

Investigation of the low Pt tracking reconstruction issue

Try to find out the useful samples to help to investigate the low Pt tracking reconstruction problem

Try to find out the good tools and parameters to show the problem clearly

Try to understand where and what cause the problem

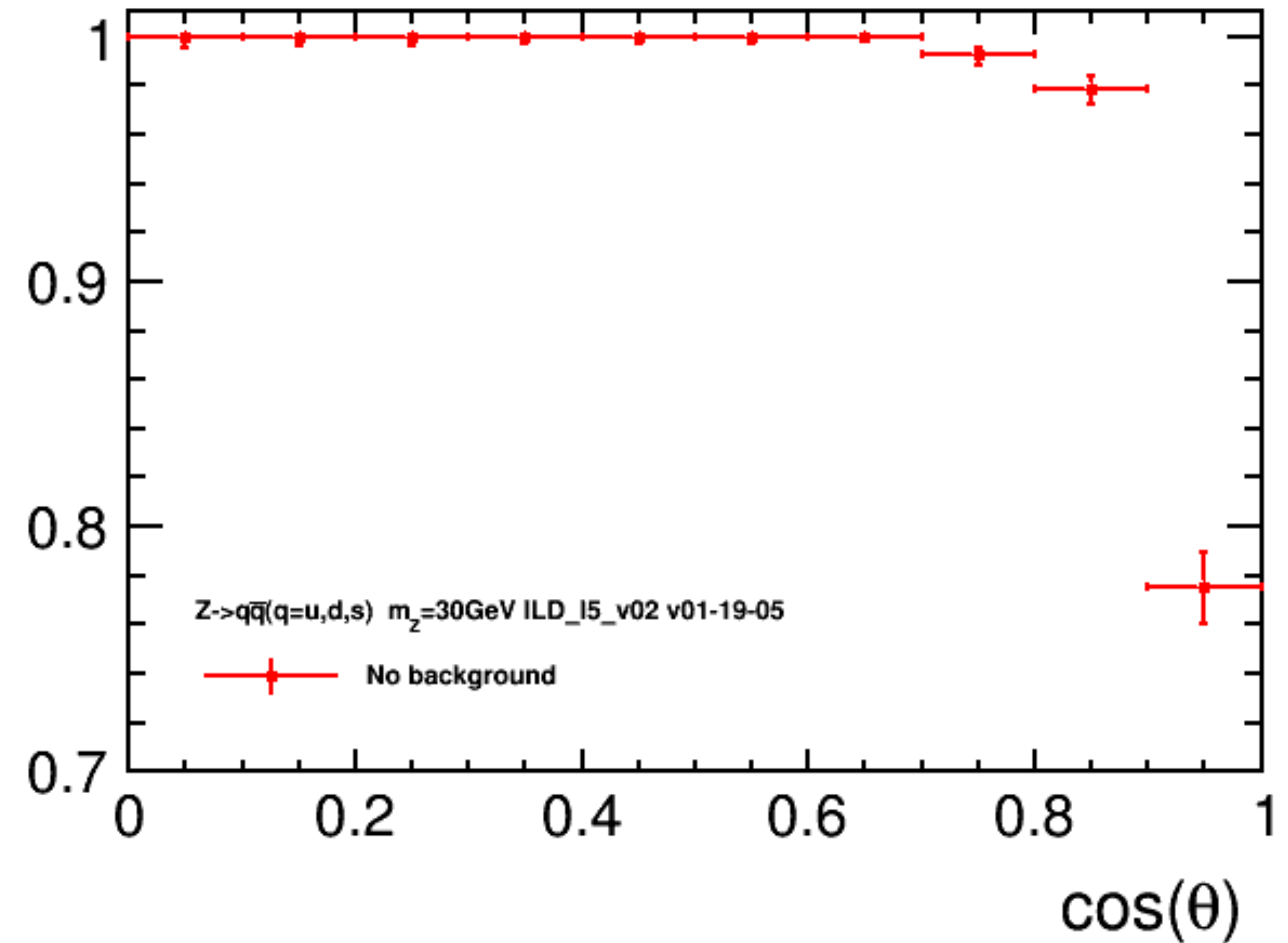
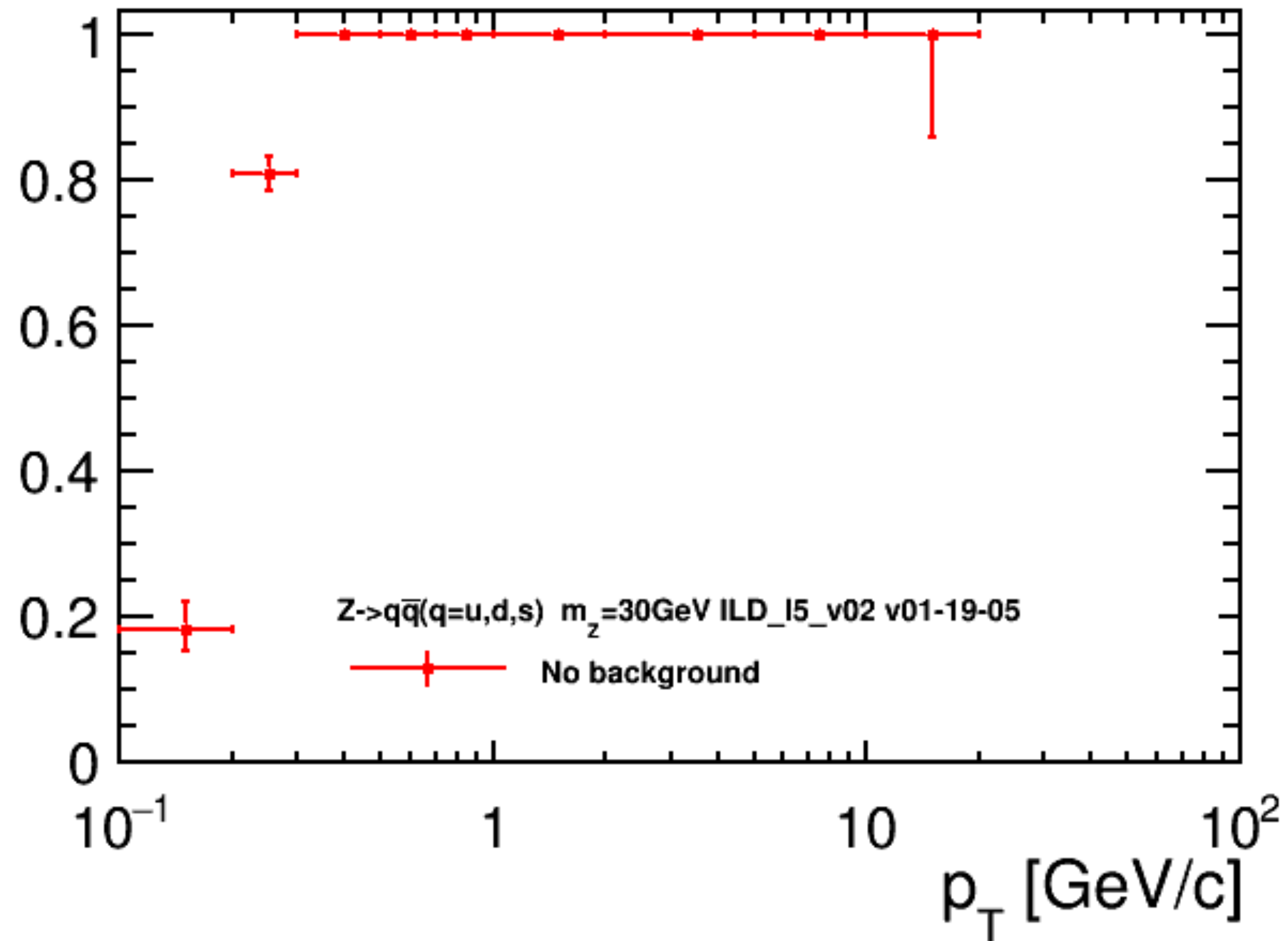
Finally, base on the understood information, to fix and improve the low Pt tracking reconstruction

Shaojun Lu
shaojun.lu@desy.de
17 January 2018

ILD Performance: Tracking Efficiency

preliminary *Zuds30GeV*

Tracking efficiency



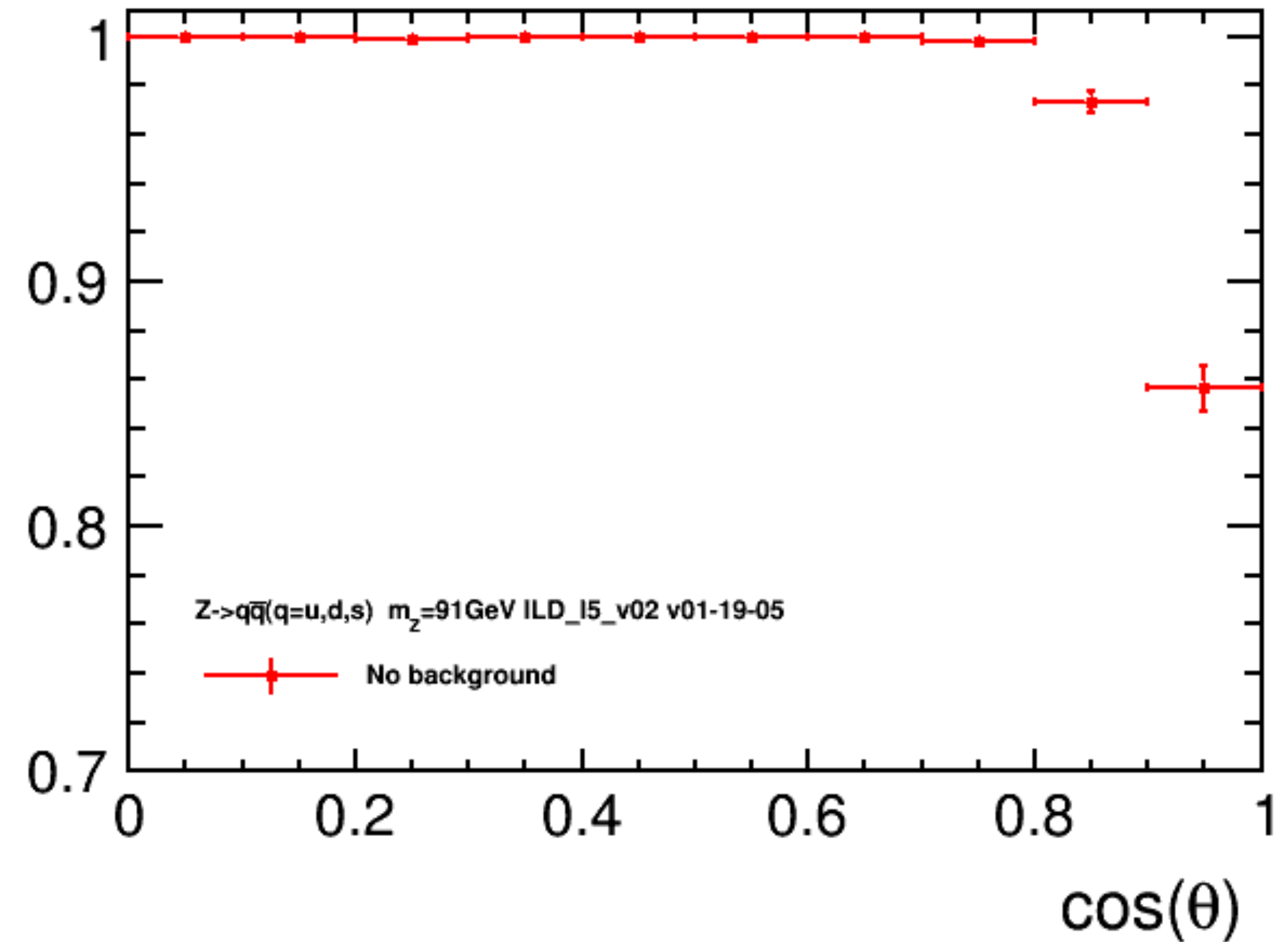
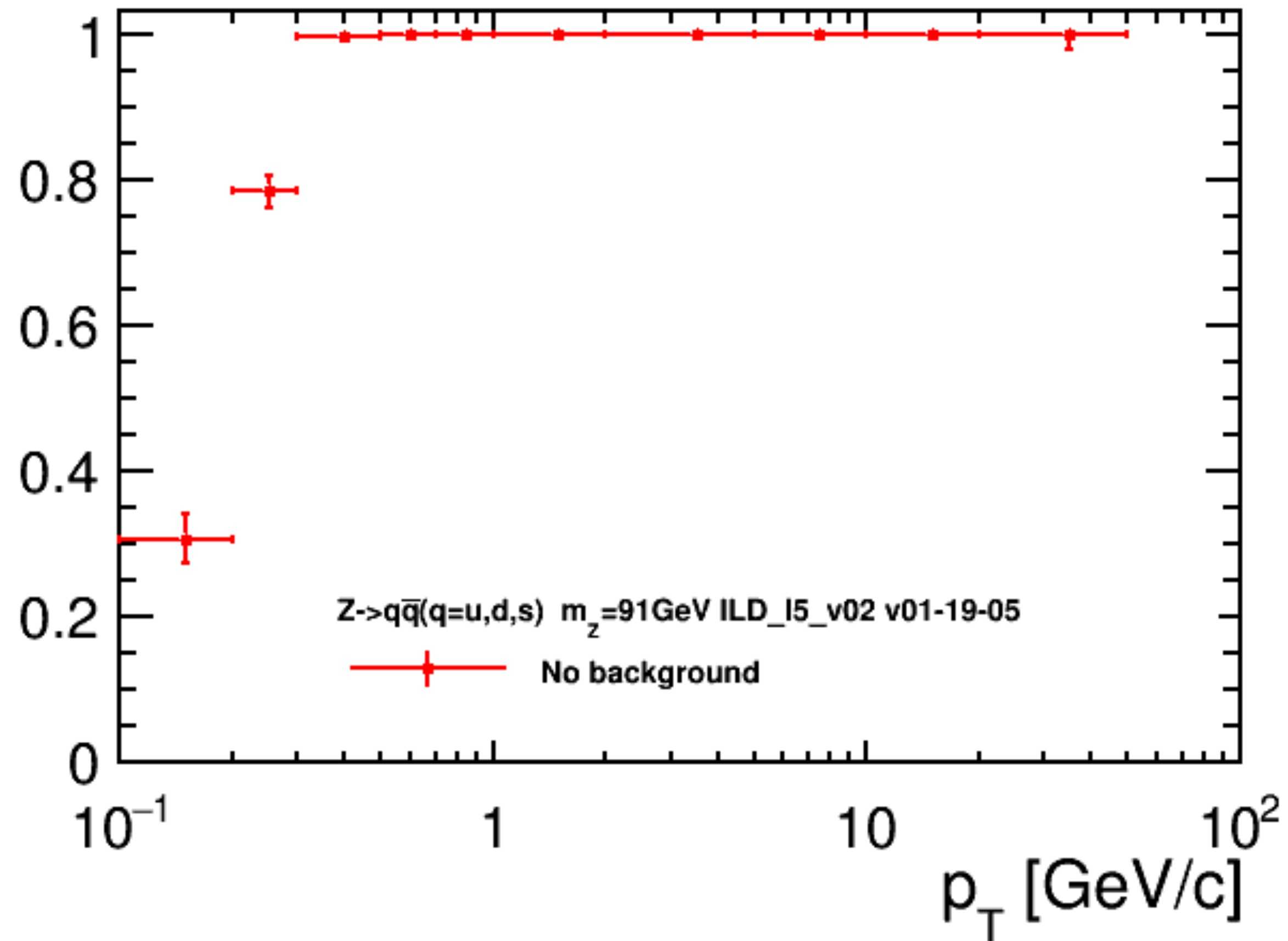
Zuds30GeV sample has no/less high Pt particles.
Tracking efficiency is lower at low Pt and forward region.

ILD Performance: Tracking Efficiency

preliminary

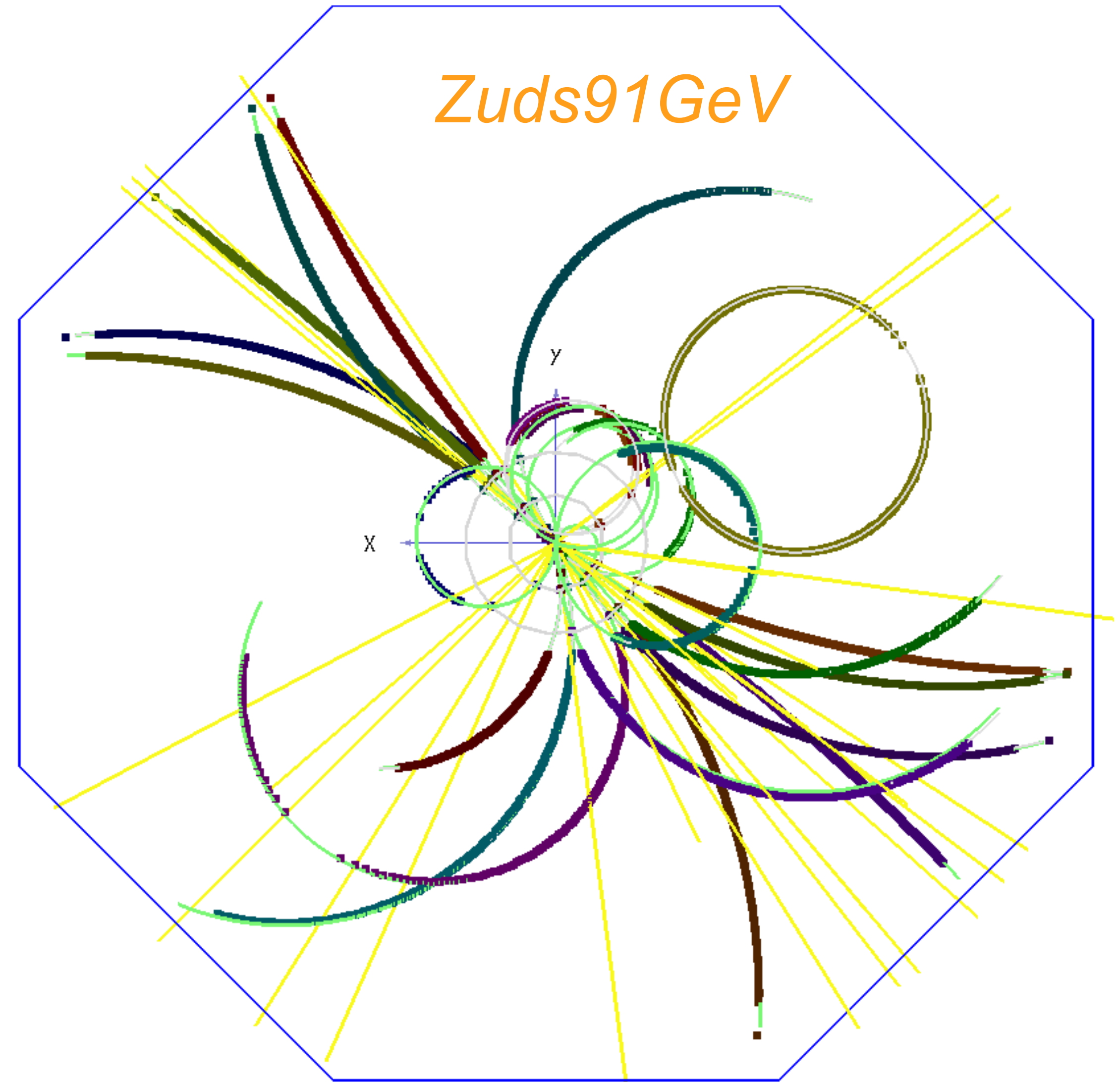
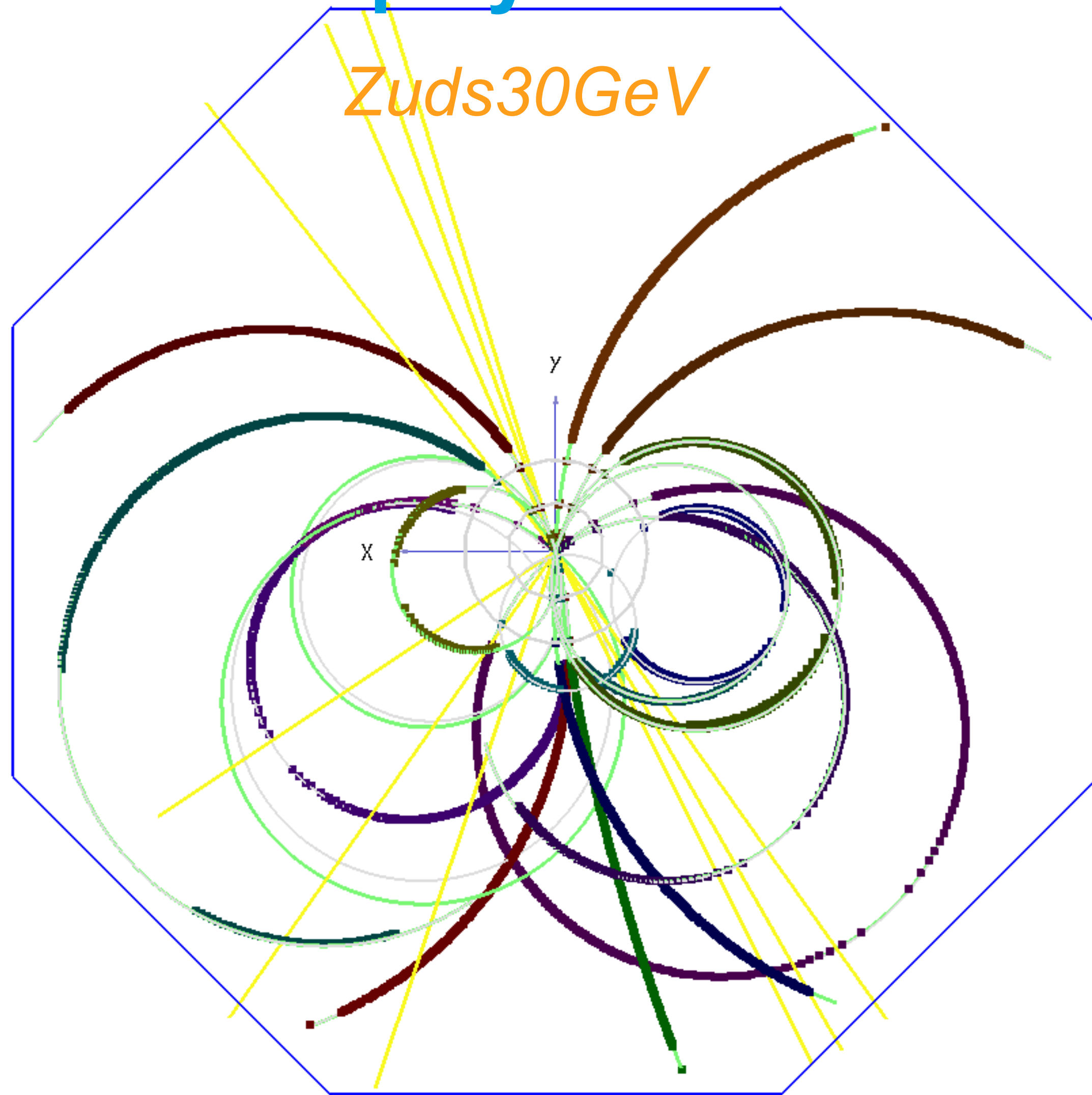
Zuds91GeV

Tracking efficiency



Zuds91GeV sample has more high Pt particles than Zuds30GeV.
Tracking efficiency is the lower at low Pt and forward region as Zuds30GeV.

Event display

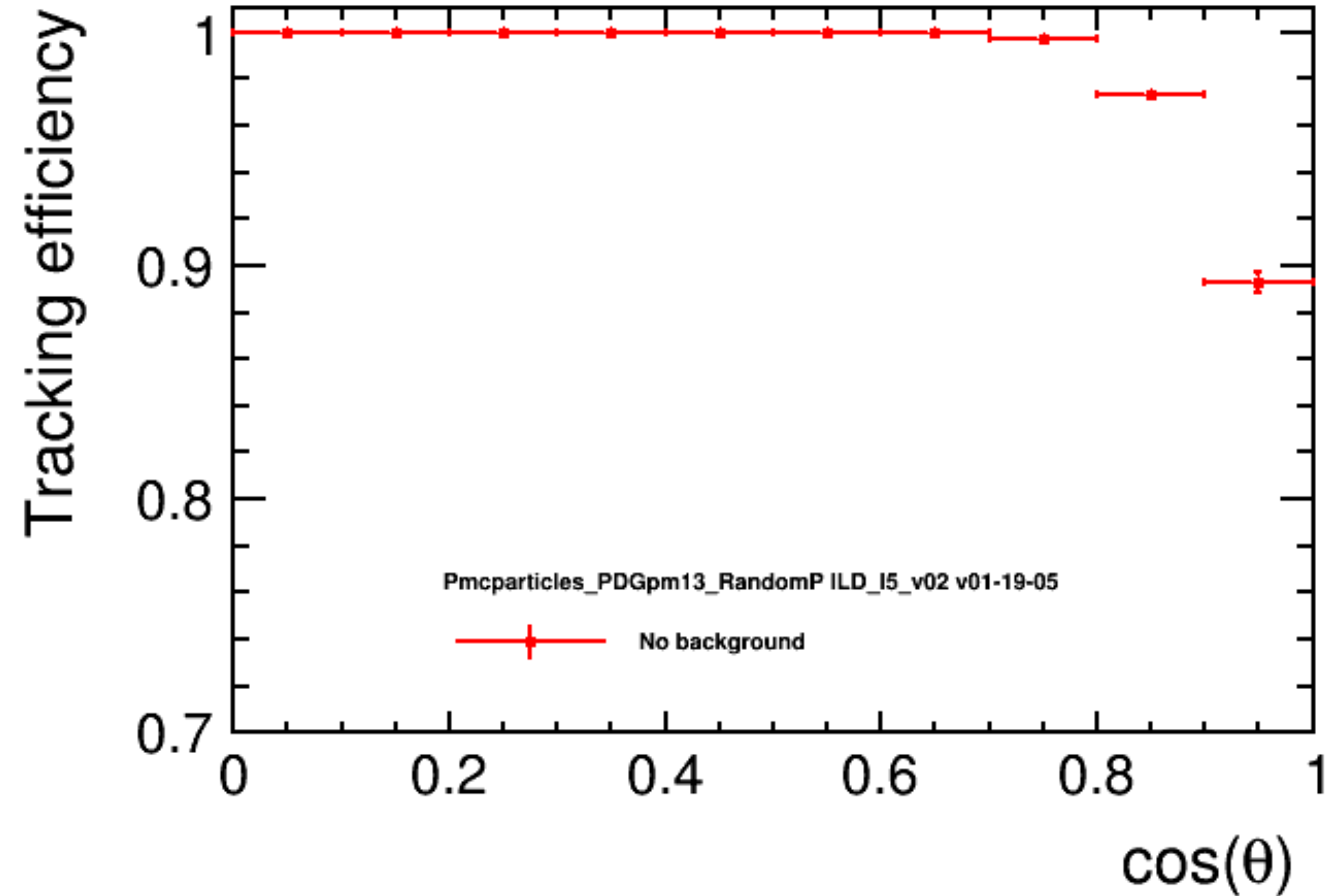
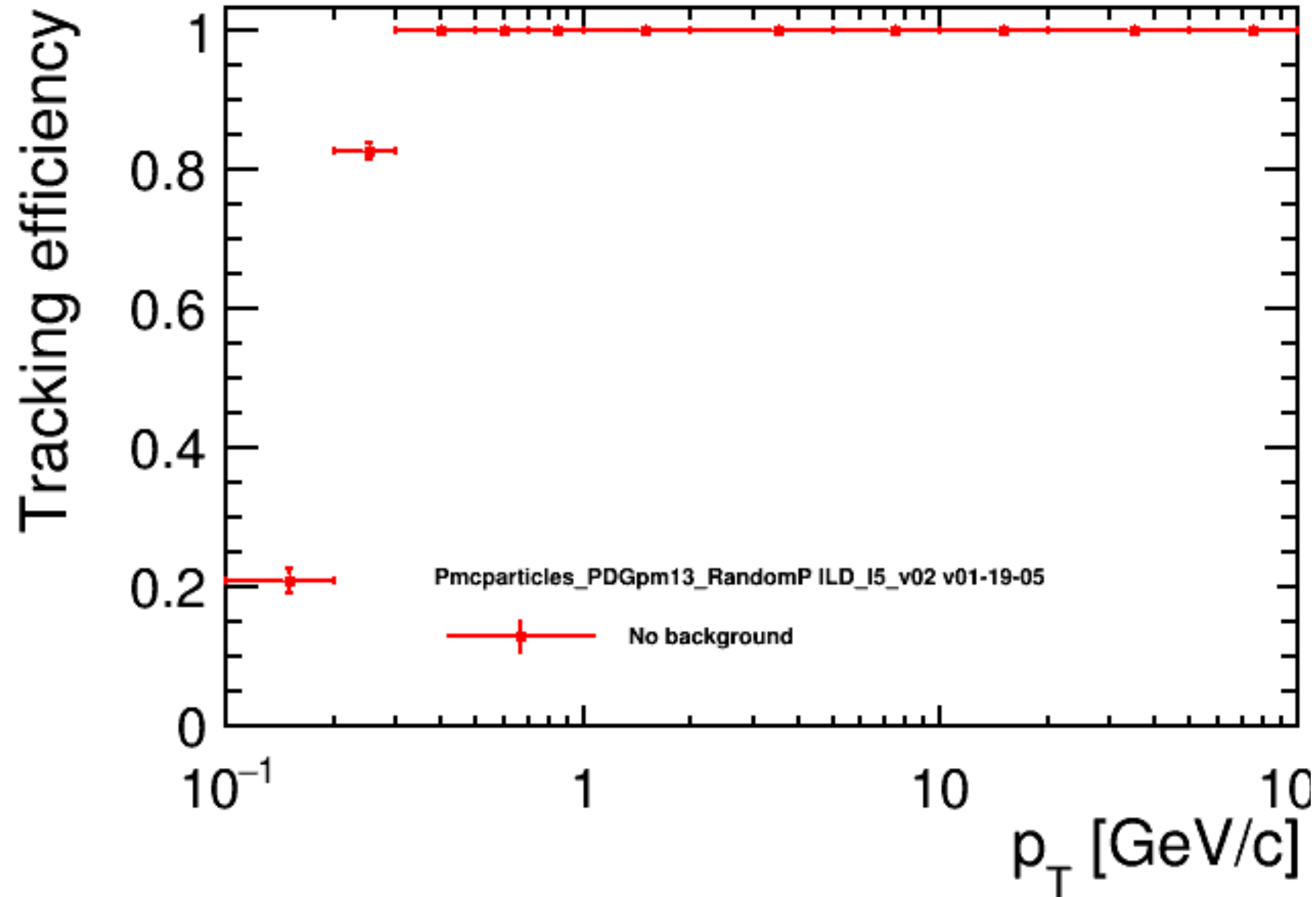


Both are very complex, even Zuds30GeV is still hard to find out this low Pt track by eye easily

ILD Performance: Tracking Efficiency

preliminary *single Muon*

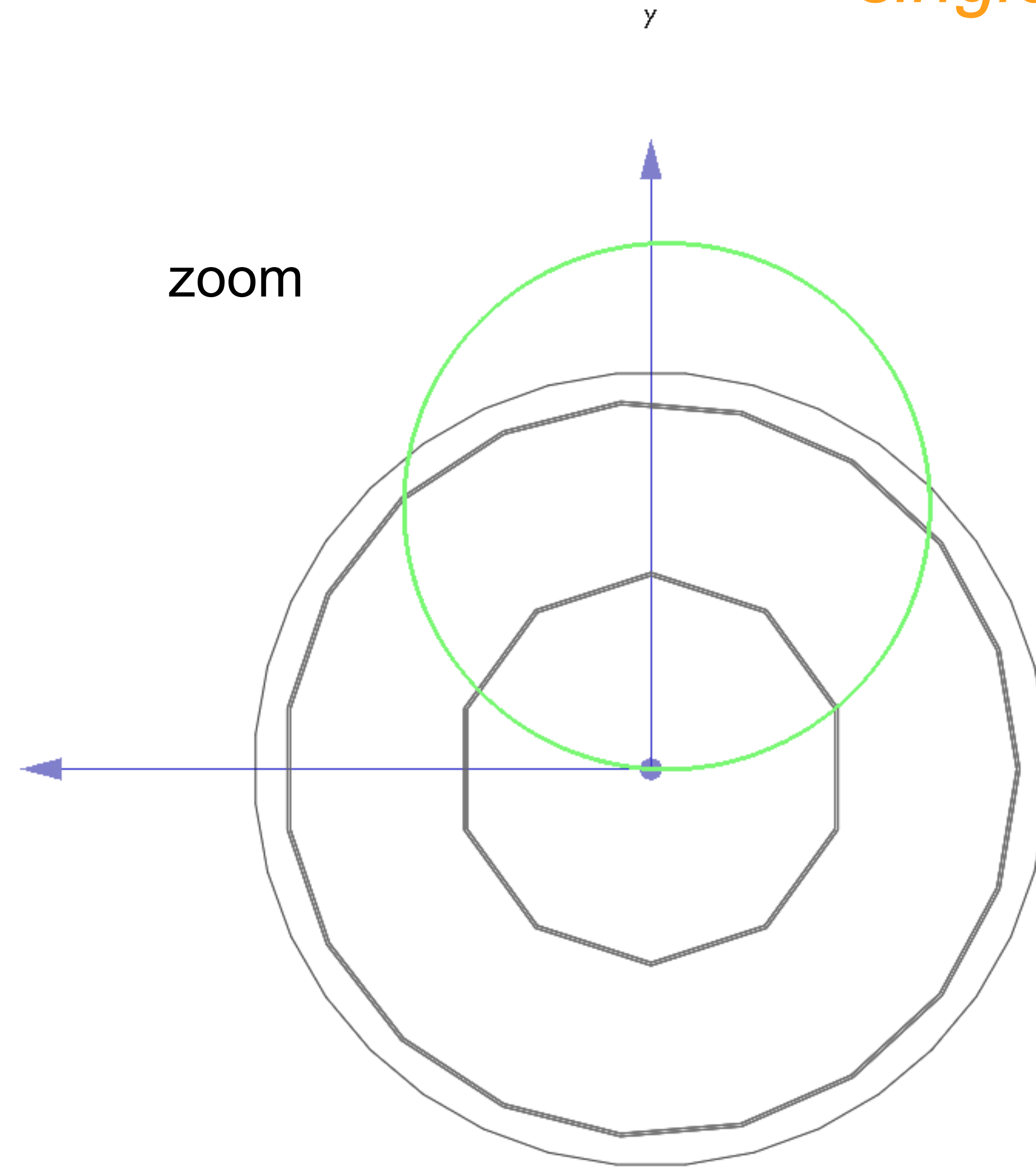
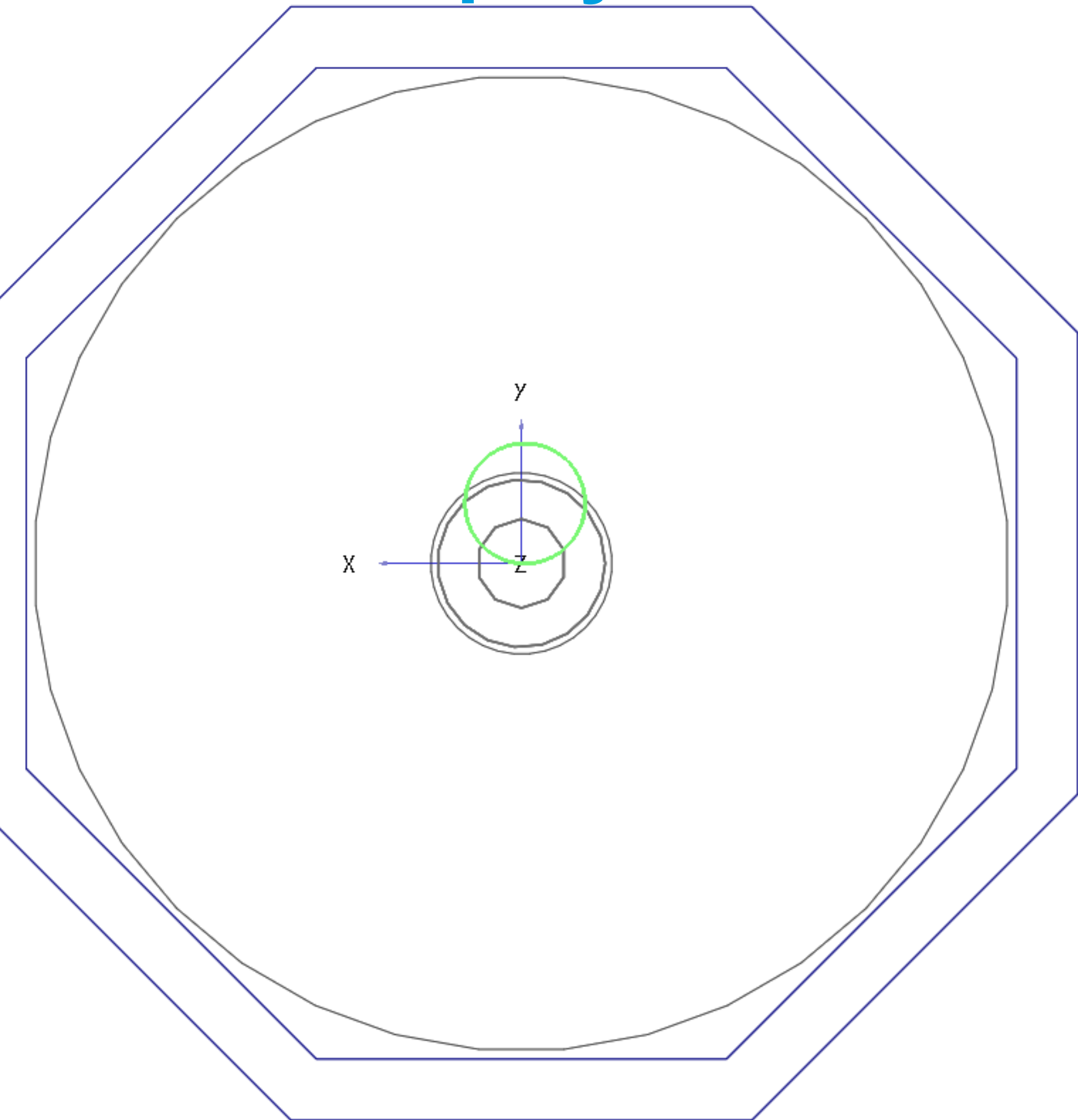
Thanks Akiya for the test production of single Muon with random direction and momentum.



Tracking efficiency is lower at low Pt and forward region.

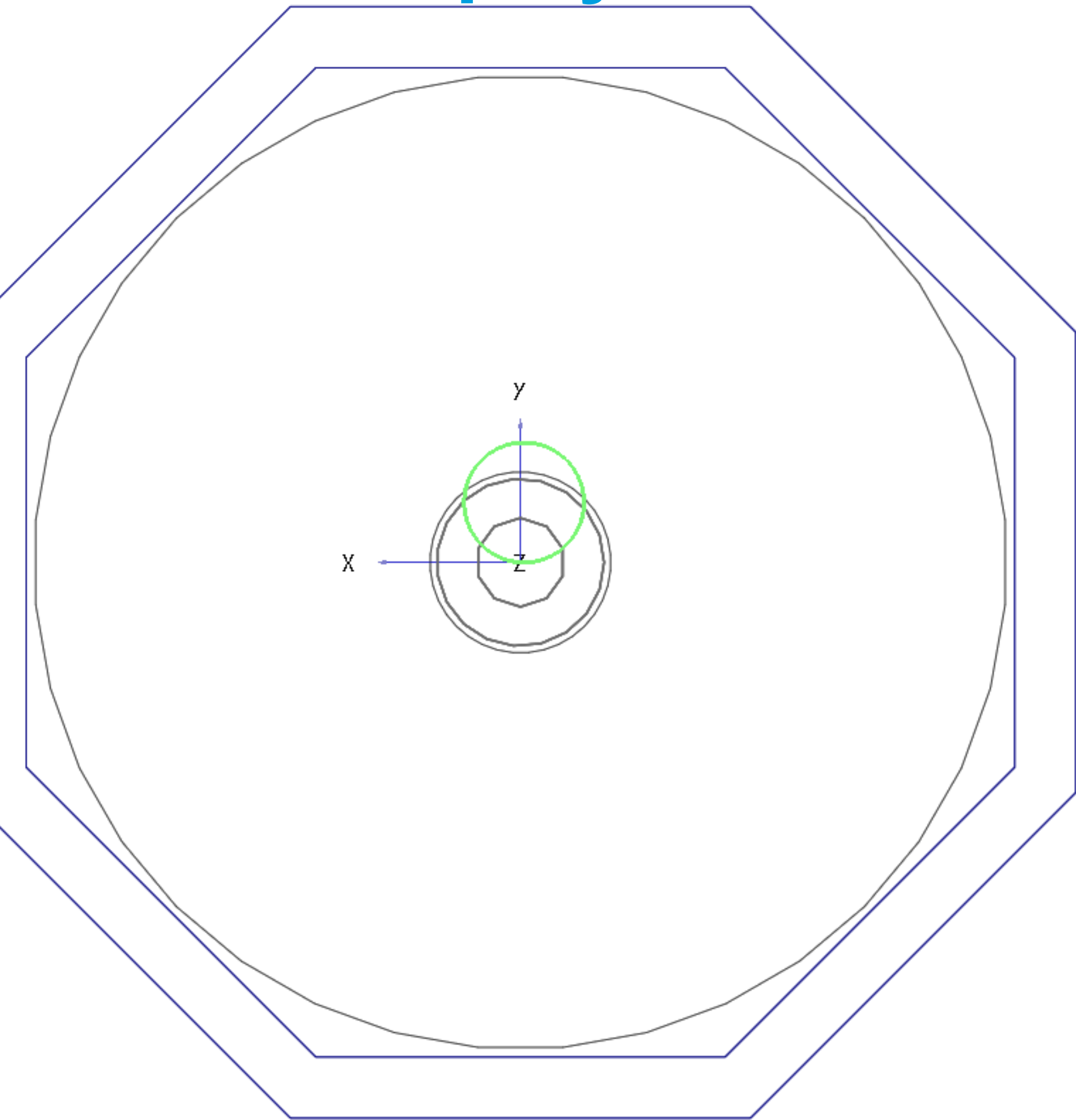
Event display

single Muon



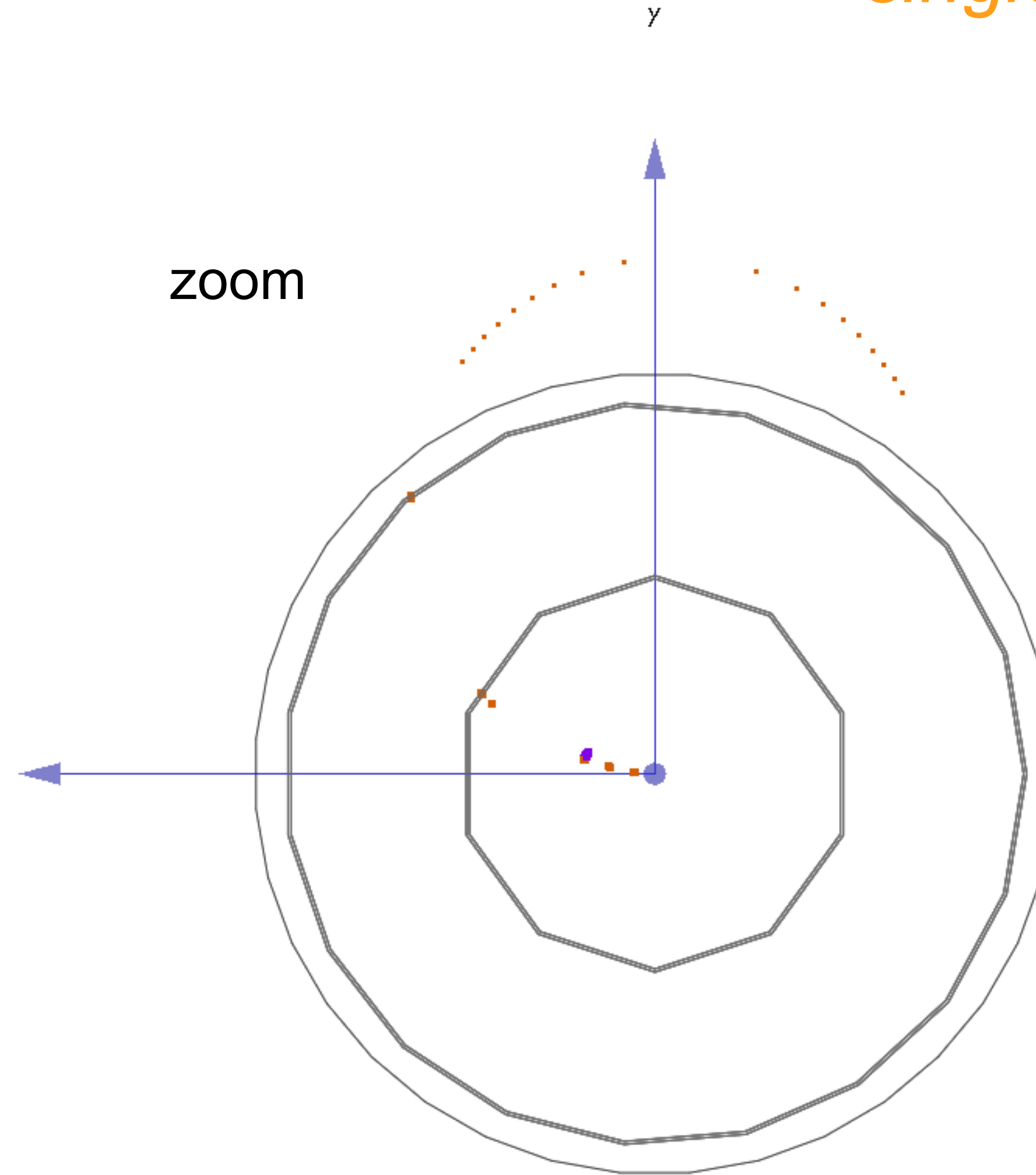
Single Muon is a very clear, and power tools to help us (human) to understand the computer algorithm problem

Event display



single Muon

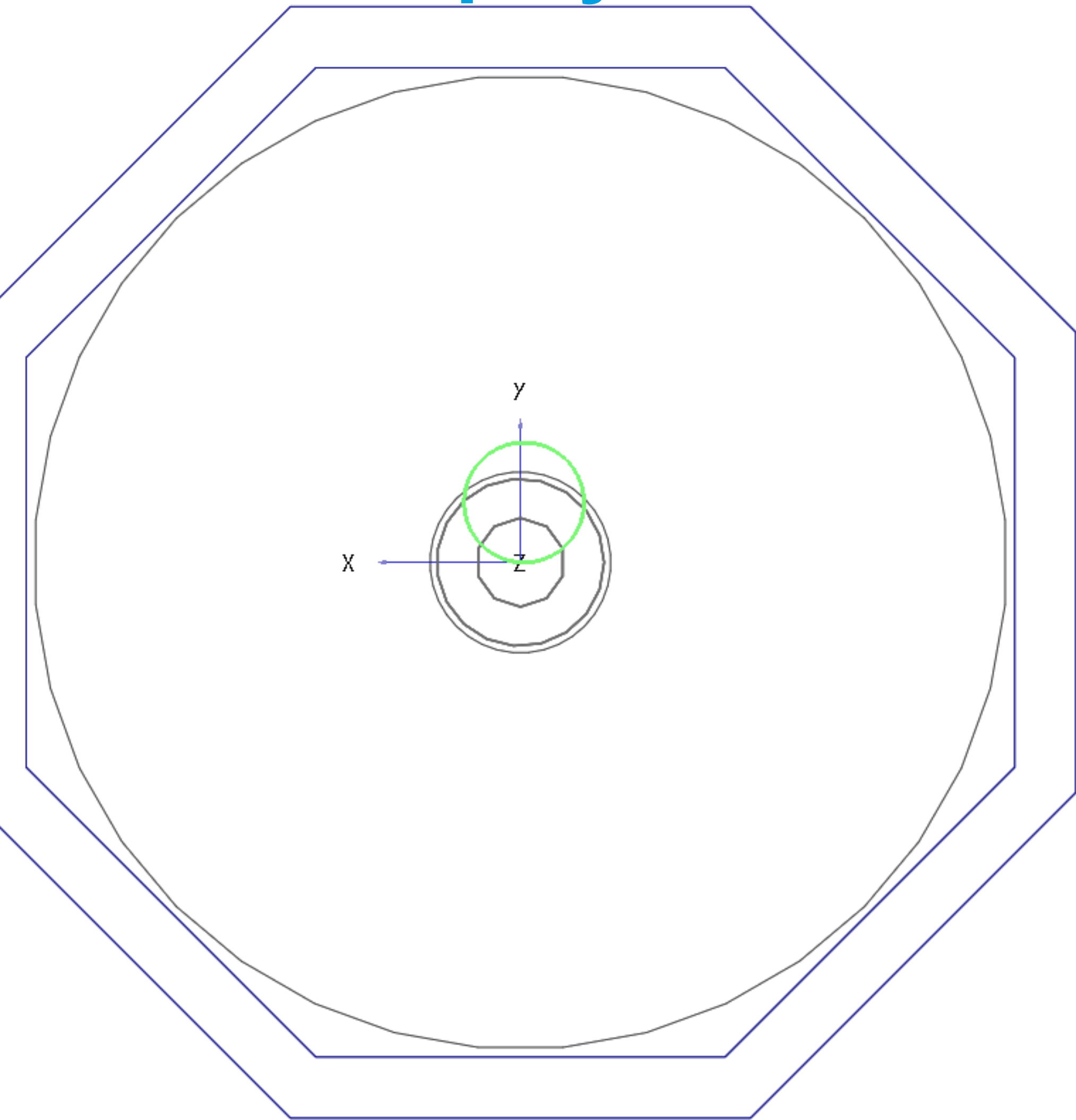
zoom



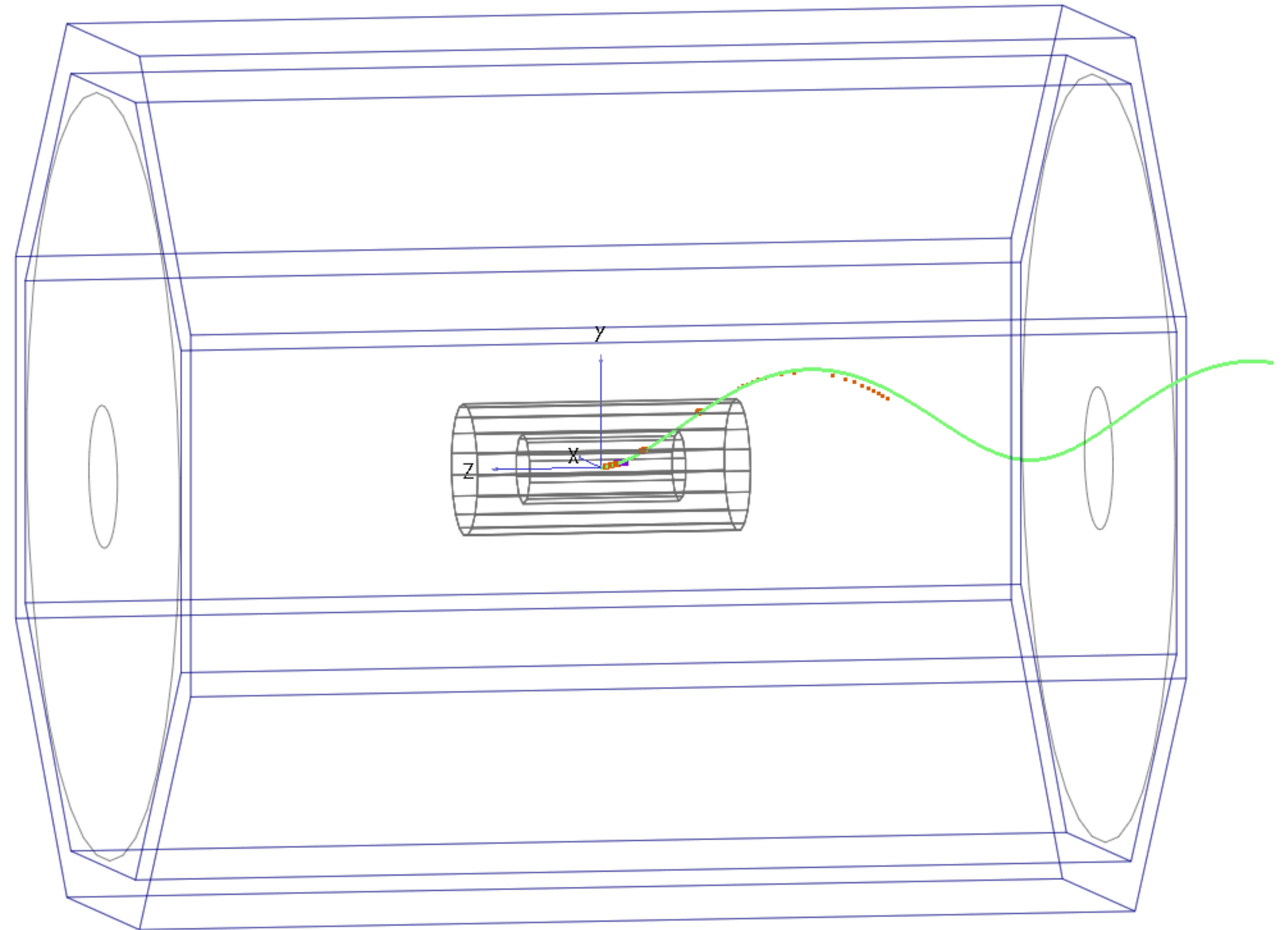
Single Muon is a very clear, and power tools to help us to understand the computer algorithm problem

simTrackHits in the ILD_I5_v02 tracking detectors from this single Muon $P_t = 0.2\text{GeV}$

Event display



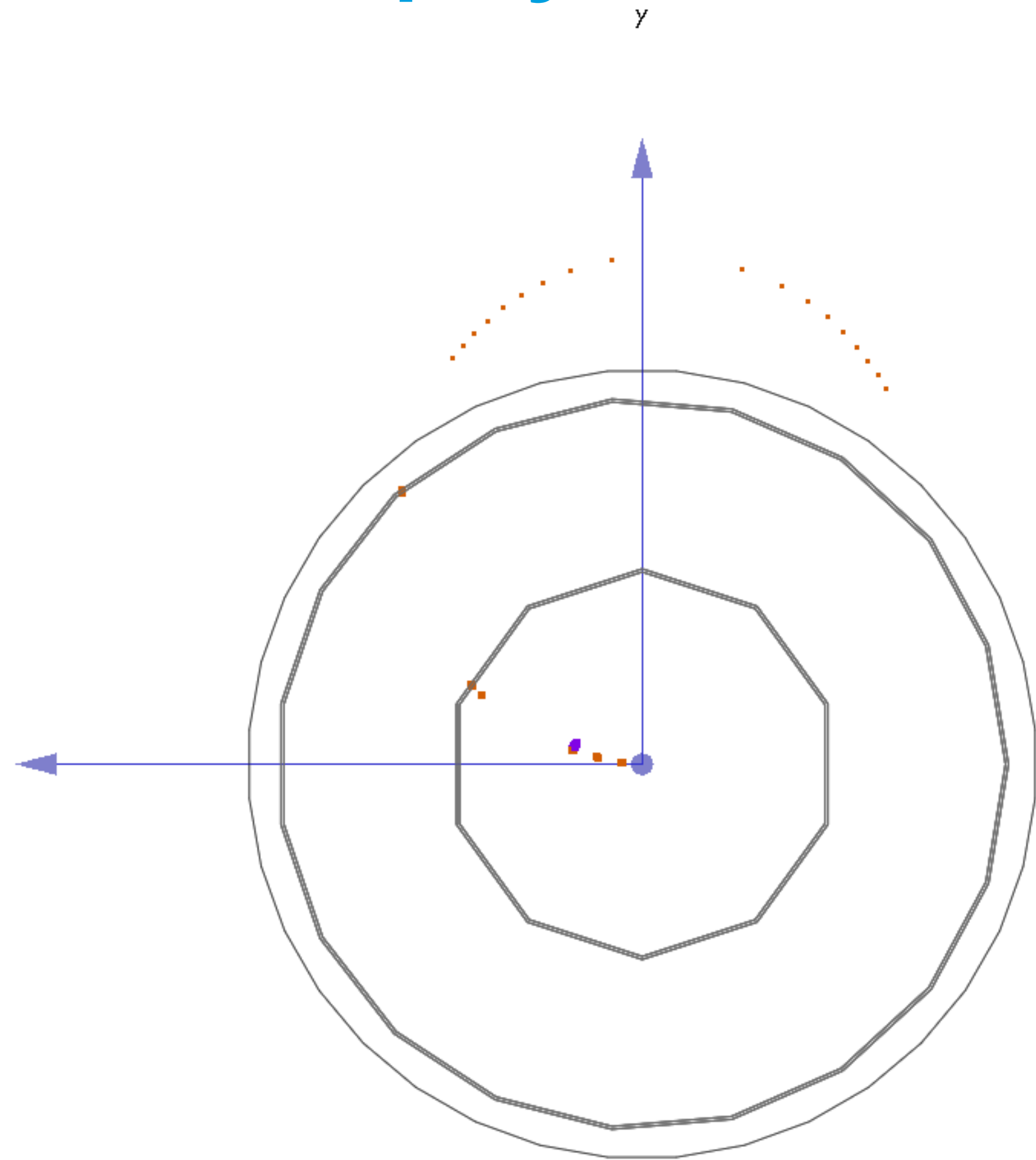
single Muon



There are many of such events.

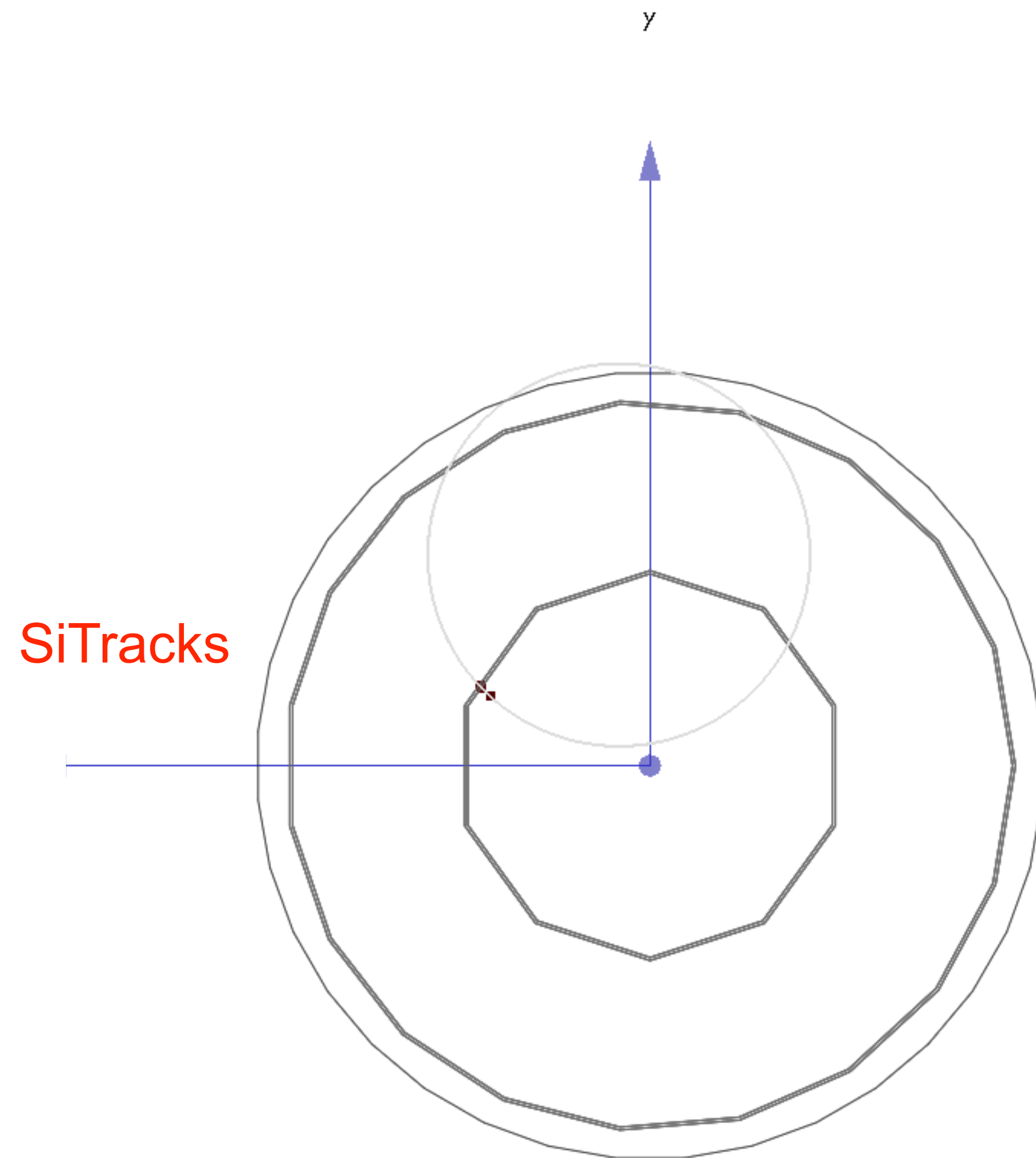
simTrackHits in the ILD_I5_v02 tracking detectors
from this single Muon $P_t = 0.2\text{GeV}$

Event display



simTrackHits in the ILD_I5_v02 tracking detectors from this single Muon $P_t = 0.2\text{GeV}$

single Muon

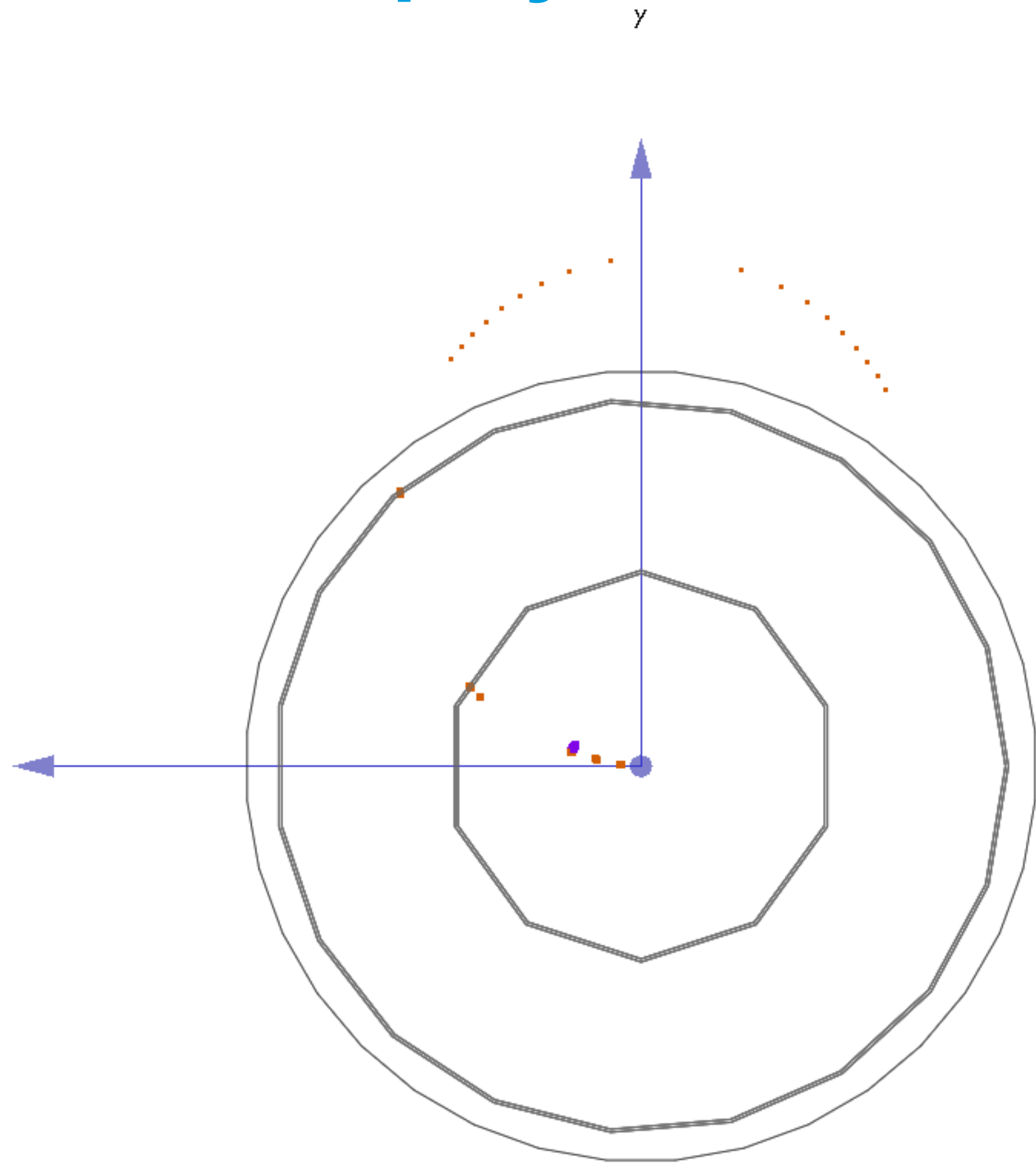


SiliconTracking algorithm could not find all hits from VXD and SIT of this track

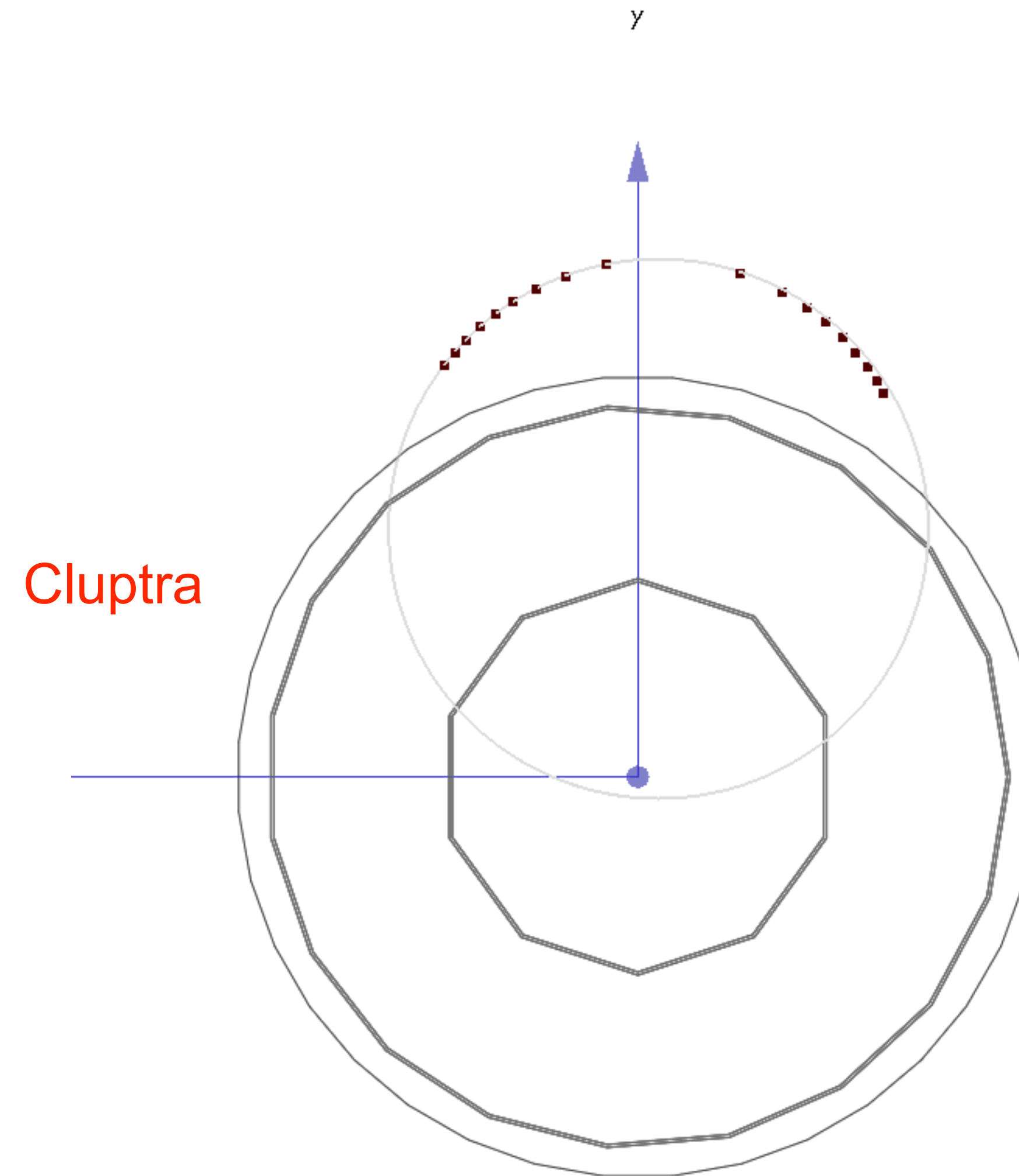
Question: Is it wrong?

Event display

single Muon



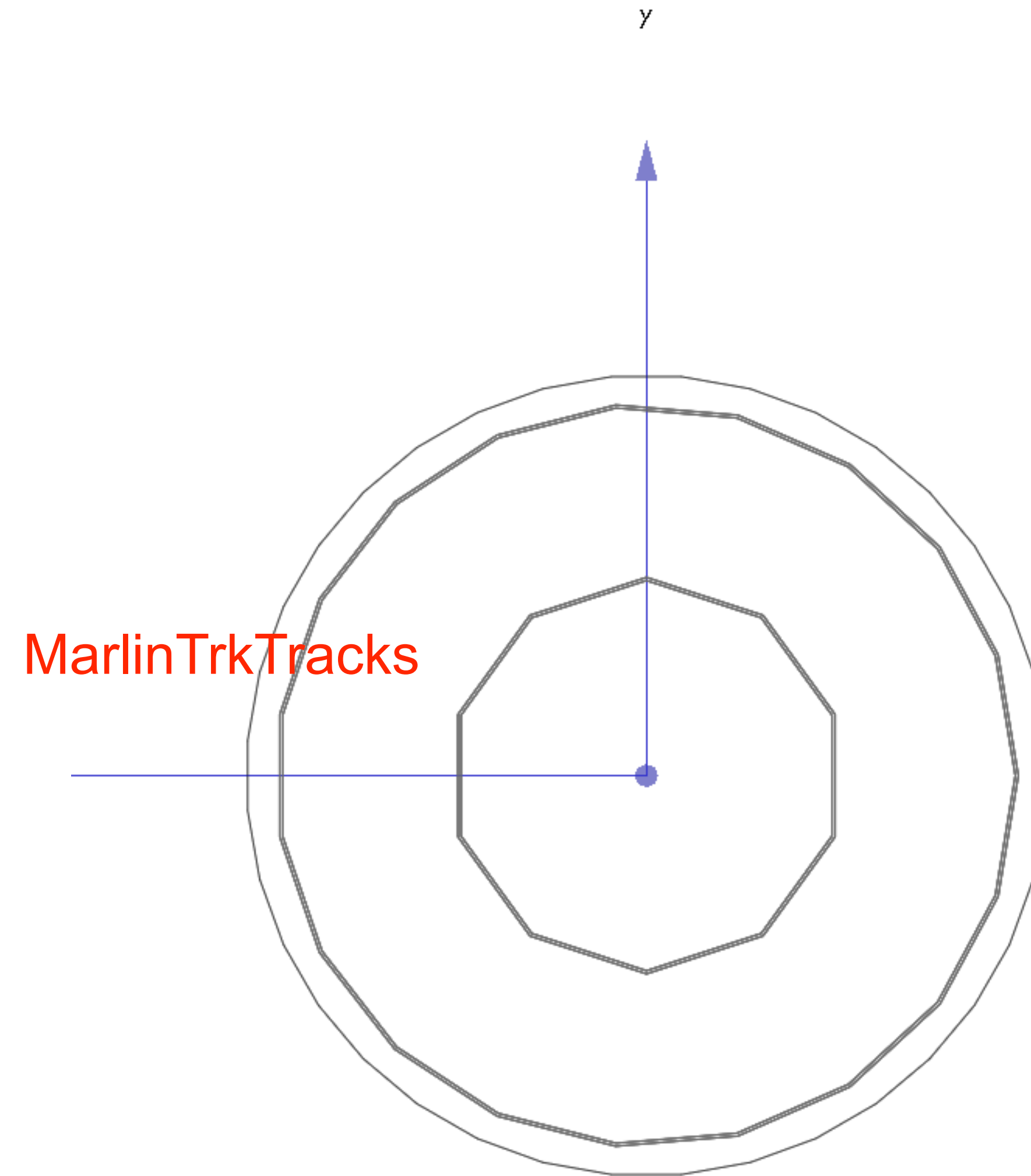
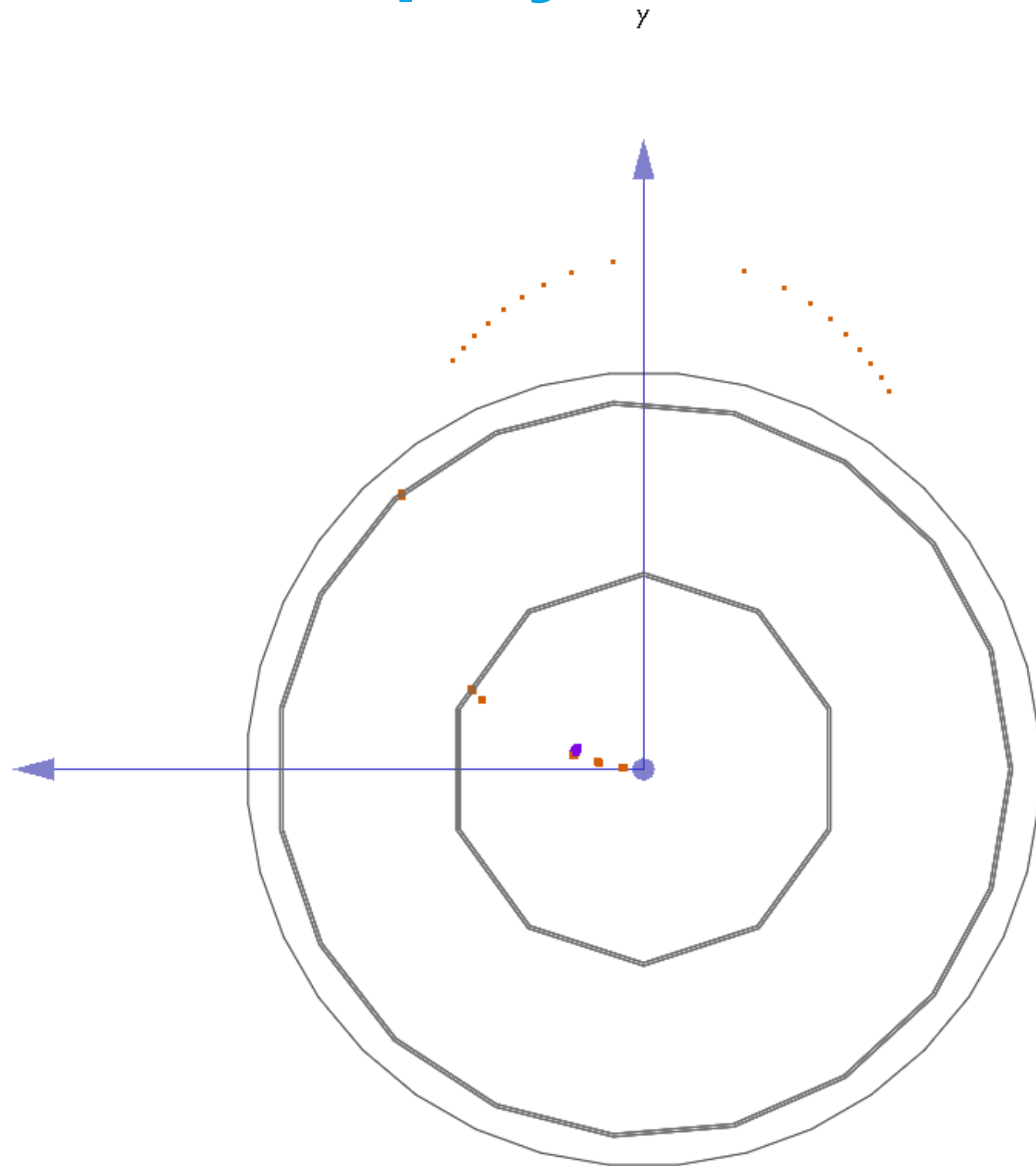
simTrackHits in the ILD_I5_v02 tracking detectors from this single Muon $P_t = 0.2\text{GeV}$



Cluptra algorithm could find all the hits in TPC from this track

Event display

single Muon

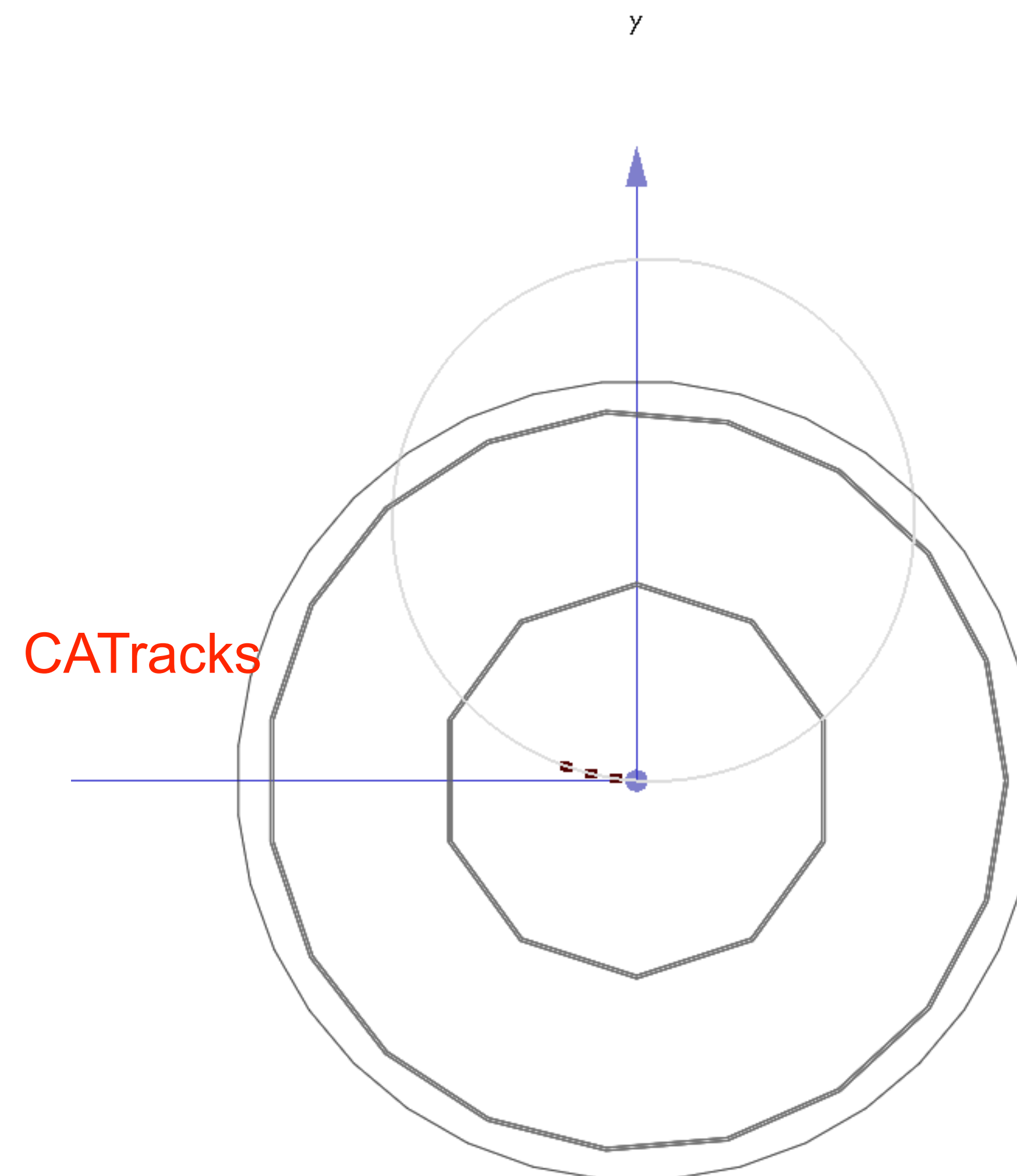
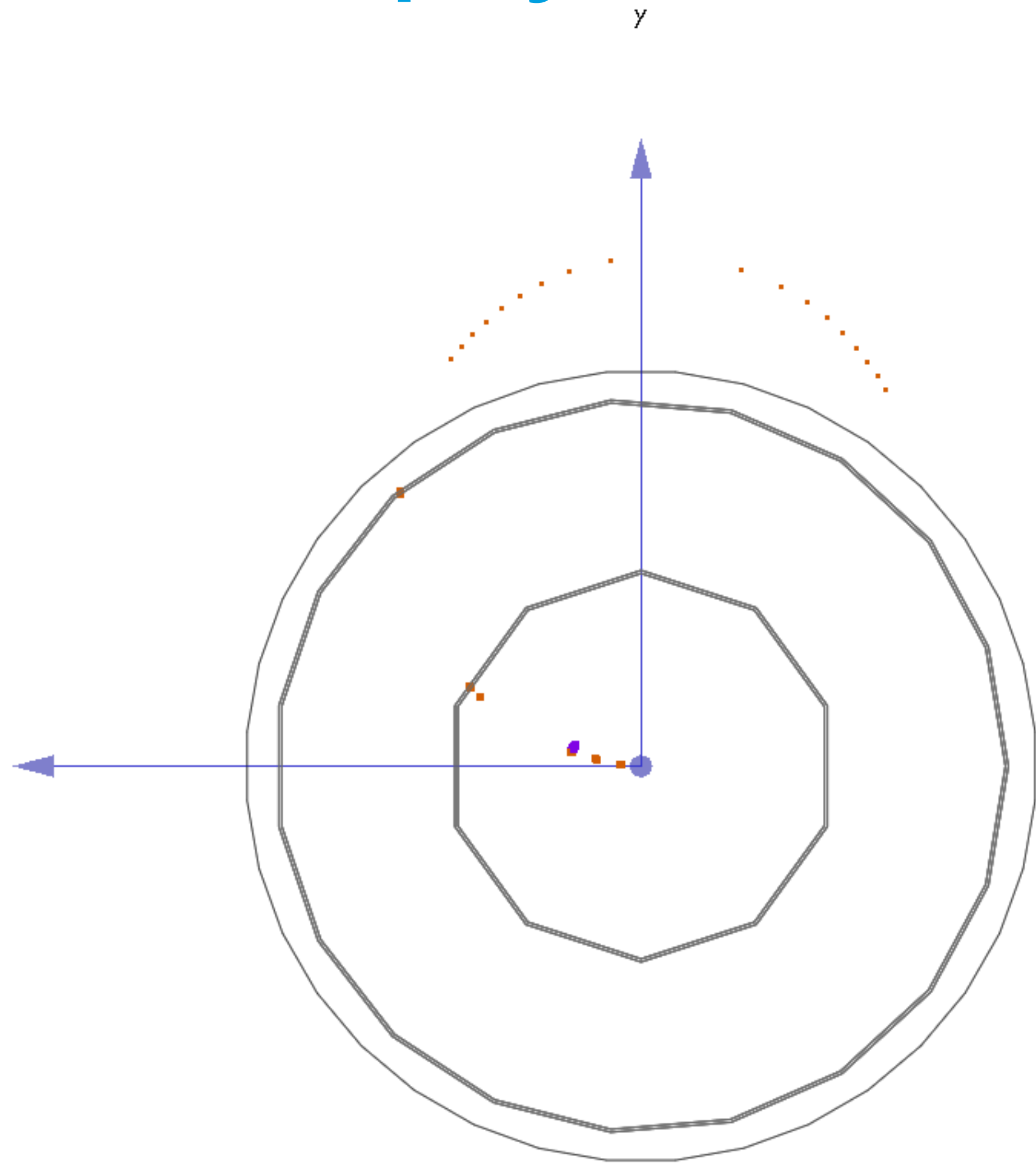


simTrackHits in the ILD_15_v02 tracking detectors
from this single Muon $P_t = 0.2\text{GeV}$

Due to the SiliconTracking algorithm could not find this track
Finally, there is not MarlinTrkTracks

Event display

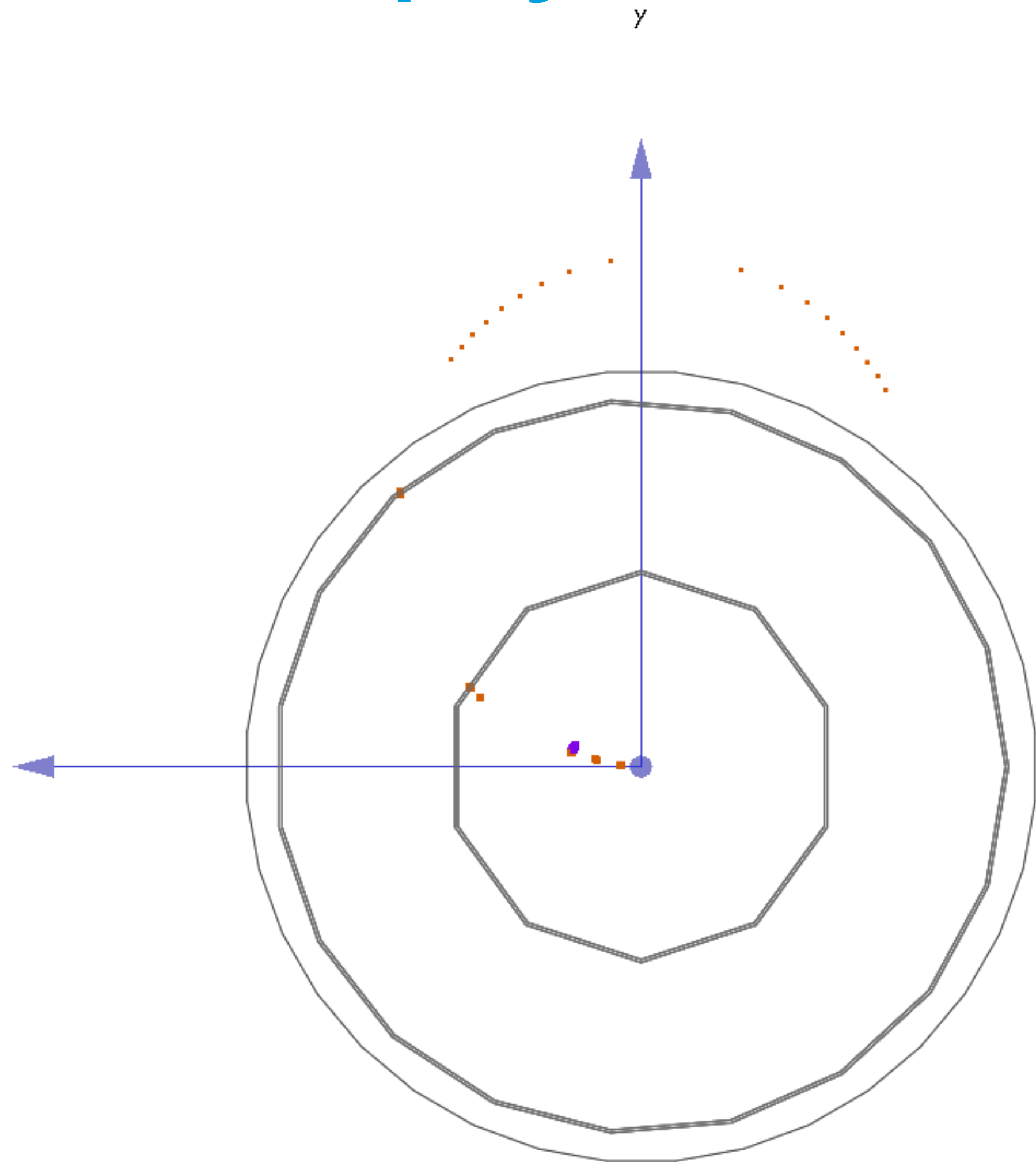
single Muon



simTrackHits in the ILD_15_v02 tracking detectors
from this single Muon $P_t = 0.2\text{GeV}$

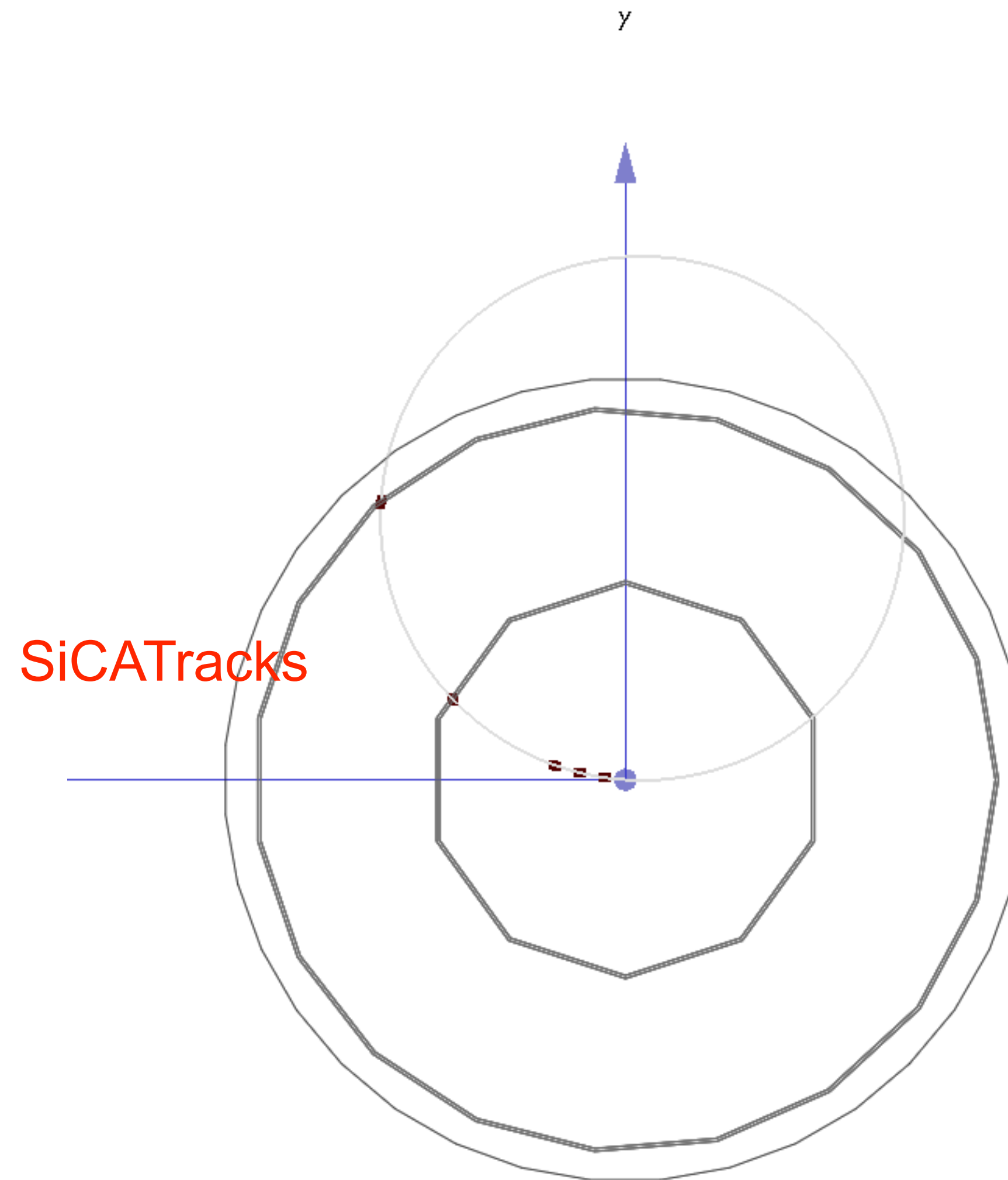
Mini-vector algorithm works well for VXD as we can see

Event display



simTrackHits in the ILD_I5_v02 tracking detectors
from this single Muon $P_t = 0.2\text{GeV}$

single Muon

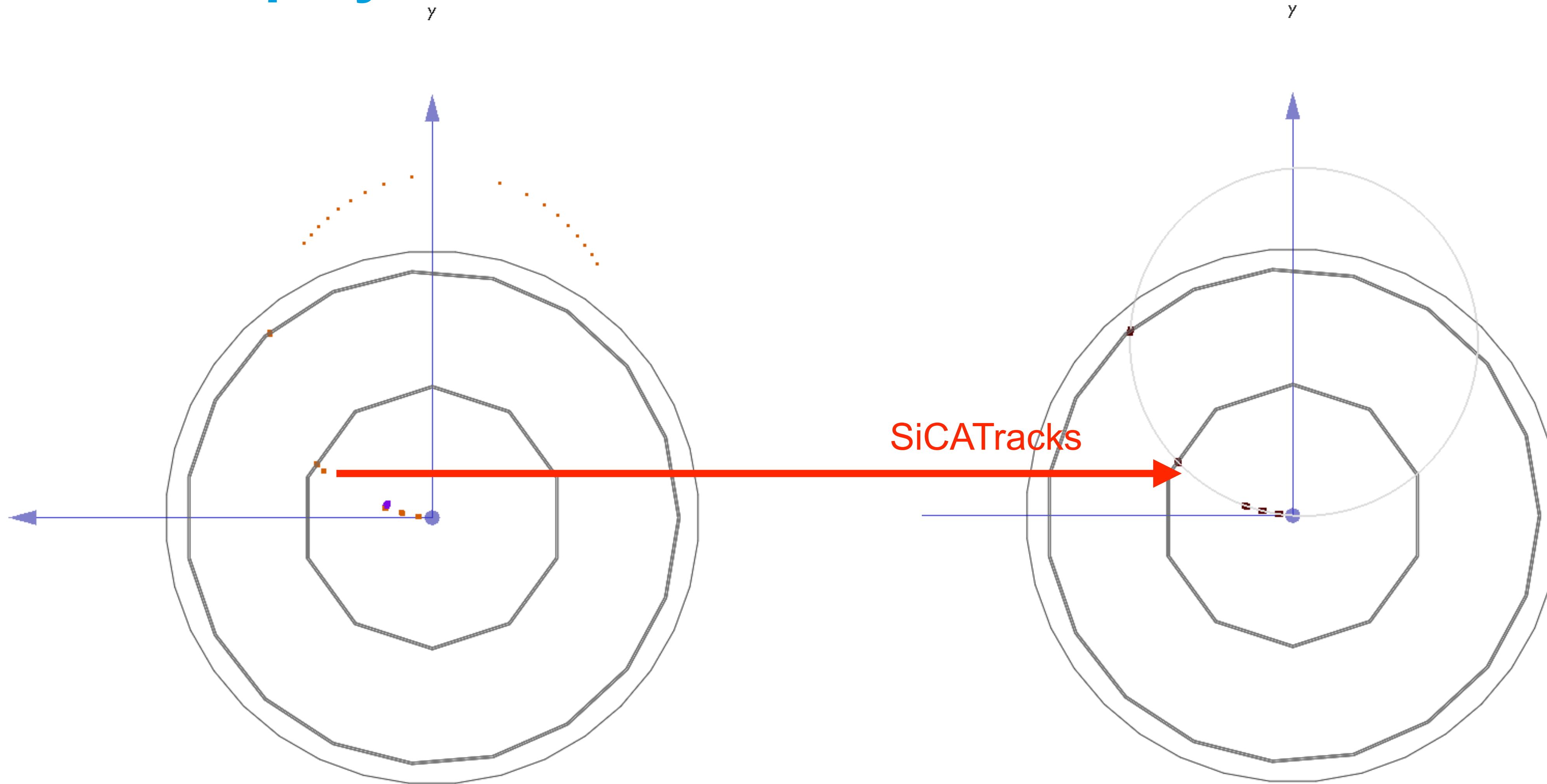


Mini-vector algorithm works well for VXD as we can see
Extrapolate to SiT, it works well, as we can see too.

Question: Is it right?

Event display

single Muon



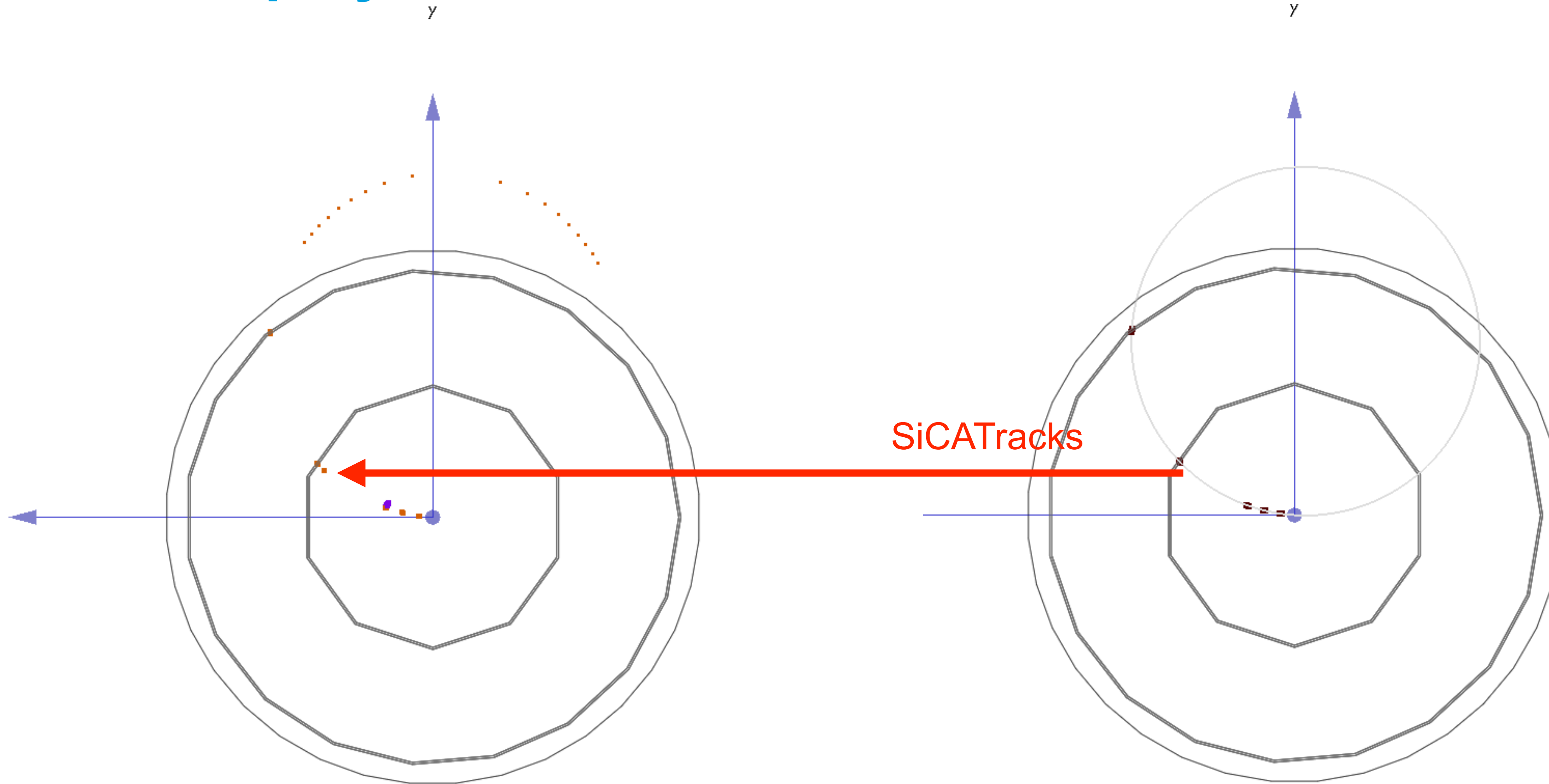
simTrackHits in the ILD_I5_v02 tracking detectors
from this single Muon $P_t = 0.2\text{GeV}$

Mini-vector algorithm works well for VXD as we can see
Extrapolate to SIT, it works well, as we can see too.

Question: Is it right?

Event display

single Muon

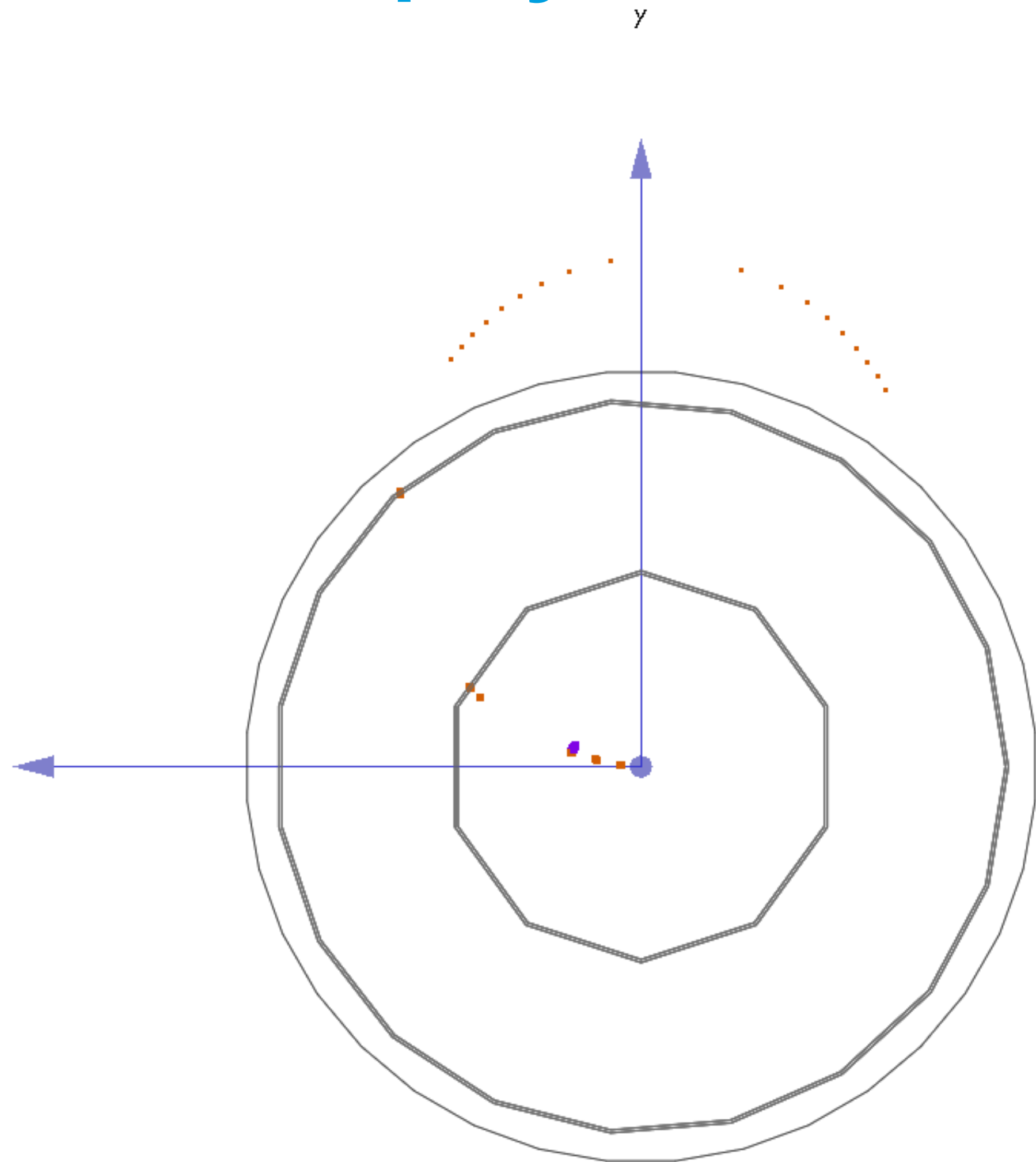


simTrackHits in the ILD_15_v02 tracking detectors
from this single Muon $P_t = 0.2\text{GeV}$

Mini-vector algorithm works well for VXD as we can see
Extrapolate to SIT, it works well, as we can see too.

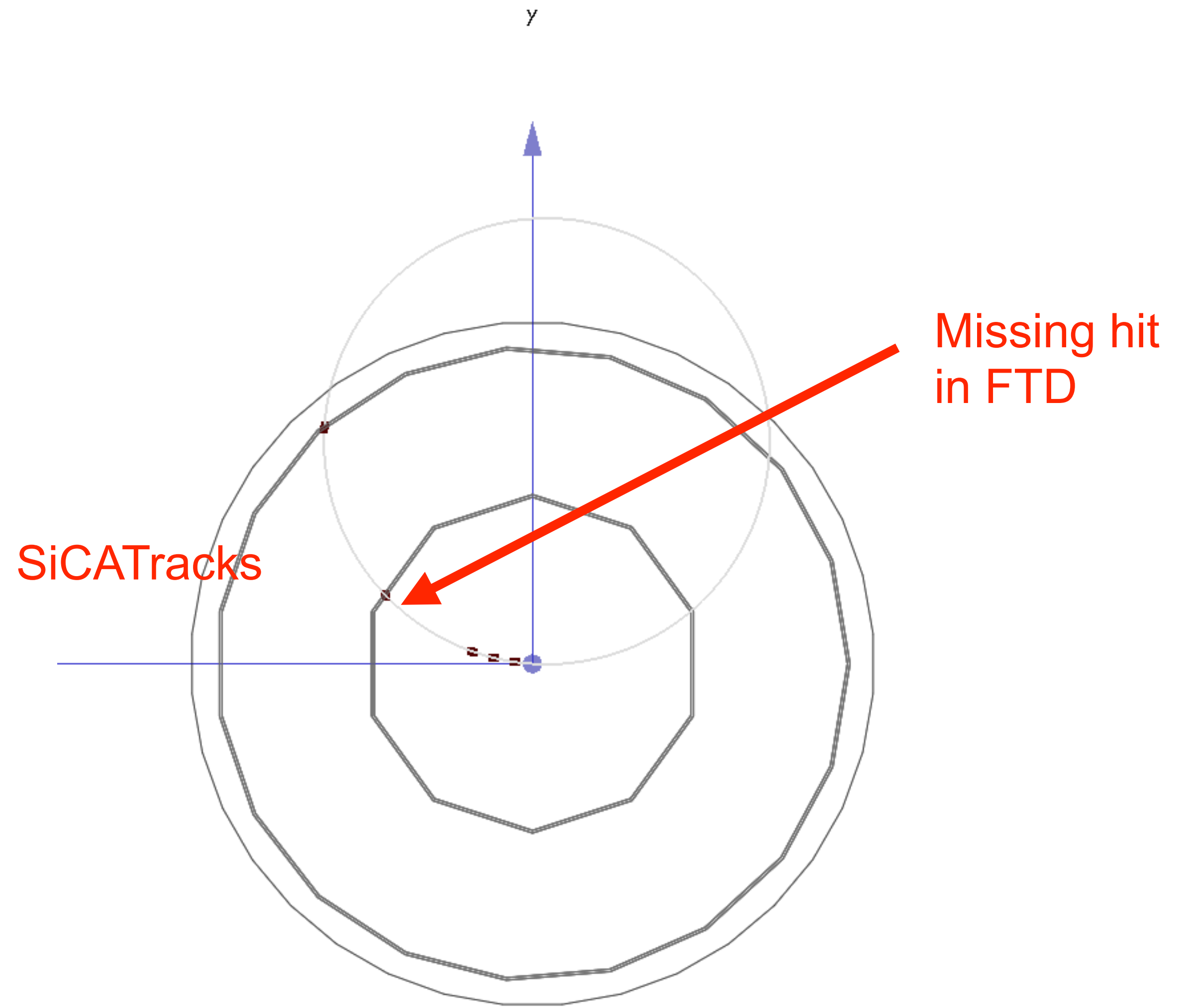
Question: Is it right?

Event display



simTrackHits in the ILD_I5_v02 tracking detectors from this single Muon $P_t = 0.2\text{GeV}$

single Muon



Mini-vector algorithm works well for VXD as we can see Extrapolate to SIT, it works well, as we can see too.

Question: Is it right?

ILD Performance: D0 and momentum resolution

SiTracks -> MarlinTrkTracks:

Did not affect D0 and momentum resolution

➡ The track is total ignored, no reconstruction (bad reco)

CATracks -> MarlinTrkTracks:

Improve the tracking efficiency

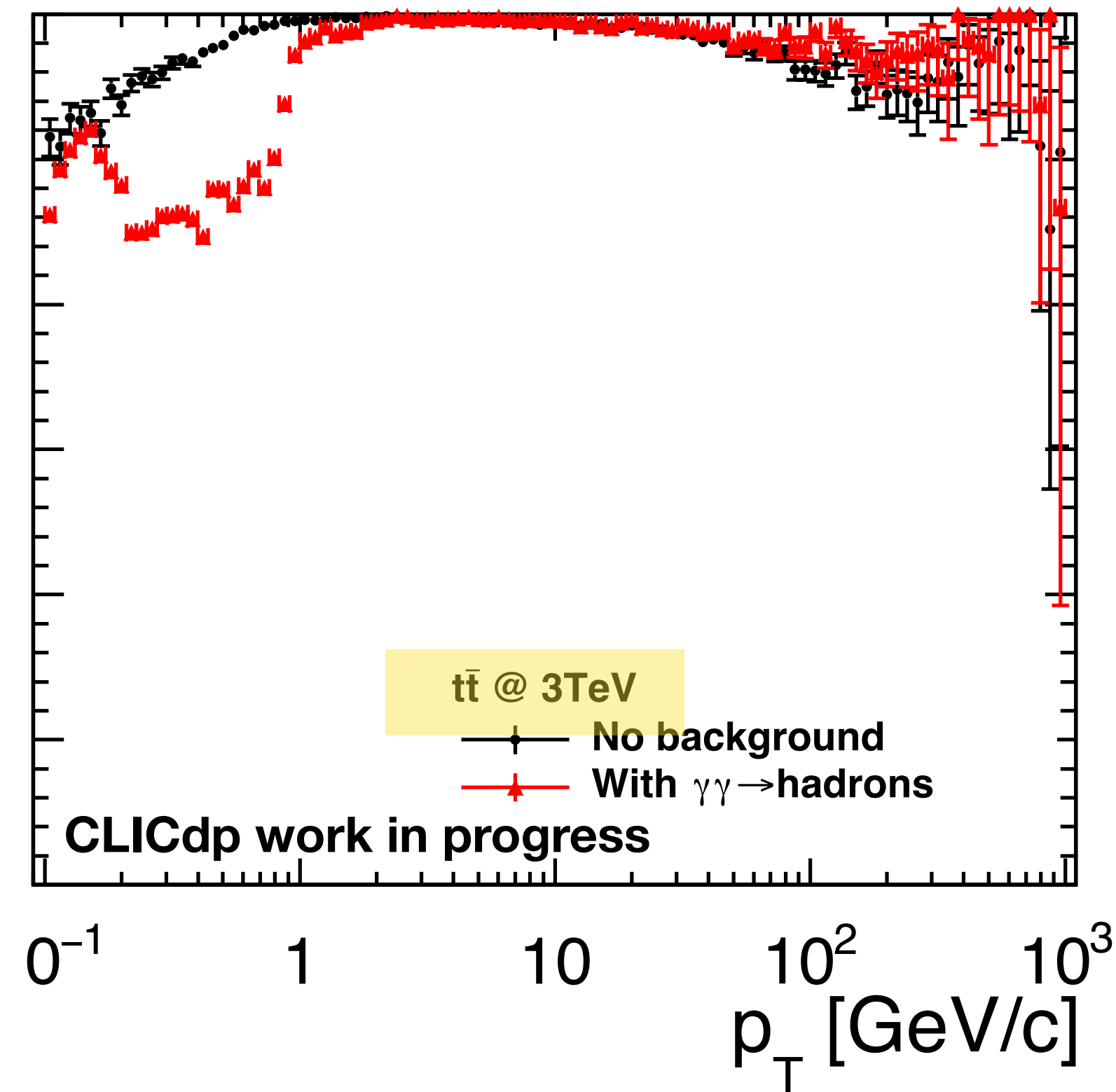
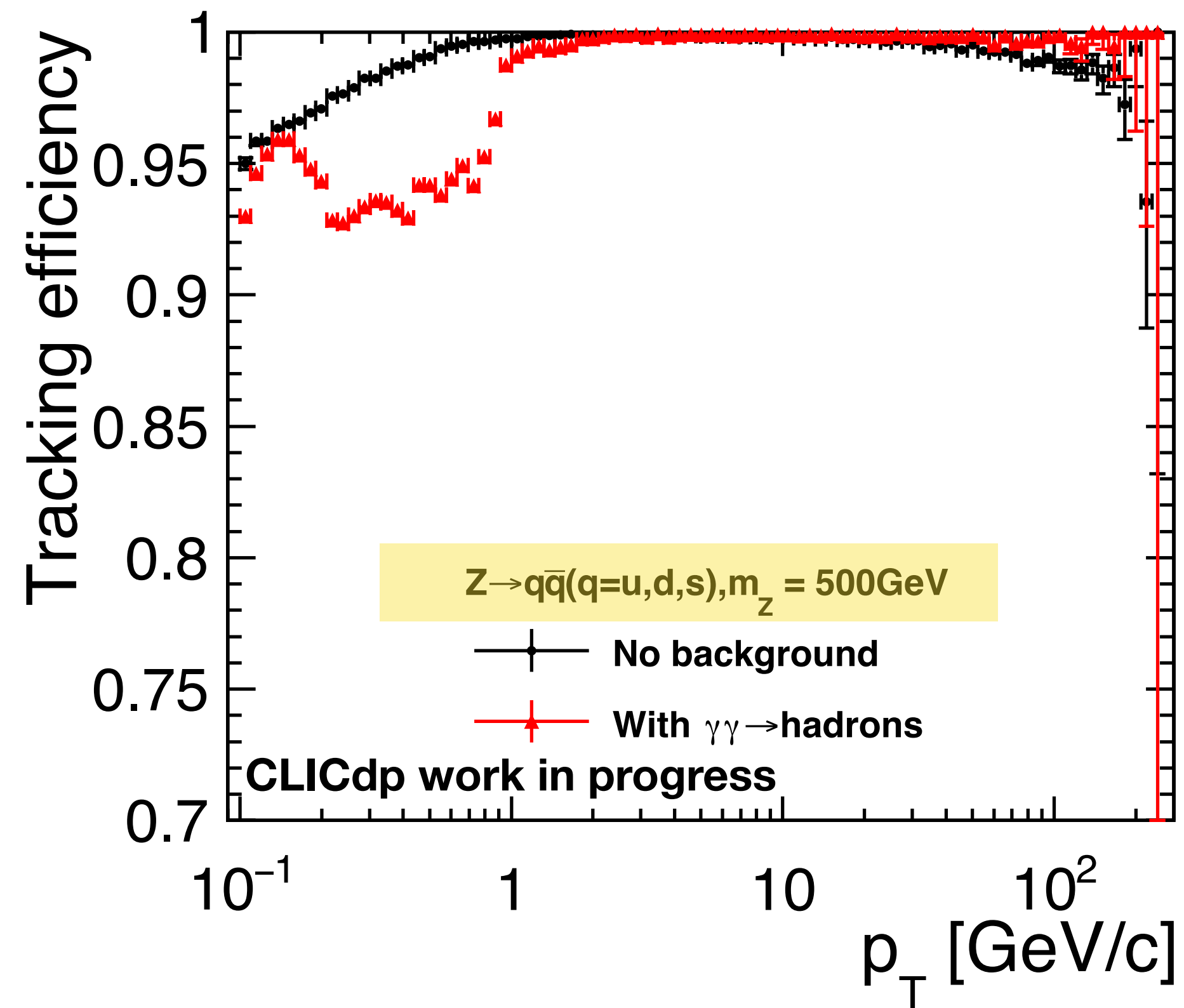
May affect D0 or momentum resolution

➡ Some tracks have been reconstructed with missing FTD hit

It is clear a findable track. May help us to improve low Pt tracking reconstruction.

CLIC Conformal Tracking

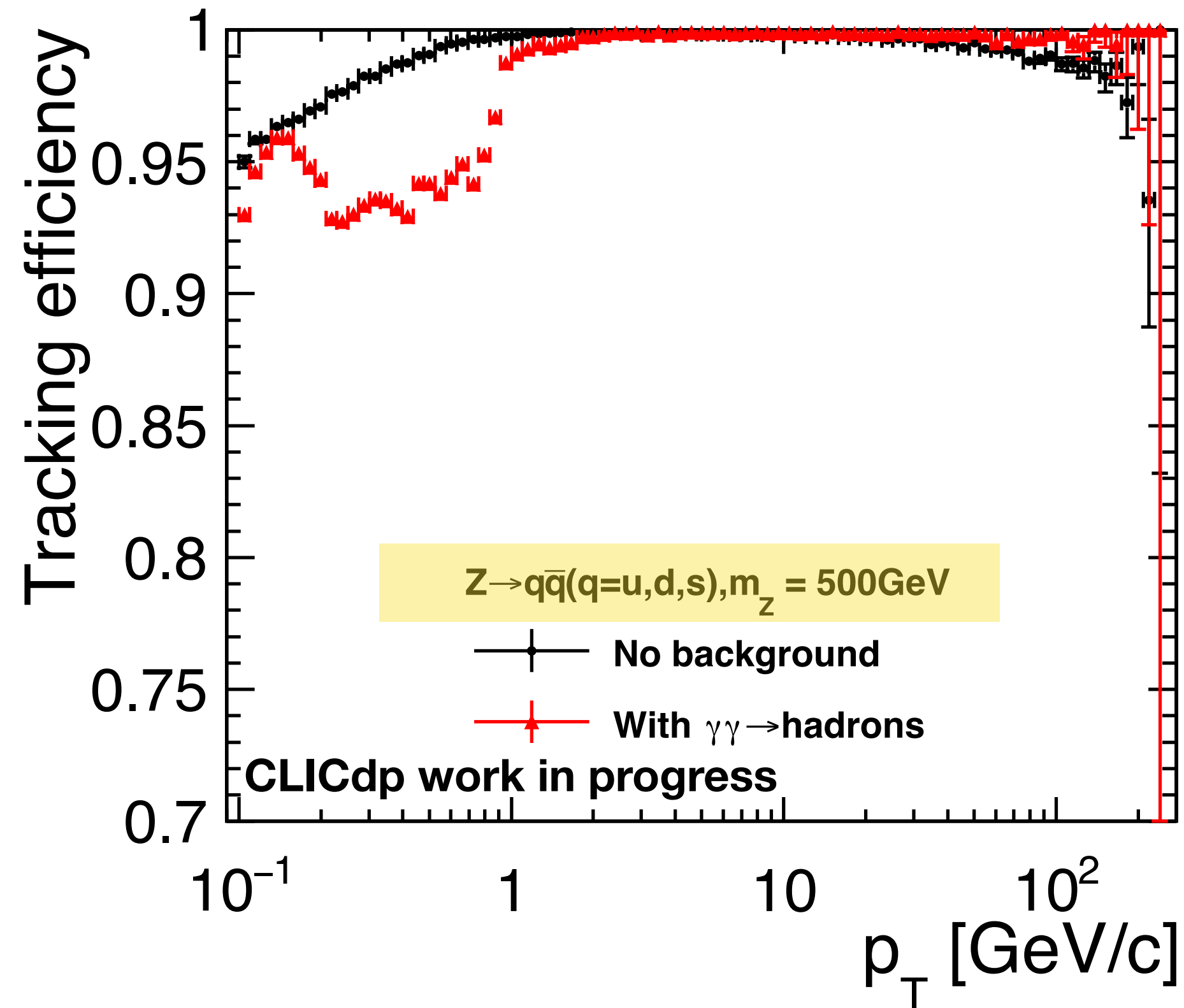
- ☆ vertex $R < 50$ mm
- ☆ $10 < \theta < 170$ deg
- ☆ purity $> 75\%$



- ☆ Above 1 GeV/c:
 - ☆ efficiency $> 99\%$ up to 100 GeV/c
 - ☆ efficiency $> 97\%$ up to 1 TeV/c
 - ☆ performances mostly unaffected by background overlay

CLIC Conformal Tracking

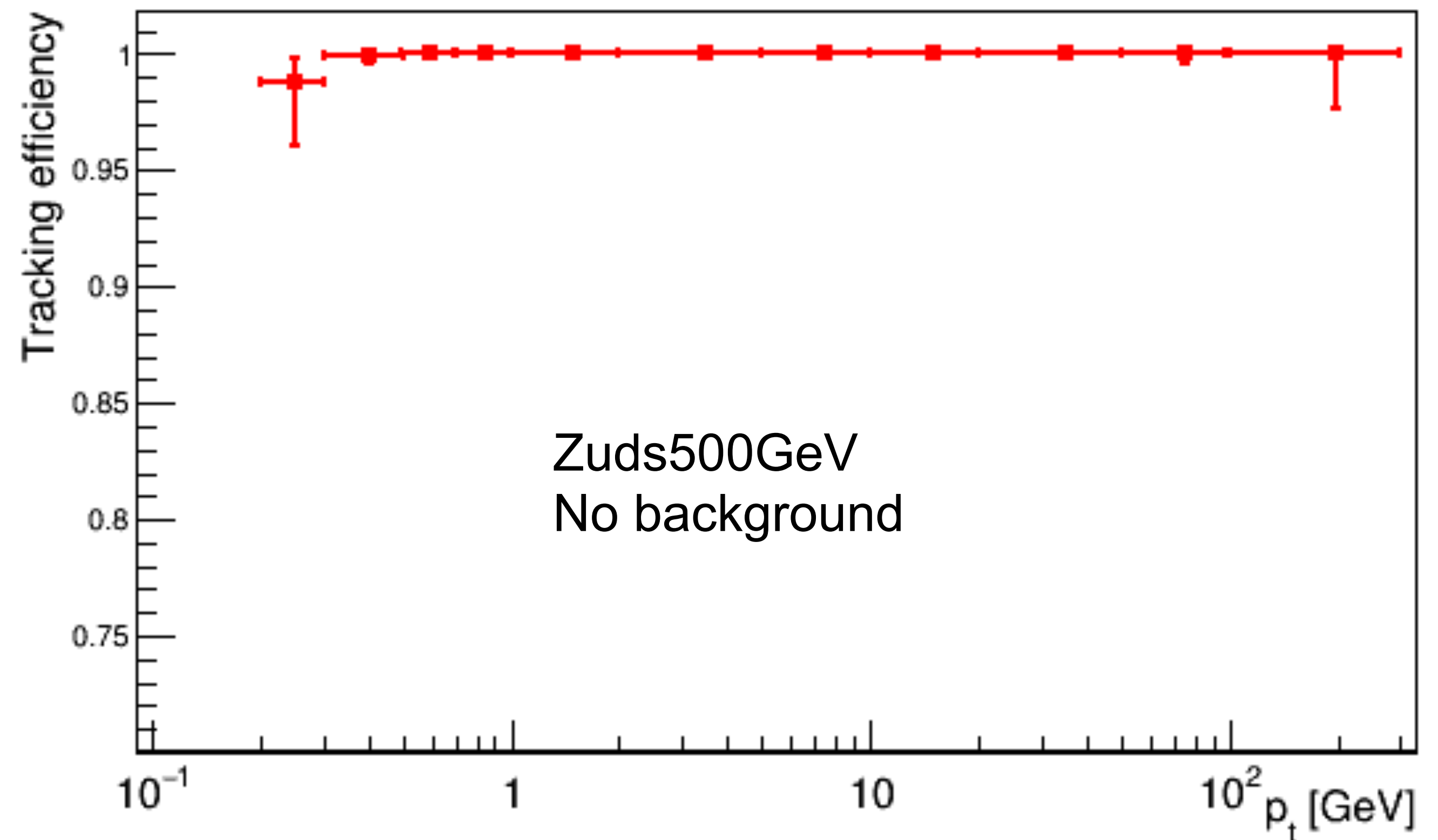
- ☆ vertex $R < 50$ mm
- ☆ $10 < \theta < 170$ deg
- ☆ purity $> 75\%$



- ☆ Above 1 GeV/c:
 - ☆ efficiency $> 99\%$ up to 100 GeV/c
 - ☆ efficiency $> 97\%$ up to 1 TeV/c
 - ☆ performances mostly unaffected by background overlay

ILD barrel tracking system

- vetex < 10 mm
- cosThetaCut < 0.8
- purity $> 74\%$



- $p_T > 0.2$ GeV, efficiency $> 99\%$**
- $p_T > 0.3$ GeV, efficiency $\sim 100\%$**

Summary

The samples has been tagged for reproduce the low Pt issue.

➔The low Pt tracking reconstruction algorithms issue have been seen clearly.

A local steering file has been used with two tracking pattern recognition algorithms running at the same time during Marlin reconstruction.

➔It is possible to compare two algorithms performance for exact identical track in the same event.

➔Try to add ConformalTracking for ILD too.

Base on the identified information, try to fix the issue and improve the region from barrel(VXD) to forward(FTD) for low Pt tracking performance.

**ILCSoft_v01-19-05
ILDConfig_v01-19-05-p01
ILD_test_production**