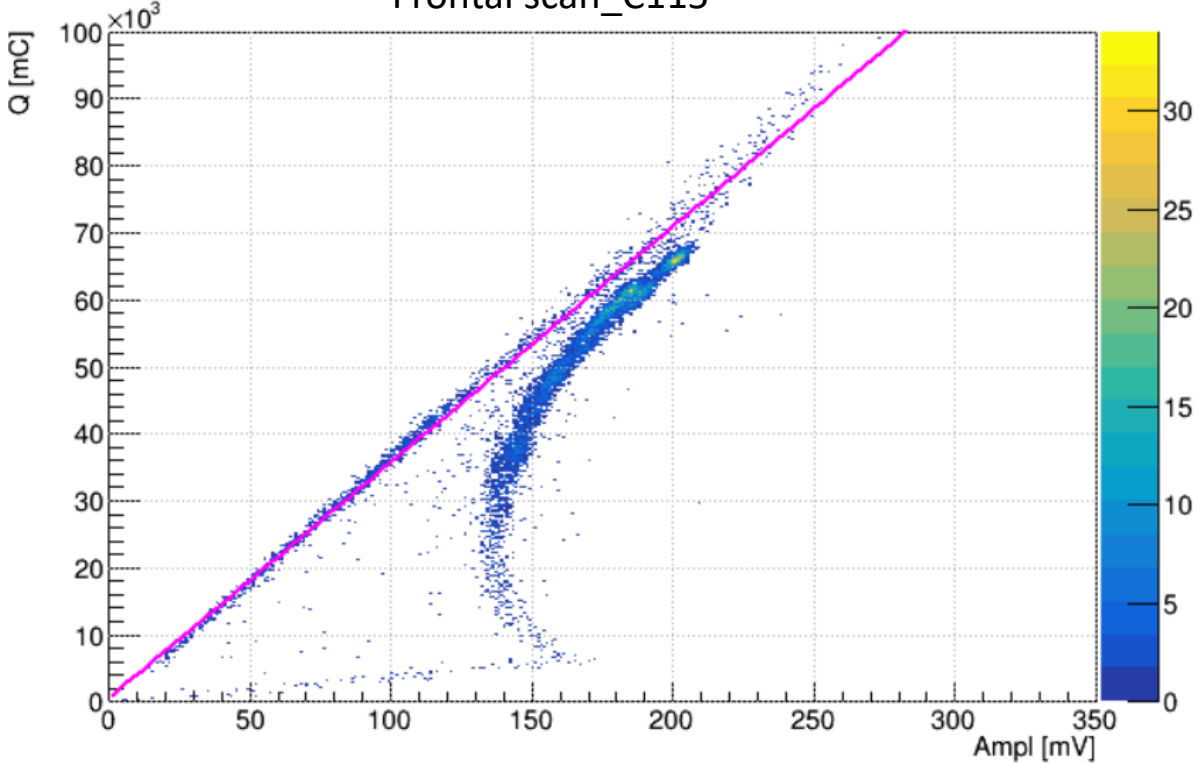


- Profile of Charge Vs Amplitude scatter plot for all the positions together
- Fit on the profile to obtain a straight line

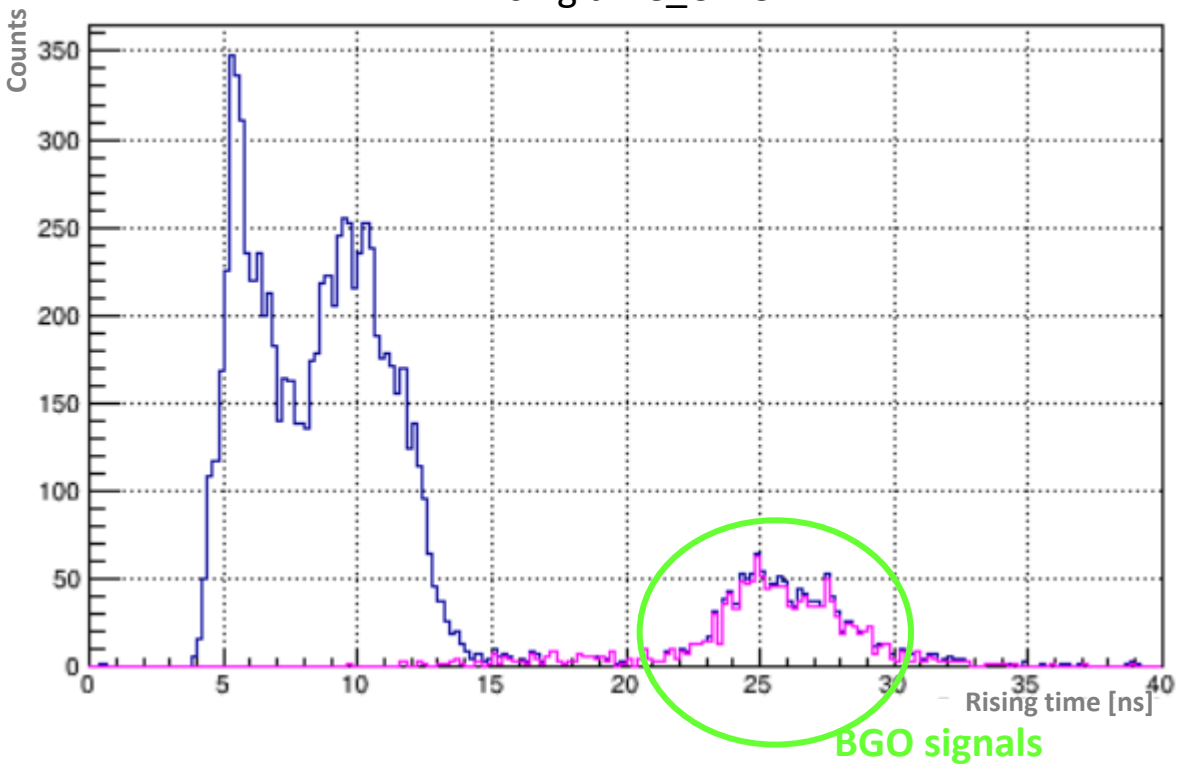


Frontal scan

Frontal scan_C115



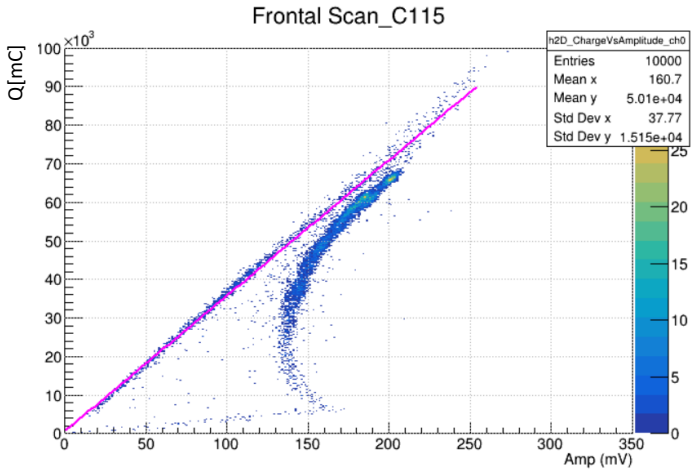
Rising time_C115

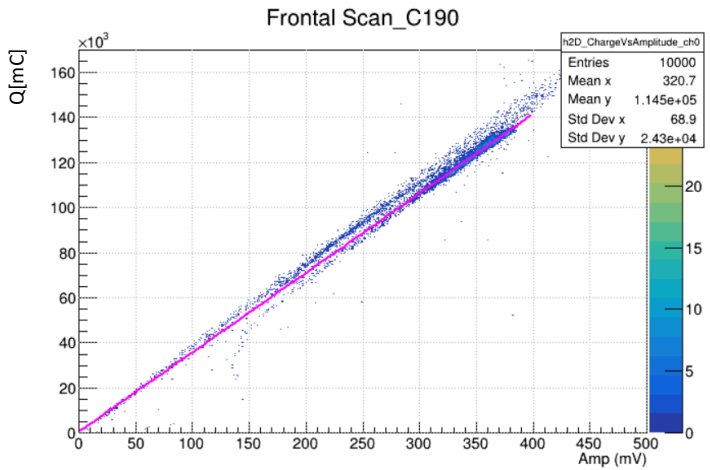


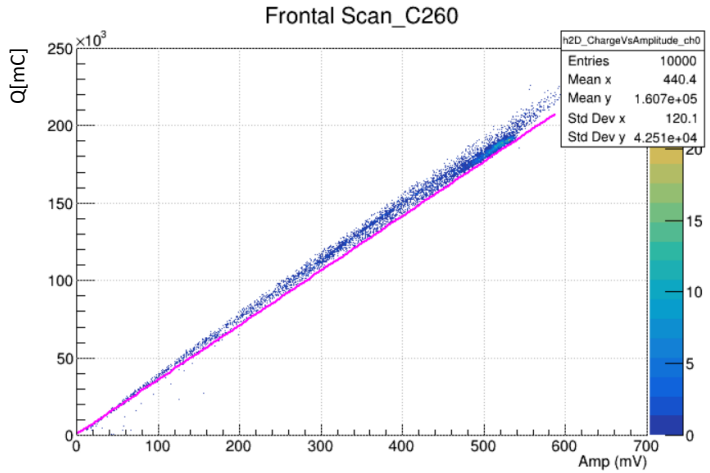
- Plot of the separation line, obtained from the lateral scan, is overlapped on frontal scan data with the same energy.
- Selecting only events with charge larger than the fit, we found a distribution similar to the right peak in rising time distribution
- Rising times in BGO signals are higher

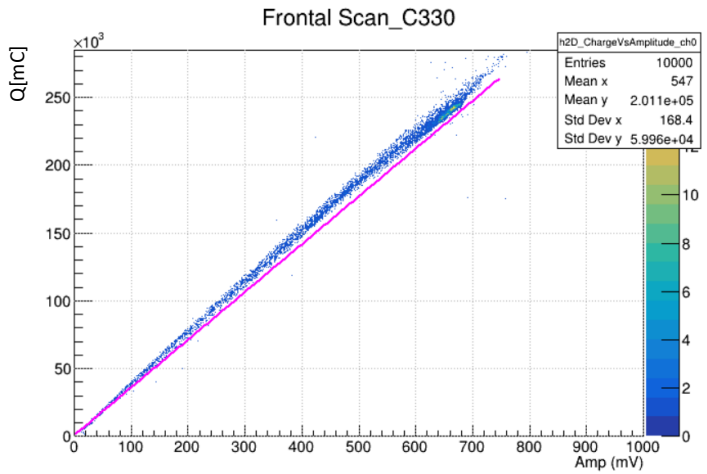
Frontal scan

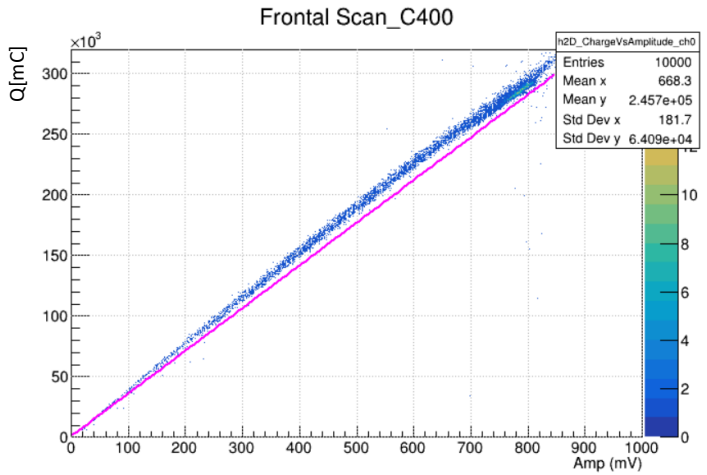
Analyzing scatter plots with higher energies it is easy to see that the slope of the separation line depends on the beam energy







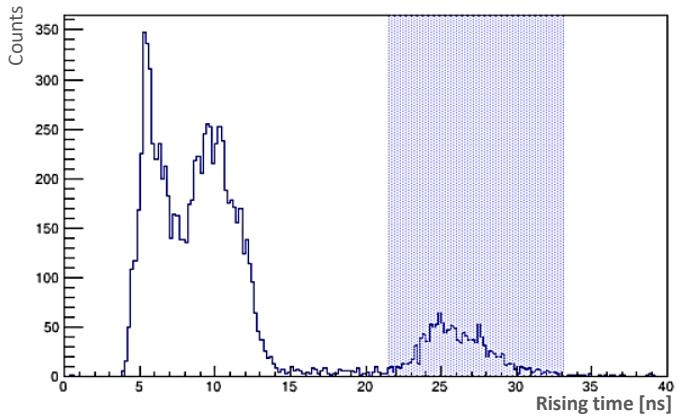




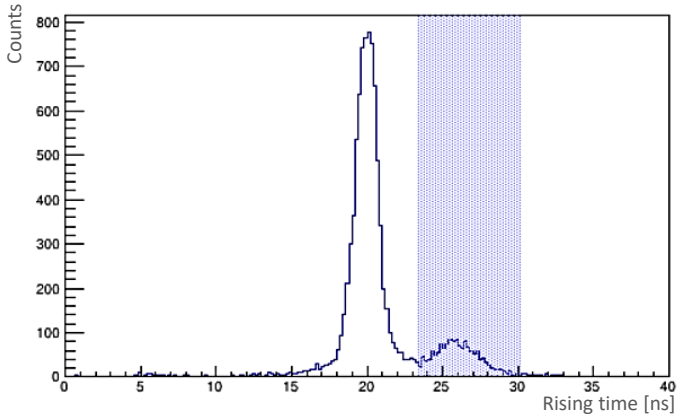
Frontal scan

- In order to find a separation line for all the energies, events with rising times corresponding to the right peak(tail) of the rising time distribution were selected

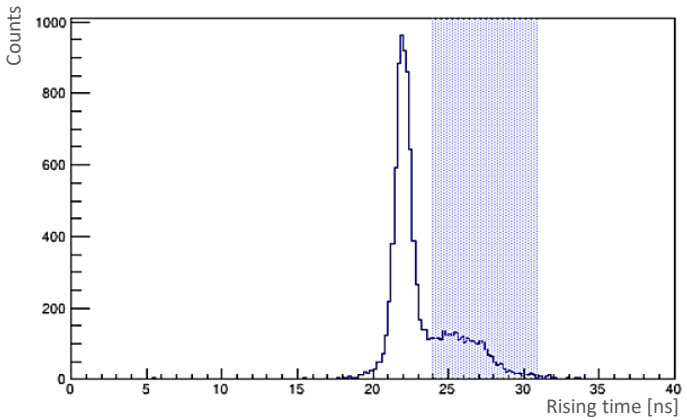
115 MeV/u



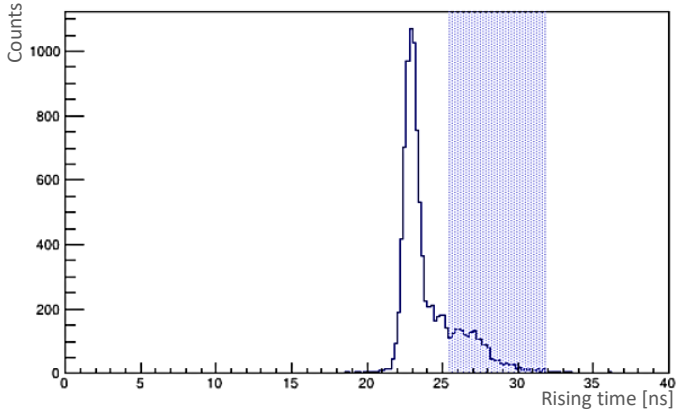
190 MeV/u



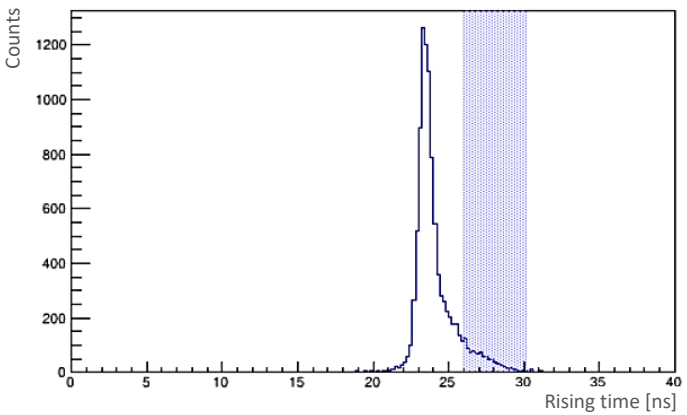
260 MeV/u



330 MeV/u

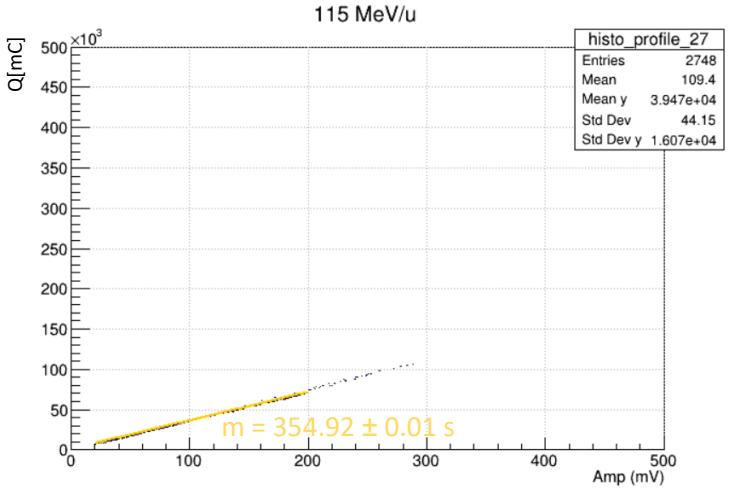


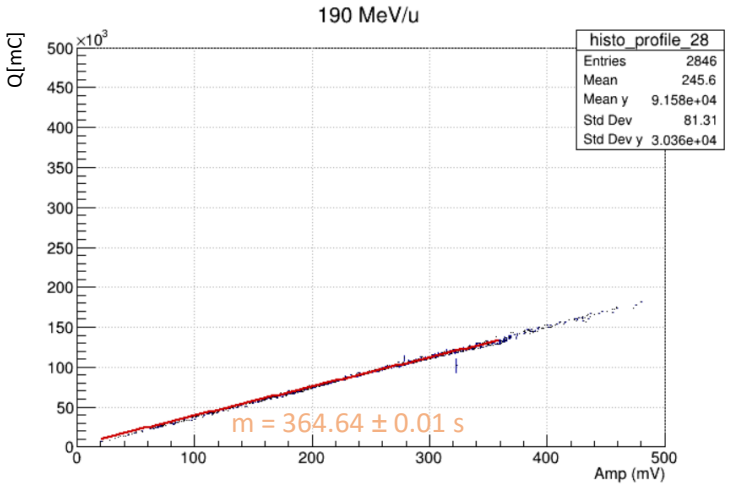
400 MeV/u

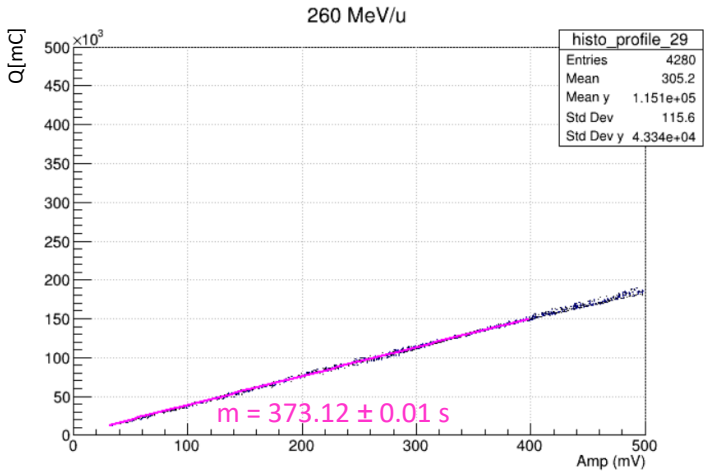


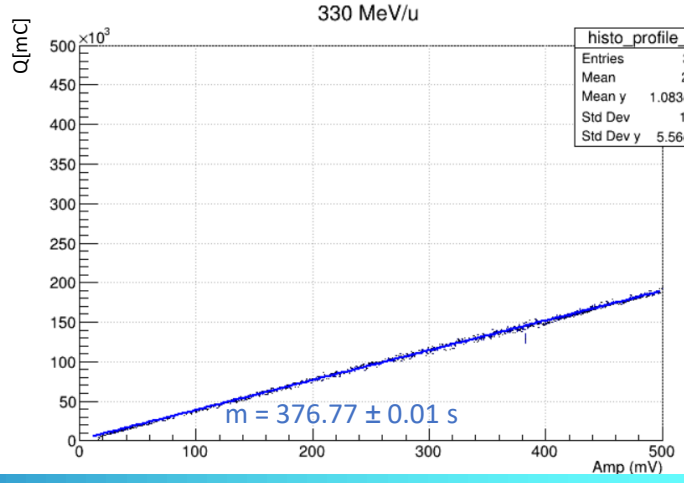
Frontal scan

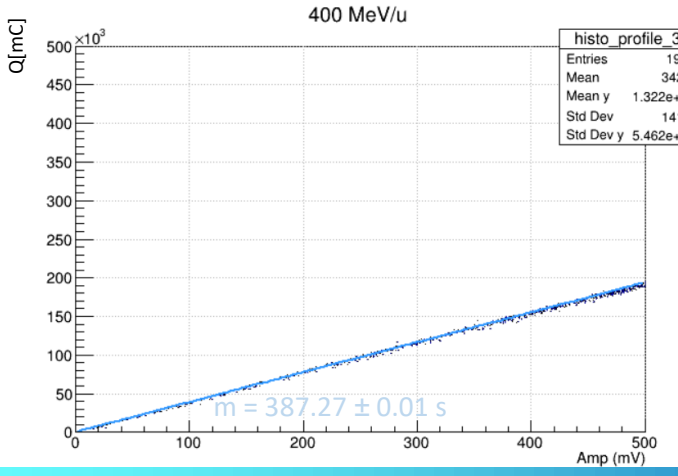
- The profiles of charge versus amplitude scatter plots for all the energies were fitted, obtaining different slopes for each energy



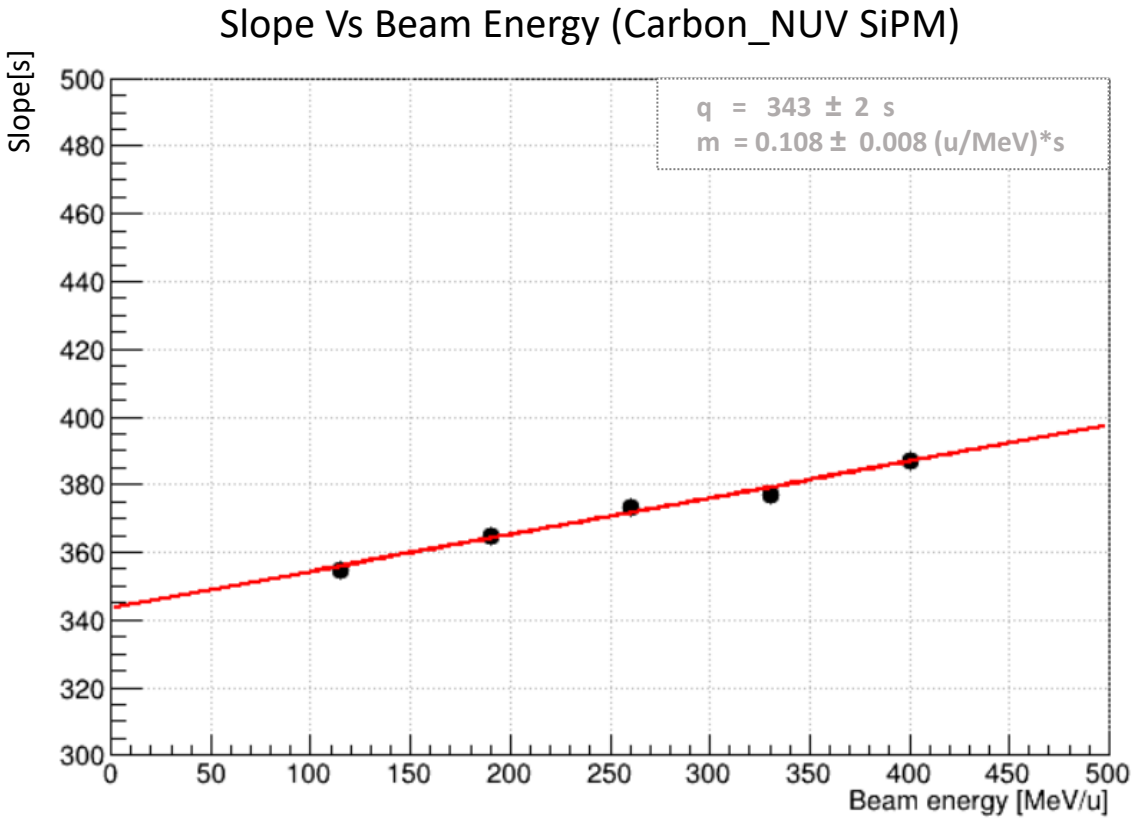








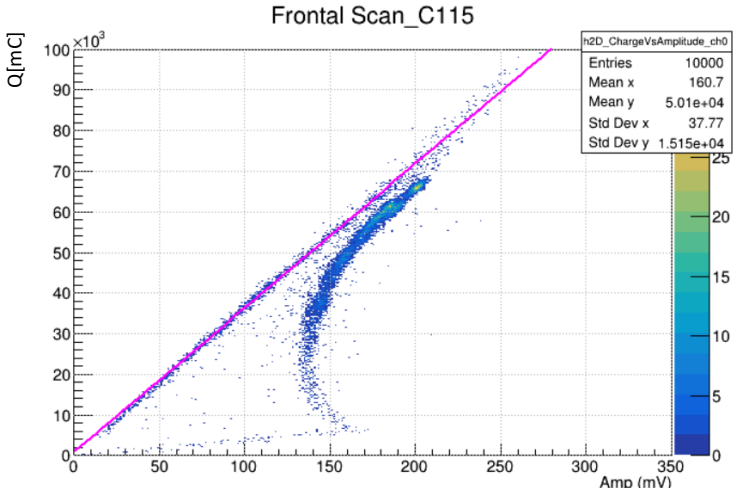
Frontal scan

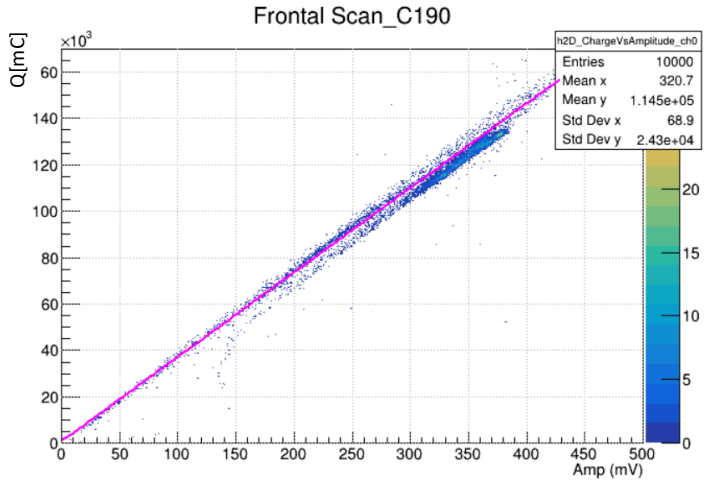


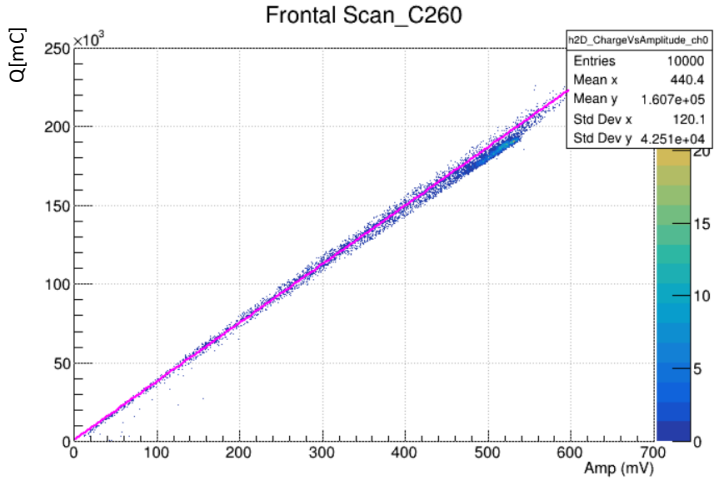
- The slope of the separation line changes with the energy of the incident beam
- The dependence of the slope of the separation line with the beam energy looks linear
- The slopes of all the separation lines can be corrected in terms of the energy.

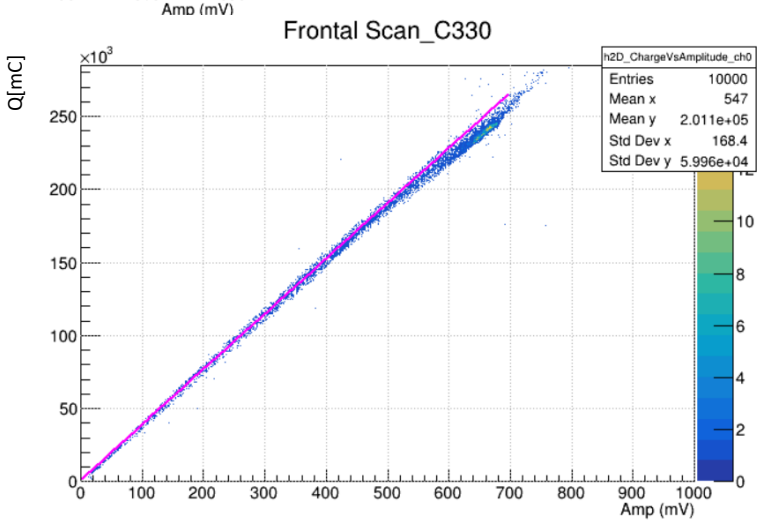
Frontal scan

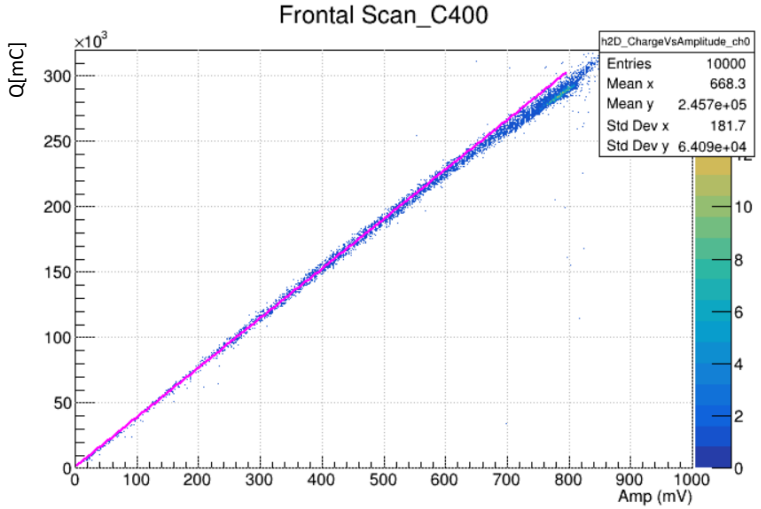
Charge Vs Amplitude scatter plots with their separation lines corrected in energy :





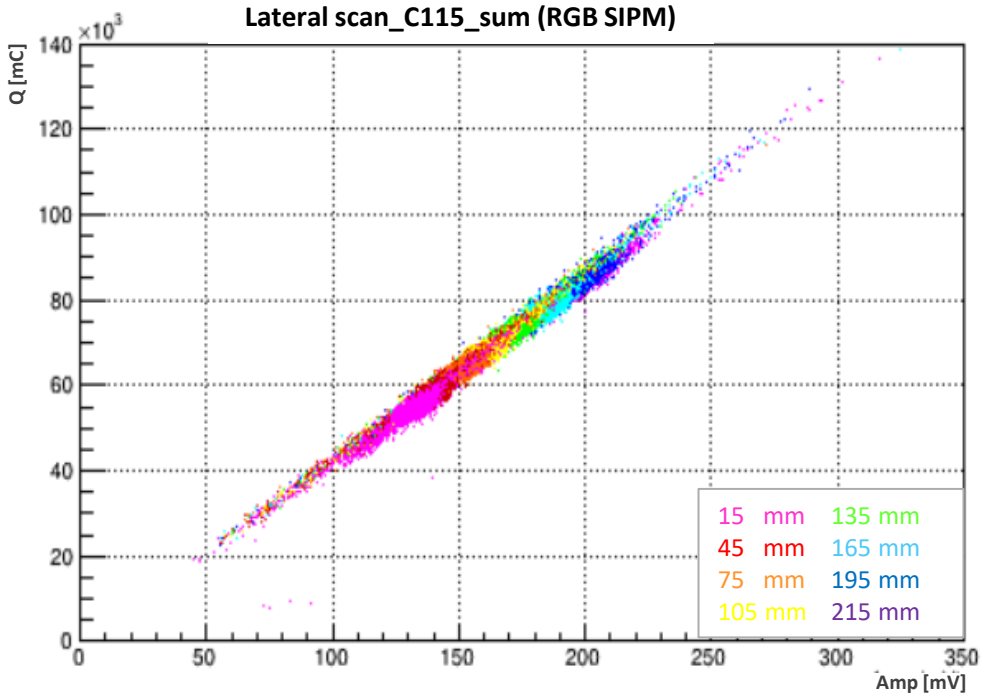


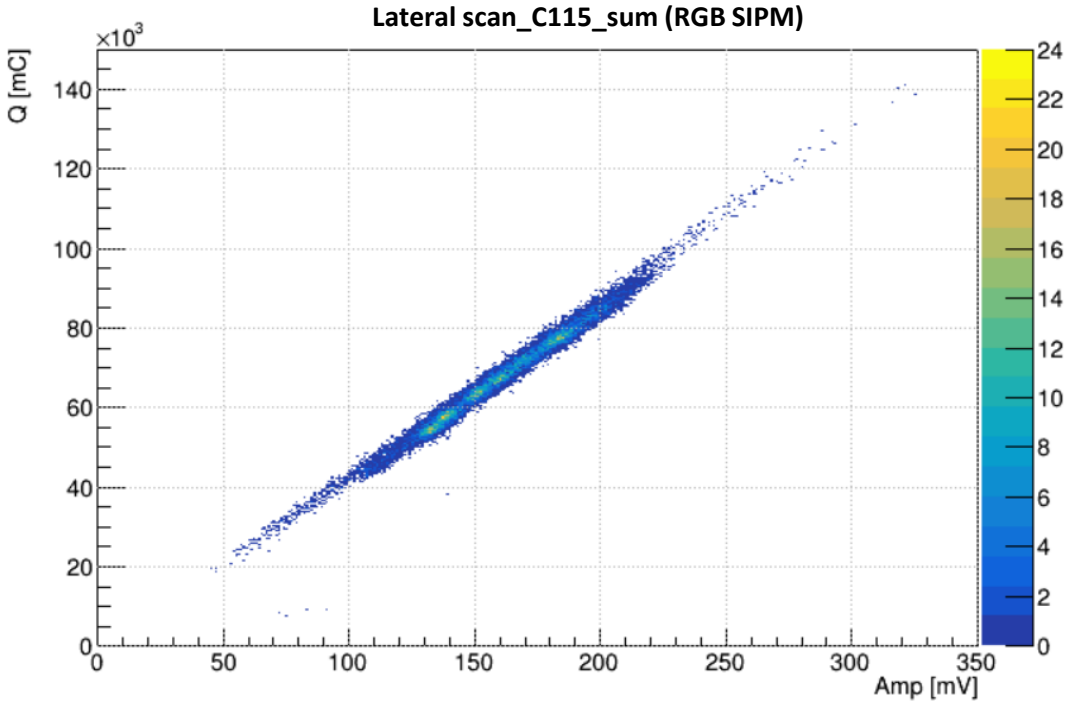




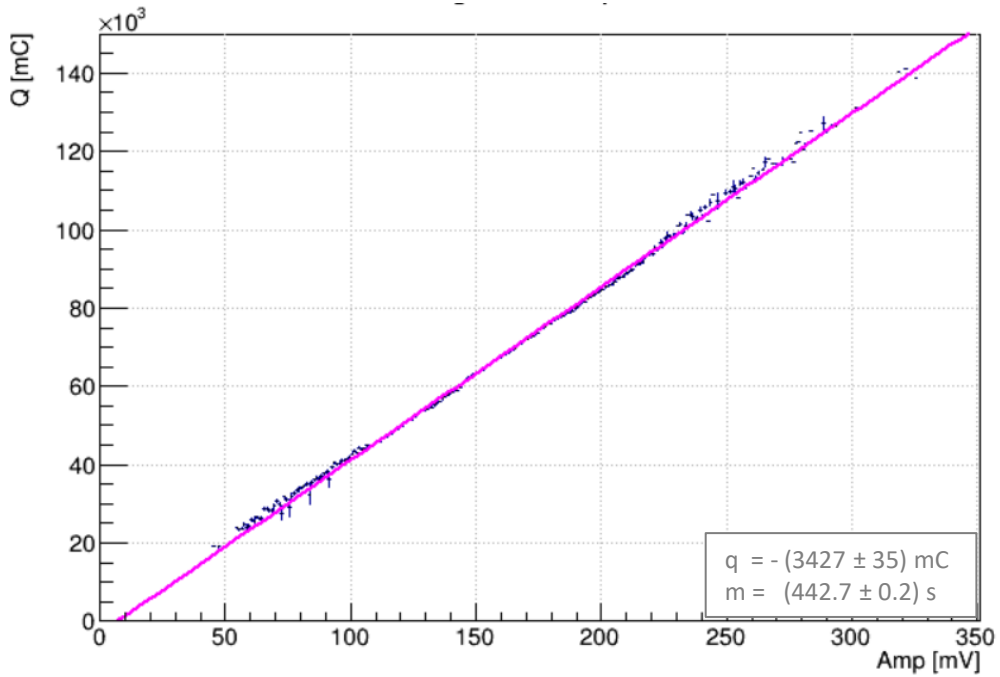
Lateral scan

- Analysis on Charge Vs Amplitude scatter plots
- RGB SiPM signals
- A direct proportionality between charge and amplitude in BGO signals is expected
- Summing all the scatter plots with different positions a distribution over the full range of charge and amplitude is obtained

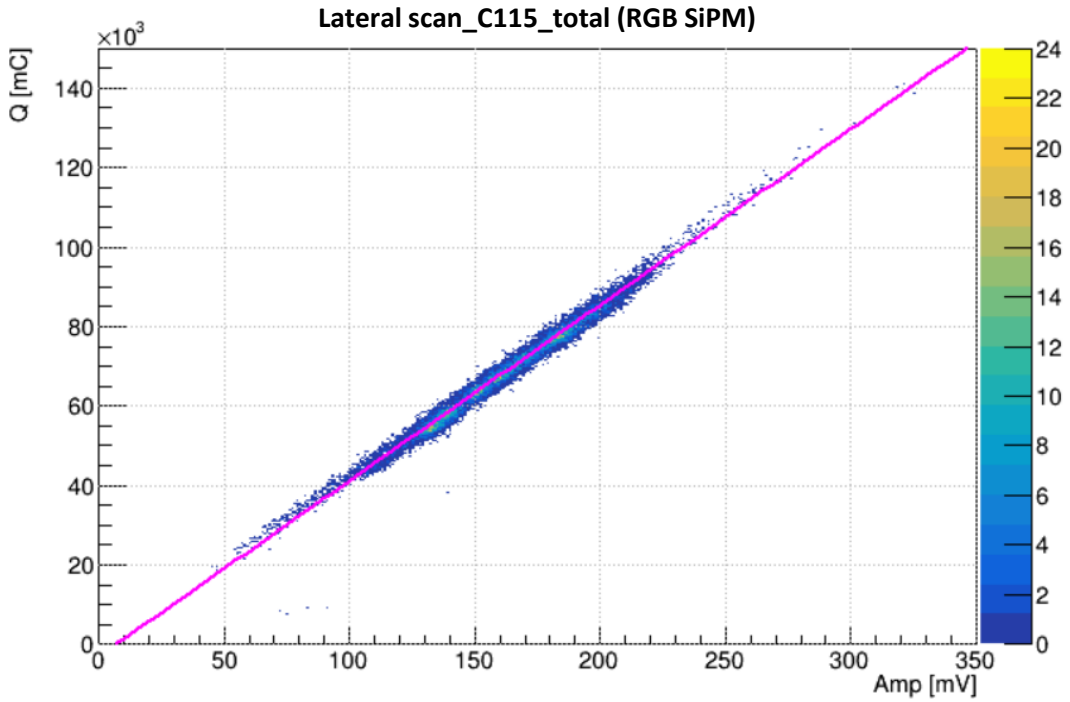




Lateral scan



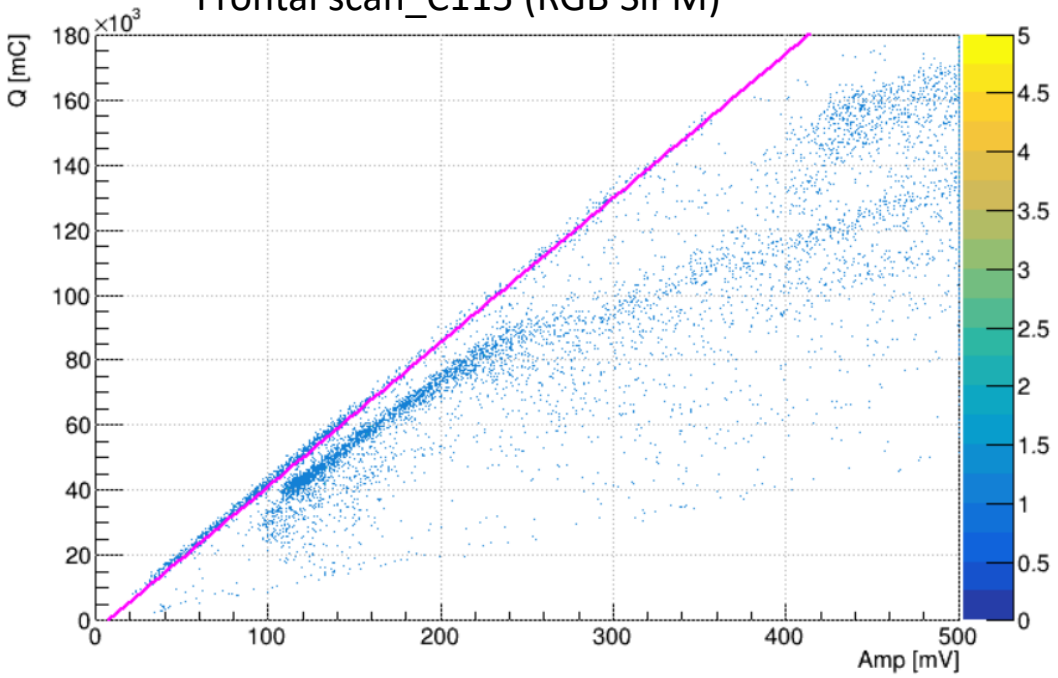
Separation straight line
(Carbon_RGB SiPM)



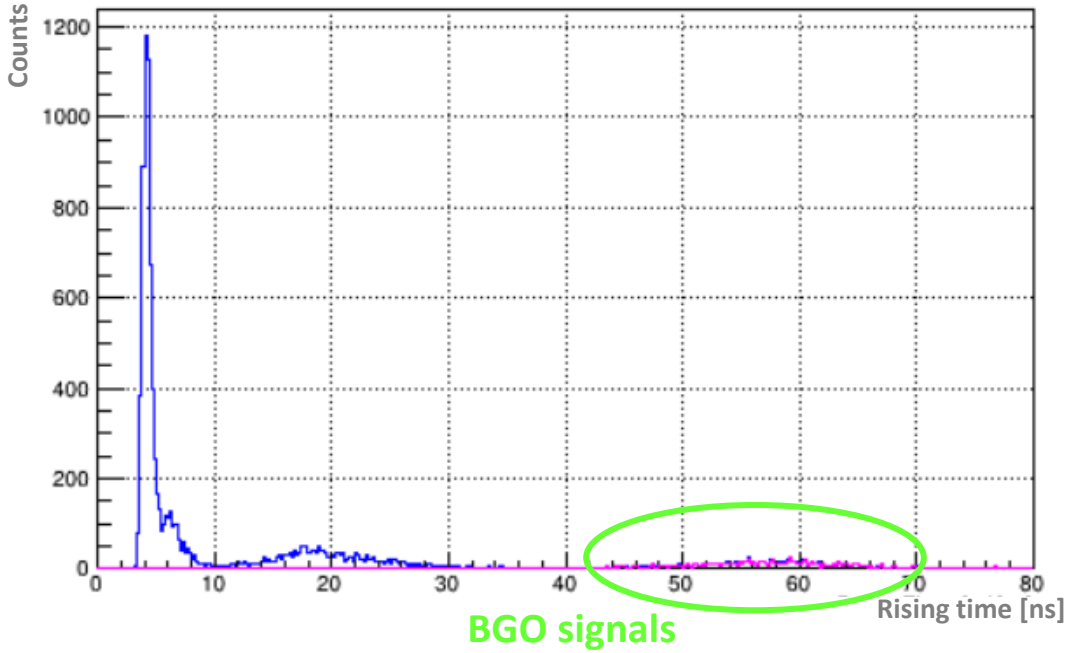
Lateral scan

- Plot of the separation line, obtained from the lateral scan, is overlapped on frontal scan data with the same energy.
- Selecting only events with charge larger than the fit, we found a distribution similar to the right peak in rising time distribution
- Rising times in BGO signals are higher

Frontal scan_C115 (RGB SiPM)

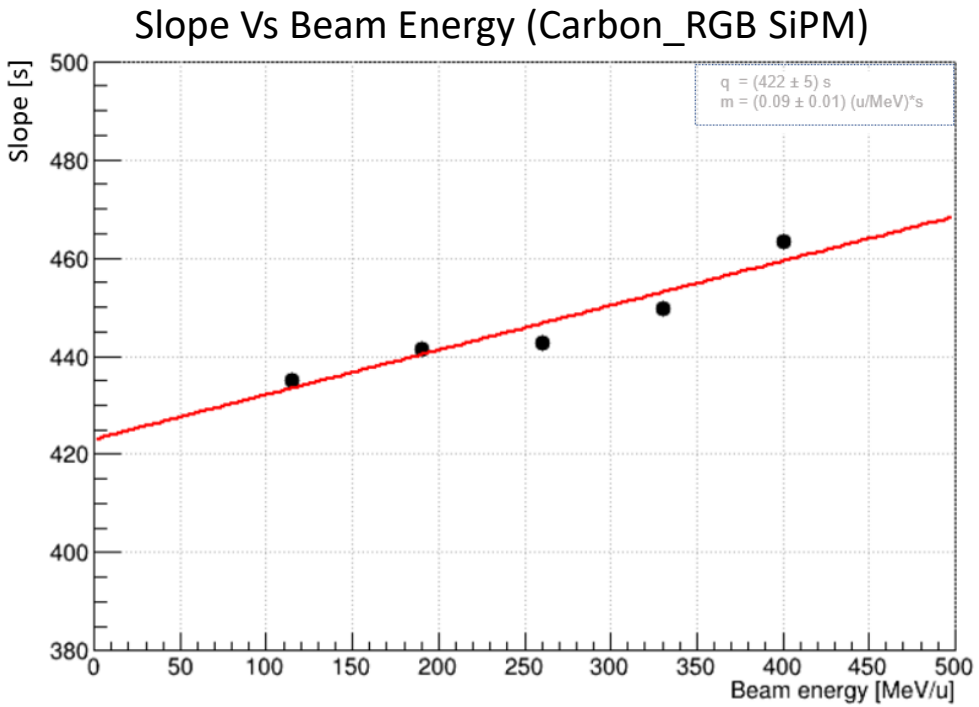


Rising time_C115 (RGB SiPM)



Frontal scan

- The slope of the separation line depends on the beam energy
- In order to find a separation line for all the energies, events with rising times corresponding to the right peak(tail) of the rising time distribution were selected
- The profiles of the scatter plots of charge versus amplitude for all the energies were fitted, obtaining different slopes for each energy



- The dependence of the slope of the separation line deviates from linearity as the energy increases
- The slopes of all the separation lines can be corrected in terms of the energy only for lower energies

Conclusions

- **BGO signals** have higher **values of rising times**
- The **slope** of the separation line **increases with the beam energy**, with a linear relationship for the signal read by the NUV SiPM
- It's possible to **separate** for the lower energies **the two signal populations** and also at higher energies for the signal read by the NUV SiPM
- The **identification of the signals originated in BGO** is implemented by combining **rising time** and **charge/amplitude information**