Possible explanation of “Elisa peak”

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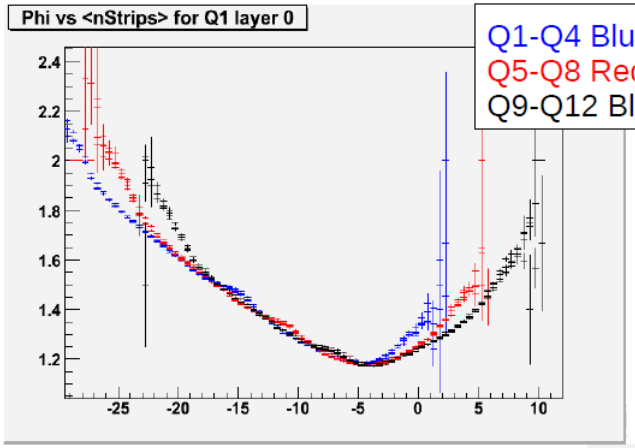
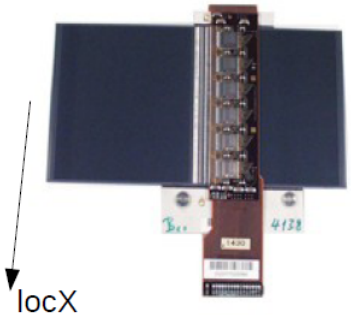
Elisa Picarro showed strange plots in her talk on 27 May 2010.

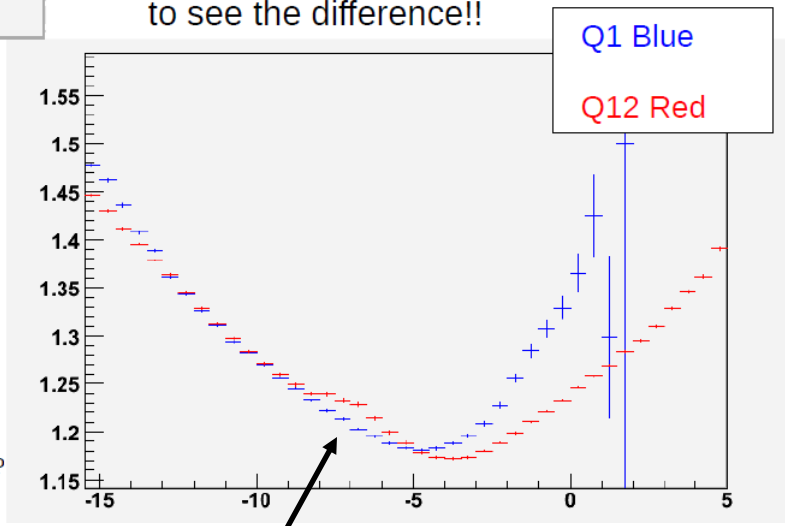
track Pt cut > 500 MeV/c.

Module Bow Study: Layer0 profiles

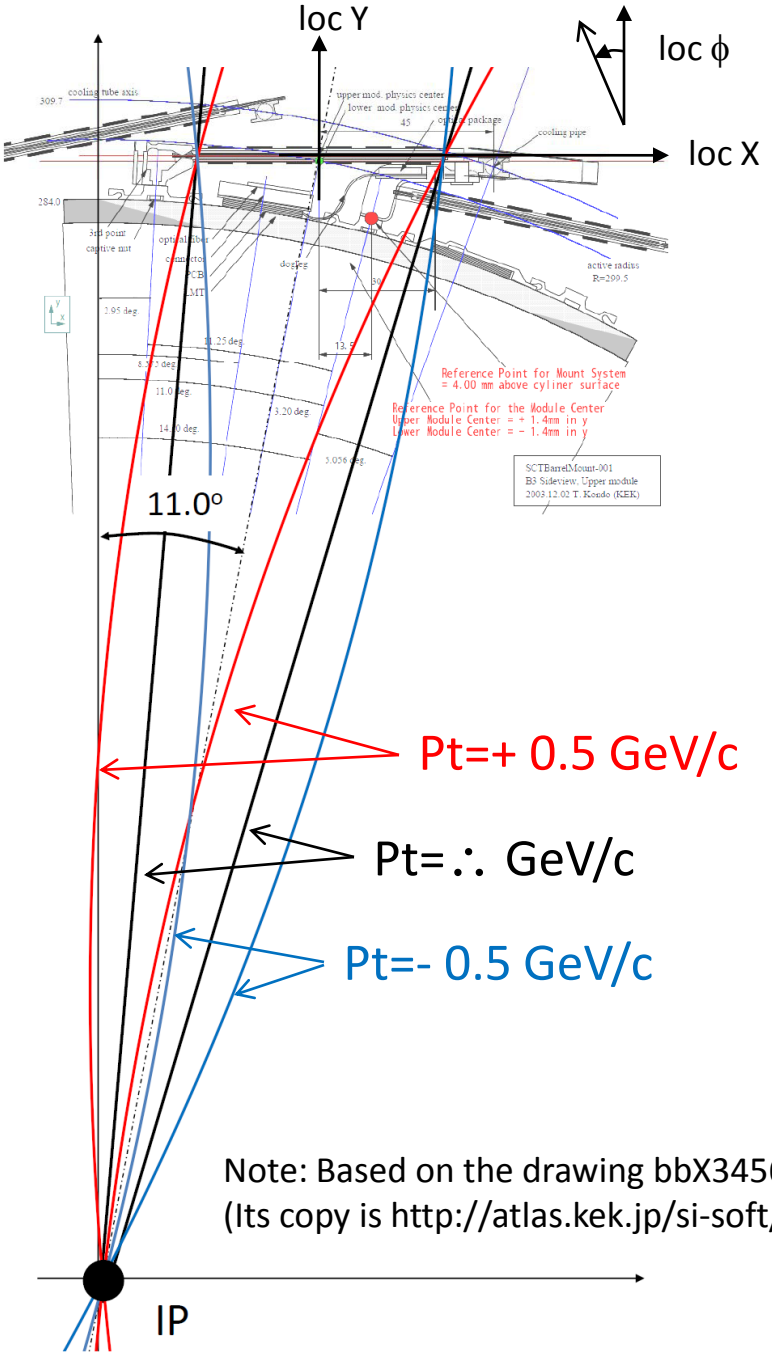


- Very different profiles varying locX
- Big change in slope. Why?
- The incident angle at which the second minima occur increases as locX increases. What are they?
- The minimum <clus.width> occurs at different inc. angles, don't need the fit to see the difference!!





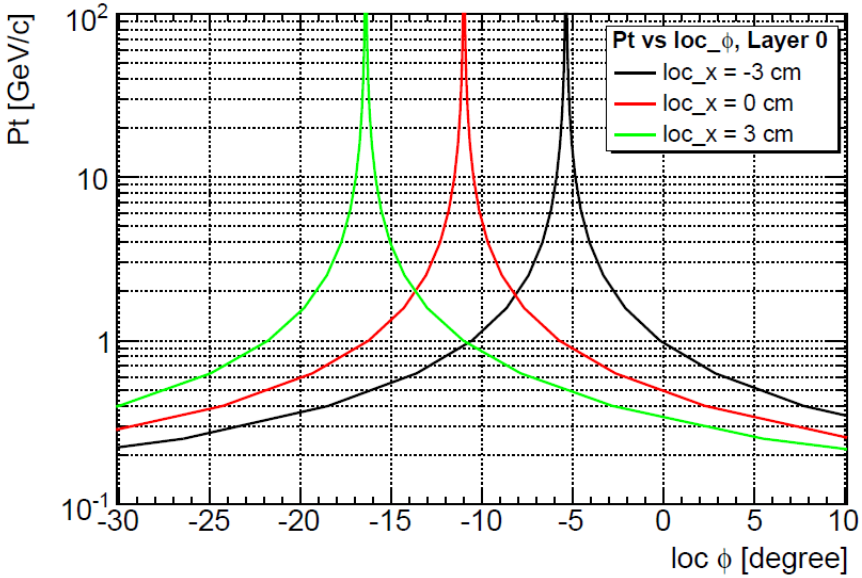
Elisa peak



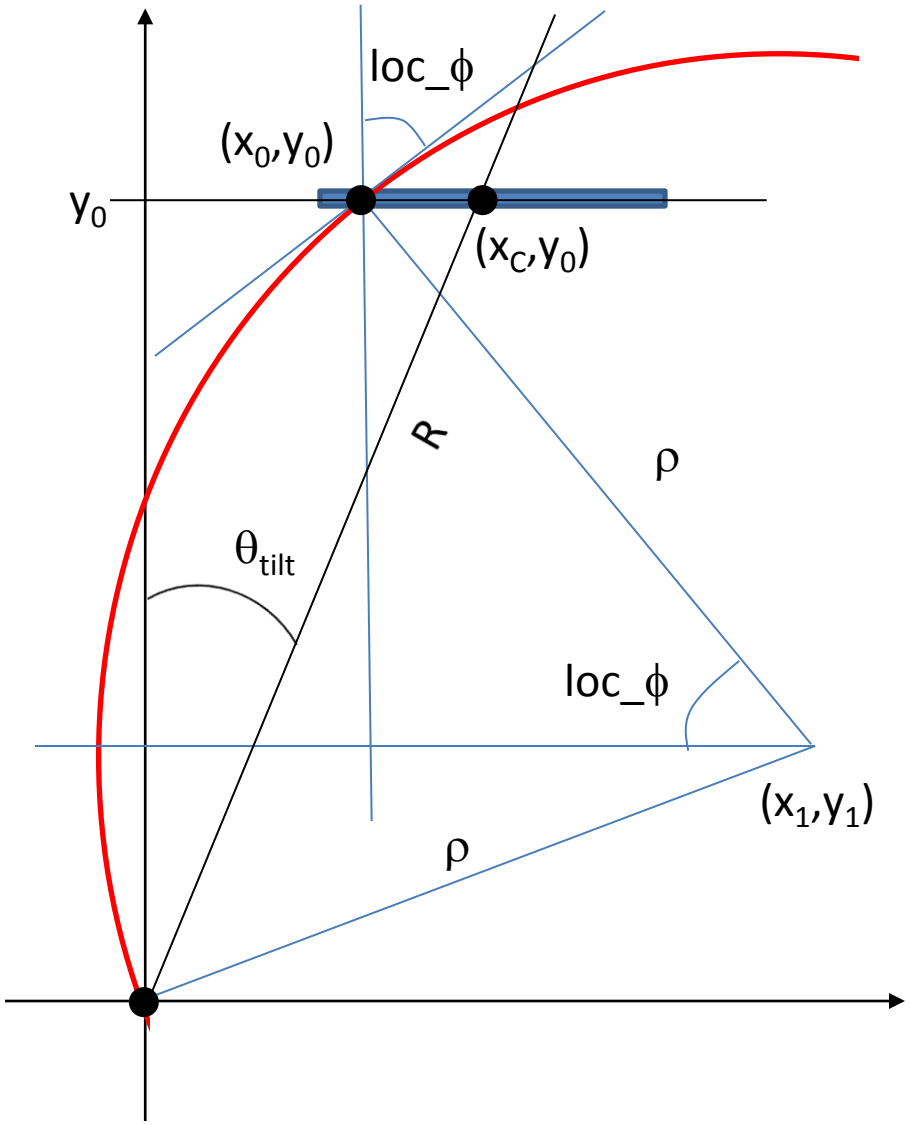
Because of the IP constraint,

Pt, loc_x and loc_ϕ

are highly correlated.



Note: Based on the drawing bbX3456
(Its copy is http://atlas.kek.jp/si-soft/geometry/bbX3456.pdf)



$$x_1^2 + y_1^2 = \rho^2$$

$$(x_0 - x_1)^2 + (y_0 - y_1)^2 = \rho^2$$

$$\rho\ [\mathrm{m}] = \frac{p\ [\mathrm{GeV/c}]}{0.3 \cdot B\ [\mathrm{Tesla}]},$$

solutions

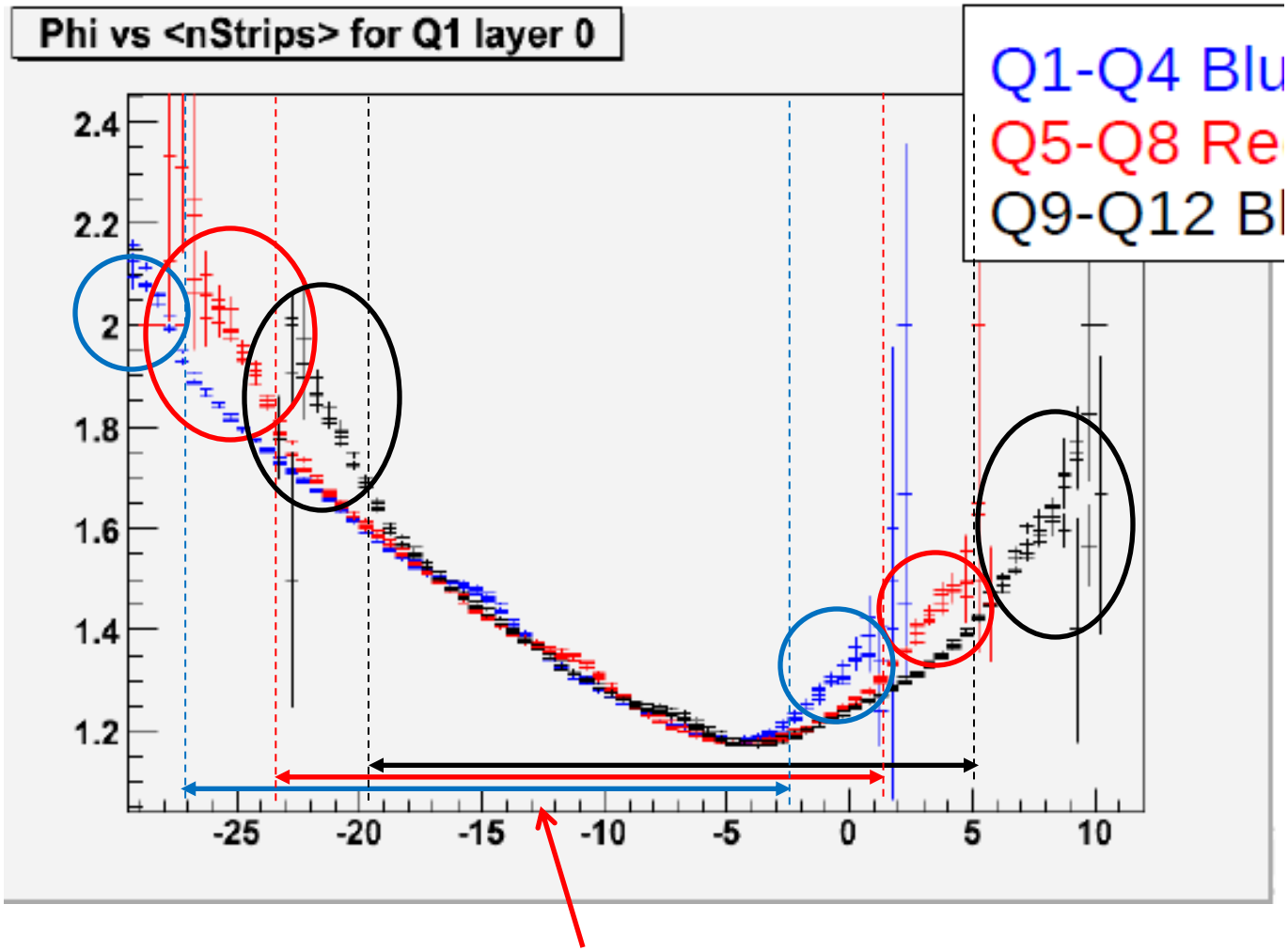
$$x_1 = \frac{Ax_0 \pm y_0\sqrt{A(4\rho^2 - A)}}{2A}$$

$$y_1 = \frac{Ay_0 \mp x_0\sqrt{A(4\rho^2 - A)}}{2A}$$

where $A = x_0^2 + y_0^2$

$$\tan(loc\_\phi) = \frac{y_0 - y_1}{x_0 - x_1}$$

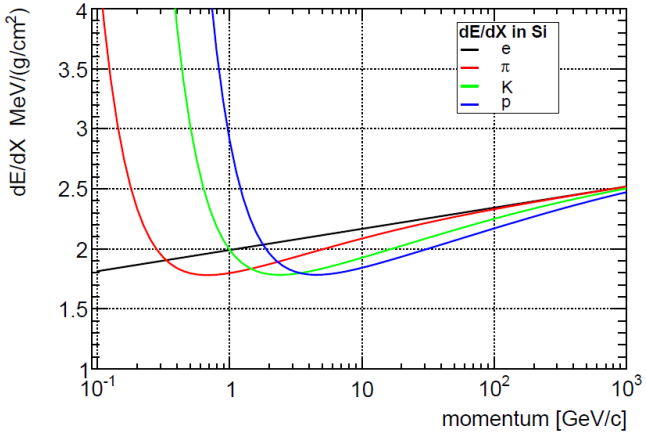
$$y_0 = R\cos\theta_{tilt}, \qquad x_c = R\sin\theta_{tilt}$$

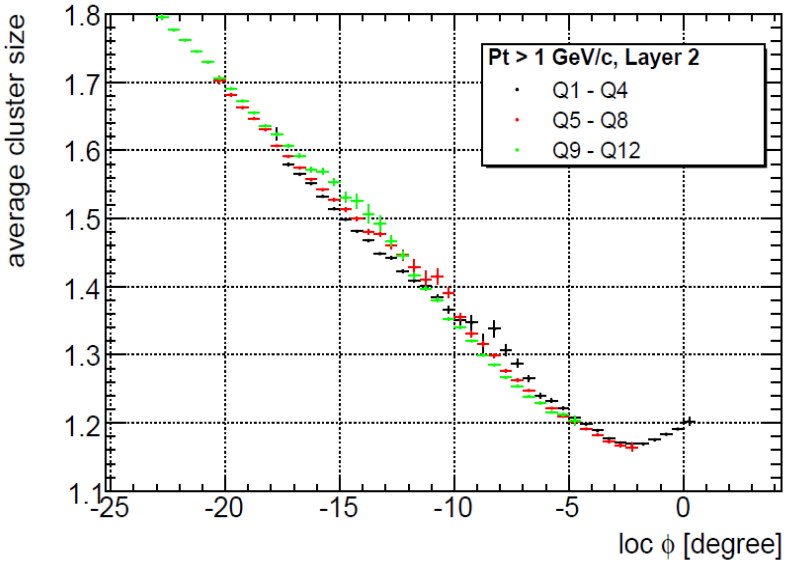


Geometrically allowed regions are noted by bottom three lines.
Therefore tracks indicated by circles are illegal and must be wrongly Reconstructed tracks.

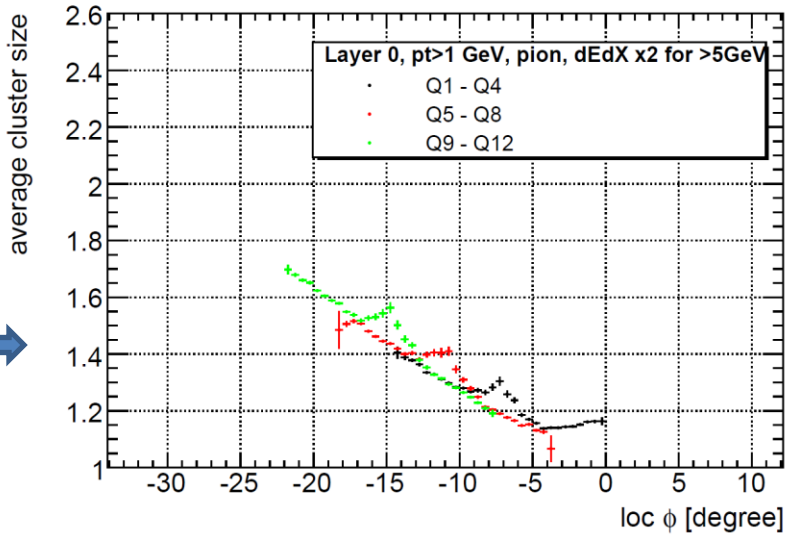
Cluster size depends on dE/dX.
dE/dX changes as a function of p.

Thus Elsa bump can possibly be explained by relativistic rise.



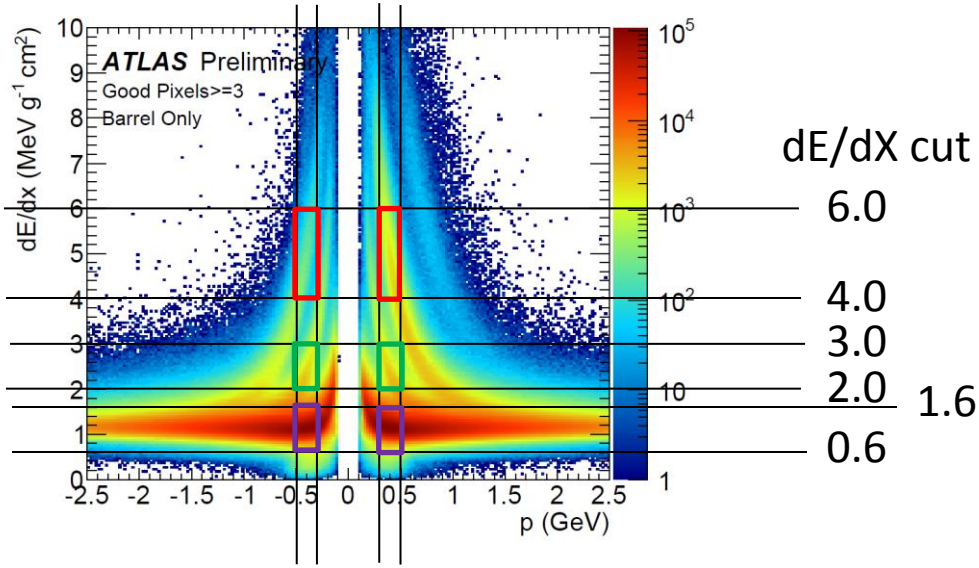


A simulation indicates bumps but the effects are smaller than data.



dE/dX of tracks for Pt>5 GeV/c are artificially increased by 2.

Note these two plots are for different layers. I will update soon.

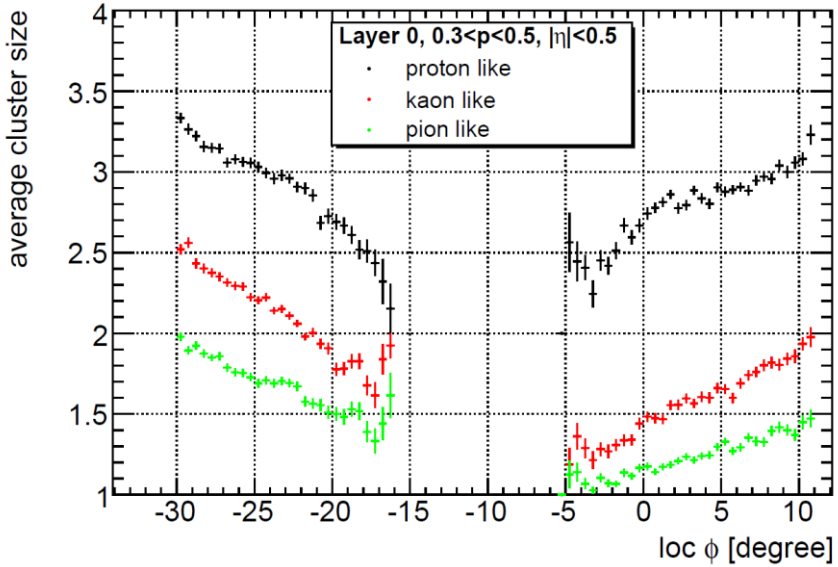


$0.3 < p < 0.5$

protons kaons pions

Proposed cuts on pixel information.

Since average cluster size depends on dE/dX of tracks, it may be possible to obtain a plot like below, by selecting particle species using pixel.



Summary

- By dividing the Barrel modules into 3 regions (for module Bow study), some parts of local_ϕ are dominated by only high Pt tracks with little contribution from low Pt tracks.

- However, the relativistic rise of pion dE/dX seems to be not sufficient enough to explain the “Elisa peak” heights. There might be some special enhancements in high Pt tracks, like jet or associated activities.

- In Elisa’s plots, there are data points which are not geometrically allowed. These illegal tracks should be looked into.

- In the region of $0.3<p<0.5$ GeV, the average cluster size may be enhanced by selecting kaon- and/or proton-like tracks using pixel particle ID information.