G.V.Rogachev, J.Hooker, V.Z.Goldberg, E.Koshchiy, B.T.Roeder, H.Jayatissa, C.Hunt, C.Magana, S.Upadhyayula, E.Uberseder, A.Saastamoinen, J. Zamora, V.Guimaraes, E.C. Polacco, S. Lukyanov and Yu. Penionzhkevich

# FUSION $^{8}B$+Ar by TexAT

# Texas Active Target (TexAT)

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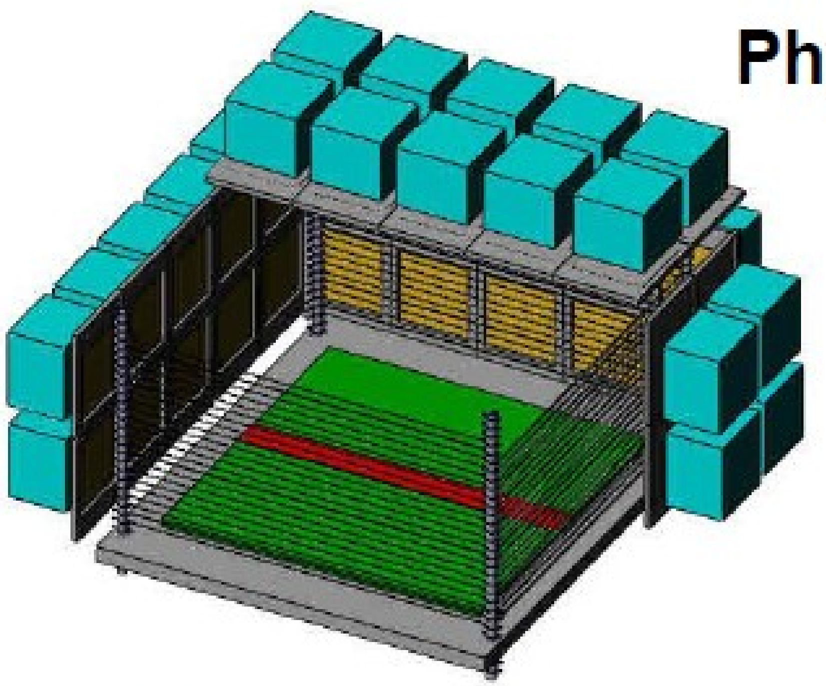
TEXAS A&M UNIVERSITY

# TexAT - Texas Active Target

Active target detector for experiments with rare isotope beams at the Cyclotron Institute



## Physics to be addressed:

### Structure of exotic nuclei

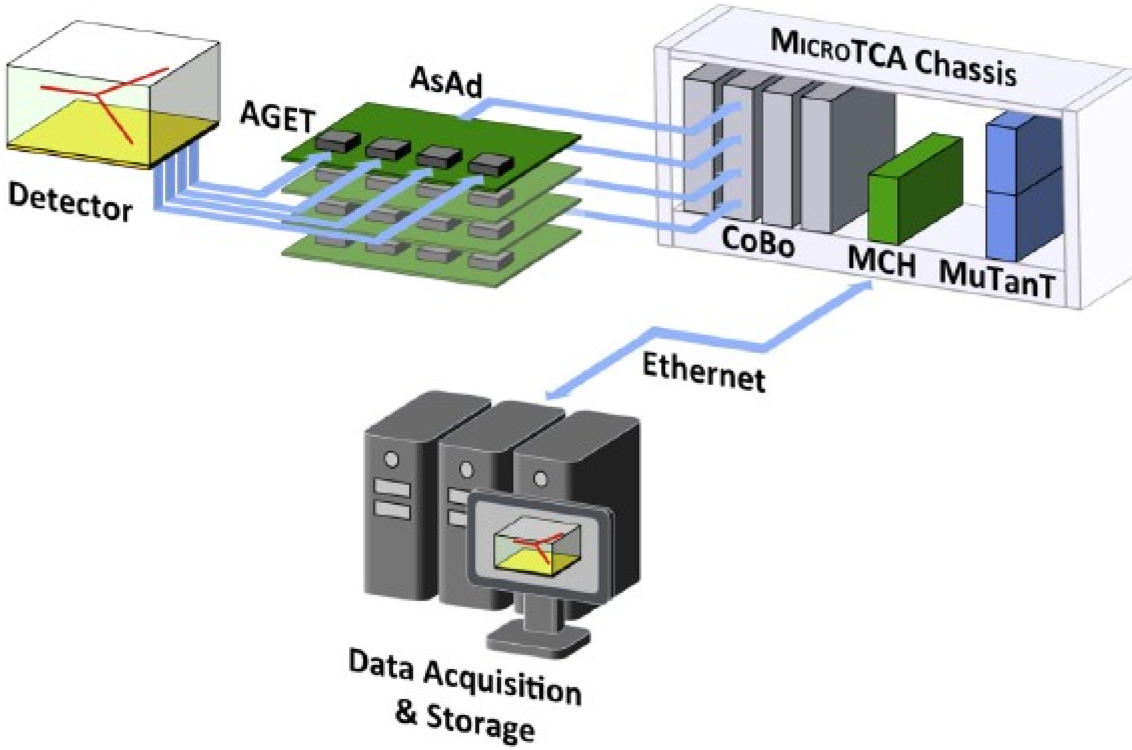
- Proton and α elastic and inelastic scattering excitation function
- Transfer reaction: (p,d); (p,t); (d,p) etc
- β-delayed charged particle decays

### Clustering phenomena

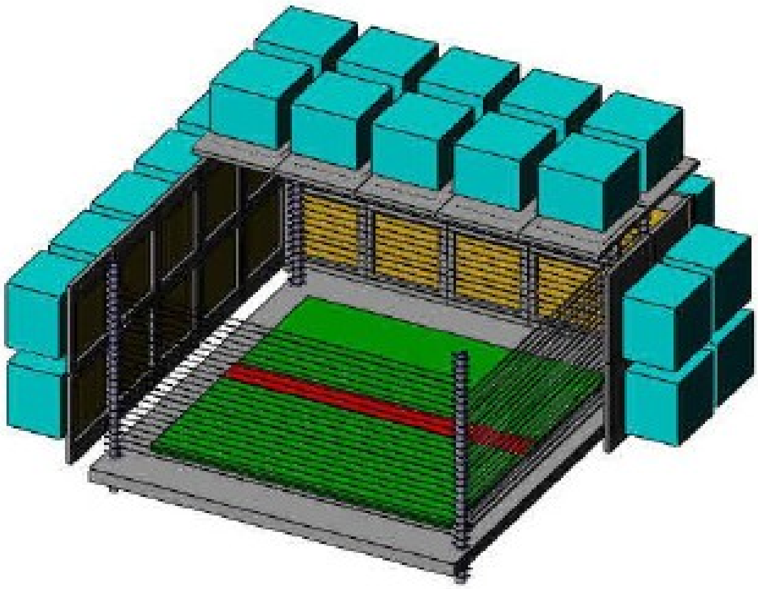
- α elastic and inelastic scattering excitation function
- Transfer reaction
- Multi-fragment breakup
- β-delayed charged particle decays

### Nuclear astrophysics

- Proton and α elastic and inelastic scattering excitation function
- (α,p) and (p,α)
- β-delayed charged particle decays
- Transfer reactions


Detector
AGET
AsAd
MicroTCA Chassis
CoBo
MCH
MuTanT
Ethernet
Data Acquisition
& Storage

# TexAT - Texas Active Target

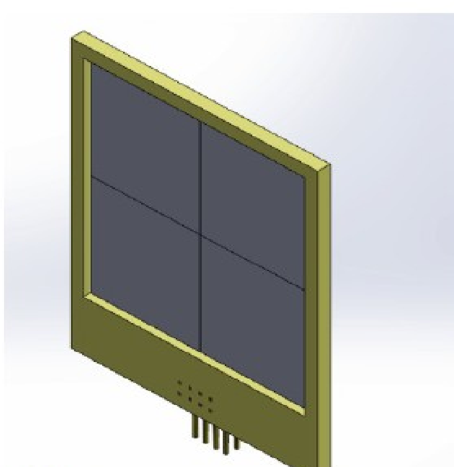


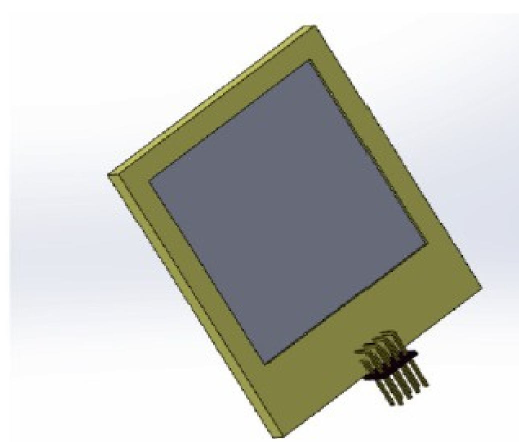
Si array - 10 quadrant detectors
for the front array,
20 + 10 + 10 top, left
side and right side
8 for the back
**58 total**

CsI(TI) - backing the Si: **58 total**

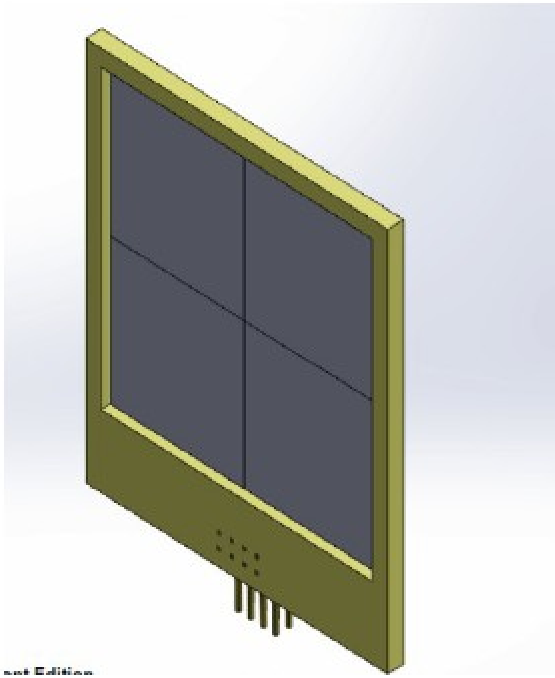
MicroMegas: **1024 channels plate**

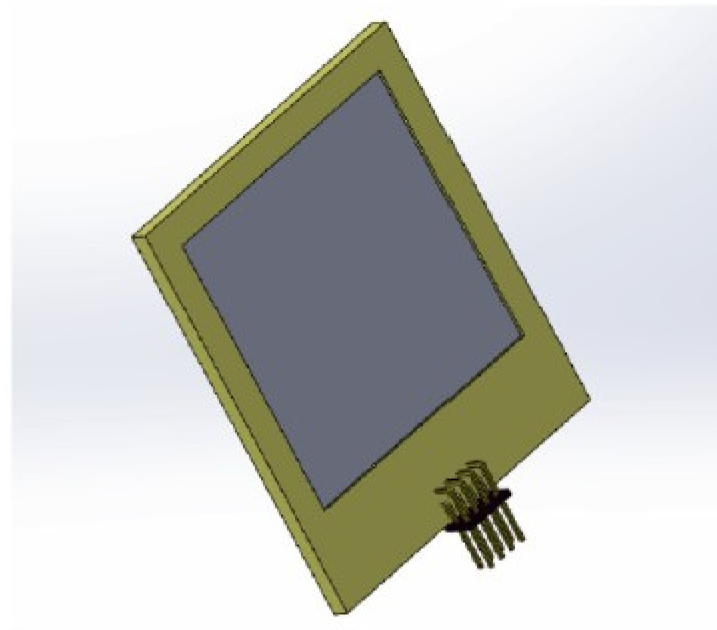
**Si detector design**

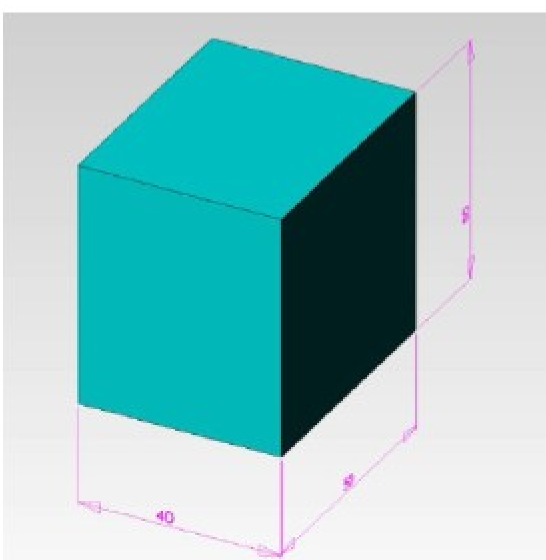


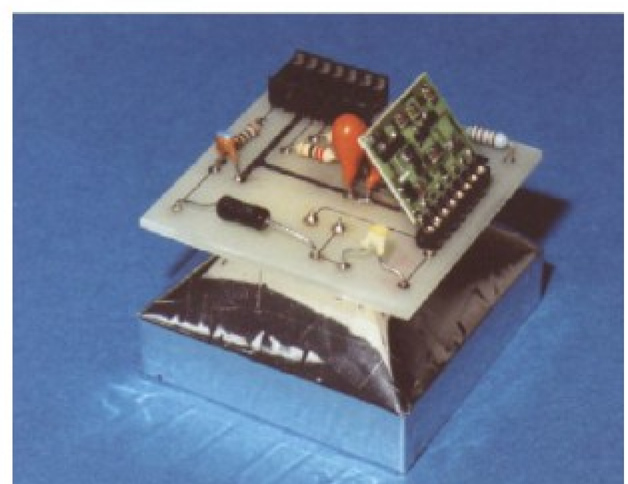


# Si detector design



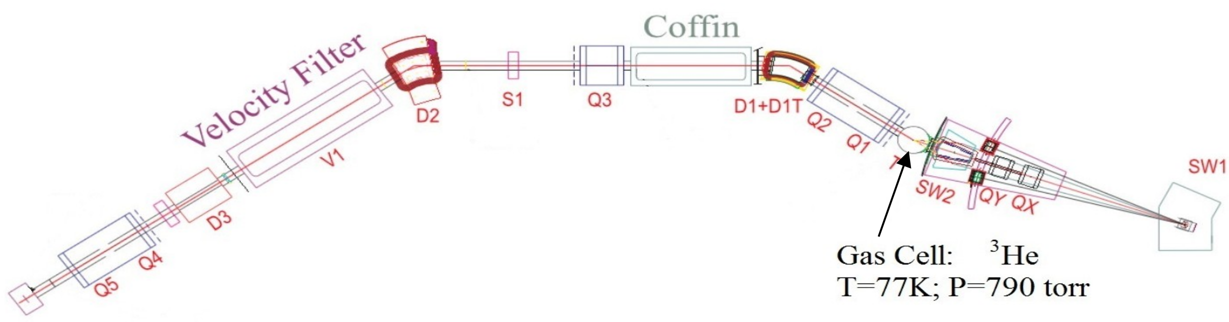




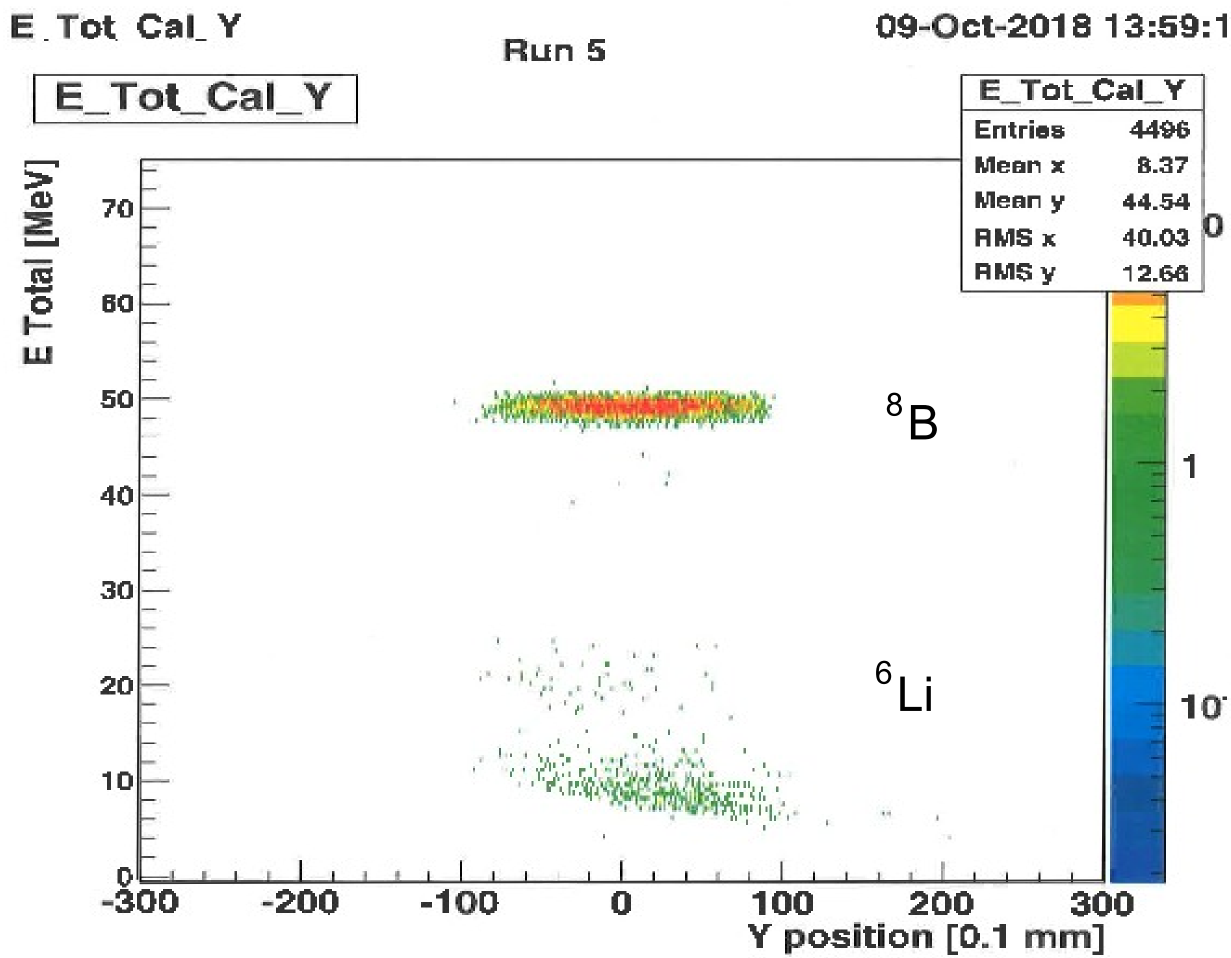



In a recent experiment we have studied a direct measurement of sub-barrier fusion of weakly-bound exotic $^{8}B$ with $^{Nat}Ar$. The radioactive beam of $^{8}B$ was produced in the $^{3}He(^{6}Li,^{8}B)n$ reaction (Q= -1.97 MeV) in inverse kinematics at the K150 Cyclotron Institute facility. The $^{3}He$ target was kept at liquid nitrogen temperature with the pressure of 790 Torr. The reaction products were separated by using the Momentum Achromat Recoil Spectrometer (MARS).

MARS




Primary beam: $^{6}$Li, E=67.8 MeV;
Secondary beam: $^{8}$B, E=48.8 MeV

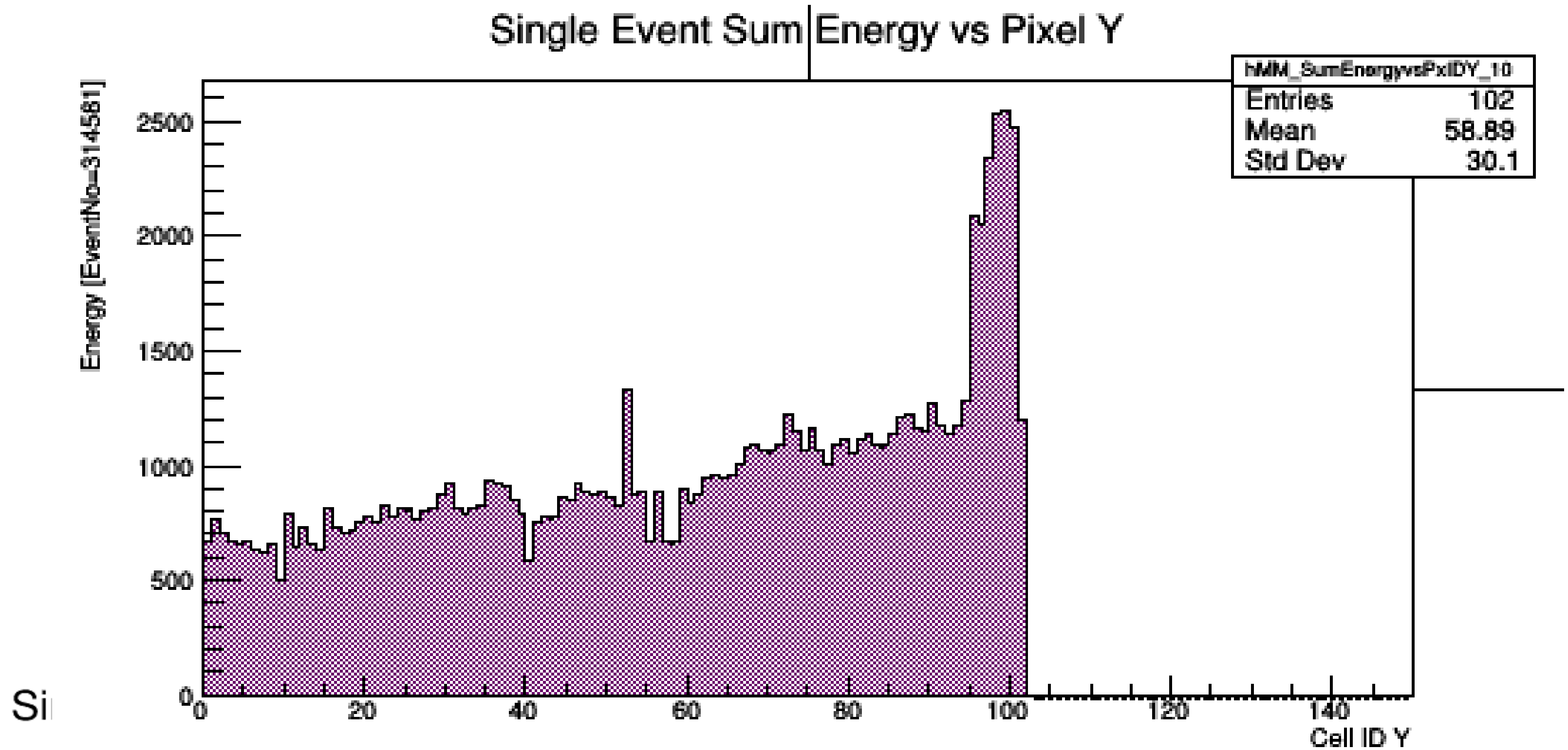


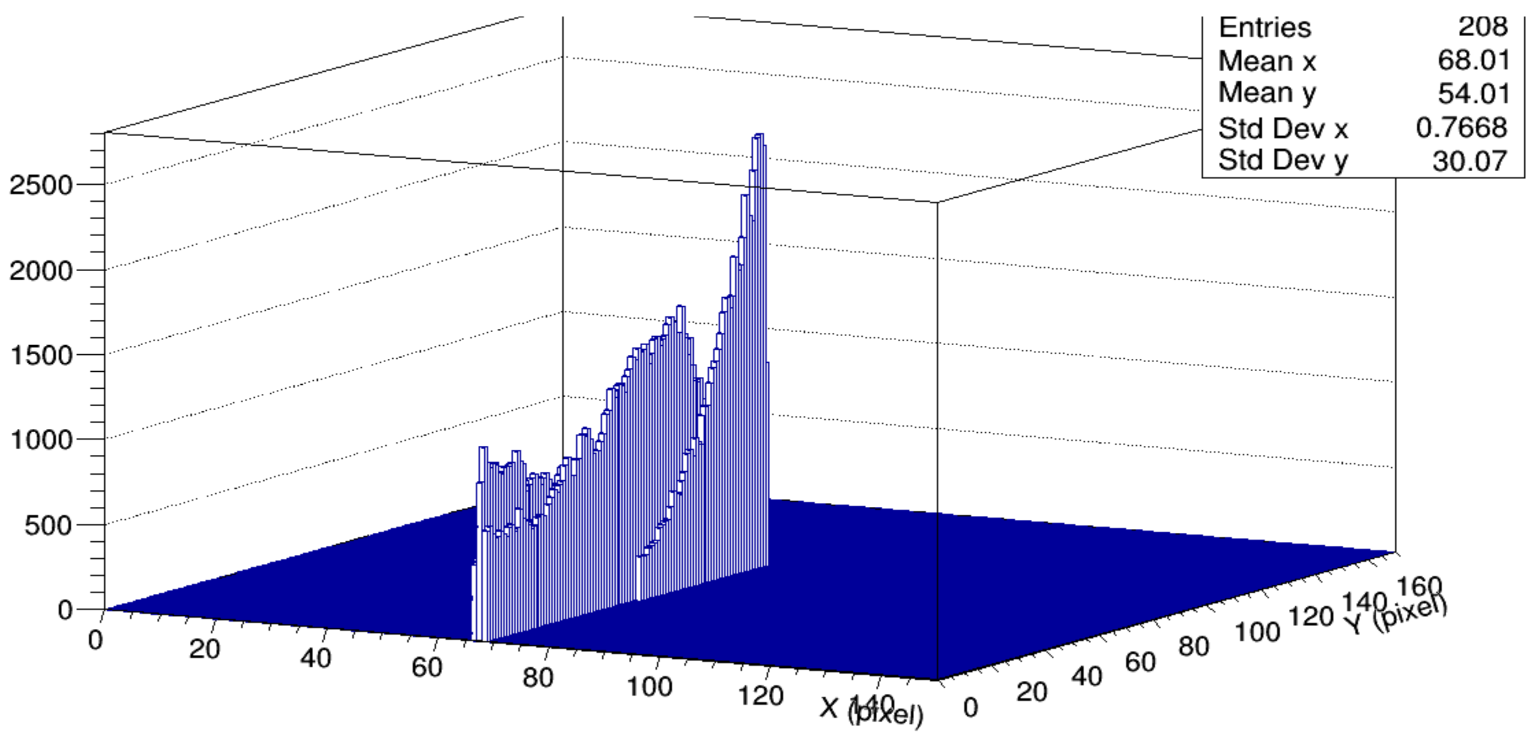

**The results of $^{8}$B beam tune. The contribution of the contaminants is less then 5% o beam.**

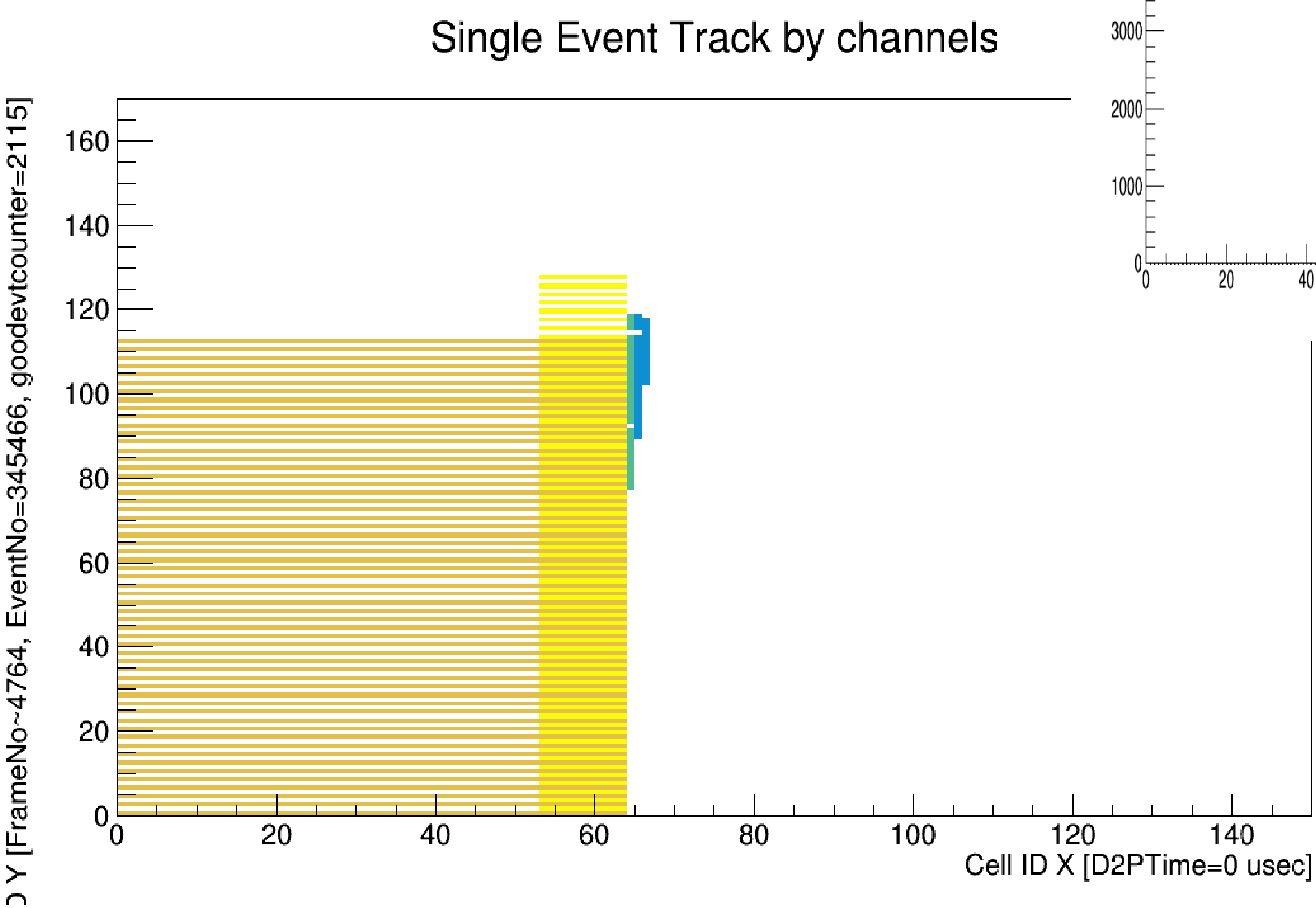
The experiment have been conducted in 3 stages:

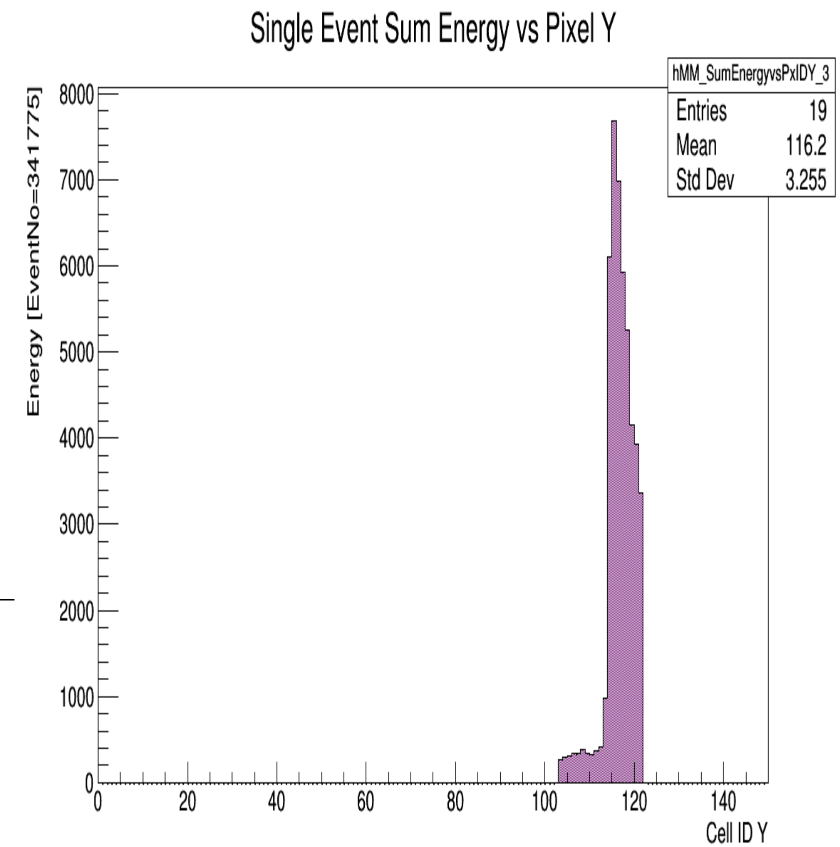
1) No gas in TexAT chamber. The secondary beam of $^{8}B$ ions re-focused to the center of TexAT chamber, monitored by Si (0- degree) detector.
2) A scattering chamber was filled with P5 gas mixture (95%Ar +5%$CH_4$). The small amount of Methane (quenching gas) was added to substantially improve an avalanche properties of pure Argon. Particle tracks were monitored online and the gas pressure (150 Torr) was chosen to stop a $^{8}B$ beam right after the end of Micromegas detector (an example of accumulated tracks/deposited energy can be shown here). Thus, we could detect all fusion events in the energy range from 0 to ~40 MeV (? To be verified).
3) Production mode

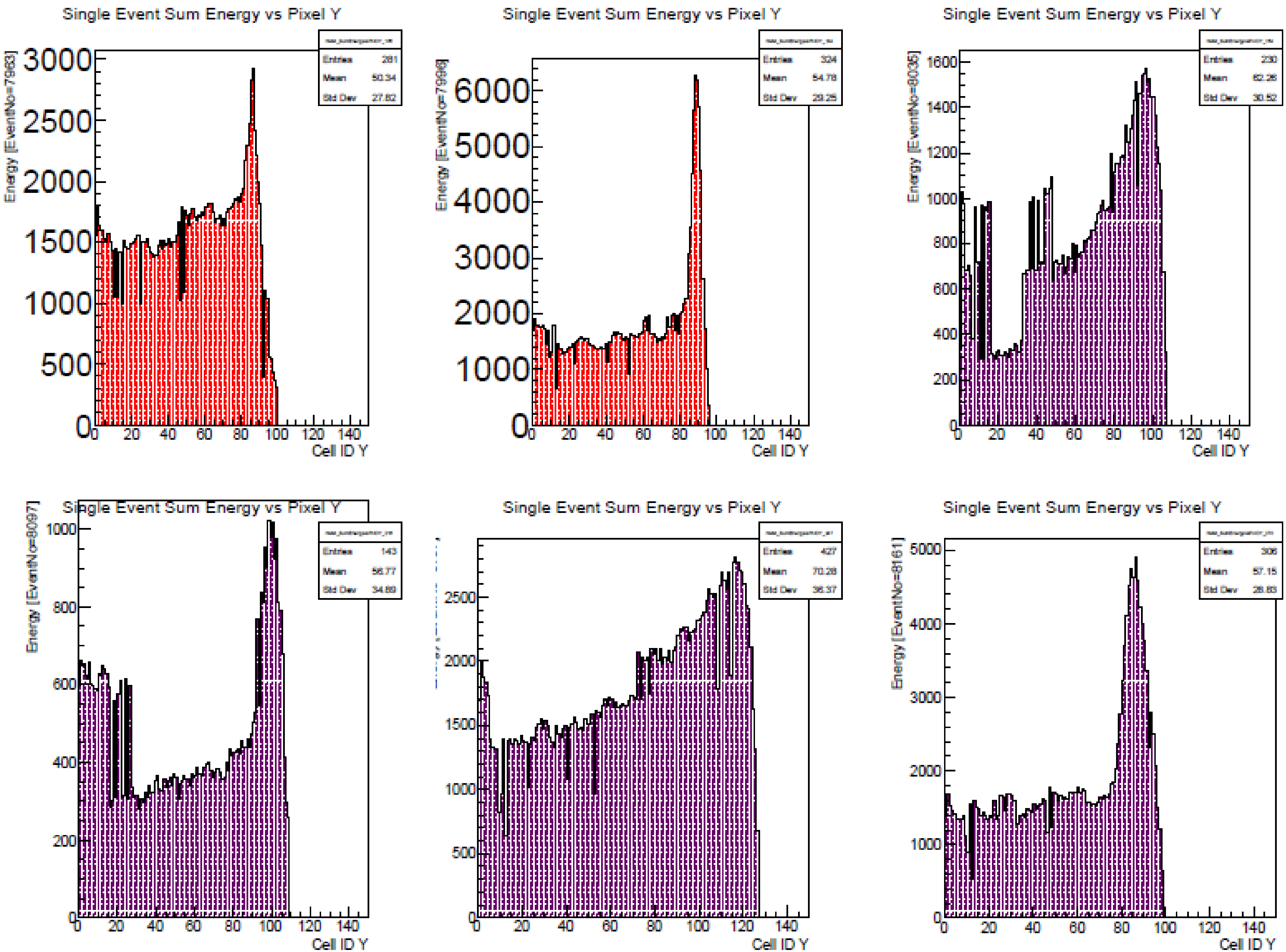
Trigger: Signals from IC, processed by Single Channel Analyzer, were tuned to $^{8}B$ events only (threshold set to cut out background background events (see FIG.2). It creates a CoBo Level 0 (L0) trigger, delayed by 5 μs to time match with MM signals. L0- trigger have been vetoed by any trigger from central area's last row pads of Micromegas detector. Thus, only presumably "fusion" or scattered events are expected to be recorded. (Further analysis to select "good" events is required).


Single Event Sum Energy vs Pixel Y
hMM_SumEnergyvsPxIDY_10
Entries 102
Mean 58.89
Std Dev 30.1
Energy [EventNo=314581]
0
500
1000
1500
2000
2500
0
20
40
60
80
100
120
140
Cell ID Y

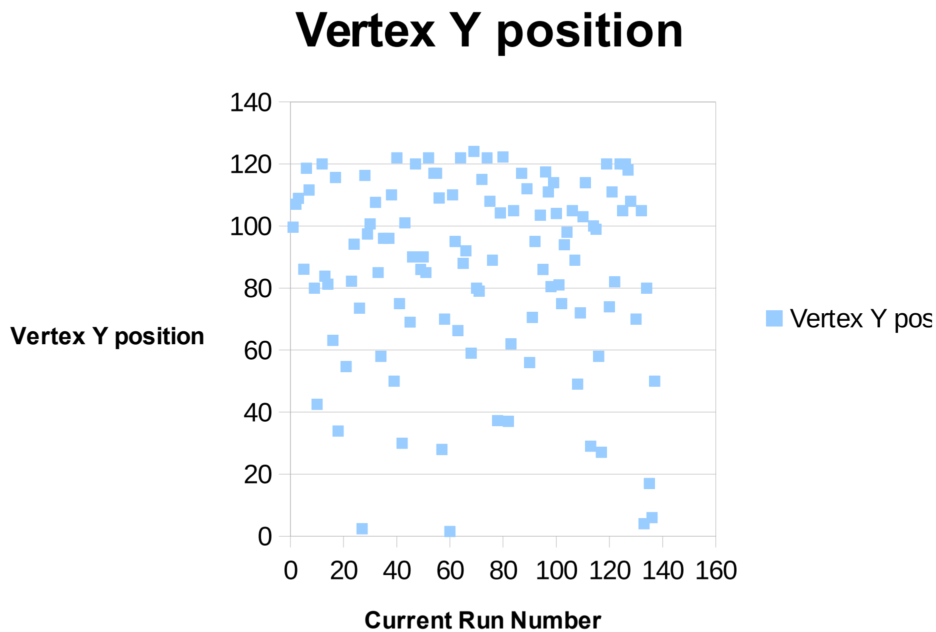

Si
Entries 208
Mean x 68.01
Mean y 54.01
Std Dev x 0.7668
Std Dev y 30.07
0
500
1000
1500
2000
2500
0
20
40
60
80
100
120
140
X (pixel)
0
20
40
60
80
100
120
140
160
Y (pixel)

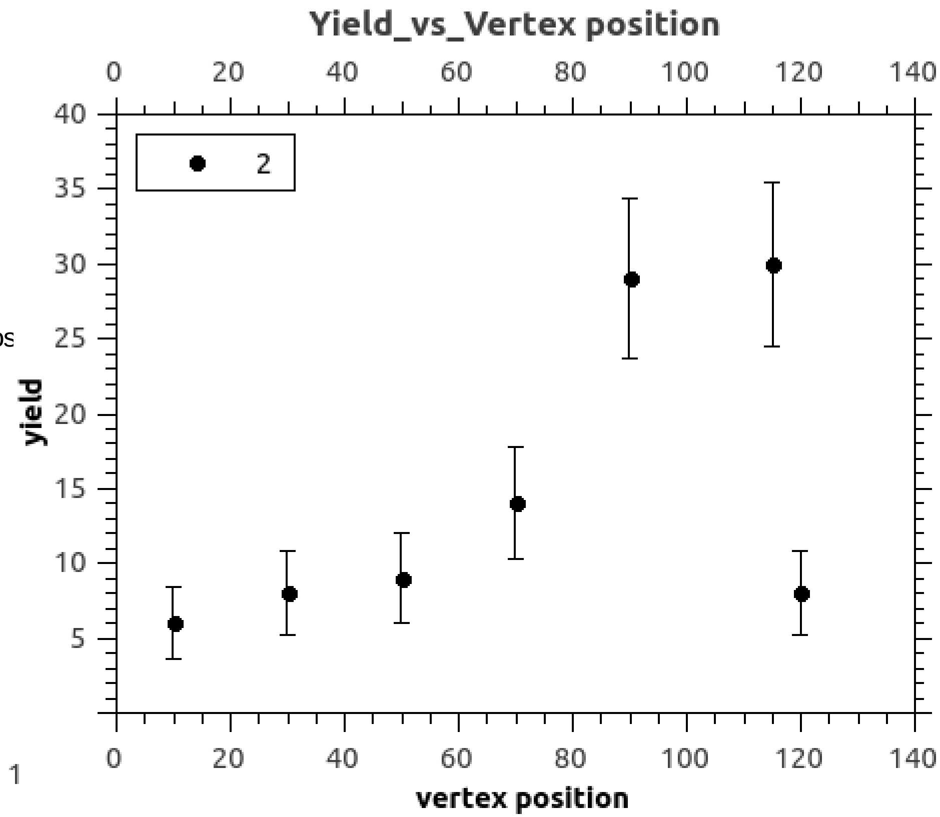

Single Event Track by channels
D Y [FrameNo~4764, EventNo=345466, goodevtcounter=2115]
Cell ID X [D2PTime=0 usec]

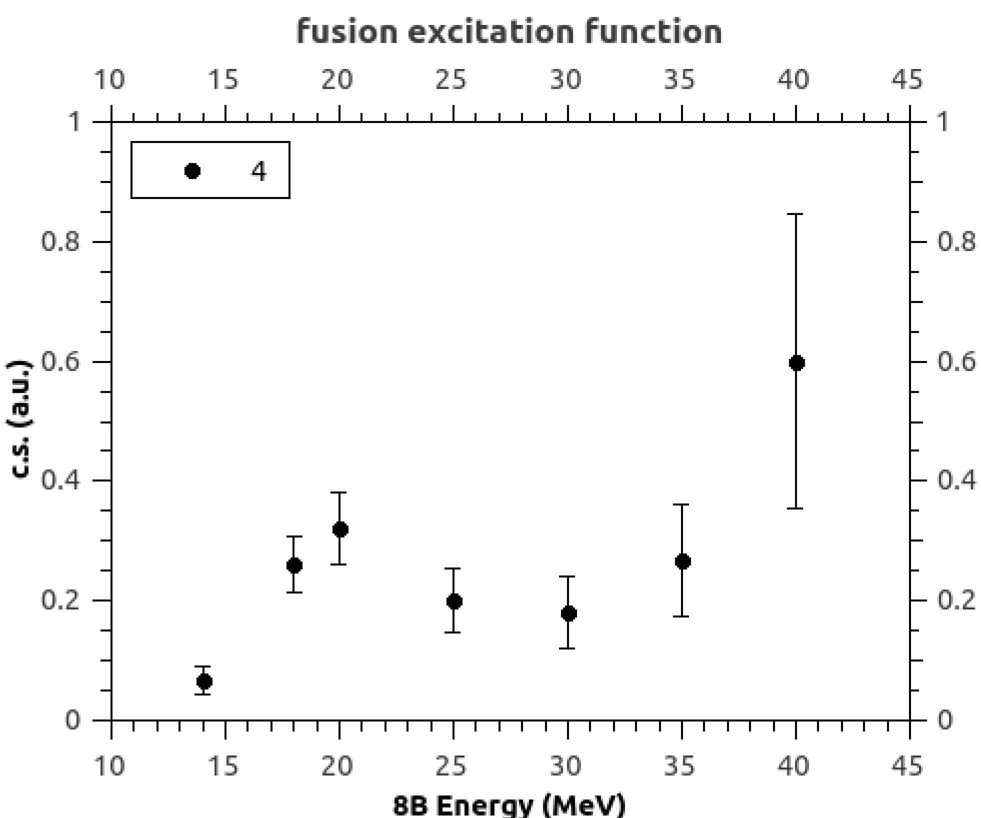

Single Event Sum Energy vs Pixel Y
hMM_SumEnergyvsPxIDY_3
Entries 19
Mean 116.2
Std Dev 3.255
Energy [EventNo=341775]
Cell ID Y



Single Event Sum Energy vs Pixel Y
Energy [EventNo=7963]
Cell ID Y
Single Event Sum Energy vs Pixel Y
Energy [EventNo=7998]
Cell ID Y
Single Event Sum Energy vs Pixel Y
Energy [EventNo=8035]
Cell ID Y
Single Event Sum Energy vs Pixel Y
Energy [EventNo=8097]
Cell ID Y
Single Event Sum Energy vs Pixel Y
Cell ID Y
Single Event Sum Energy vs Pixel Y
Energy [EventNo=8161]
Cell ID Y




VERY Preliminary

# Some improvements

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journal homepage: www.elsevier.com/locate/nima

## Fusion studies with low-intensity radioactive ion beams using an active-target time projection chamber

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[d] Physics Department, University of Michigan, Ann Arbor, MI 48109, USA
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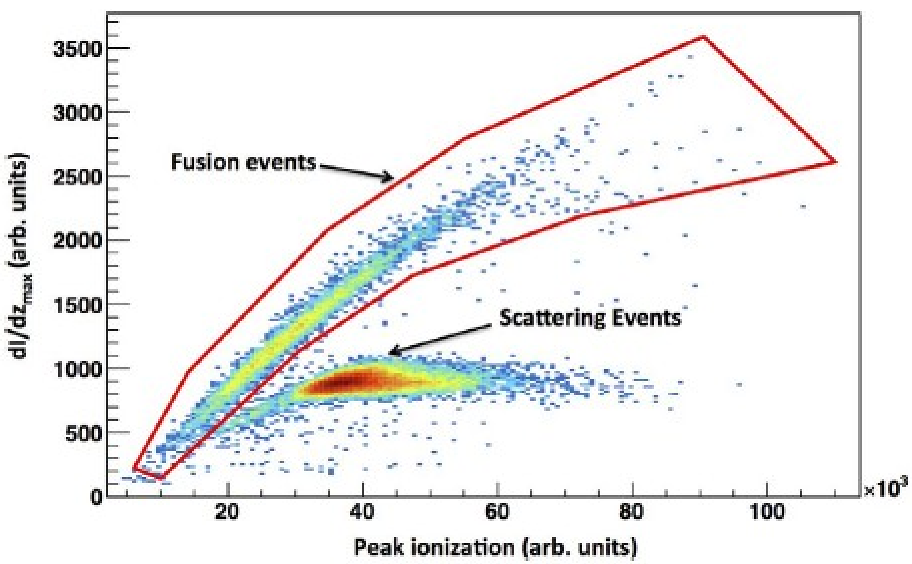


**Fig. 7.** Maximum derivative of the ionization $(dI/dz)_{max}$ vs. the maximum amplitude of the ionization along the track for the events shown in Fig. 6. The accepted fusion events are indicated. A very weak "second branch" containing fusion events appears at higher peak ionization. The exact nature of events in this branch is unknown. They may be due to real physics, or possibly some type of problem in measuring the true width of the fusion peak.