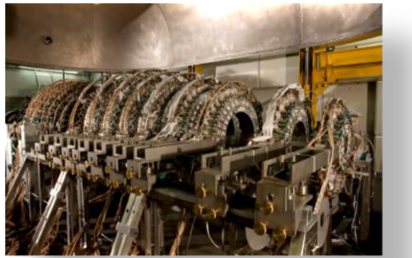
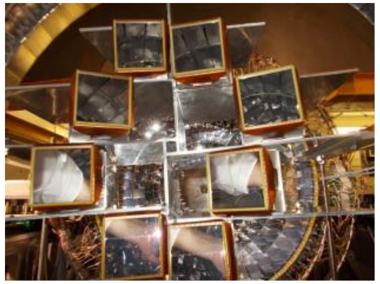
A Pixellation method for the FARCOS array

G.Cardella for the CHIRONE **collaboration**





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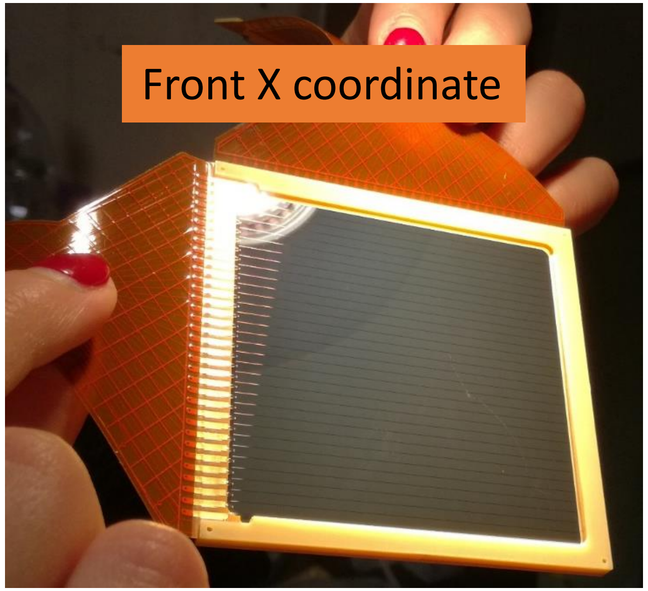
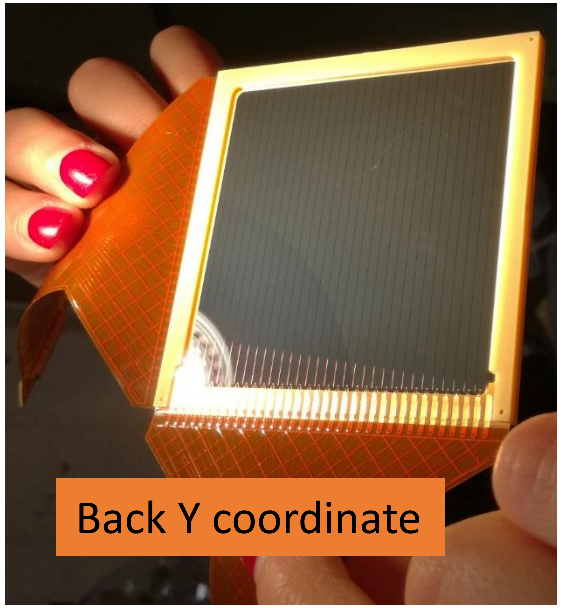
A Double Side Silicon Strip Detector (DSSSD) is a detector with strips on both sides enabling to extract with a relatively small number of electronic channels a precise position information of detected particles



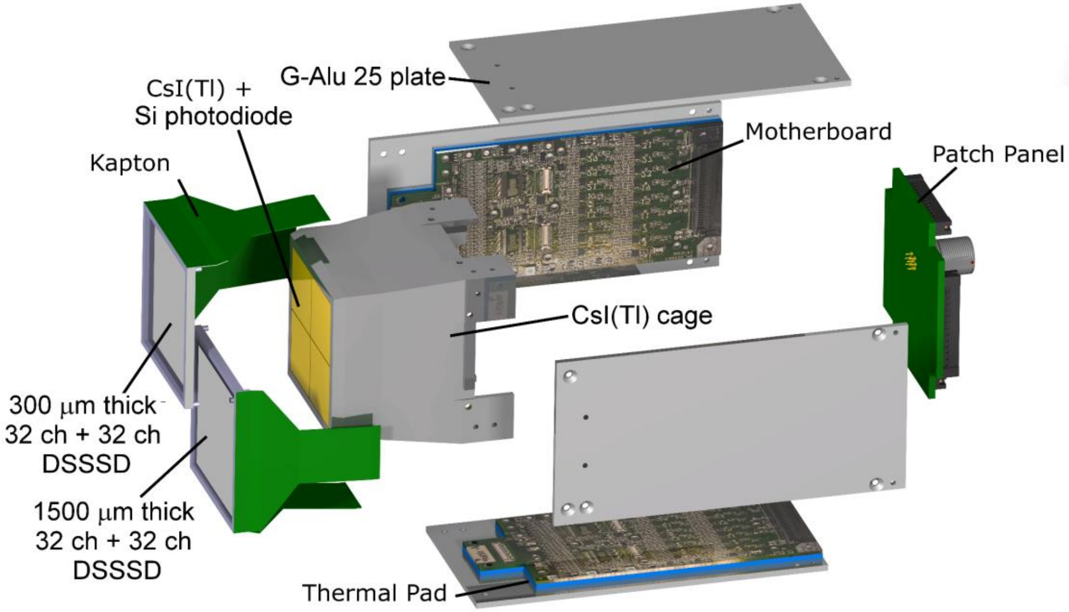


Pixellation: assign to each detected particle the x-y position

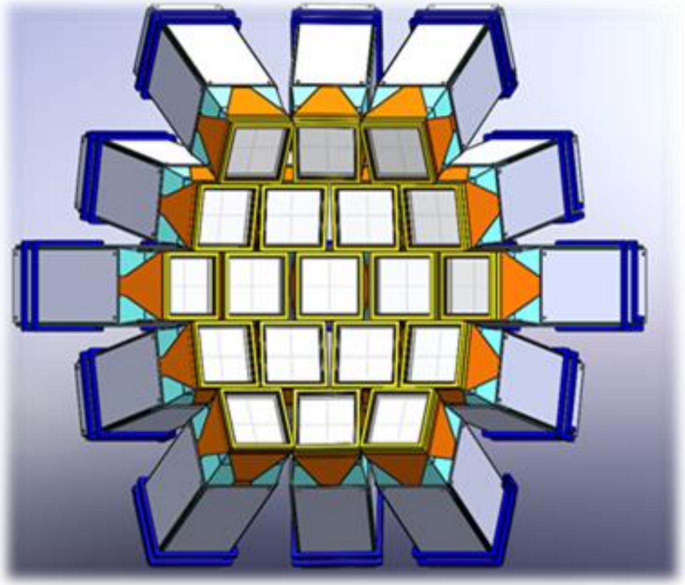
simple with only one particle detected

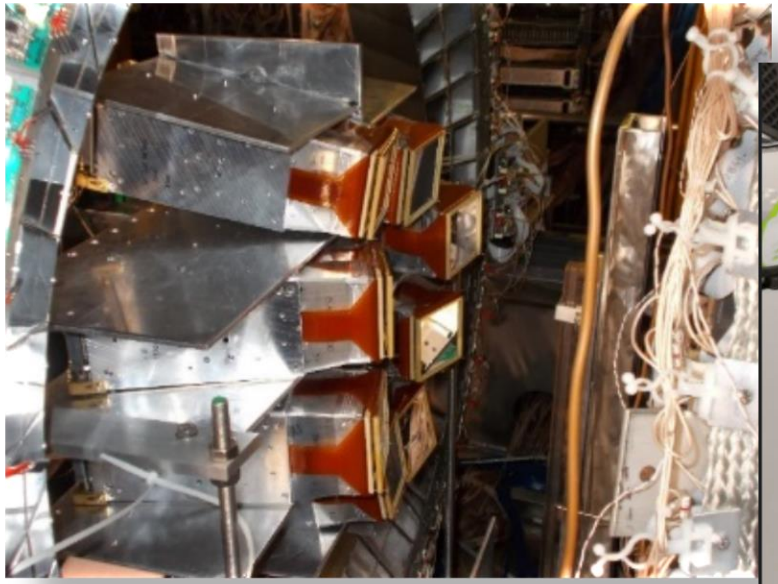
complex when many particles are detected in the same telescope

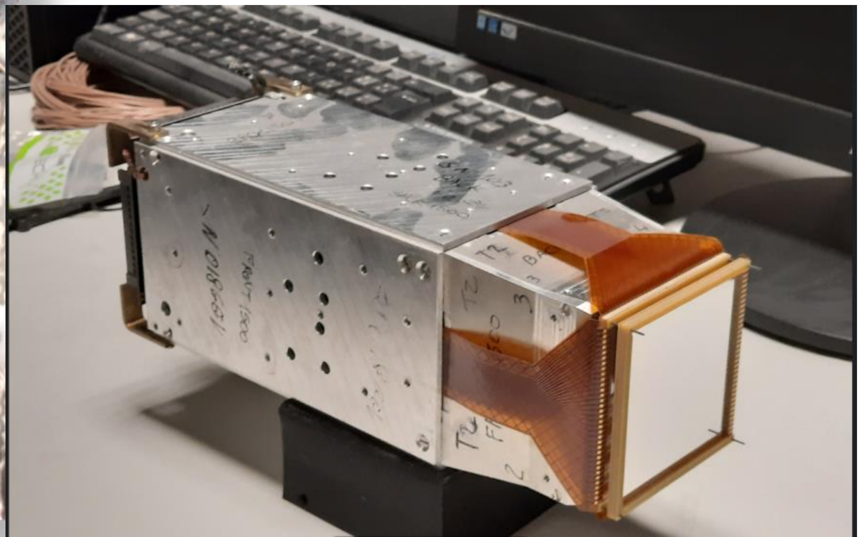
FARCOS ARRAY at LNS

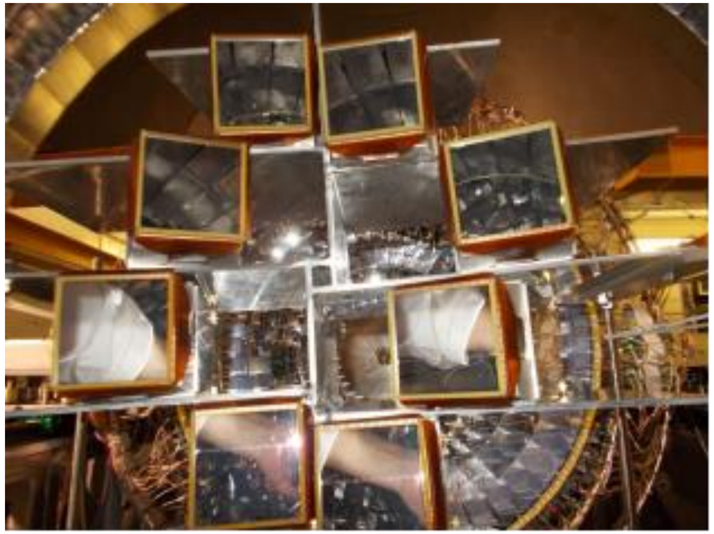


Farcos is an array of 20 triple telescope with two stages of DSSSD 300 μm and 1500 μm both with 32x32 strips 2 mm wide with a third stage with 4 CsI(Tl) 6 cm long

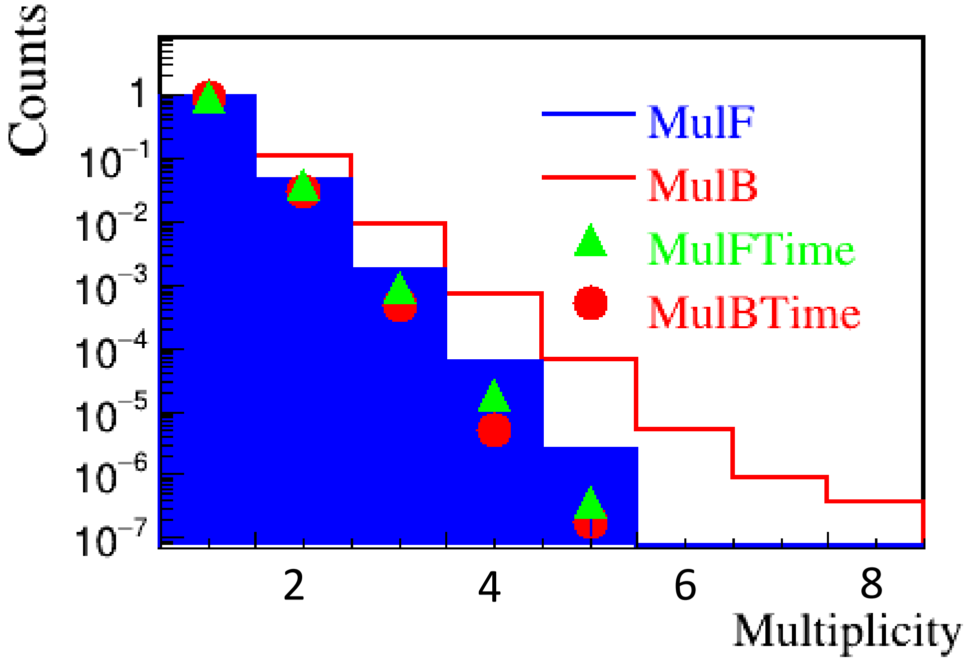






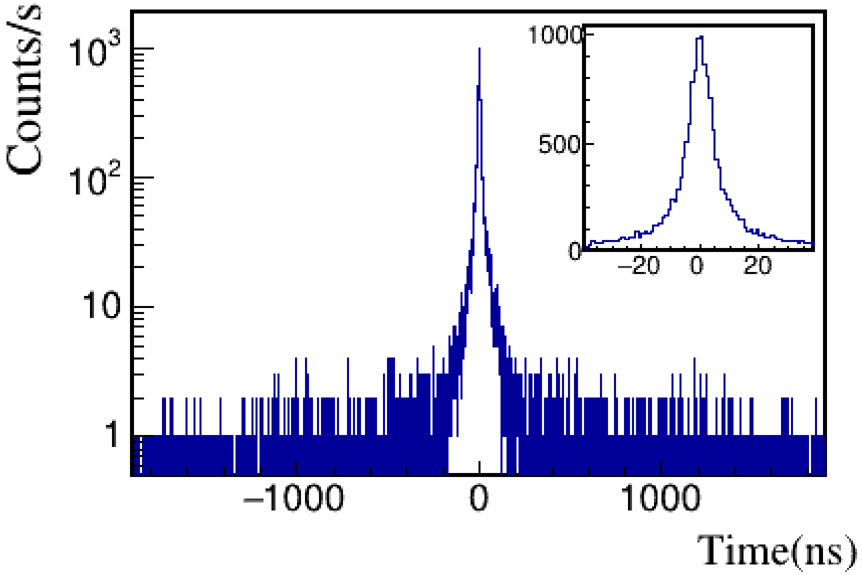


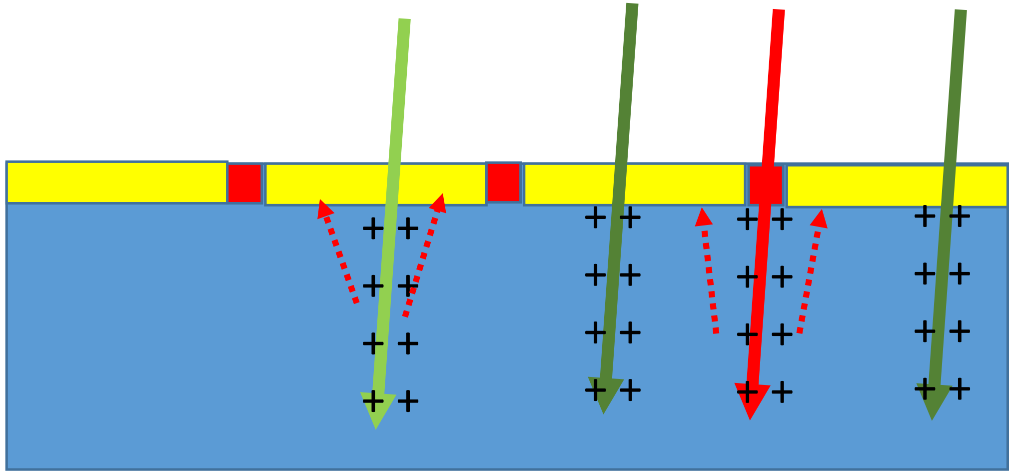
I will show results of a test experiment with the **reaction α+^{12}C at 64 MeV performed at LNS** – 4 FARCOS telescopes were used mounted at 40 cm from the target. We will show the coincidence measurements of 2-3 α particles to test the pixellation work



Large multiplicity affected by noise – random coincidences – interstrip events -

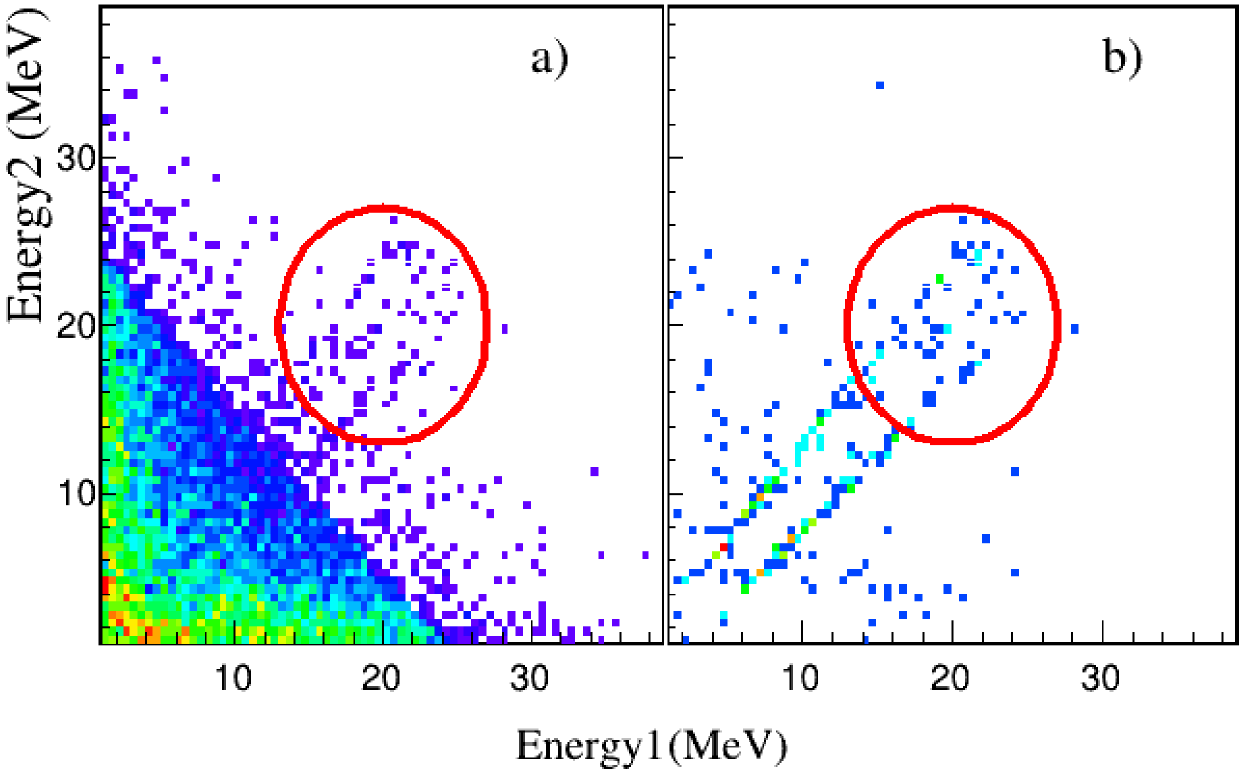
We have measured the multiplicity distribution of particles stopped in the first stage of FARCOS telescopes





If a particles is detected in a region between two strips the charge generated by the particle can be shared between the two strips – **This is an INTERSTRIP event**

We can observe interstrip events plotting the energy detected in two contiguous strips



However not all events detected in two contiguous strips are interstrip events there can be also **good coincidences as the ^{8}Be decay in two α particles**

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How we can recover an interstrip event?

k=0 stripF 1 eneF 6.96109 timeF 86.0709
k=0 stripB 17 eneB 16.8495 timeB 84.0194
k=1 stripF 8 eneF 22.0452 timeF 84.9274
k=1 stripB 18 eneB 5.7962 timeB 83.0444 !!!!!possible interstrip stripb 17 and 18
k=2 stripF 9 eneF 12.5163 timeF 60.4874 BAD timing
k=2 stripB 28 eneB 7.05978 timeB 83.4301
Data Multiplicity =3

Exclude events out of good time window

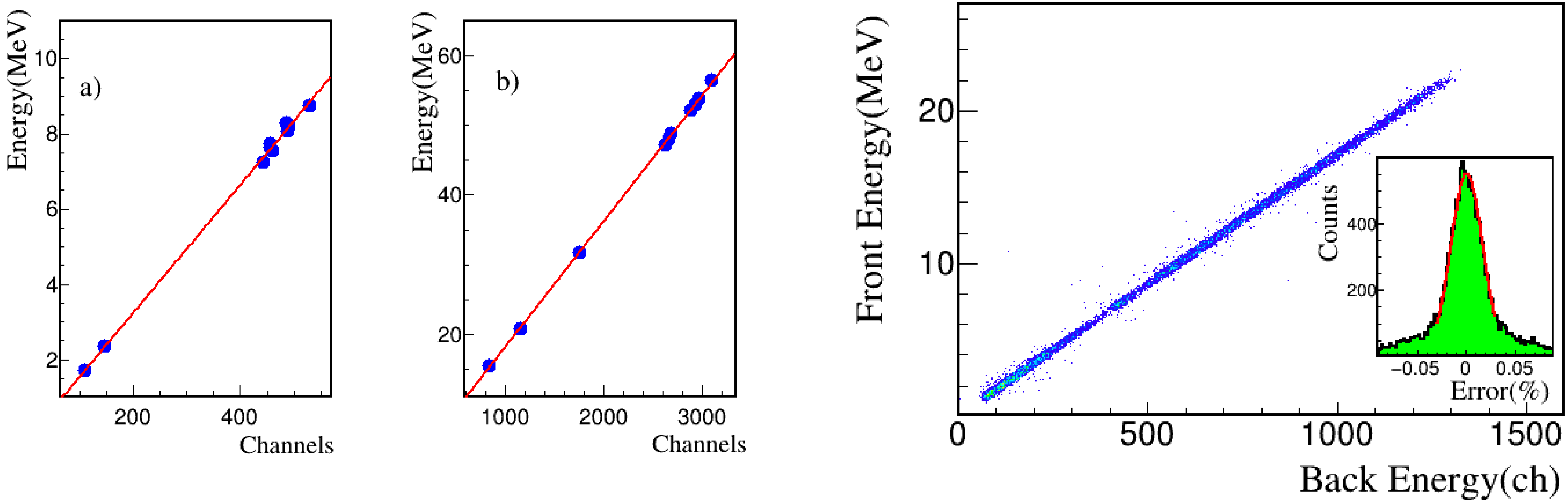
Correct Event Pixel

$ENE_{front} = ENE_{back}$

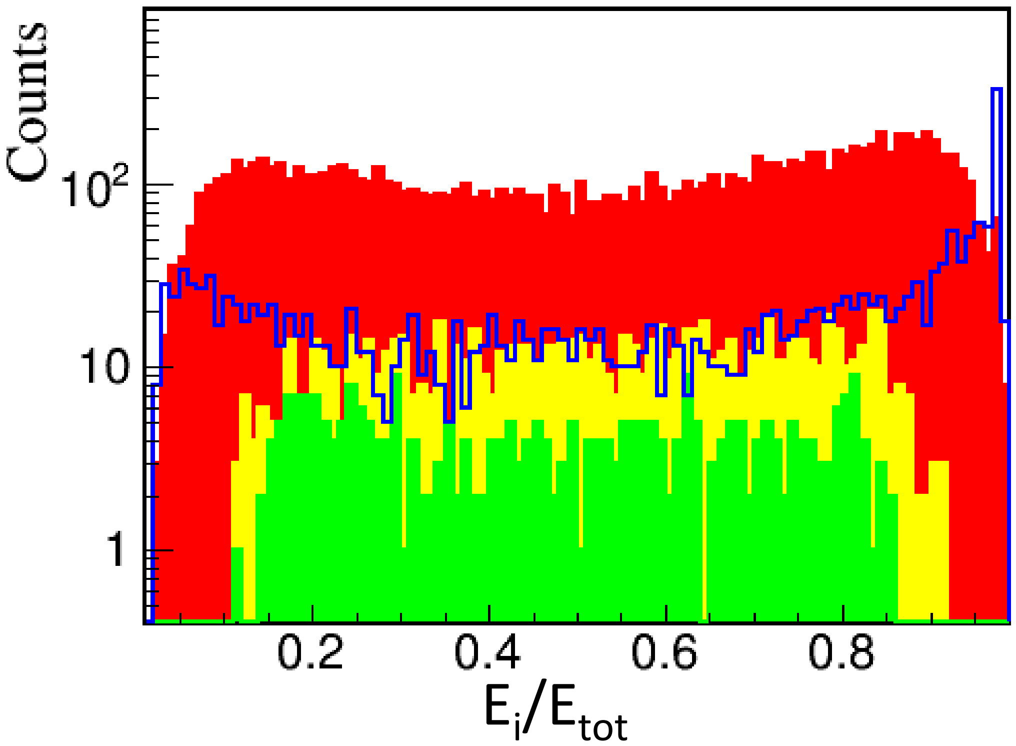
Reordered event:
k=0 stripF 1 eneF 6.96109 timeF 86.0709
k=0 stripB 28 eneB 7.05978 timeB 83.4301
k=1 stripF 8 eneF 22.0452 timeF 84.9274
k=1 stripB 17 eneB 22.6457 timeB 83.7699
Real Multiplicity =2

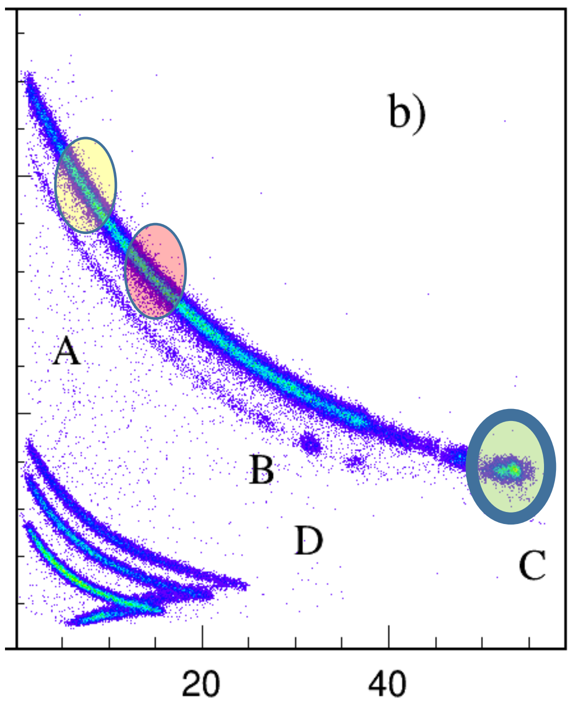
S. Kundu et al NIMA 943 (2019) 162411.

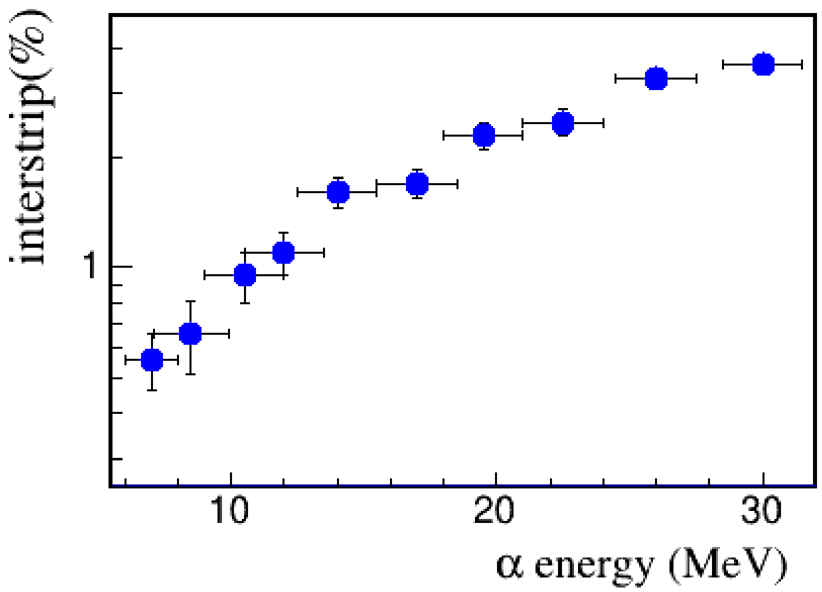
Essential the energy calibration of both front and back stages



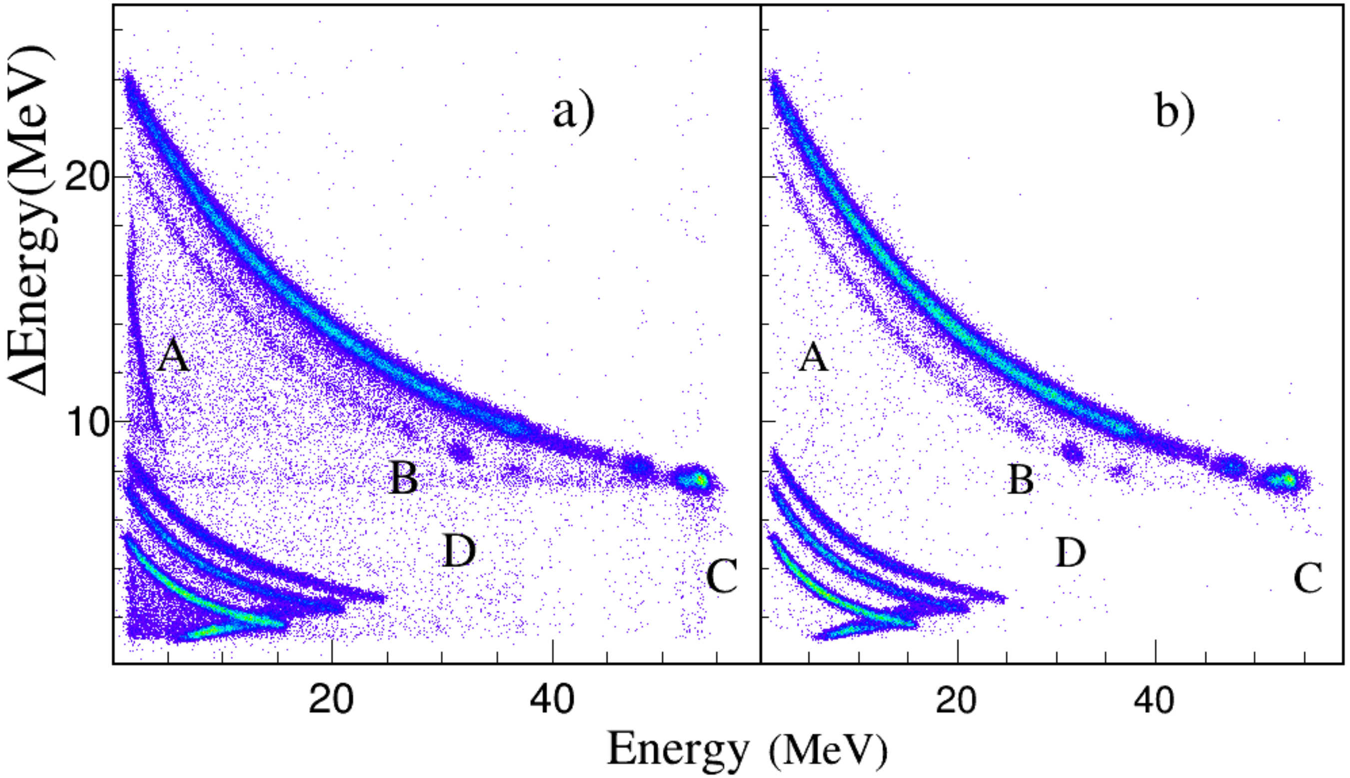
Unfortunately not all interstrip events can be recognized one of the two strips can be the under-threshold

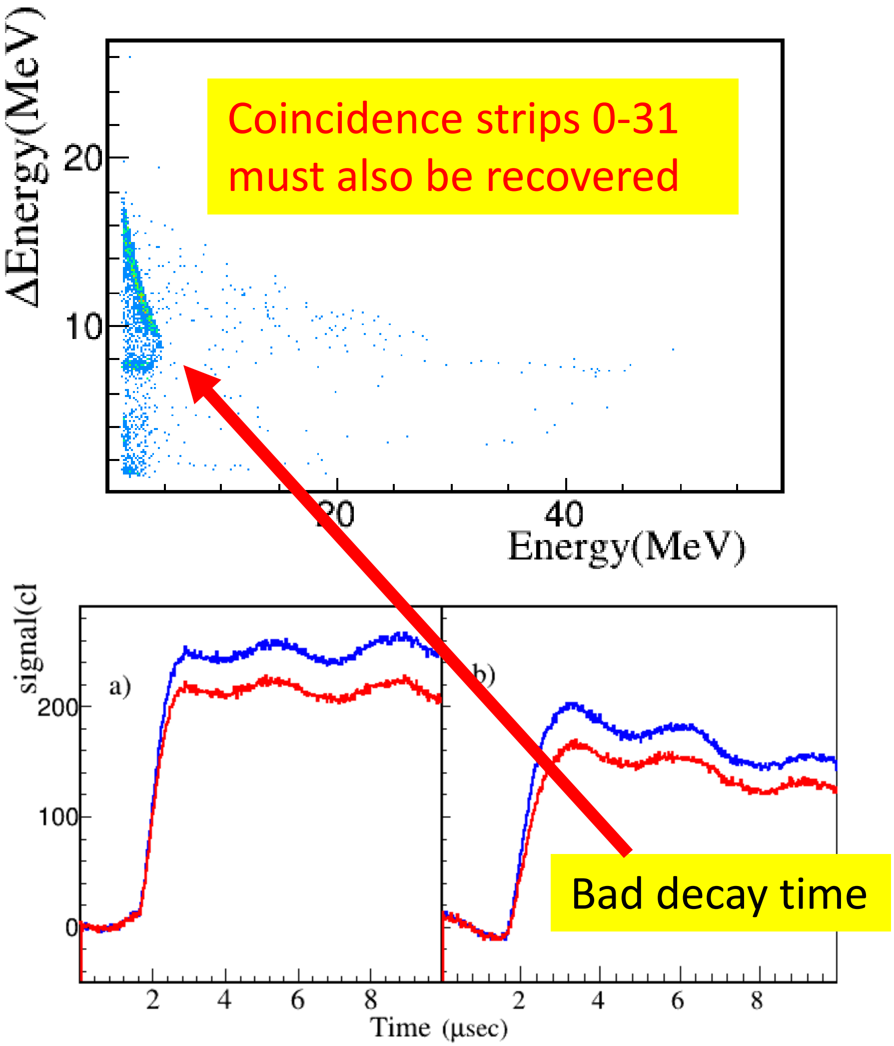






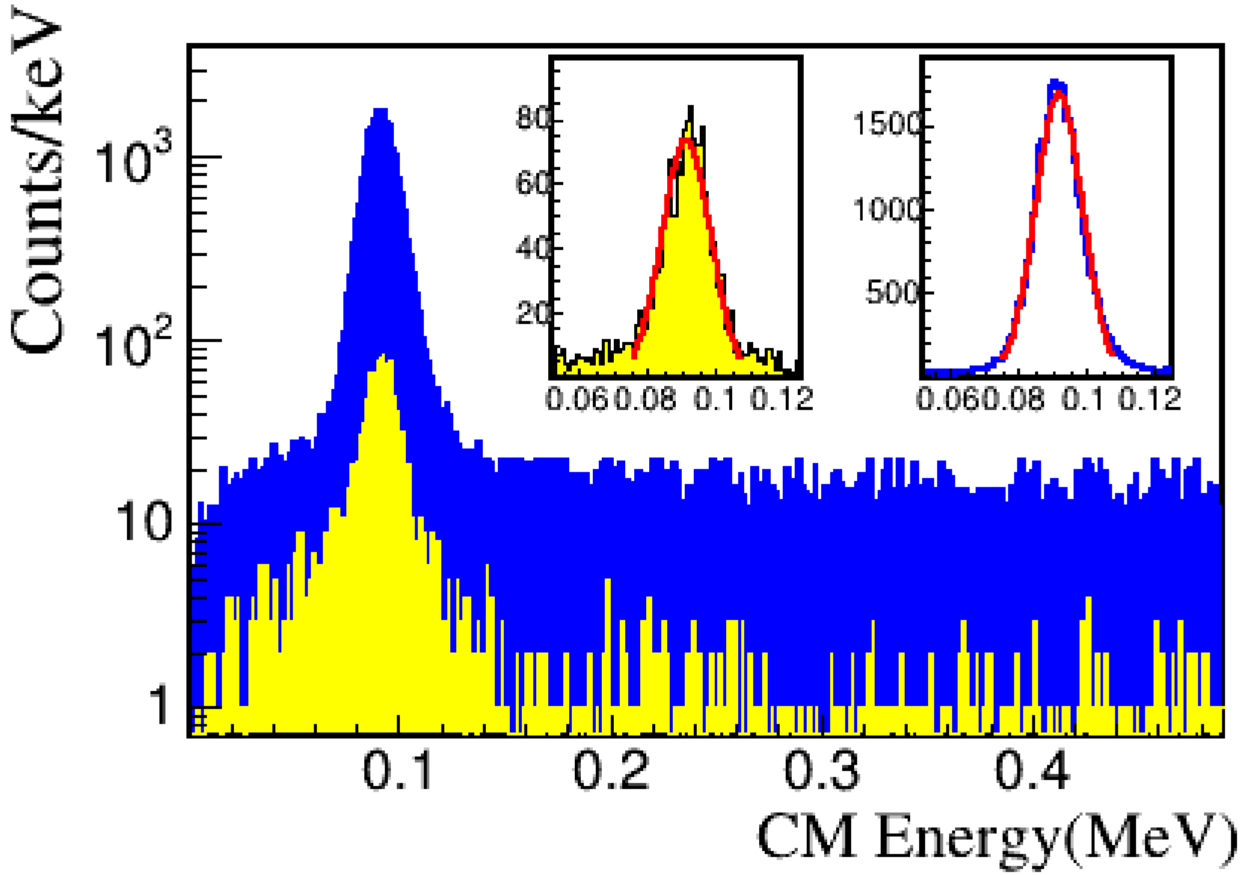
Cleaning spurious coincidences and reconstructing interstrip events allow to clean also identification scatter plot





Near guard ring events induce strange signals with fast decay time in the strips 0 and 31

^{8}Be events – α–α coincidences



Energy resolution for single strip events 7 keV

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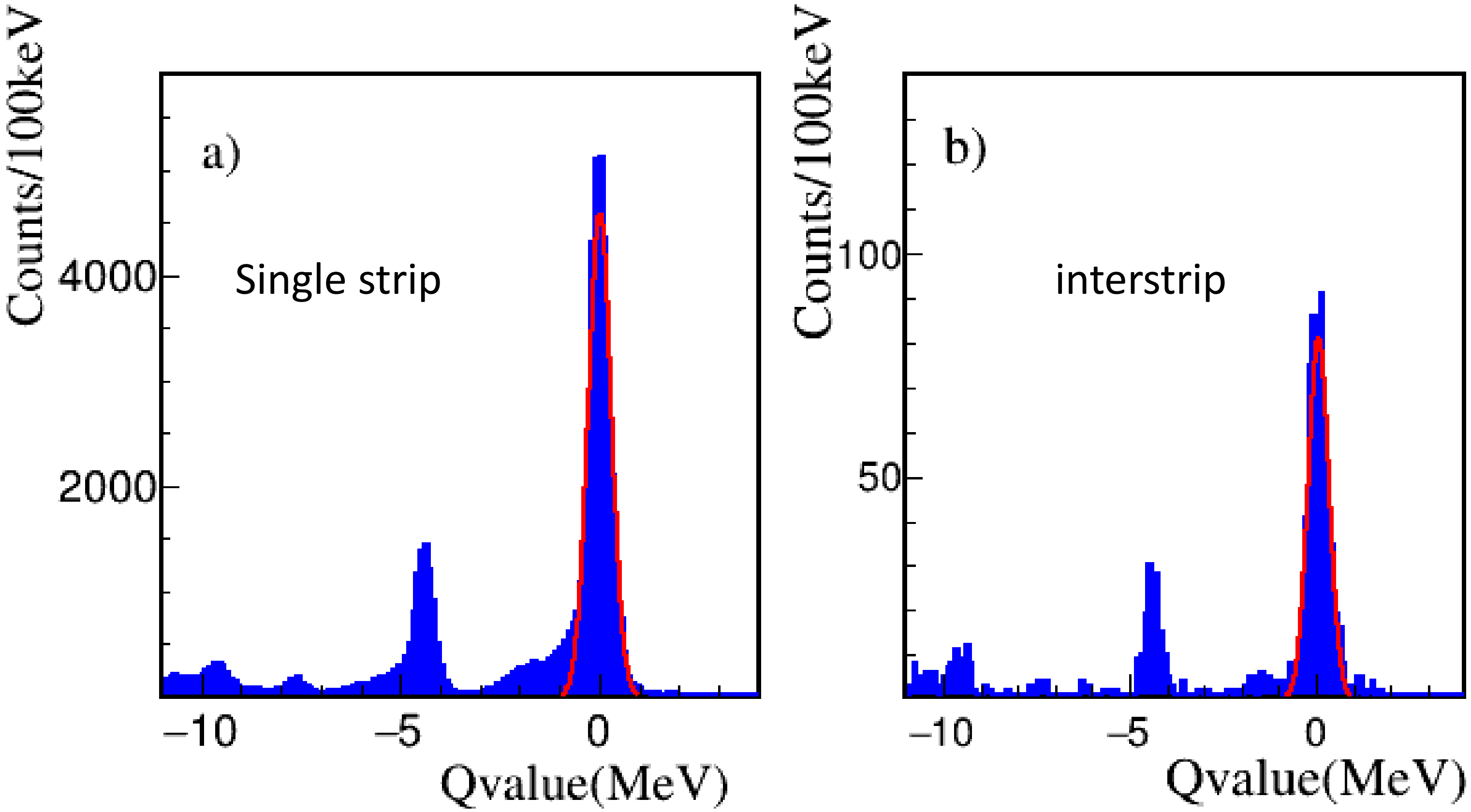
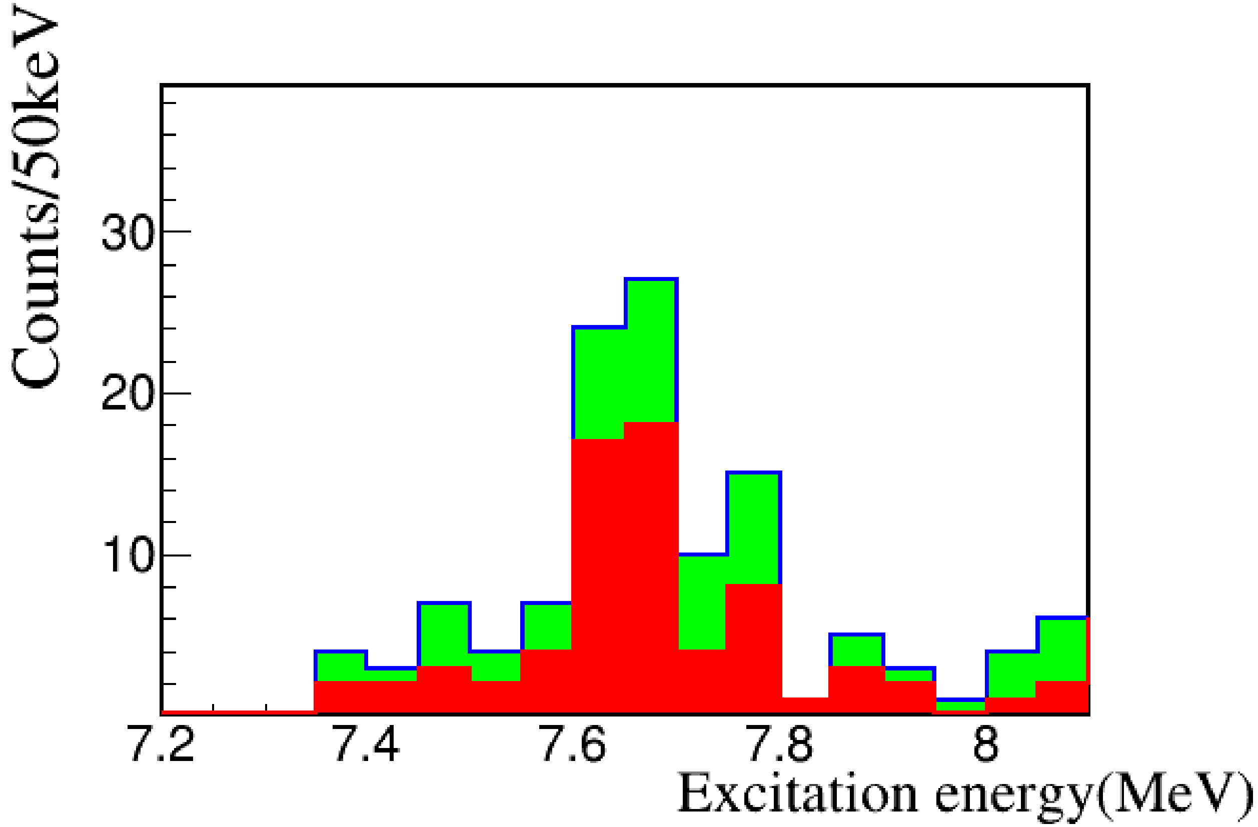
Interstrip events 7.2 keV

Reconstruction of Q-value from scattered α-particles



Sigma around 280 keV for both fits

Efficiency of the event reconstruction 3-α Hoyle state decay



Without interstrip reconstruction all coincidences between adjacent strips are lost

Whithout correction of guard ring induction (0-31) all coincidences with strip 0 and 31 are lost

Without all such event recovery we loose 40% of 3-α coincidences (red spectrum)

Conclusions

We have developed an efficient method for pixel assignment for FARCOS telescopes based on the timing and shape analysis of the signals and on the comparison of front and back energy

With this method we are also able to recover most of interstrip effects inside the limit of our detection threshold and to clean from background identification scatter plots

The gain in detection efficiency with the adopted procedure is very important in case of measurements of multiple coincidences. It is equal to 40% in the case of the detection of 3 α particles from the decay of the Hoyle state

We plan to use FARCOS in various European laboratories for particle-particle correlation measurements also coupled to the new Narcos neutron detector waiting for the new fragmentation beams at LNS with the FRAISE fragment separator

The collaboration

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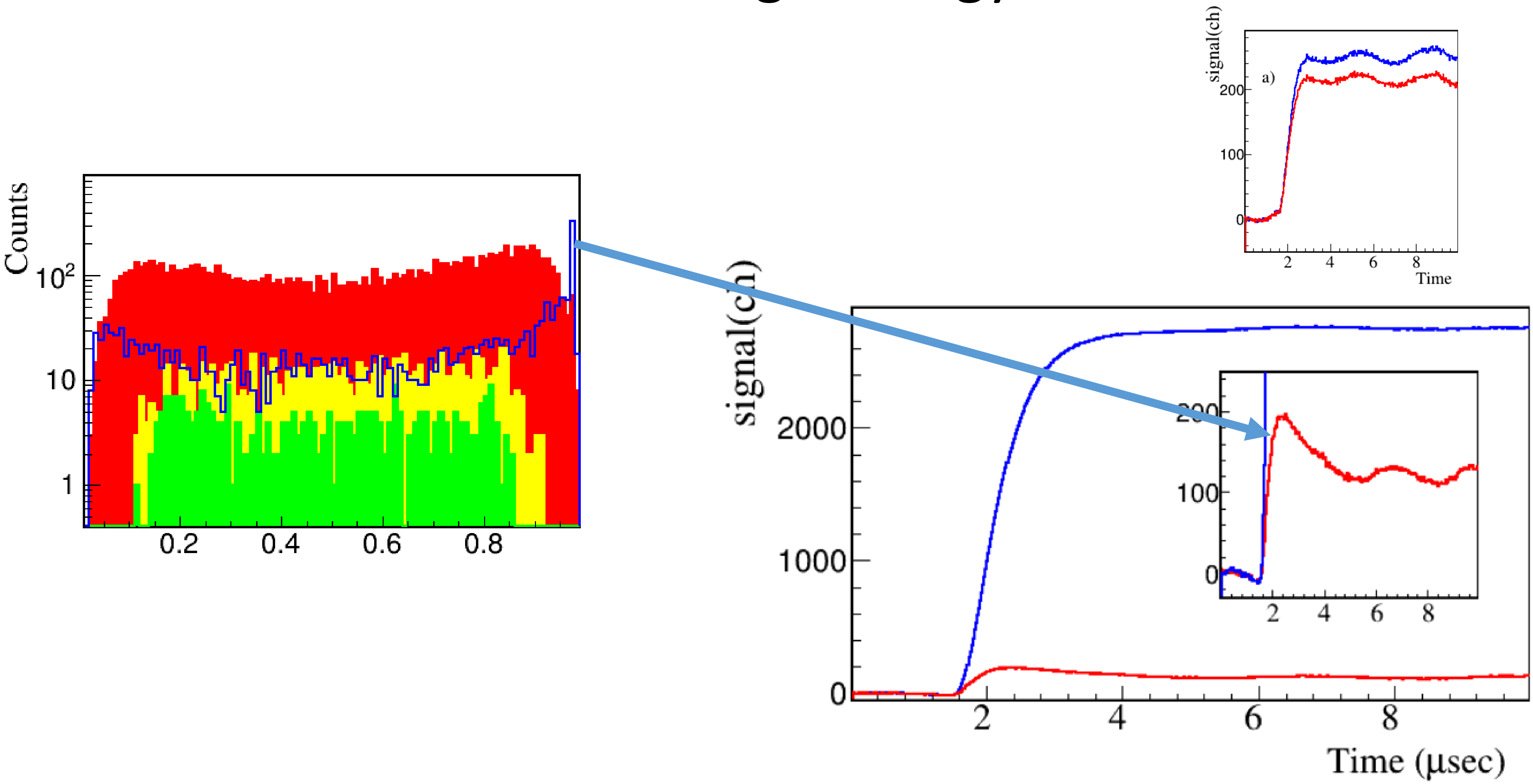
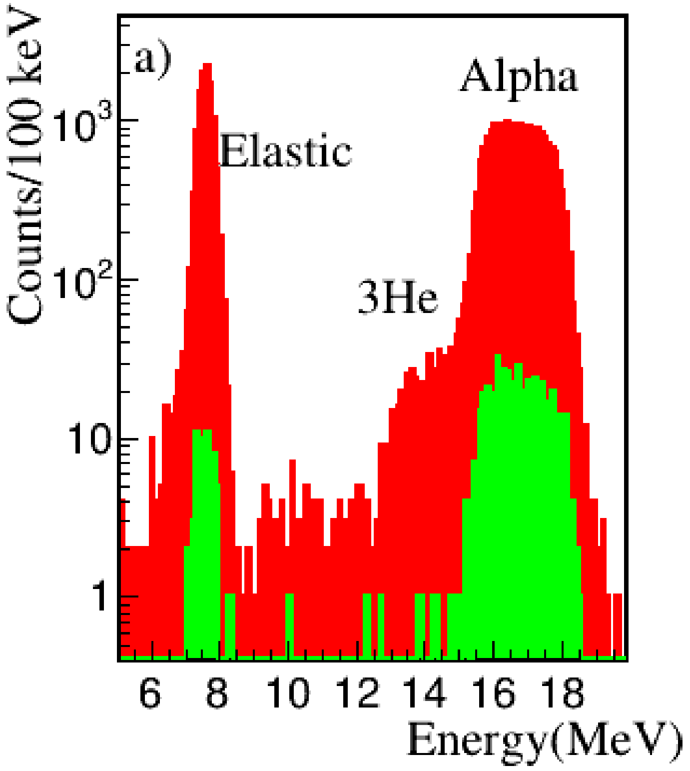
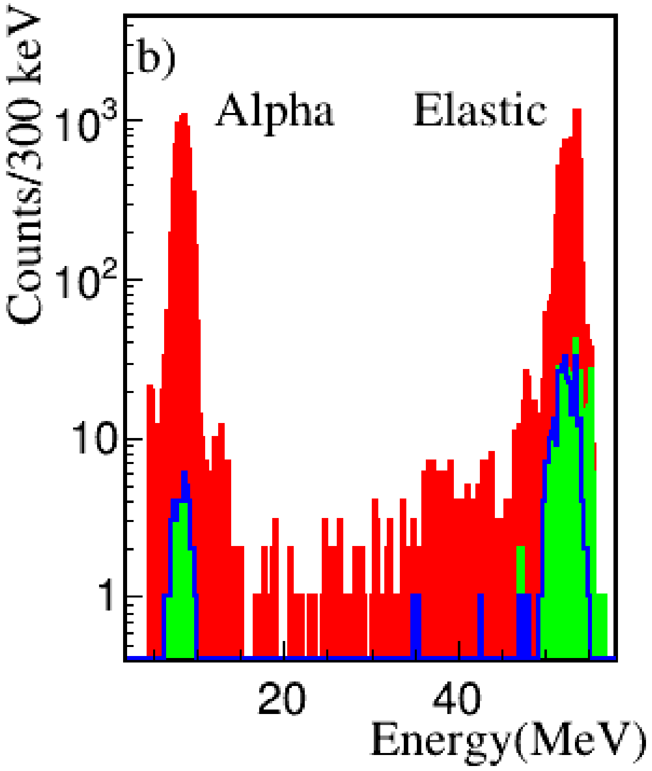
spares

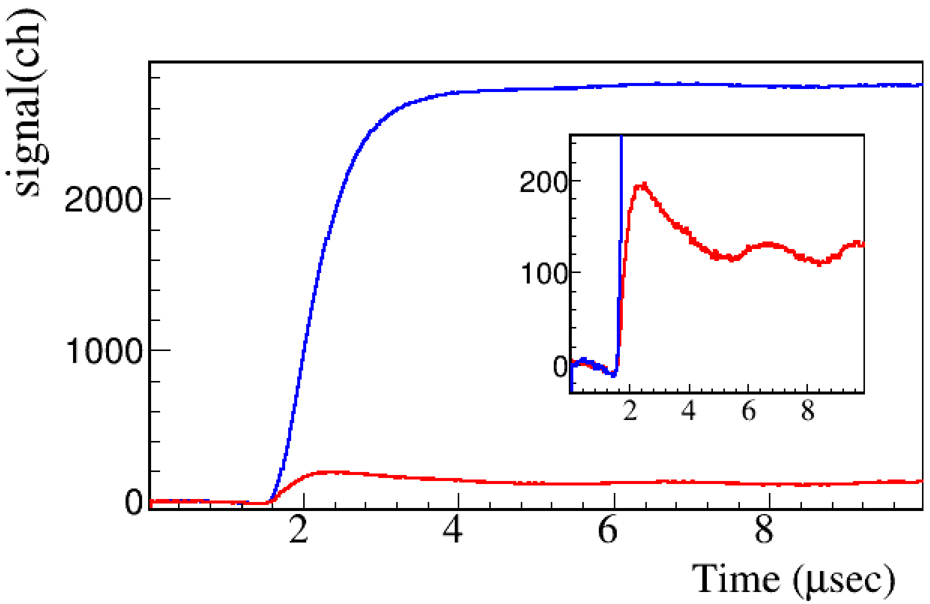
Induction at high energy



Se sommo l’energia di interstrip (verde) ho la stessa forma dello spettro di eventi con singola strip toccata – problema solo per elastici su 1500 micron dove troviamo eventi con energia più alta dell’elastico – strano effetto di induzione visibile solo su segnali molto alti – eliminabile con fit opportuno

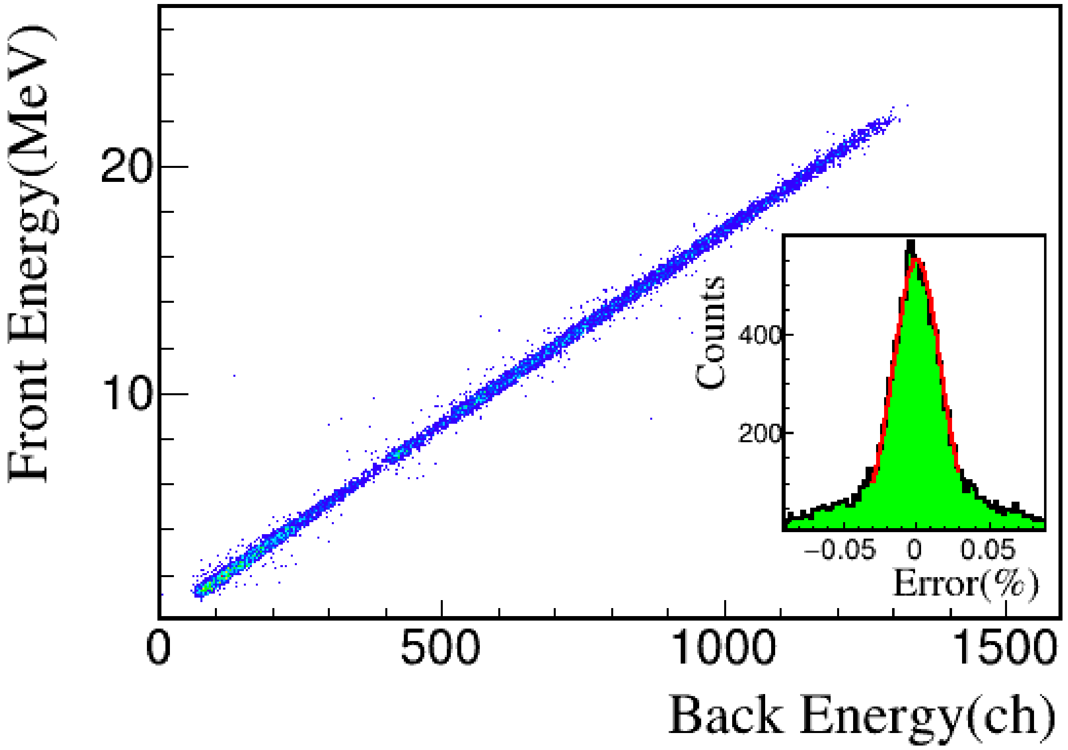






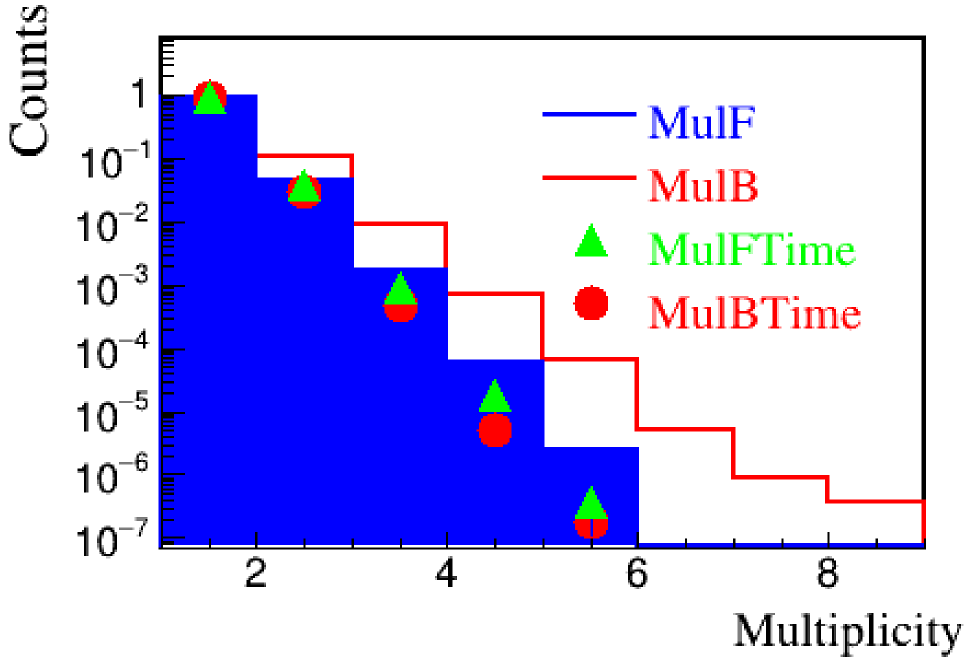
NB nel segnale indotto Decay time più rapido ma anche il rise time è più veloce (quasi la metà)

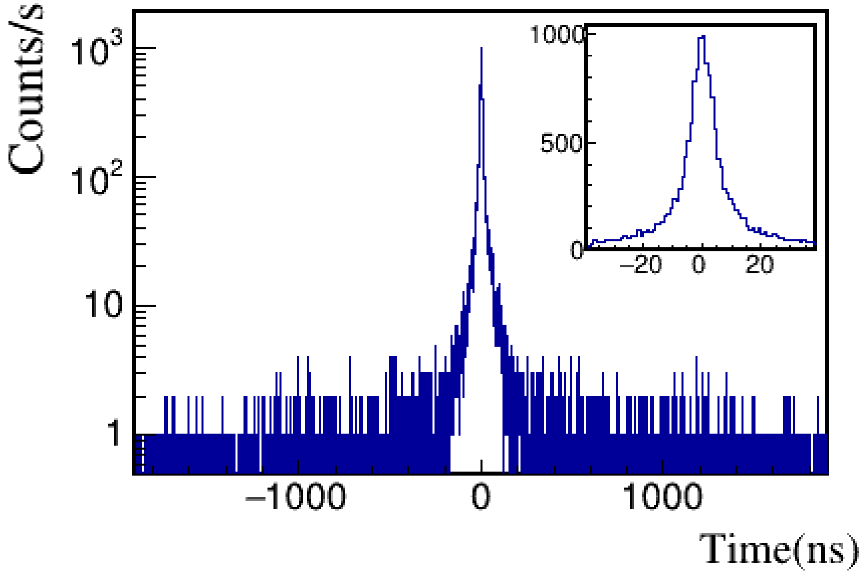
La calibrazione delle strip Back è stata fatta con una matrice energy ch (back)- energy MeV front (tutte meno 0 e 31)

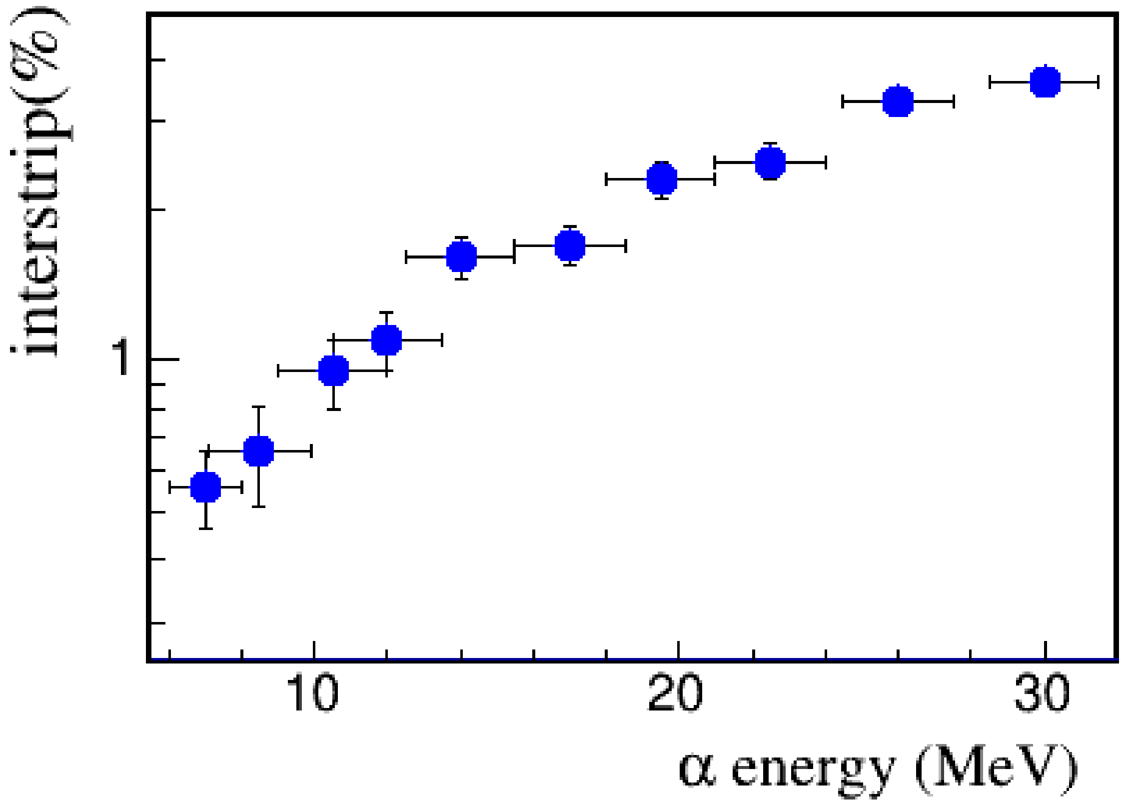


la differenza tra energia front ed energia back dopo la calibrazione è una gaussiana con sigma attorno a 1.6%

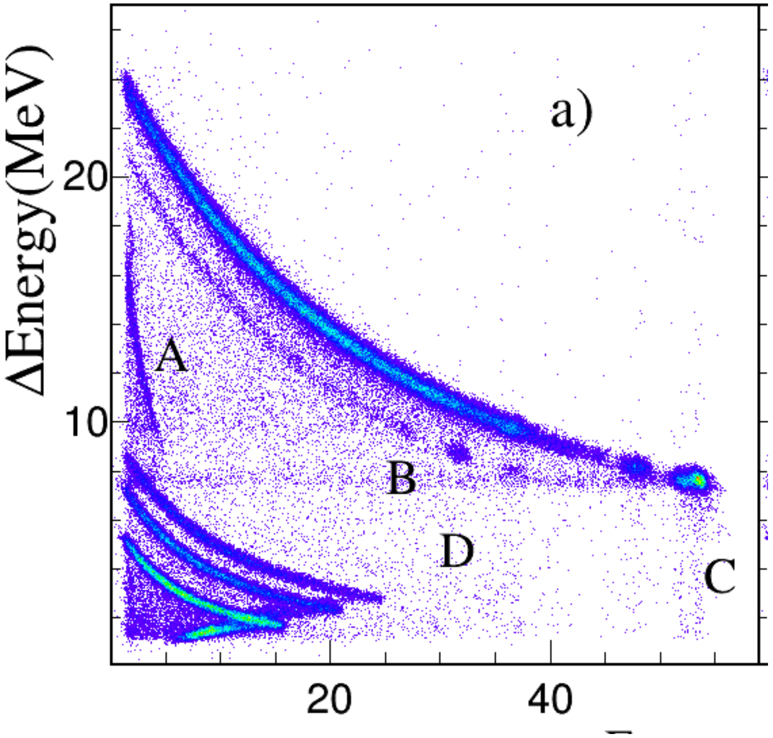
La molteplicità raw del primo stadio è molto alta ho eventi anche con molteplicità 7-8 nel back 300
È dovuta alla presenza di random (con GET prendiamo eventi entro una finestra di 10 microsec.)
Se mettiamo una finestra di accettazione di un centinaio di ns la differenza tra front e back sparisce e la distribuzione diventa ragionevole





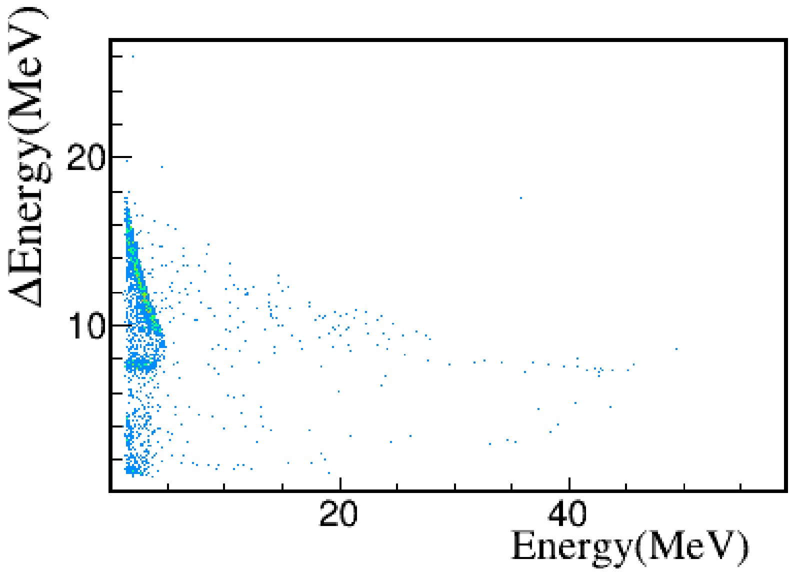


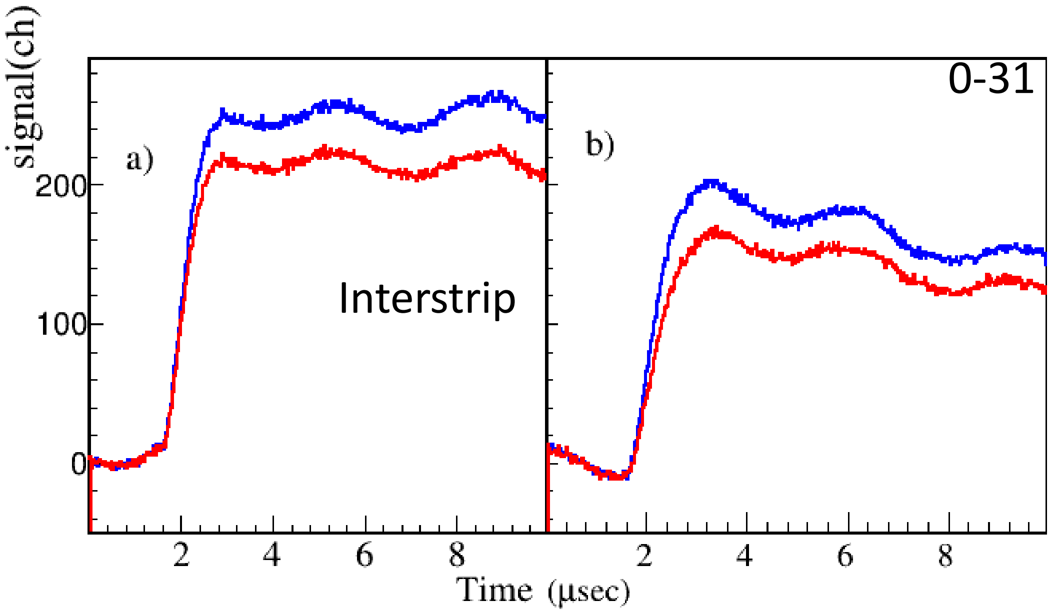
Nel front 1500 ho efficienza di ricostruzione che satura a circa 3.5% equivale a circa 70 micron



Altro tipo di eventi strani sono un eccesso di coincidenze tra le strip 0 e 31 (sia front che back – eventi indotti dal guard ring per accoppiamento capacitivo con le strip 0 e 31 –

Si distinguono da un decay time veloce rispetto ai segnali standard – eliminando questi segnali posso usare eventi rivelati nelle strip 0 e 31





Per le future analisi indispensabile:

Tempo per front e back – rise time per front e back – decay time per front e back