

TOF-dE/dx results with 40-cm
scintillator bars irradiated with
Protons and Carbon ions

FOOT Performances Meeting

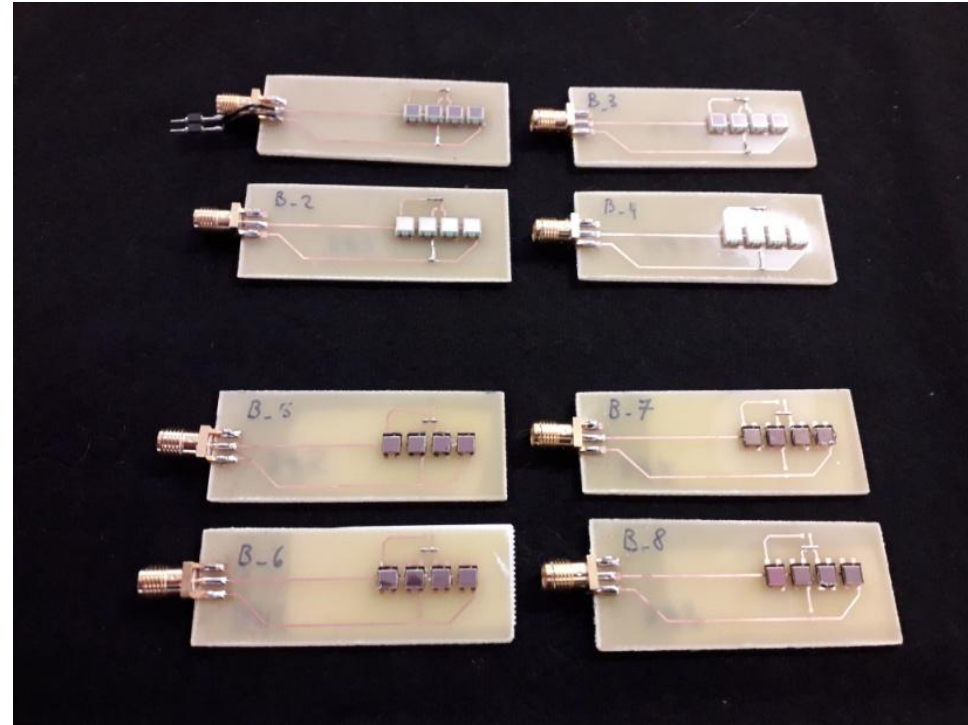
08/05/2018

Matteo Morrocchi

Set-Up



2 EJ-200 Scintillator bars 20 x 3 x 400 mm



- 4 Hamamatsu 25 um cell size
(2 parallel of 2 series)
- 4 ASD 40 um cell size
(1 series)

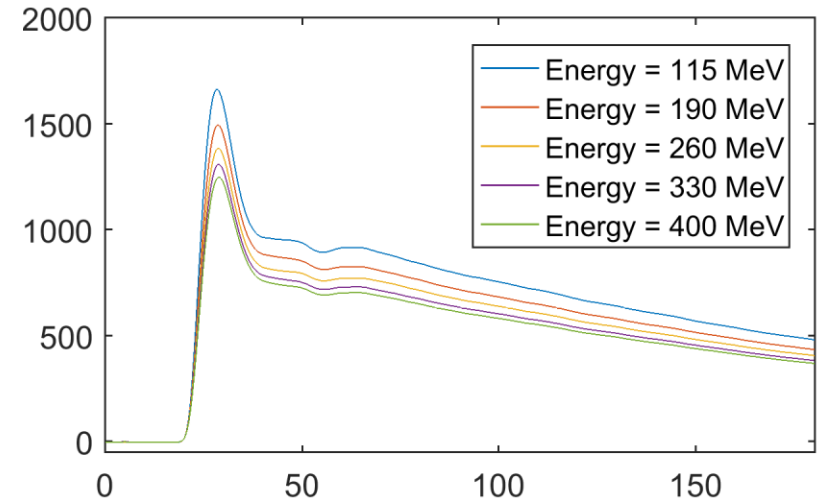
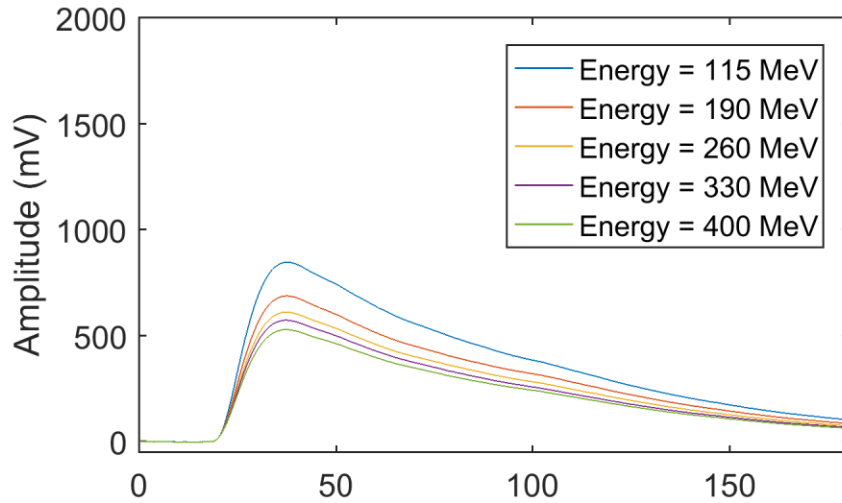
Waveforms



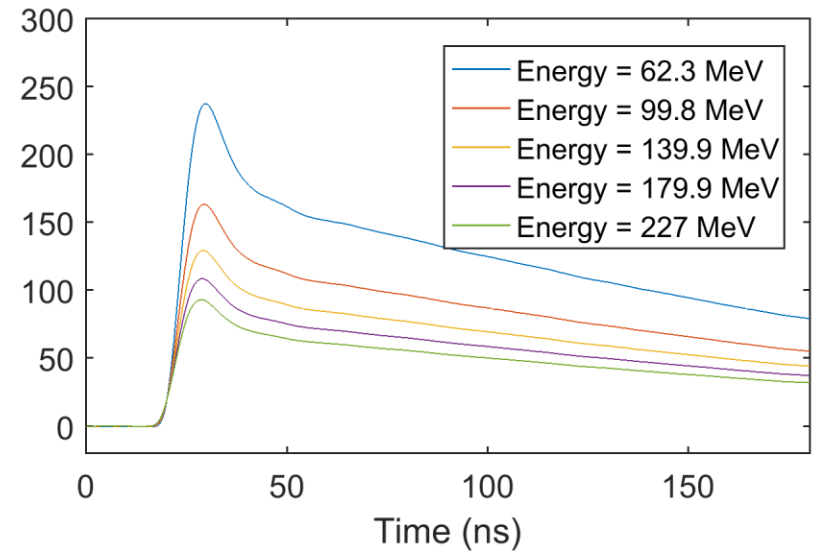
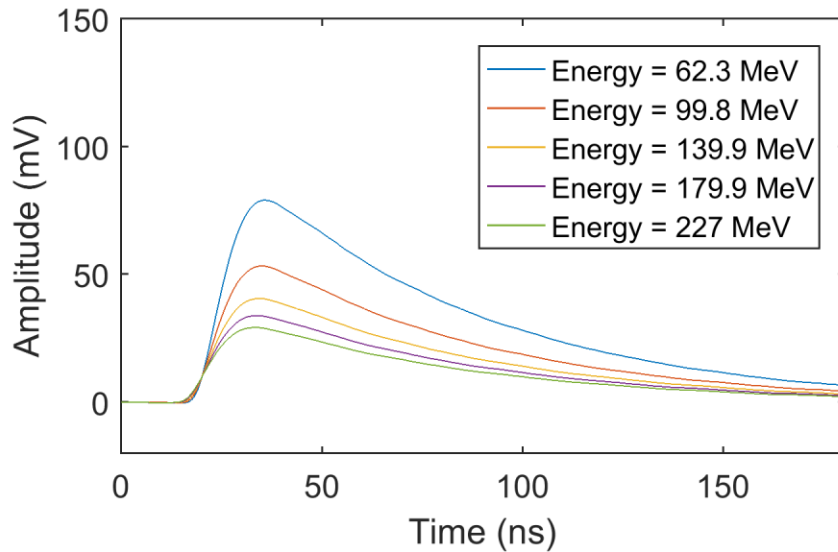
Hamamatsu

AdvanSiD

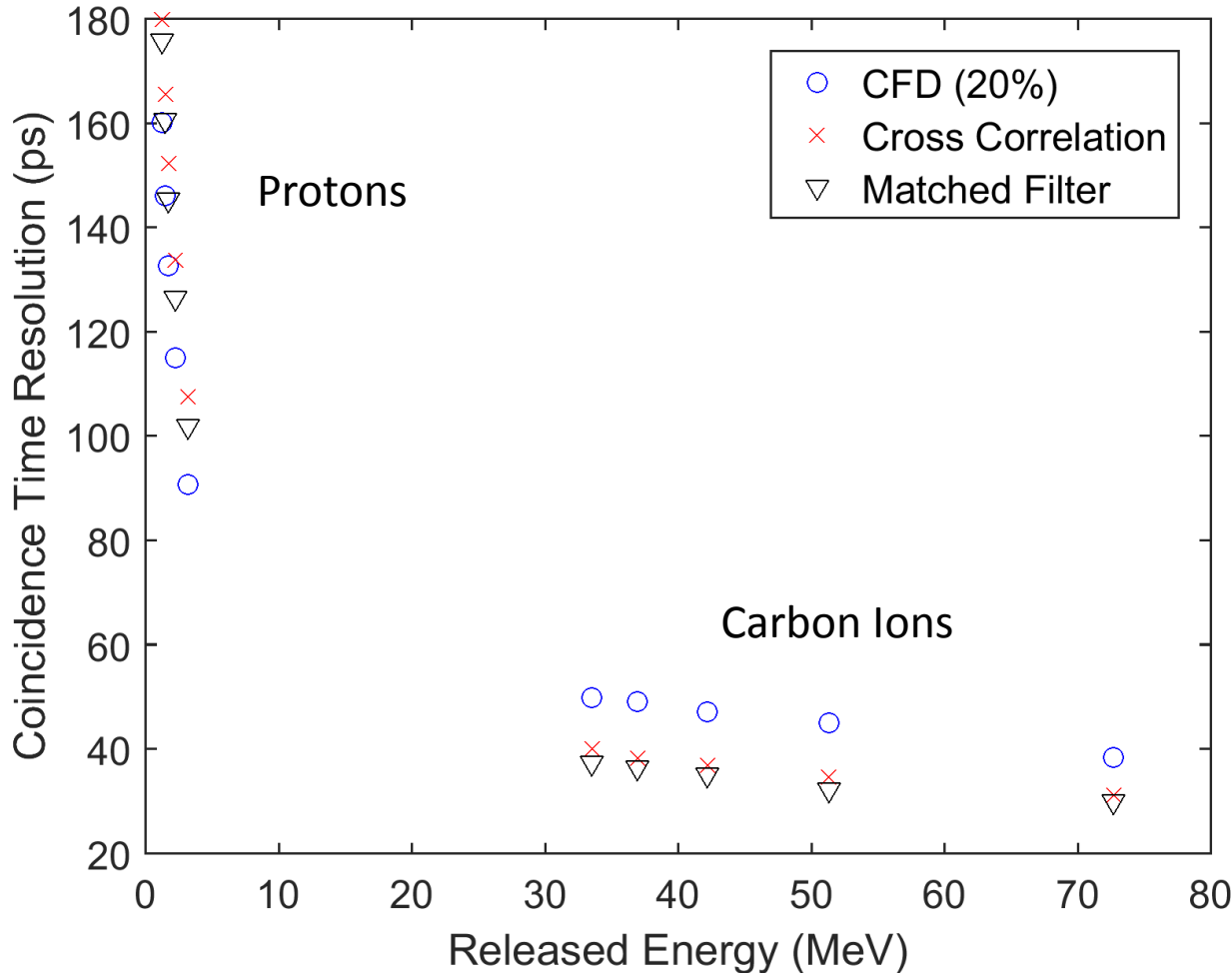
CARBON



PROTON



Coincidence Time Resolution



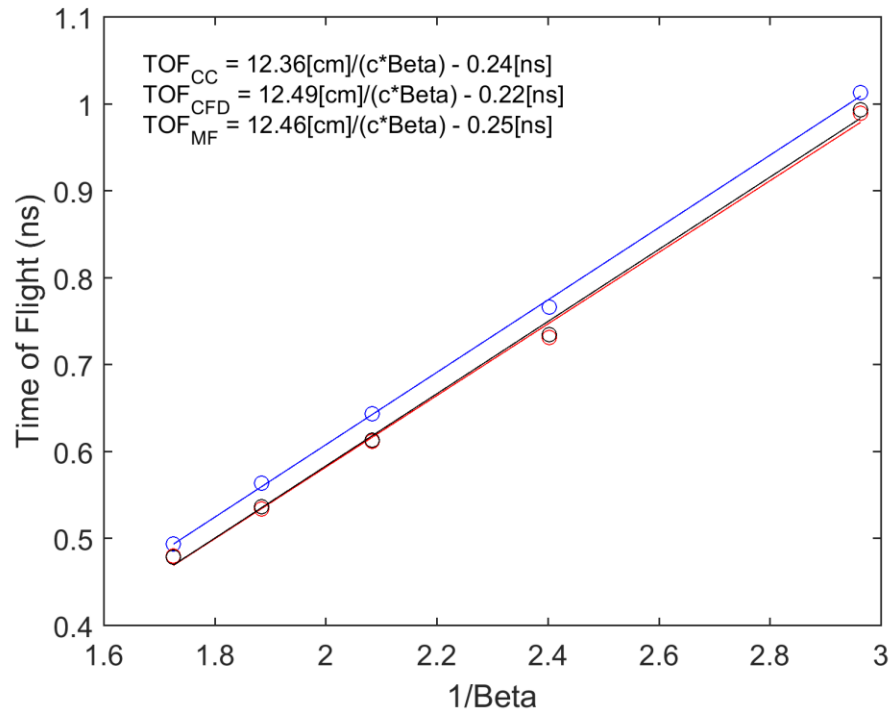
A single waveform pattern was used for each channel in every acquisition.

Two parameters were fitted in the Matched Filter (t_0 and Amplitude)

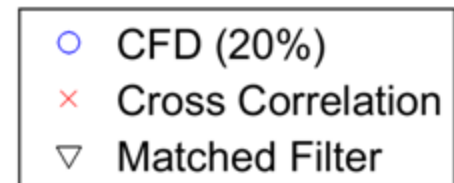
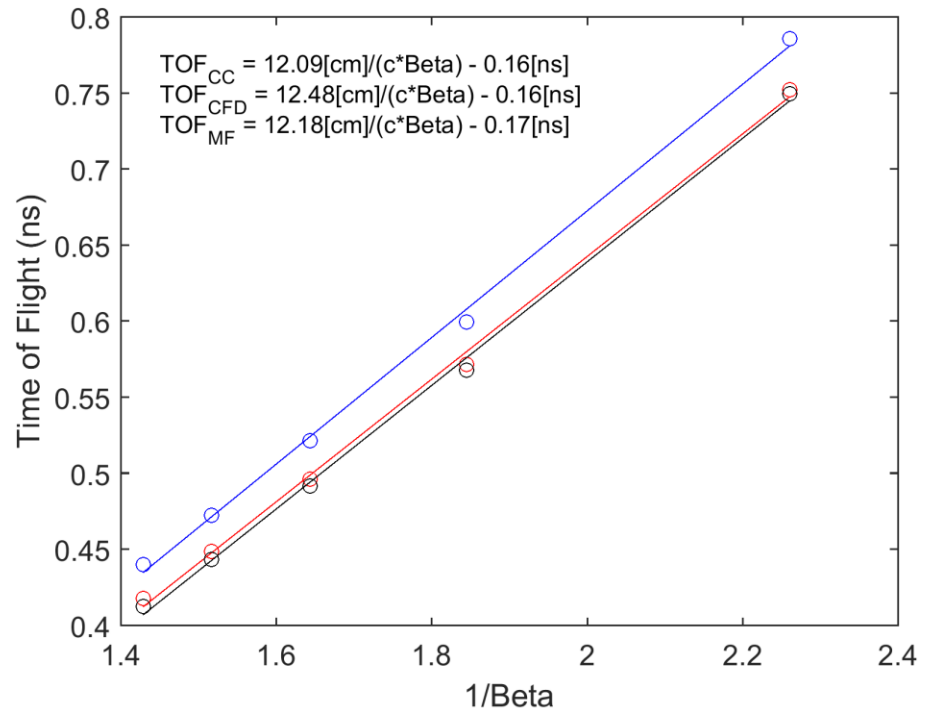
Time Of Flight



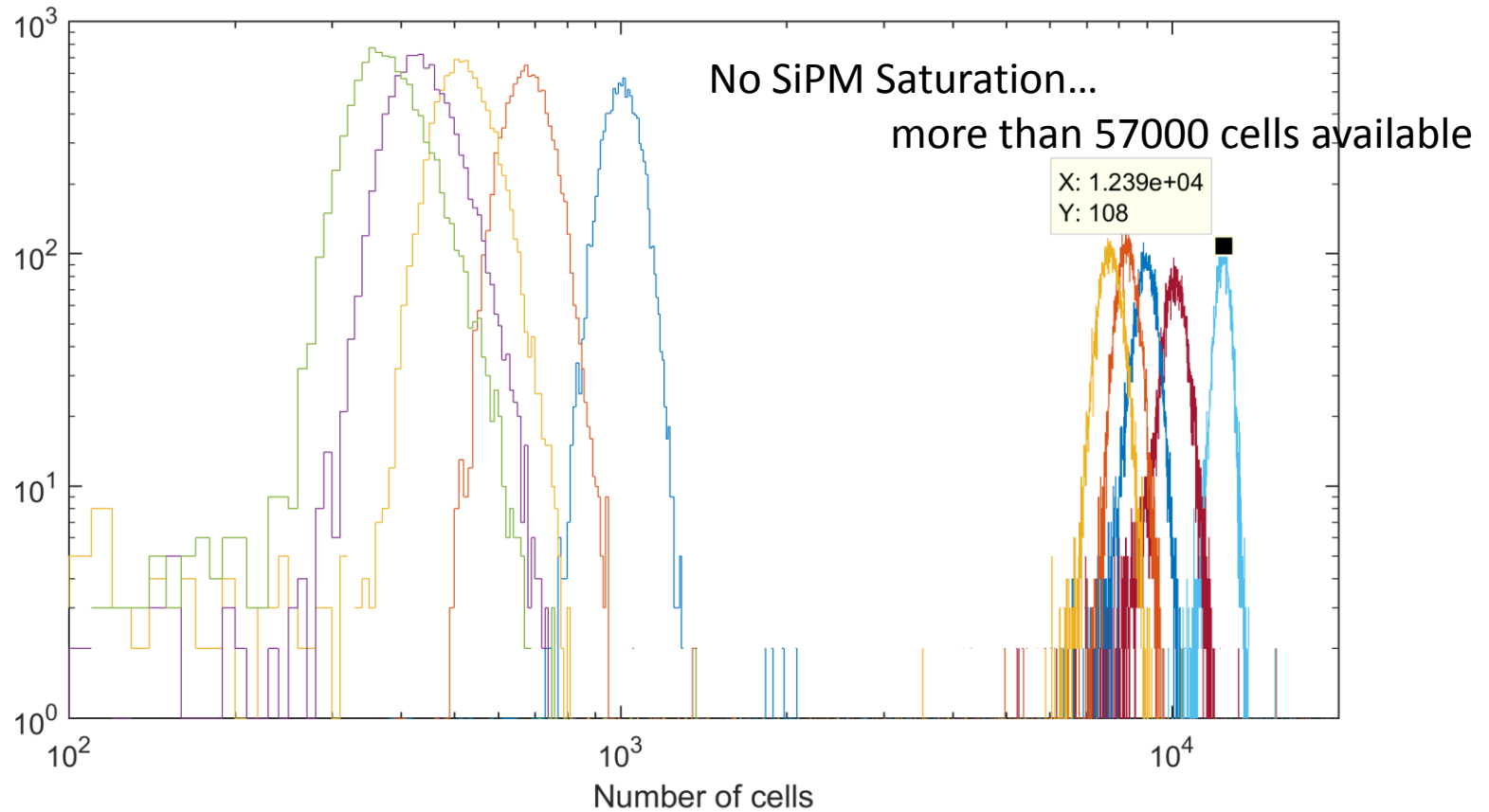
PROTON



CARBON



Collected Energy



...But still Energy behavior is not linear!

Scintillator Saturation



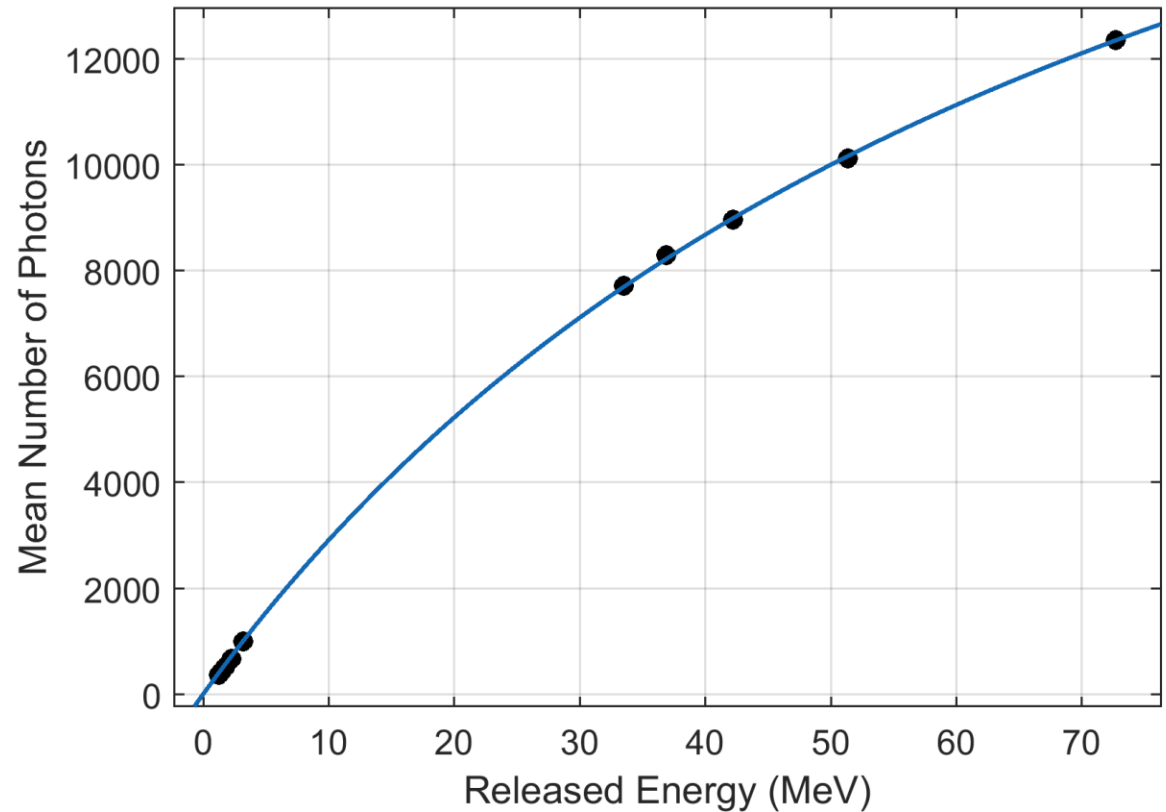
Birks Model:

$$N_{\text{ph}} = s \cdot (E / (1 + a \cdot E))$$

$$a = 0.01284 \pm 0.008 \text{ MeV}^{-1}$$

$$s = 328 \pm 8 \text{ ph/MeV}$$

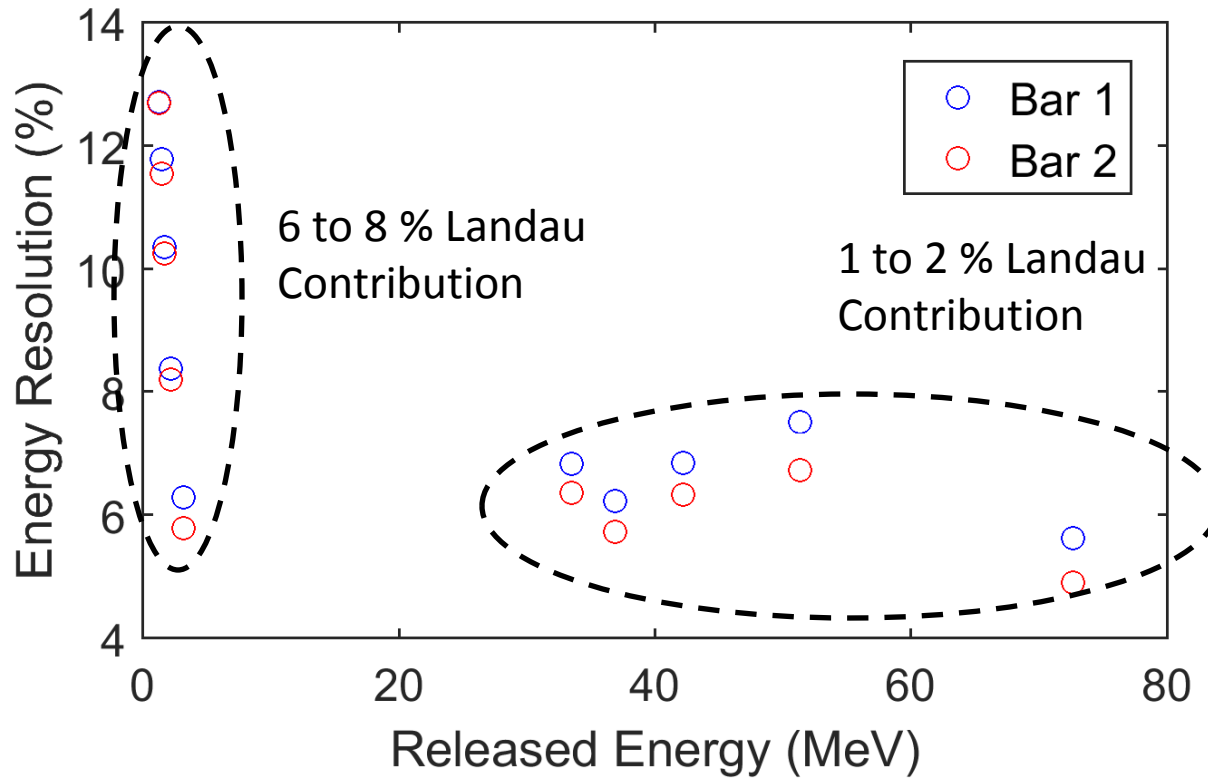
The model is used to obtain a linear response as a function of the released energy



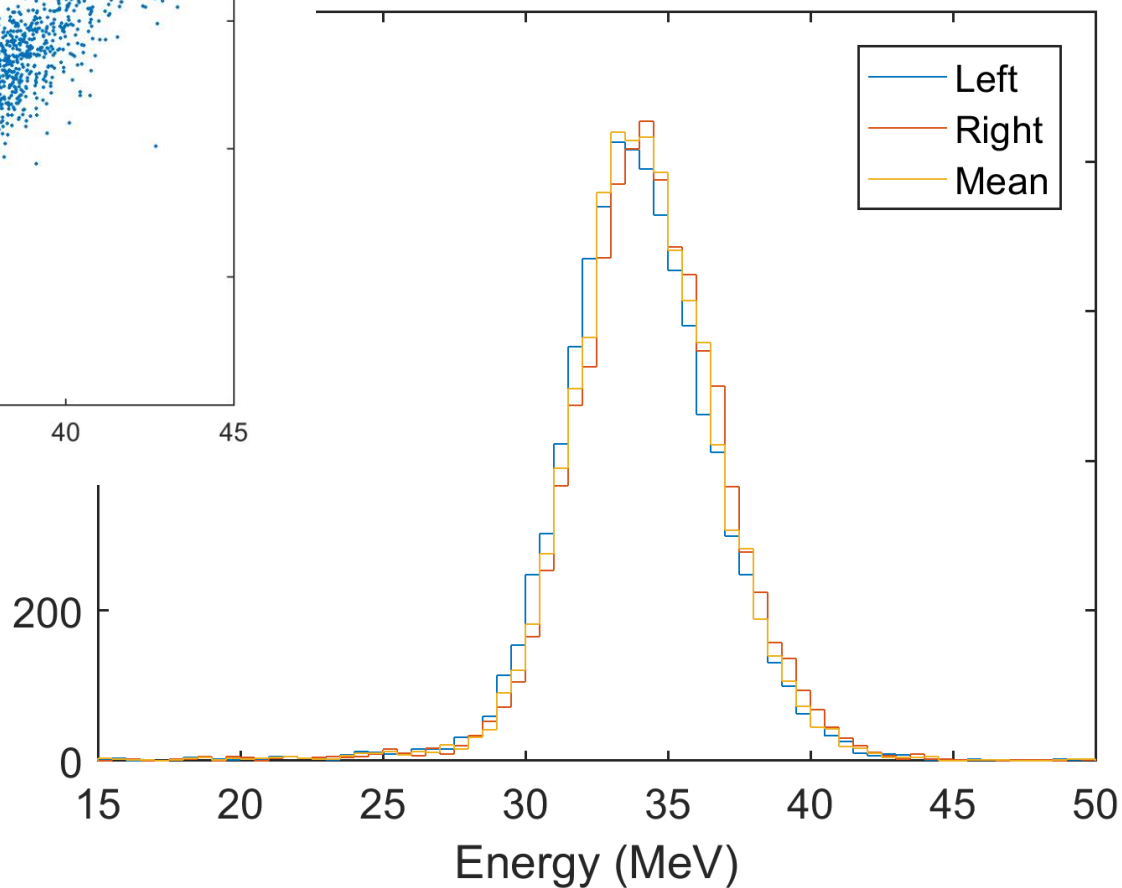
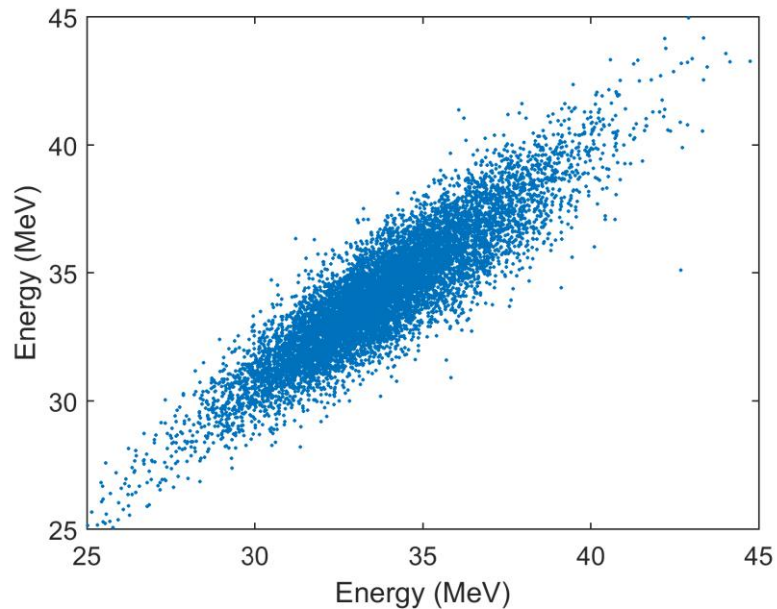
Energy Resolution



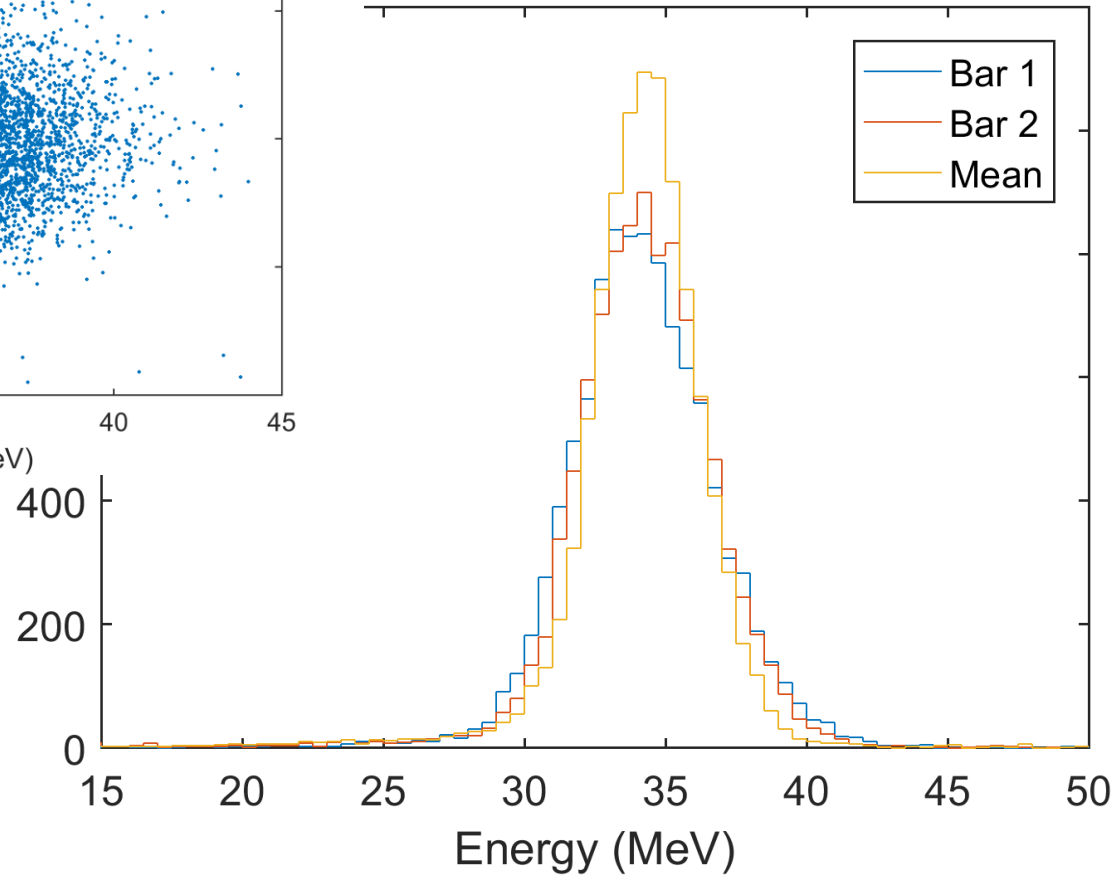
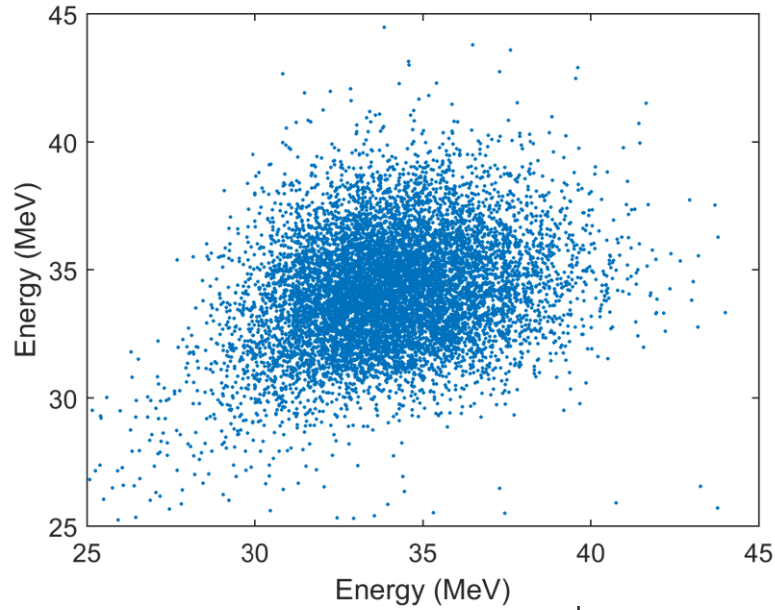
Energy resolution is expressed as the std of the energy collected on each bar divided by the mean. Landau fluctuation in released energy was not subtracted.



Left vs Right Comparison



Bar vs Bar Comparison



Conclusions



- Timing performance is compliant with requirements, even with CFD method
- Energy resolution is not compliant
 - An energy spread larger than expected was observed (linearization, fluctuations?)
- SiPM dynamic range is enough for all the particles, no needs to investigate different samples
- Need to investigate scintillator saturation, use also of PMT for comparison in next test beam