

Early investigation of the MVTX commissioning

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2. Data

- RUN 20124, documented in tag "sPH-TRIG-2023-001"

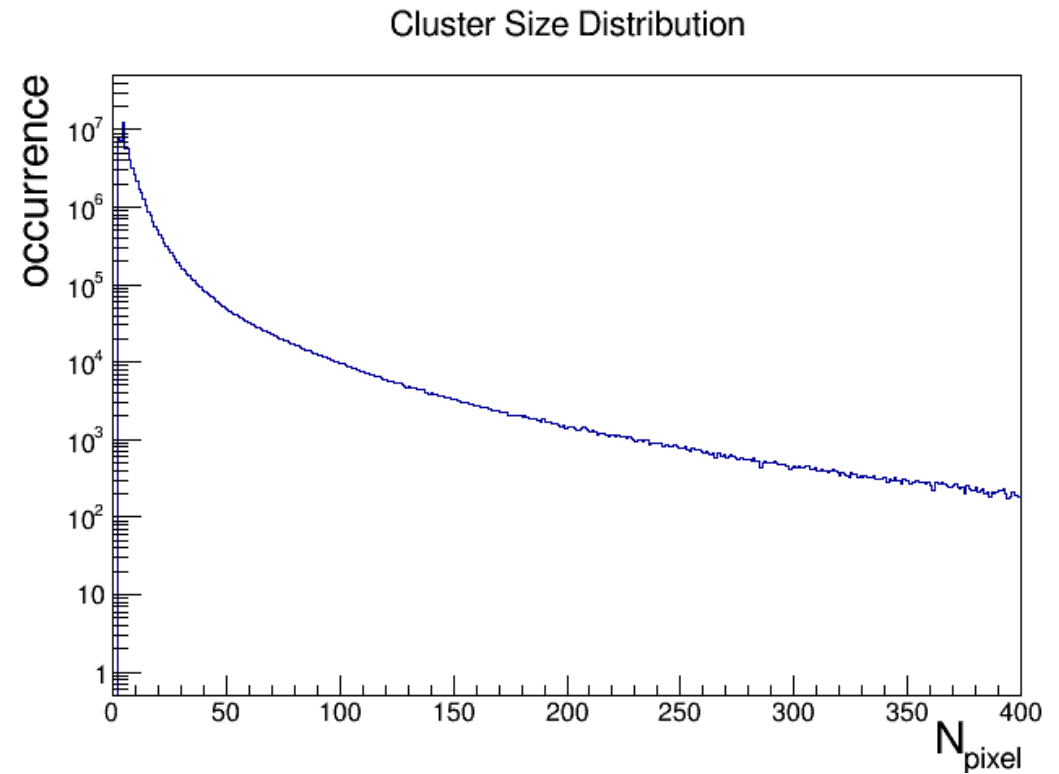
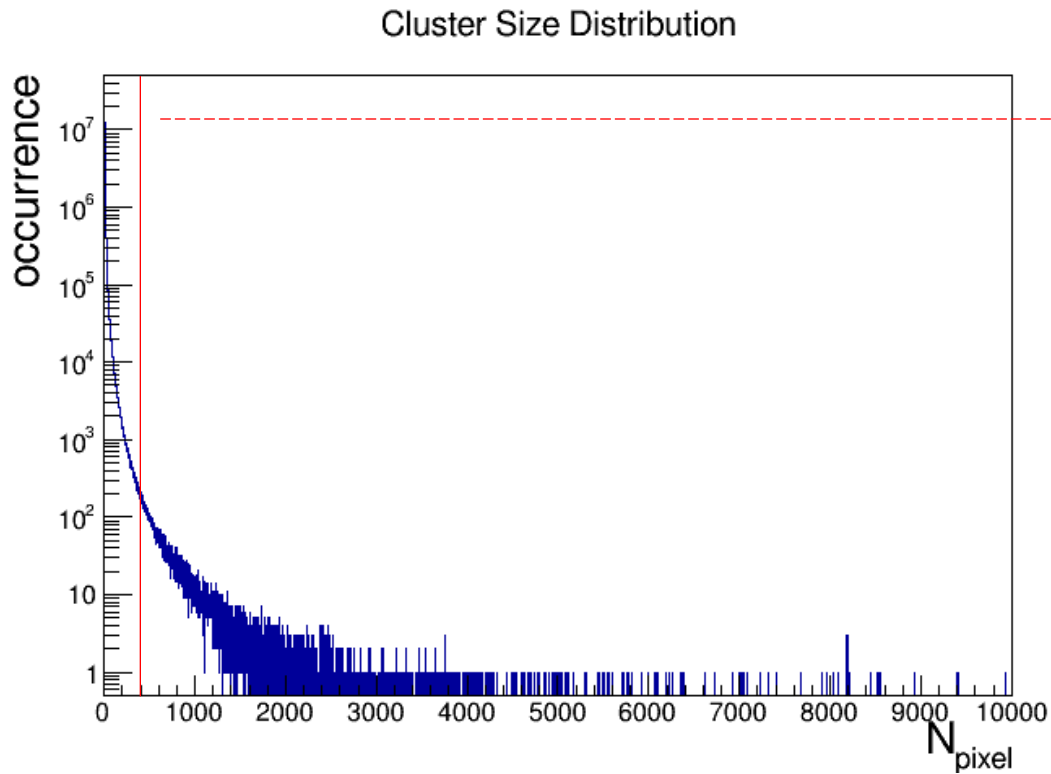
/sphenix/lustre01/sphnxpro/commissioning/MVTX/data/runs/

- MVTX_FLX0/20230627-145225_FelixFakeHitRate/mvtx_mvtx-flx0-00020124-0000.evt
- MVTX_FLX1/20230627-145227_FelixFakeHitRate/mvtx_mvtx-flx1-00020124-0000.evt
- MVTX_FLX2/20230627-145225_FelixFakeHitRate/mvtx_mvtx-flx2-00020124-0000.evt
- MVTX_FLX3/20230627-145225_FelixFakeHitRate/mvtx_mvtx-flx3-00020124-0000.evt
- MVTX_FLX4/20230627-145225_FelixFakeHitRate/mvtx_mvtx-flx4-00020124-0000.evt
- MVTX_FLX5/20230627-145225_FelixFakeHitRate/mvtx_mvtx-flx5-00020124-0000.evt

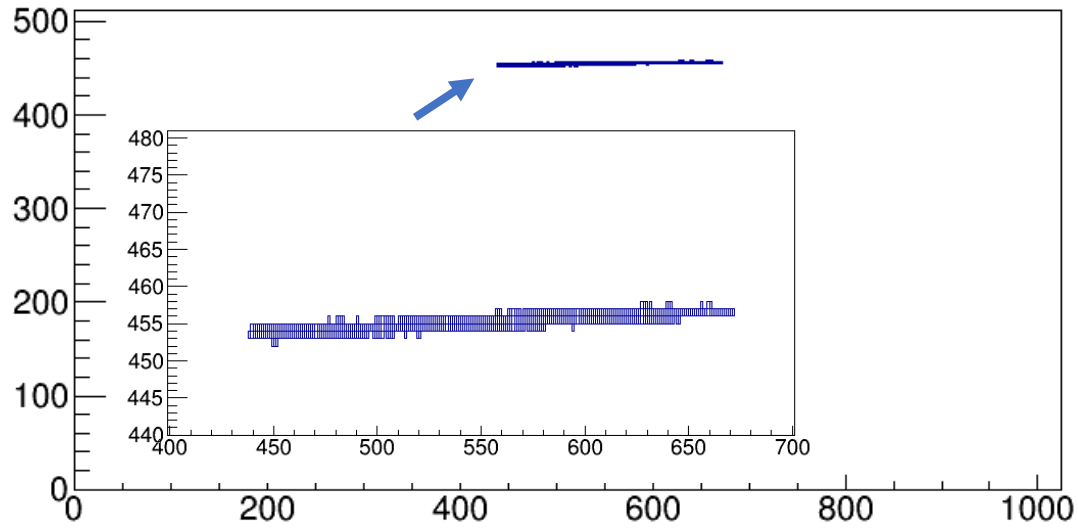
3. Cluster characteristics

3.1 Significant number of clusters have large sizes.

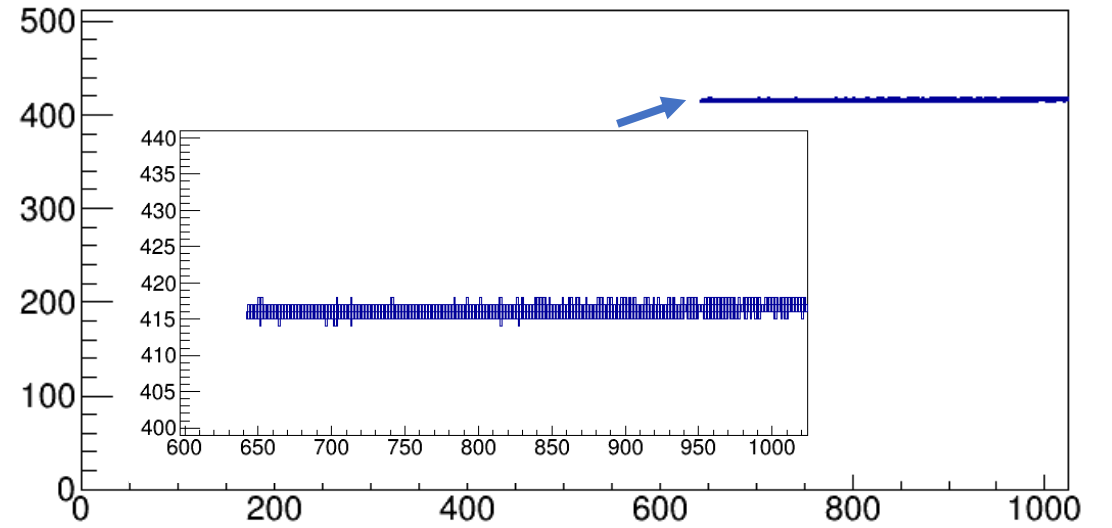
- Cluster : consecutively firing pixels grouped together



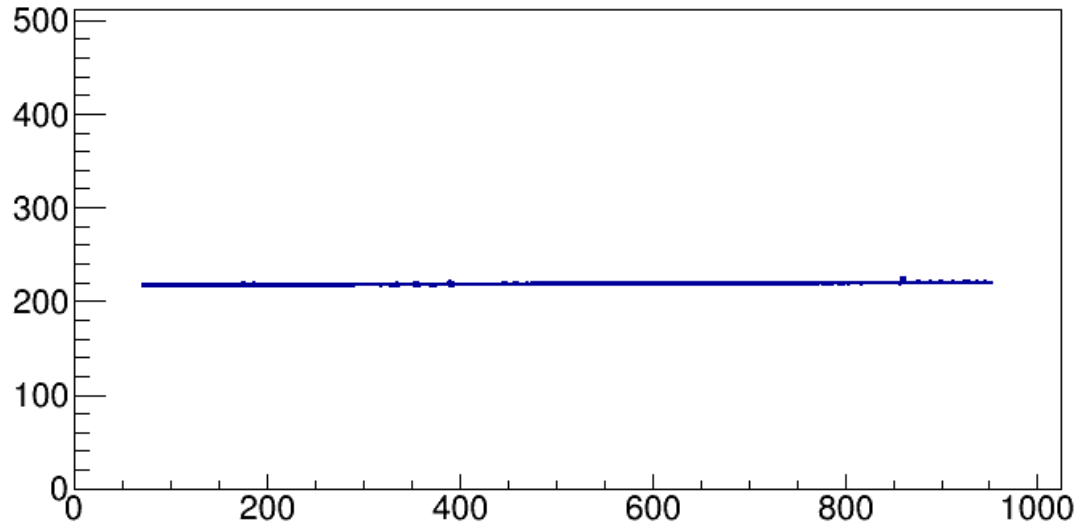
Case 1, cluster size = 486



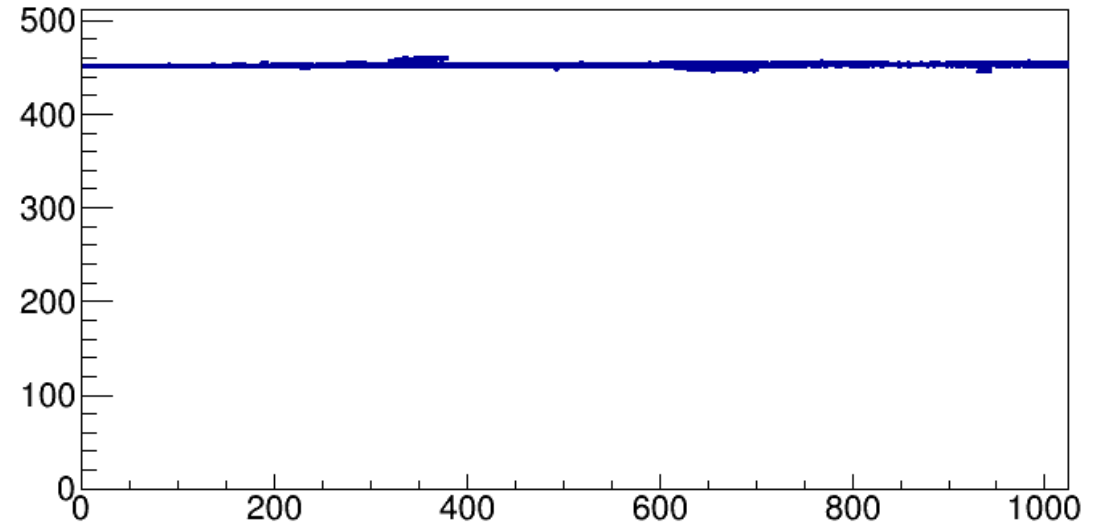
Case 2, cluster size = 850



Case 3, cluster size = 2036



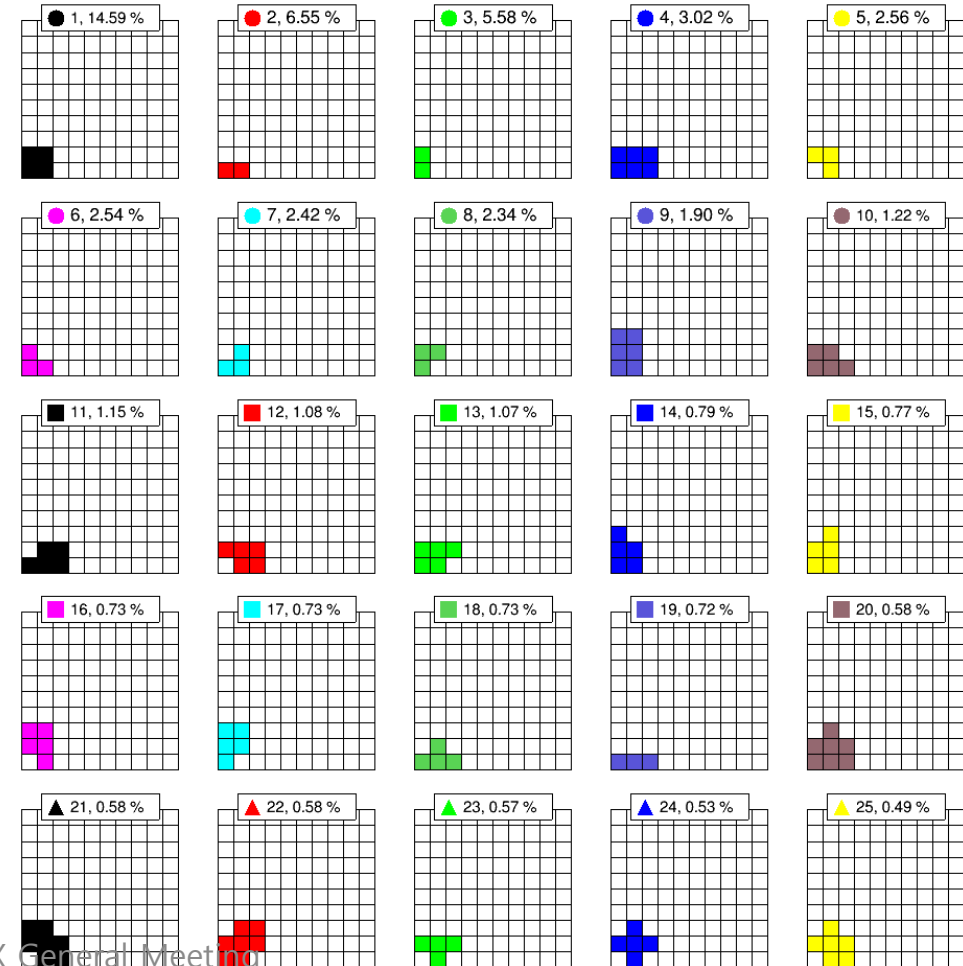
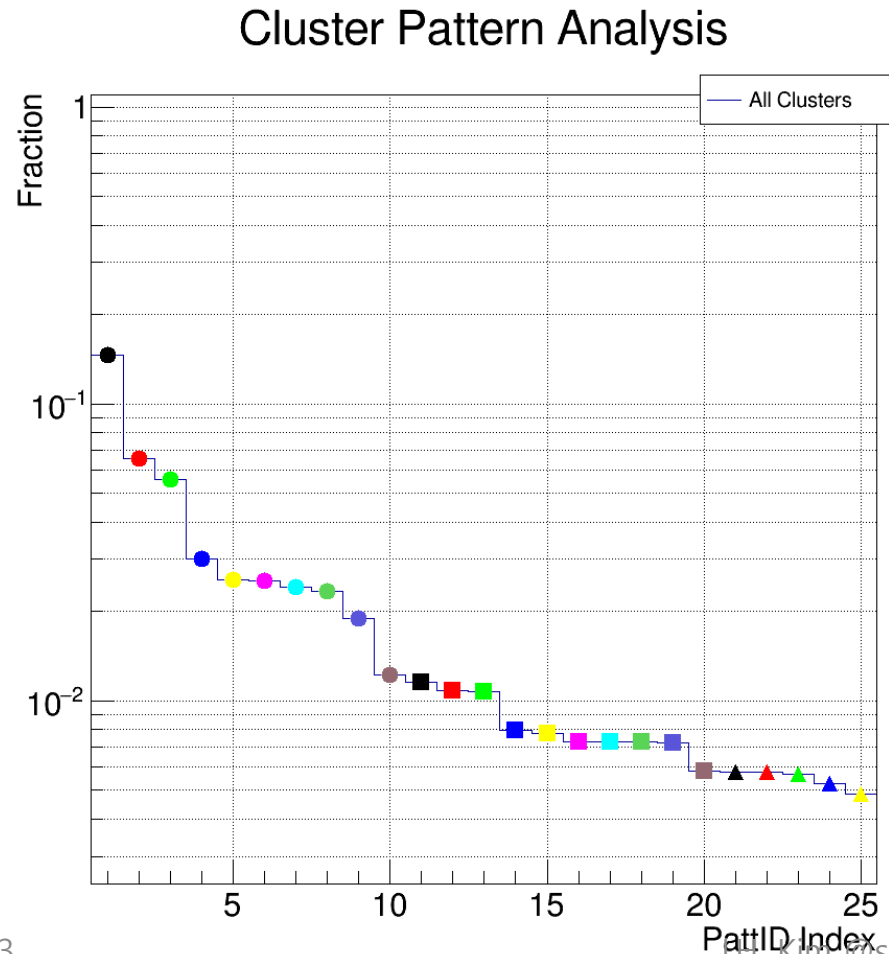
Case 4, cluster size = 4686



3. Cluster characteristics for possible tracks

3.2 Most frequent cluster patterns have 4 or less pixels firing.

- All cluster patterns used for further study are shown.

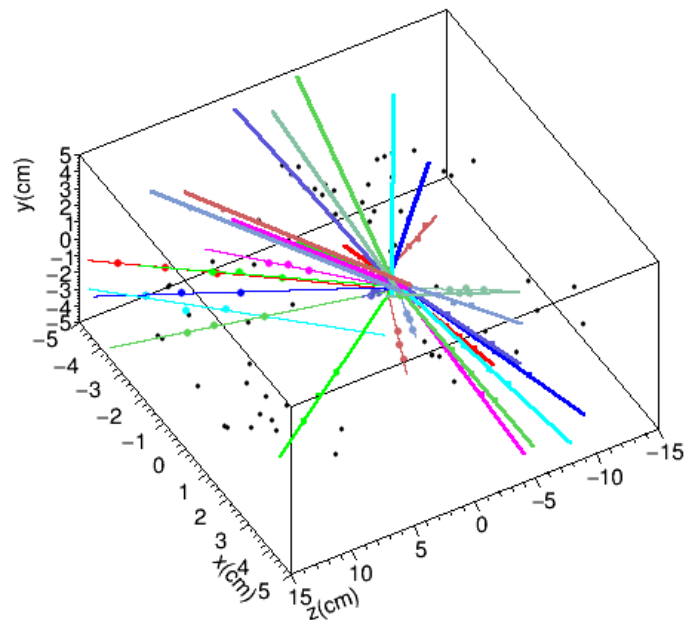
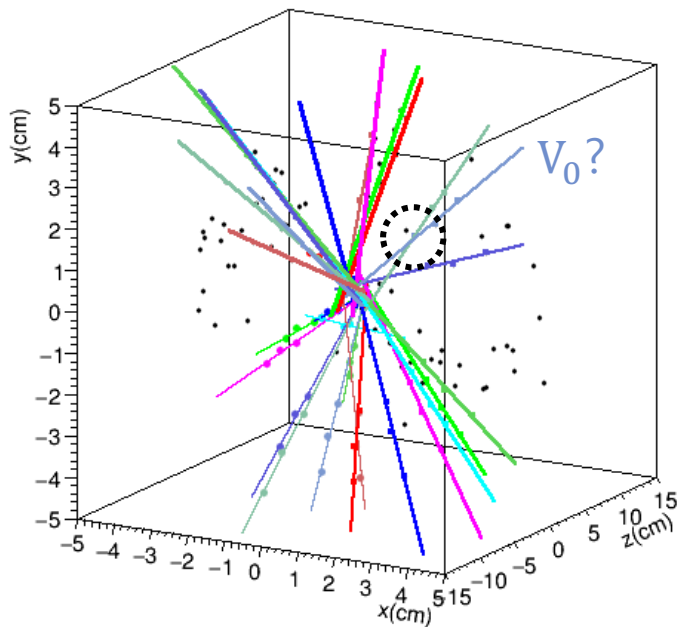


4. Crude tracking

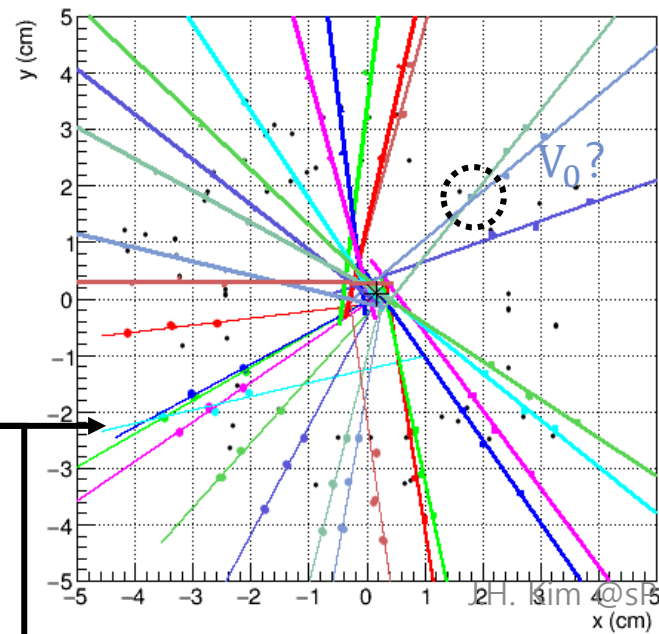
- We scanned 100,000 strobos (~ 1000 ZDC coincidence) from the RUN specified above.
- We assumed
 1. three consecutive hits in the layer 0, 1 and 2(perfect efficiency),
 2. there are poor but approximate detector alignment(sufficiently large search window),
 3. particle trajectories are straight line within the given limitation,
 4. and collisions occurred along the nominal collision axis.
- We selected low occupancy events or peripheral events ($N_{cl,0} > 12$, $N_{cl,1} > 12$, $12 < N_{cl,2} < 50$) to ensure enough granularity and verify the coincidence of hits.

BCO 1027781058195, $N_{\text{pixel}} = 1240$

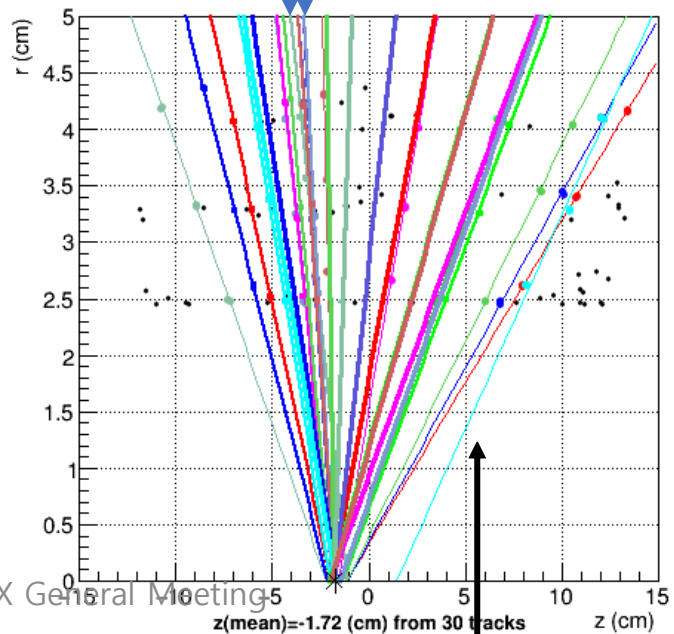
Cluster : 56 / 53 / 36 ; Track : 30



(MVTX) x-y projection

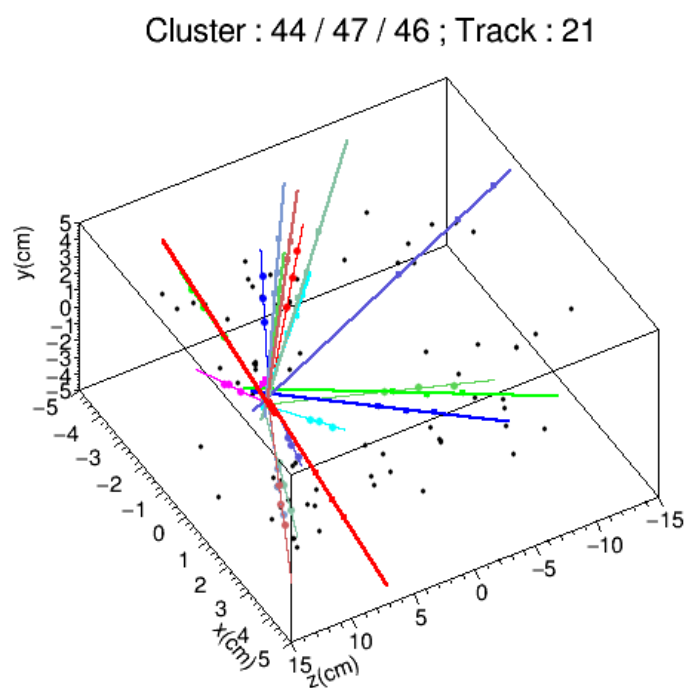
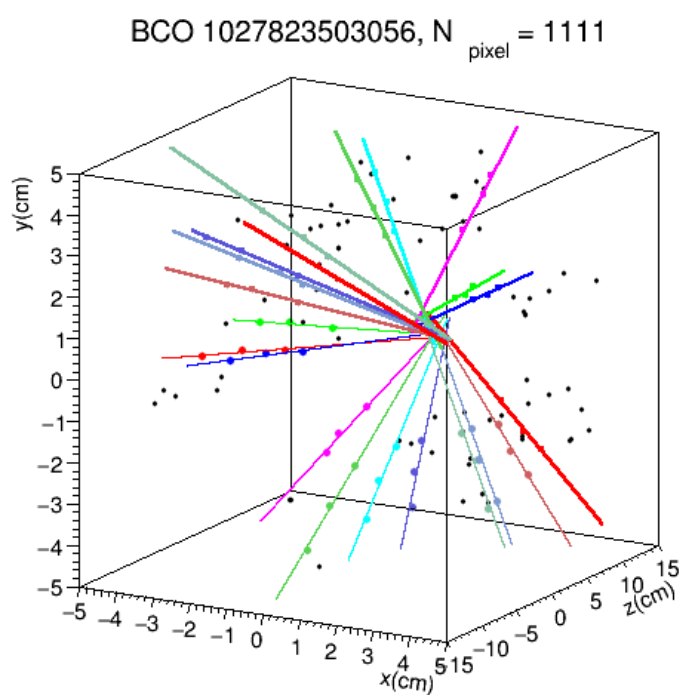


(MVTX) z-r projection

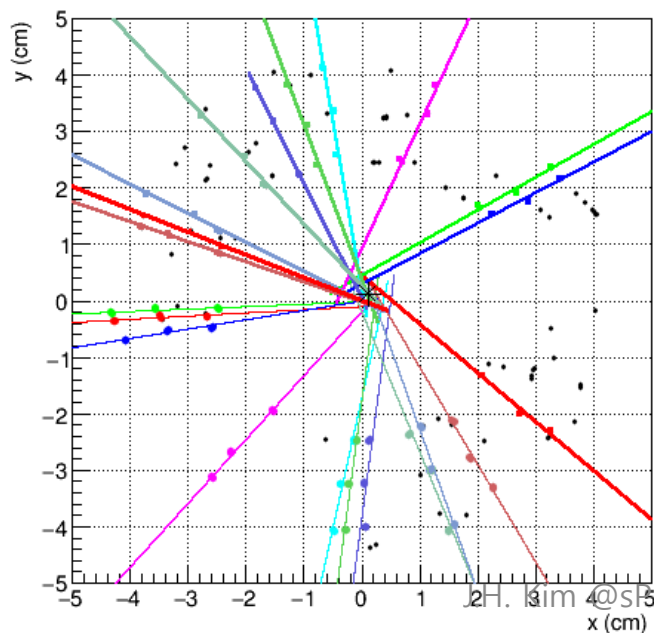


Wide search window,
Wrong reconstruction?

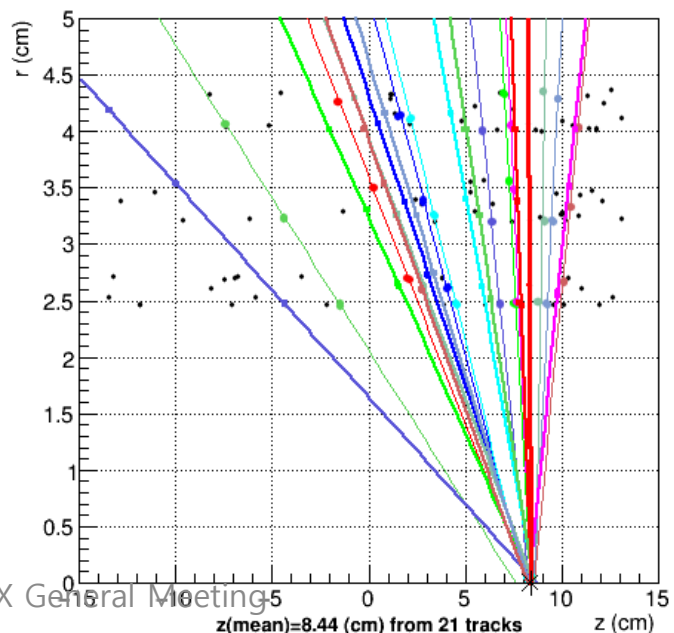
Another event



(MVTX) x-y projection

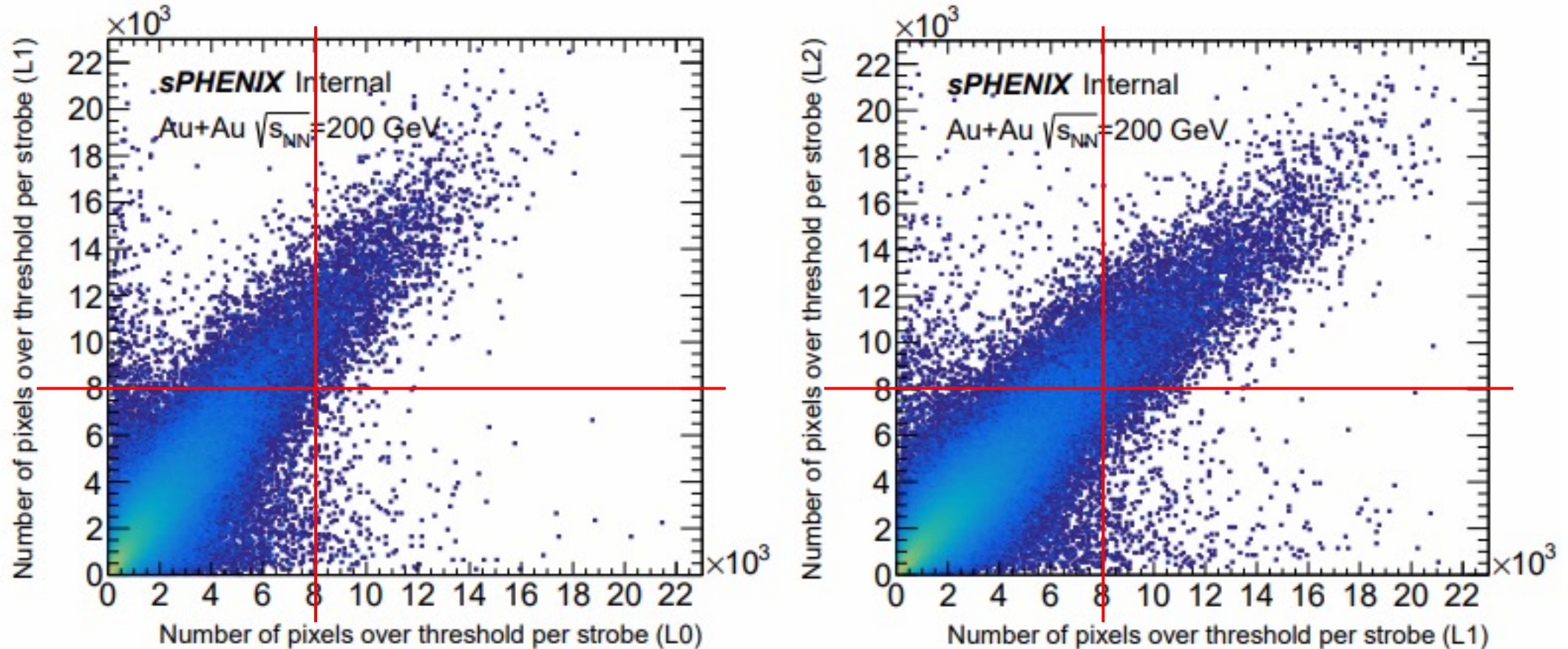


(MVTX) z-r projection



Back up

1. Introduction



All layers show there are more than 8,000 pixels fired for many events.
Where are they from?

Large clusters are the background from the upstream beam interaction.

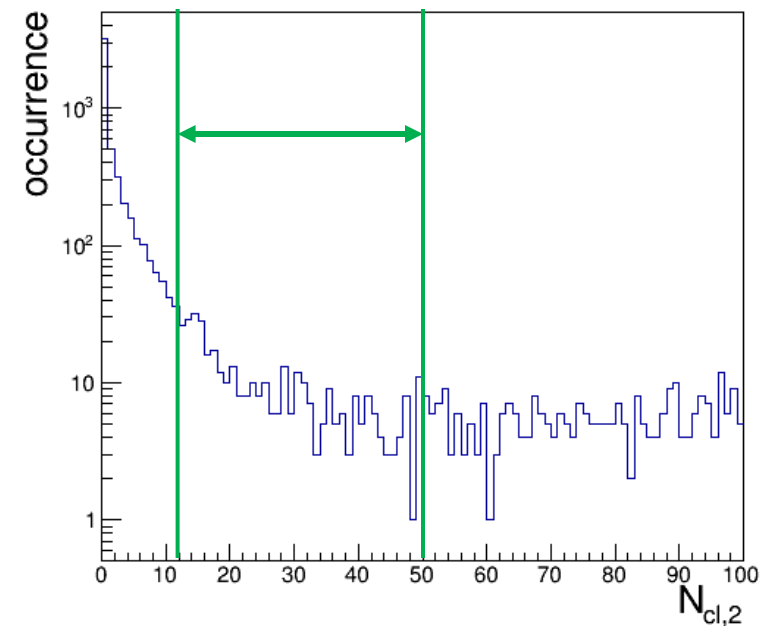
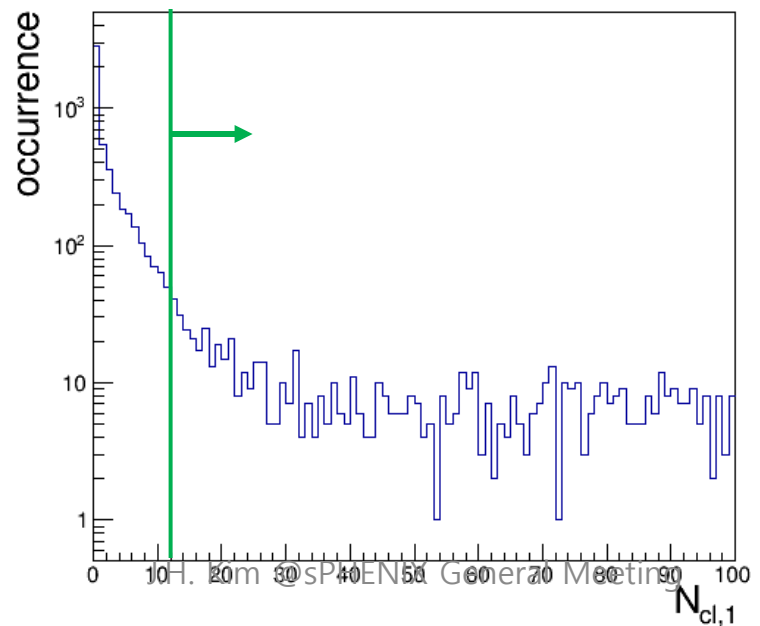
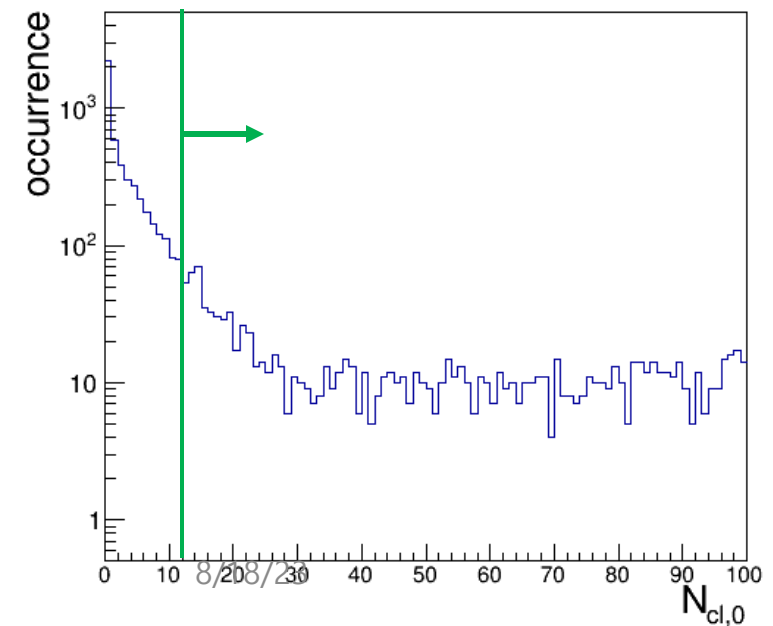
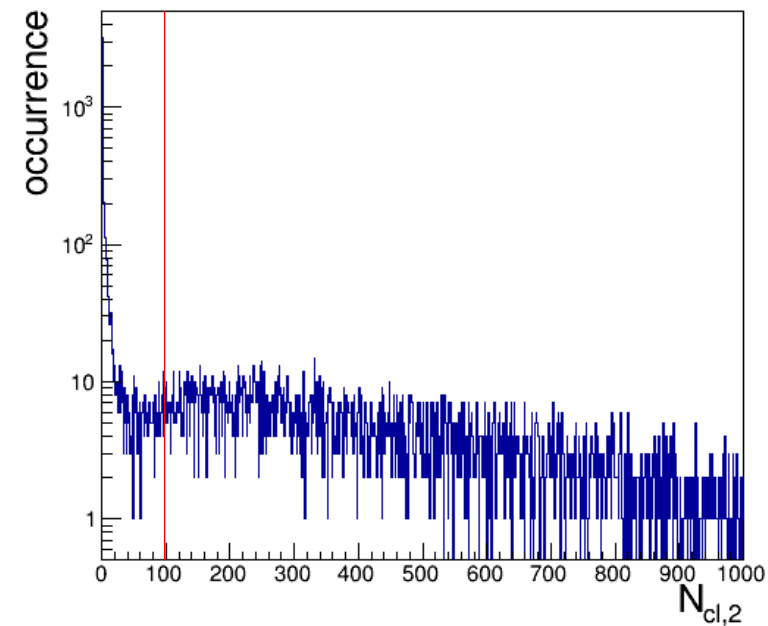
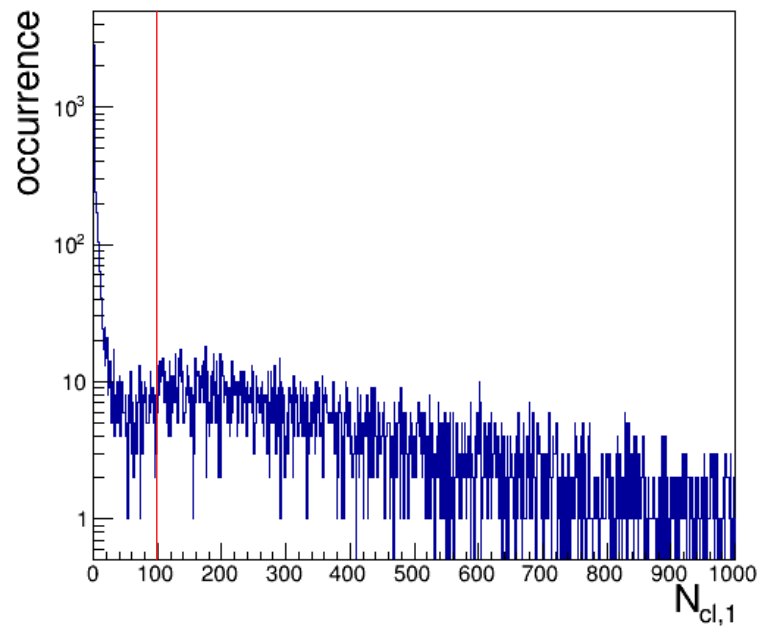
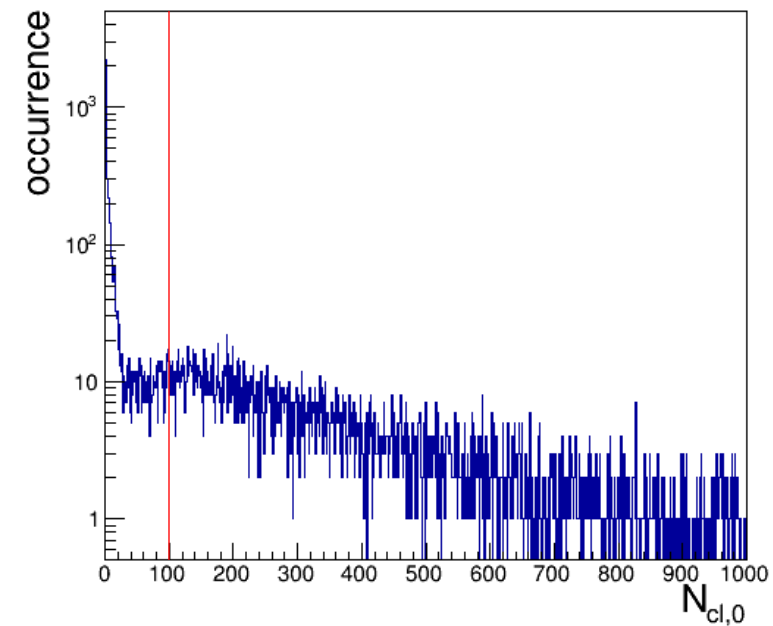
- There was low ZDC coincidence rate(100Hz) relative to the strobe rate(11,000Hz), but most of the readout frames have large number of firing pixels. Therefore, most of the recorded data are irrelevant to collision.
- There are many clusters with large sizes for most of the readout frames, and these large clusters seems to have physical origin, possibly caused by the upstream beam interaction.
- Very large clusters will stress readout with occupancy and cause failures, which might explain some difficulties in the MVTX operation.

- Distribution of $N_{cl,0}$, $N_{cl,1}$, $N_{cl,2}$, number of clusters in layer 0, 1, 2.

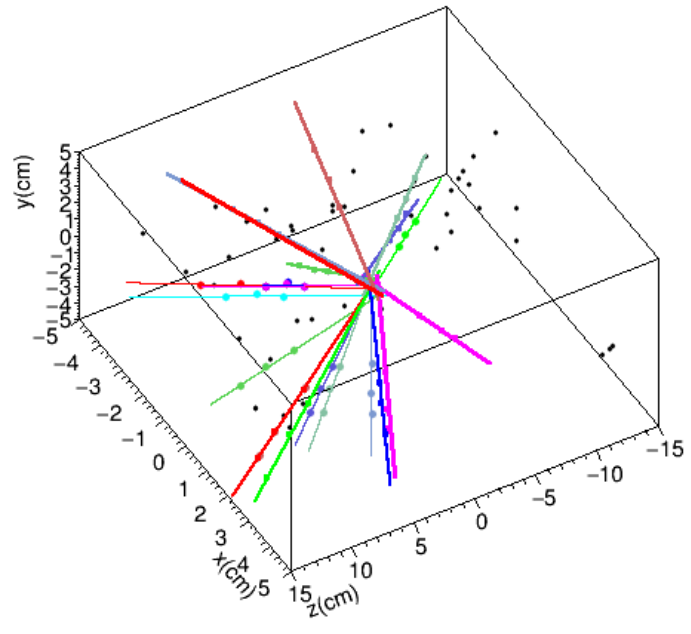
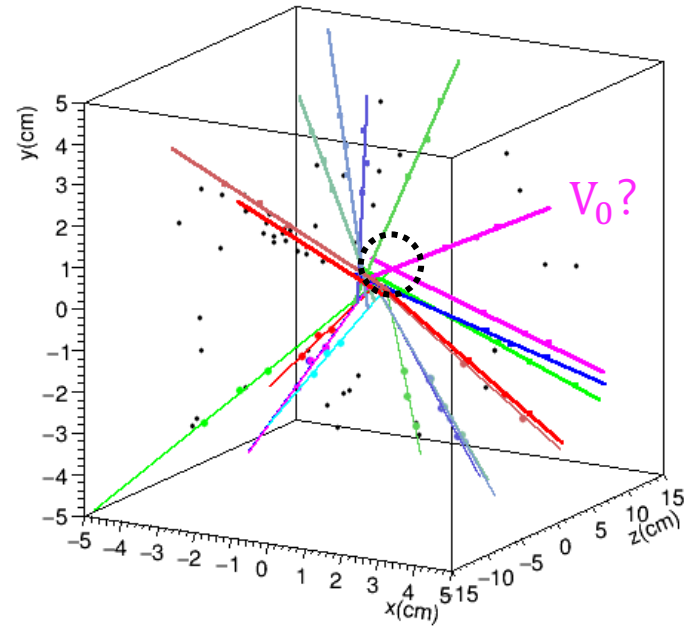
Distribution of $N_{cl,0}$

Distribution of $N_{cl,1}$

Distribution of $N_{cl,2}$

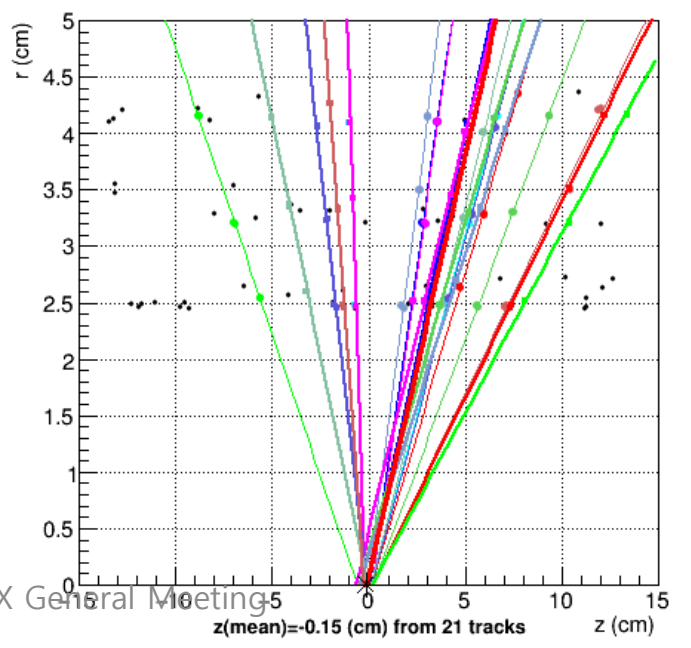
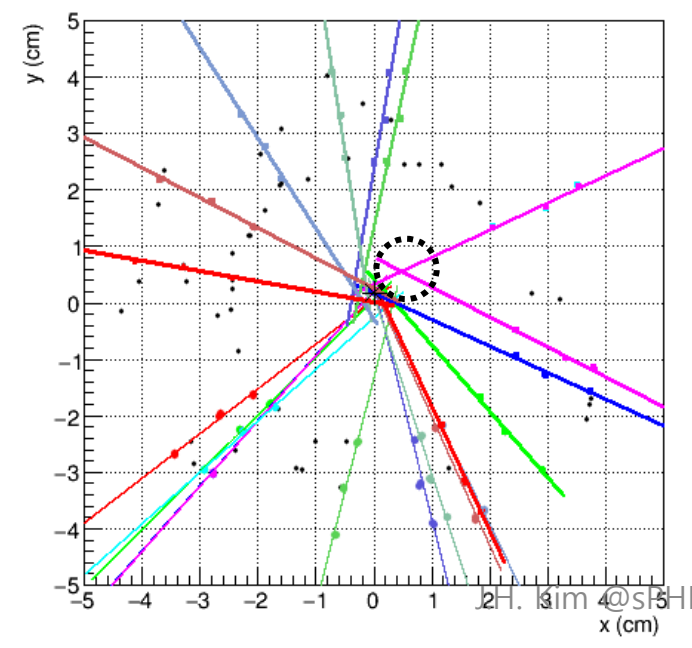


Additional Events, RUN 20124



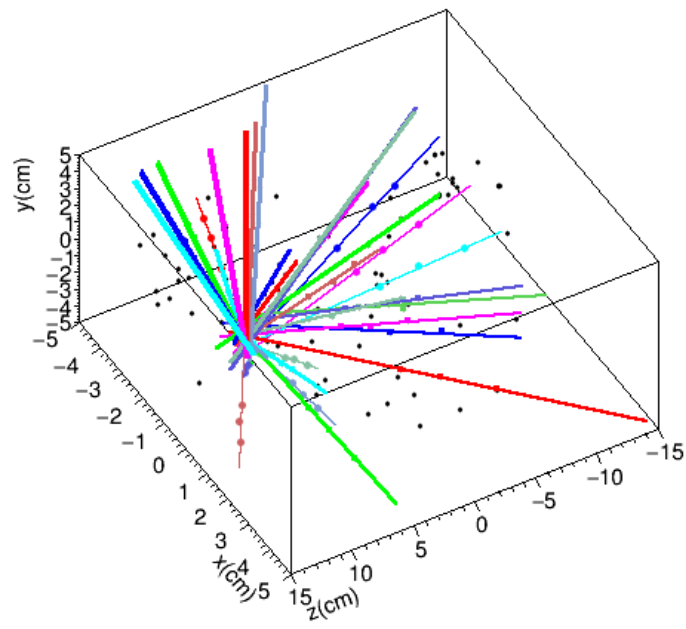
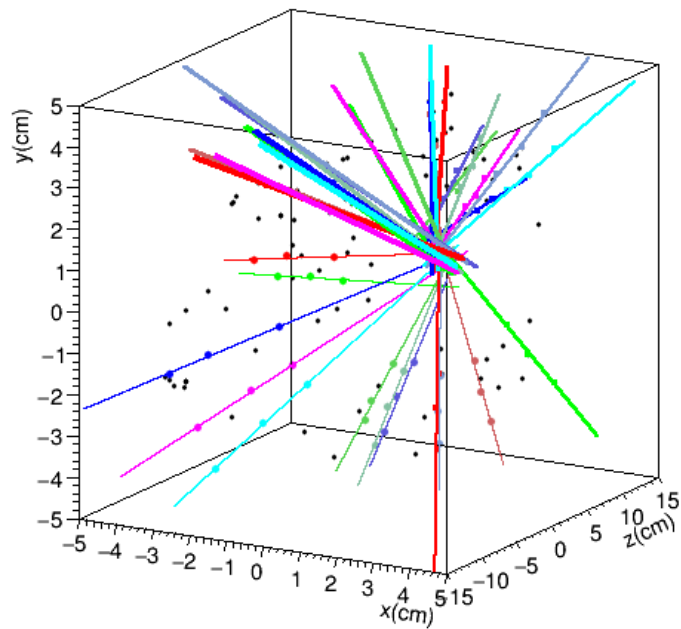
(MVTX) x-y projection

(MVTX) z-r projection



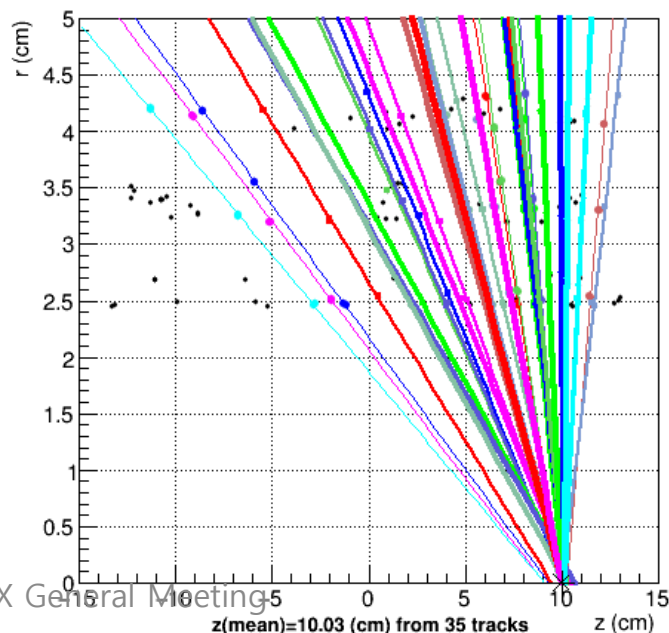
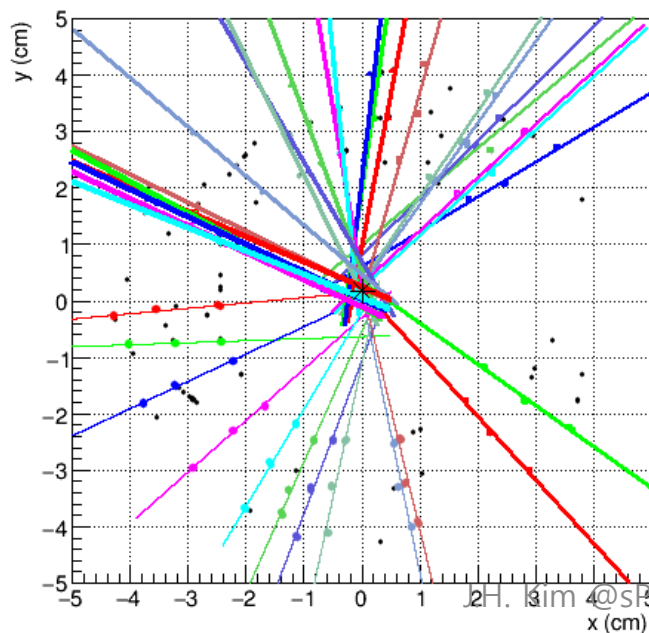
BCO 1027820151290, $N_{\text{pixel}} = 1241$

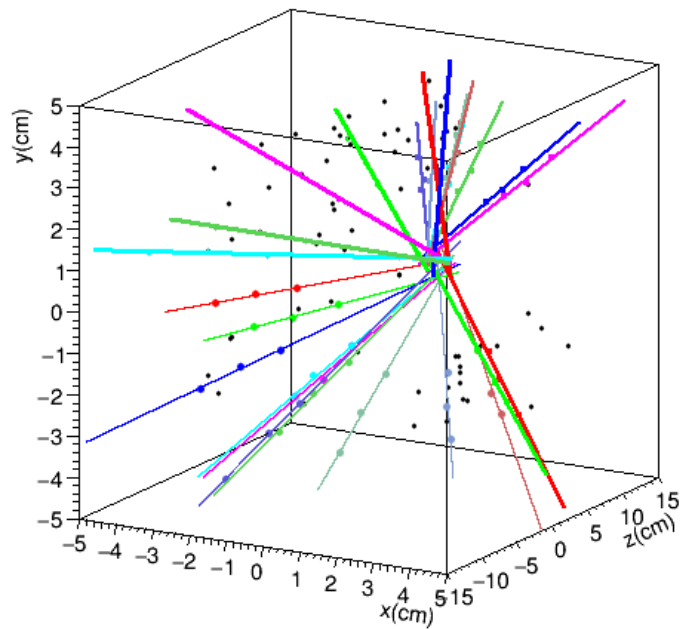
Cluster : 54 / 64 / 49 ; Track : 35



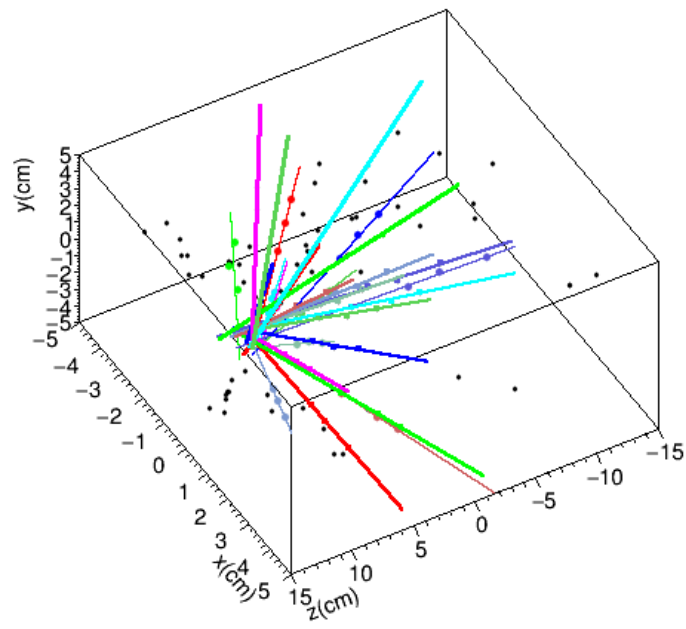
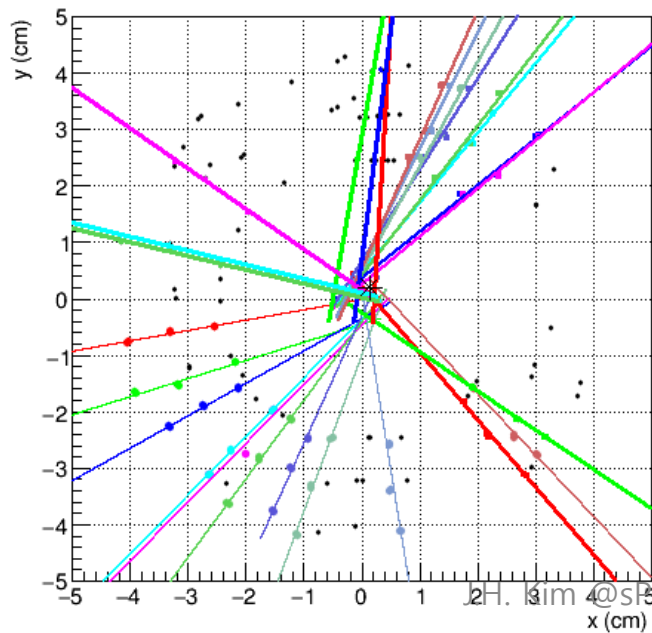
(MVTX) x-y projection

(MVTX) z-r projection

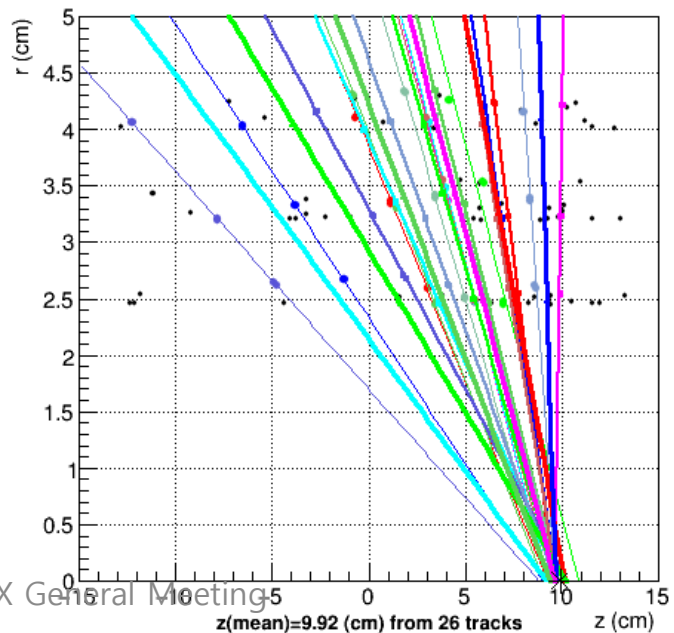




(MVTX) x-y projection

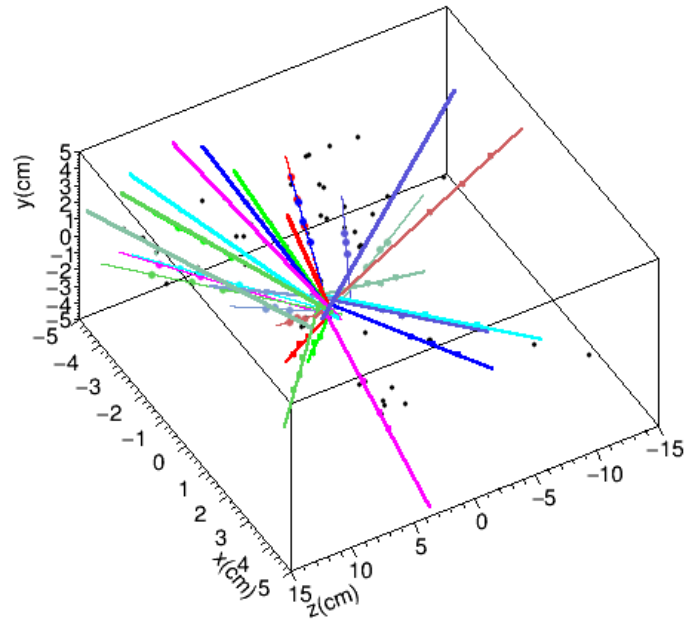
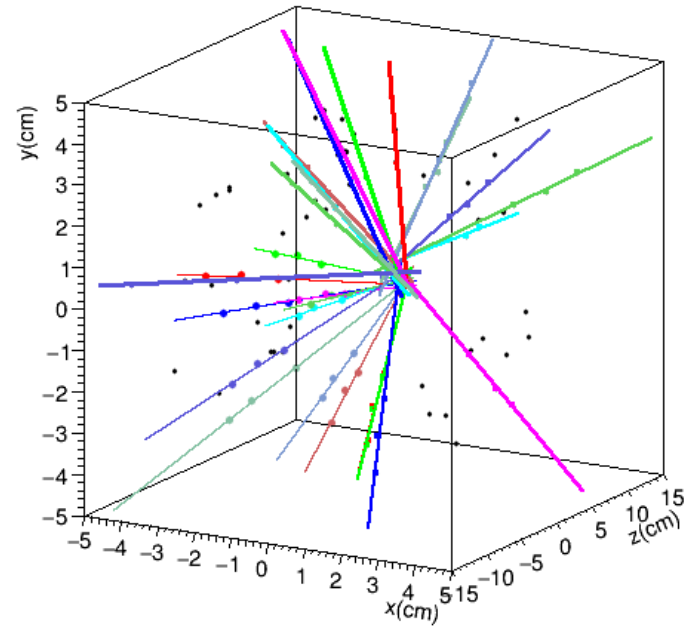


(MVTX) z-r projection



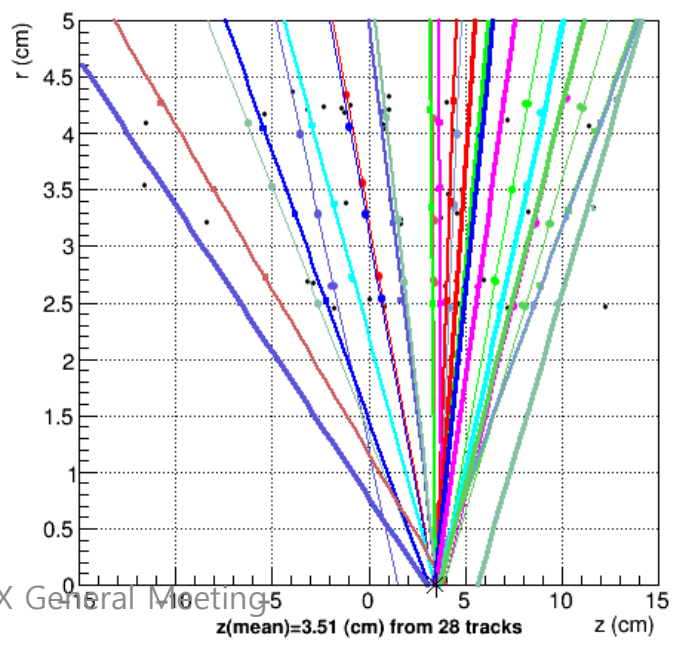
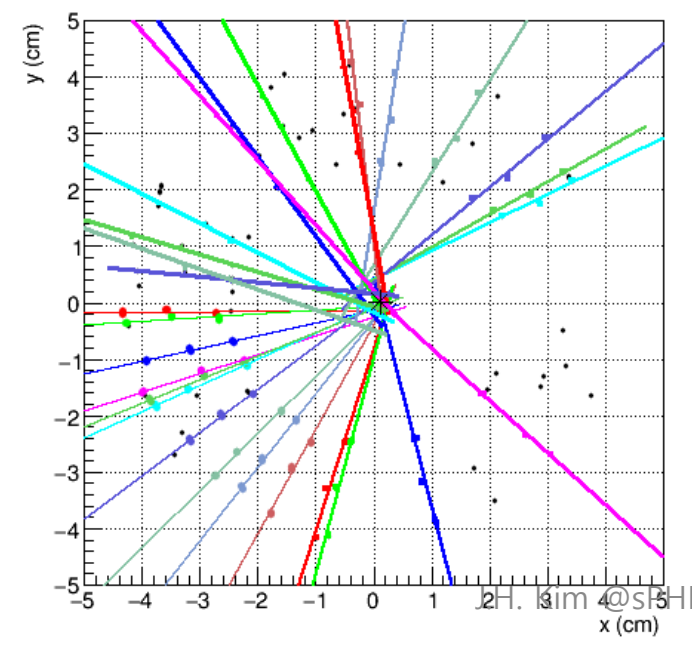
BCO 1027838682378, $N_{\text{pixel}} = 906$

Cluster : 41 / 39 / 47 ; Track : 28



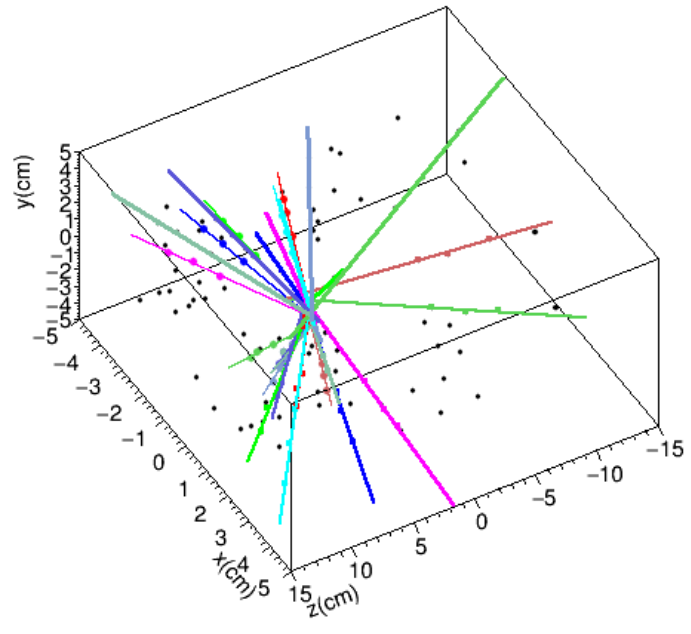
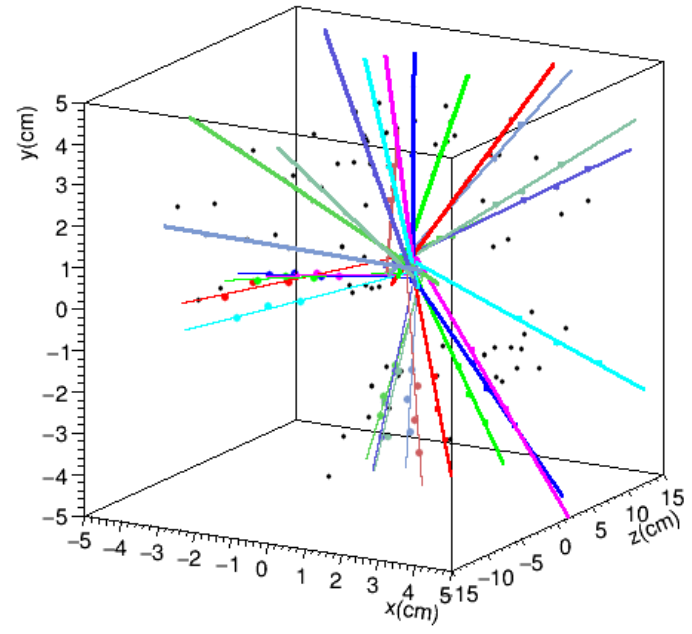
(MVTX) x-y projection

(MVTX) z-r projection



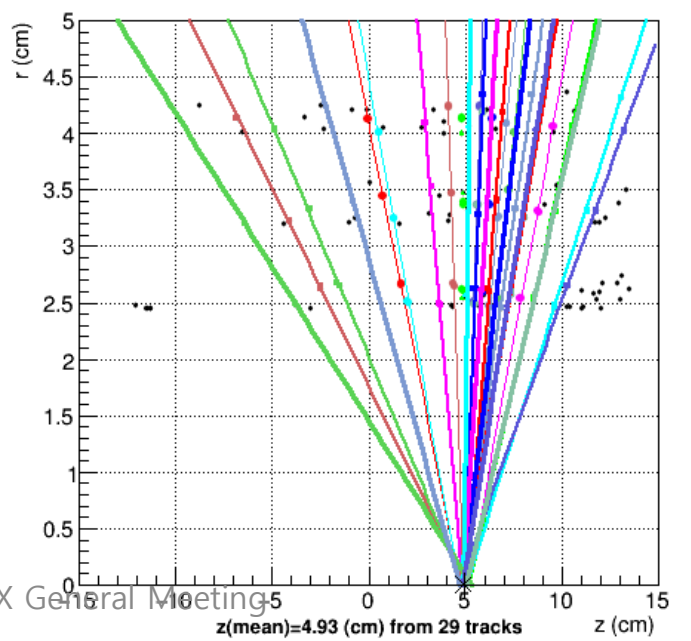
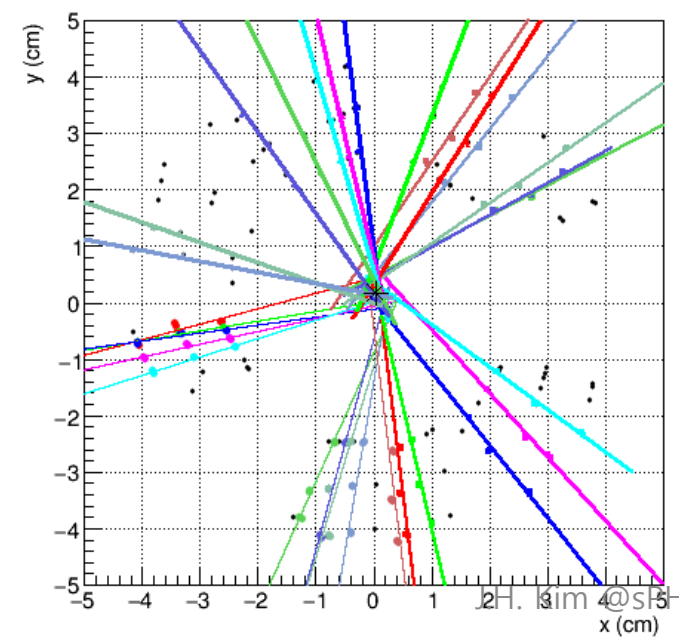
BCO 1027840160927, $N_{\text{pixel}} = 972$

Cluster : 55 / 47 / 48 ; Track : 29



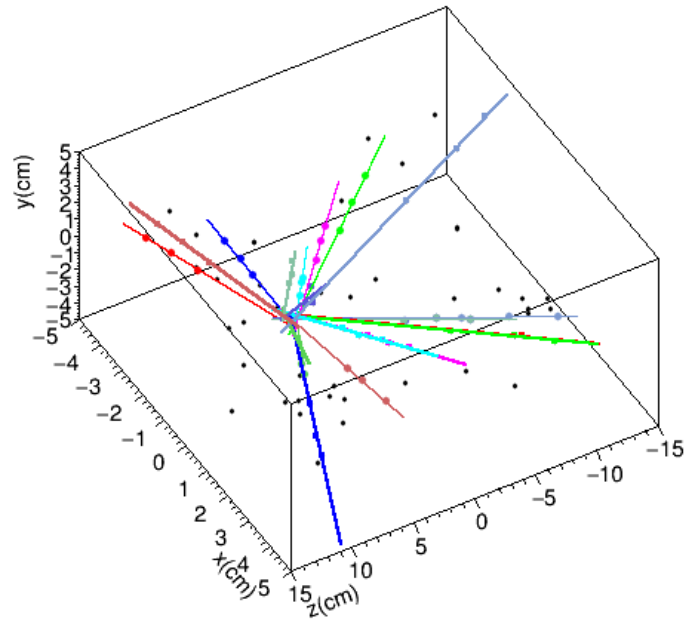
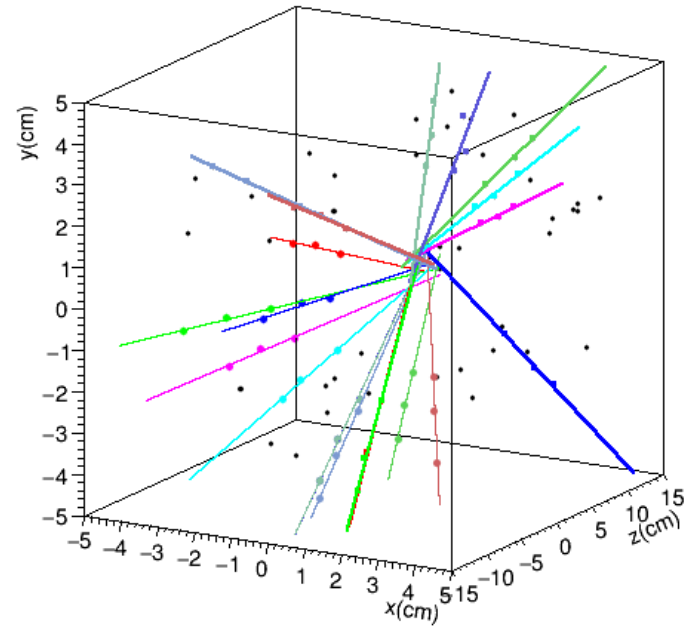
(MVTX) x-y projection

(MVTX) z-r projection



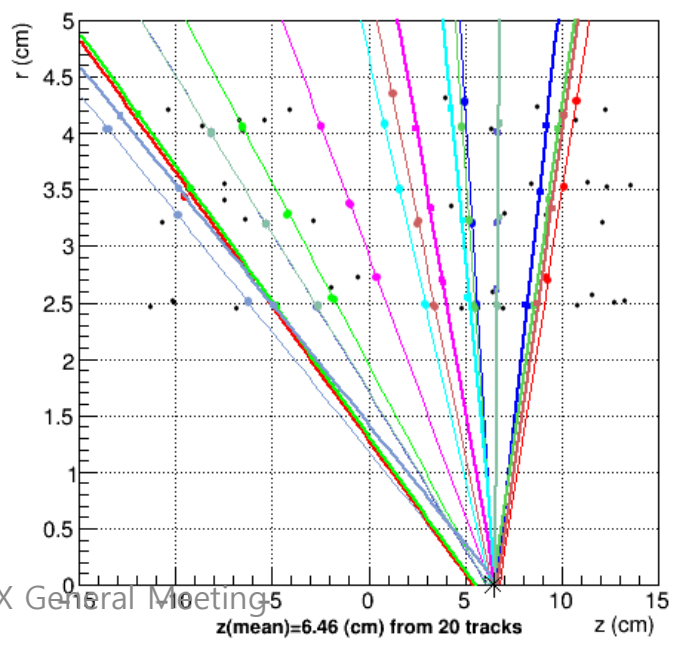
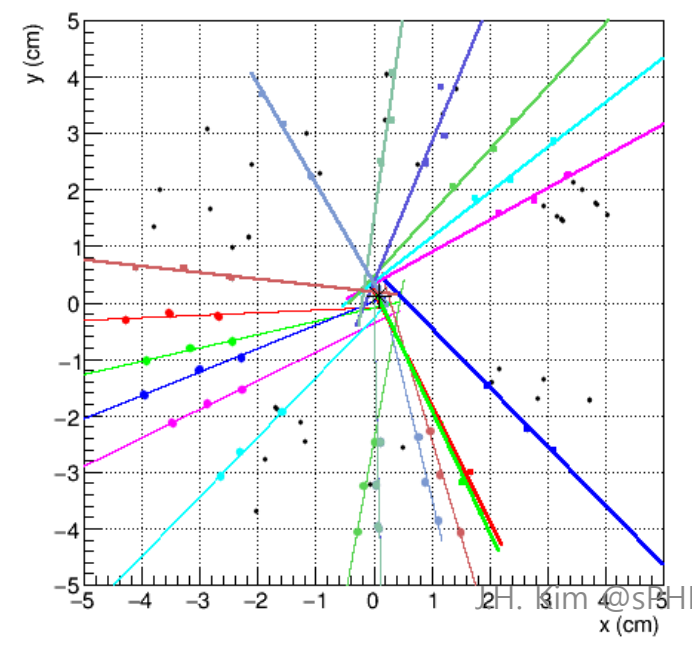
BCO 1027852136170, $N_{\text{pixel}} = 800$

Cluster : 34 / 34 / 31 ; Track : 20



(MVTX) x-y projection

(MVTX) z-r projection



$z(\text{mean})=6.46 \text{ (cm)}$ from 20 tracks