Update of Muon ID for PFA

Muon ID for PFA

- Identify muon track from cheating track
  - Goal is that taking out the track from track list for building clusters.
  - In terms of PFA, it will help avoiding the case of loosing energy.

- How to identify Muon

  1. Muon System part.
  - Find muon MIPs in Muon Detector (call it standalone muon MIP).
  - Get the standalone muon direction.
  - The direction is obtained with first and second hit of the standalone MIP. (Used to use first and last but it becomes wrong when it curves)

  2. Calorimeter part
  - Find MIPs from the seed on the surface of CAL using MIP finder.
  - If it is muon track, it will end up with showering point in last layer in HCAL. (Require last point of mip to be located in last 10 layers in HCAL endcap but not in Barrel.)
  - Get the tangent vector at the last point of the mip.

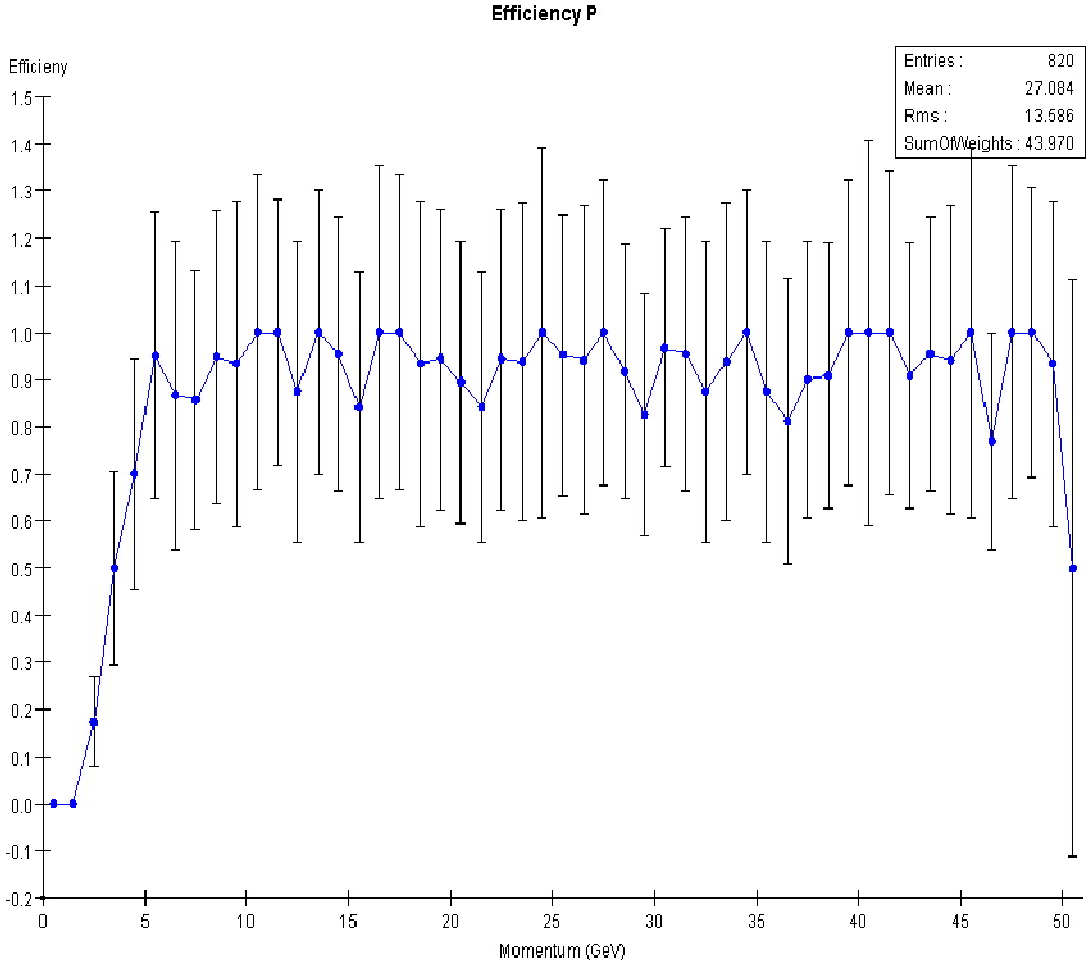
  3. Find matching track.
  - Another linking direction from last point of CAL mip and first point of standalone muon MIP.
  - Compare the three directions of combination of standalone muon direction (from 1), tangent direction (from 2) and linking direction.
  - The tangent direction will lead to corresponding track which is going to be muon track.

Muon ID for Single muon

- 1000 events muon and pion sample at the range 0-50GeV for sid02

Detector	Muon	Pion
Efficiency	82%	0.8%
Purity	100%	25%

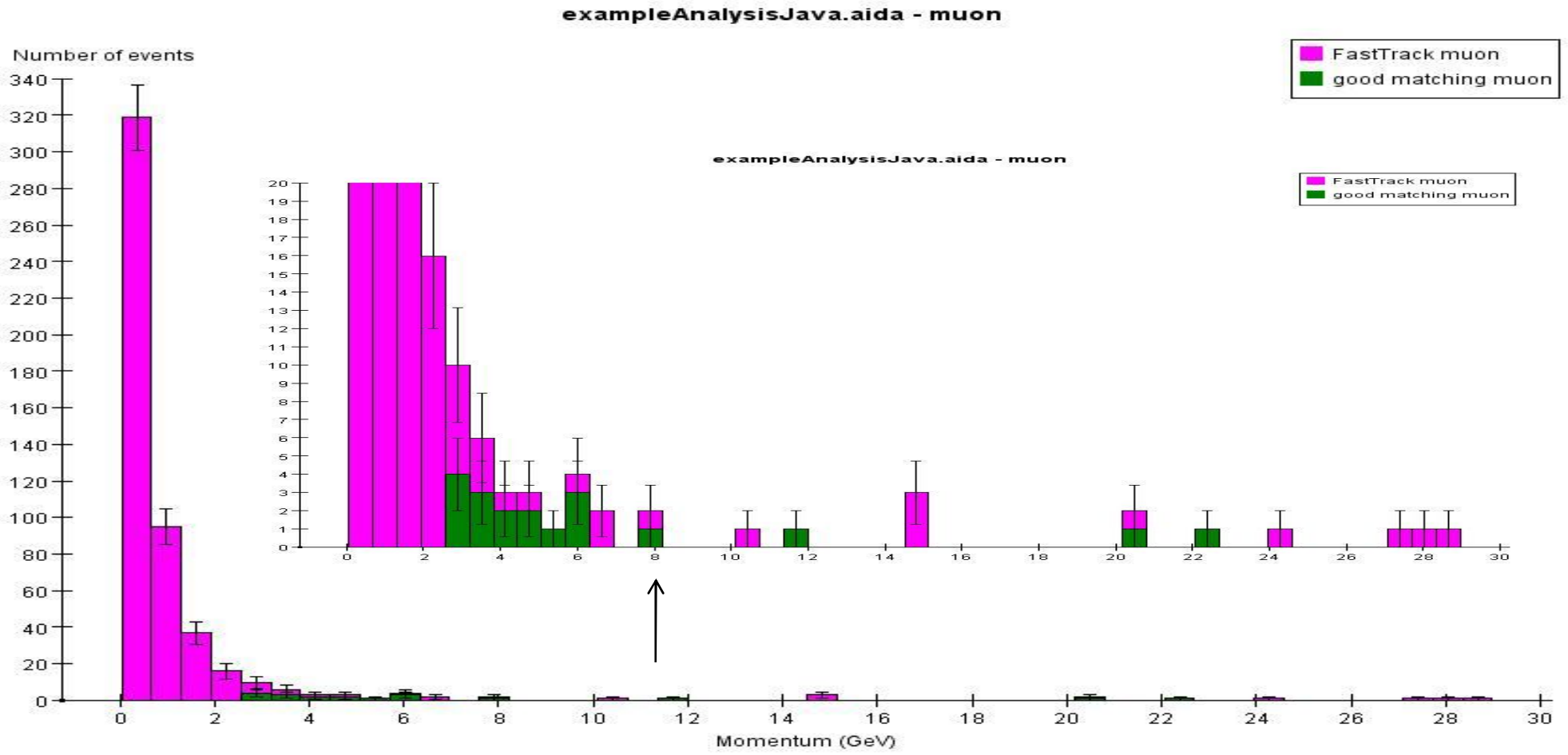
- The inefficiency is from mainly from low momentum track. Plateau is starting at 5 GeV.
- Another contribution is finding the last point of mip incorrectly in calorimeter.
  - That happens when neighbor hits in the middle of MIP.
- Even though purity for pion is 25% (2 out of 8 are muons and 6 are pions), the pions are going through Muon detector and stop without showering.



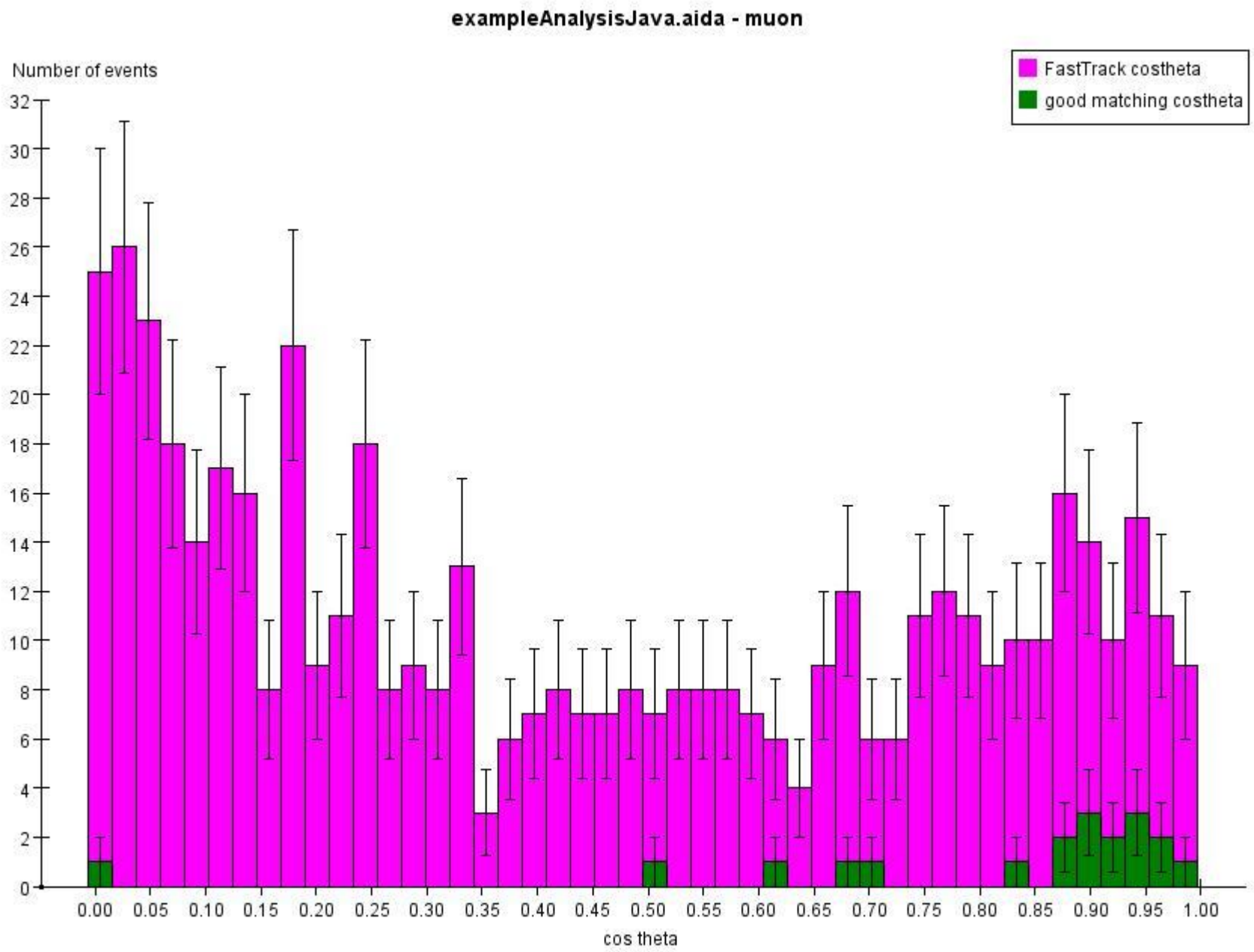
Muon ID for ZZ sample

- 1000 events in ZZ sample (ZZ decays to nunuqqbar).

Type	FastTrack	Good Reco.	Bad Reco.	Efficiency	Purity
Number of track	510	19	18	7%	50%



Muon ID for ZZ sample



Muon ID for qqbar sample

Type (# of event)	FastTrack	Good Reco.	Bad Reco.	Efficiency	Purity
qq100 (1000)	478	6	9	3.1%	40%
qq200 (500)	504	11	12	4.6%	48%
qq500 (500)	255	3	13	6.3%	19%

- Efficiency is going up as energy is up.
- Purity would be expected to be worse.
- I don’t understand the number of tracks for qq200.
  -It is not half of 1000 events sample.

Conclusion

- Below 2 GeV momentum tracks are hardly reconstructed.
- The reconstructed muons are from endcap region mostly.
- The resolution of ZZ and qqbar will not be changed even though adding muon ID.
- But it will help for lepton + jet channel sample. Need to look at other samples.
- We can improve efficiency and purity by looking at display for each case where it fails and taking into account it.