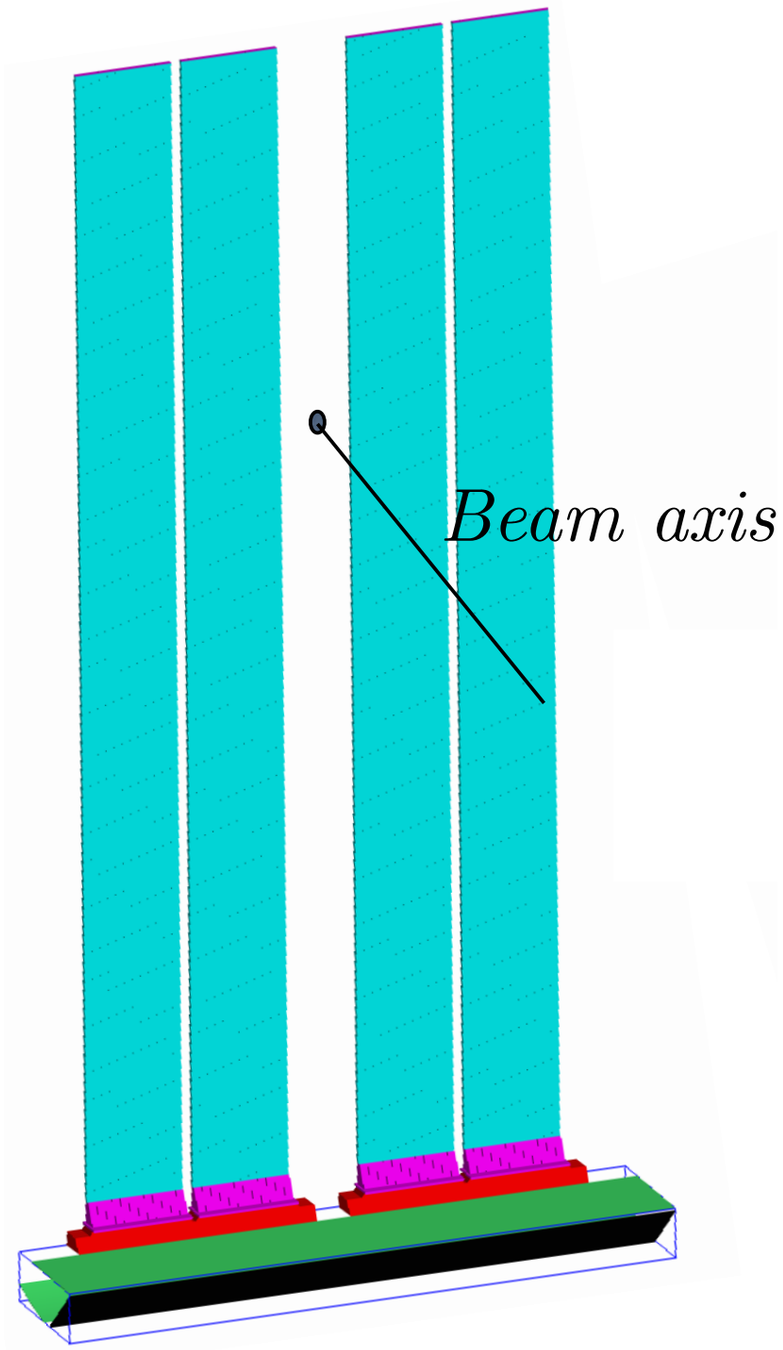
DIRC reconstruction

INTRODUCTION



Two sets of simulations, both based on Geant4:

A) generate the pion/kaons track interaction through the DIRC

B) generate the single photons within the 48 bars to make the pixel data base.

→ 16 millions photons generated per bar

Both take into account:

- Full detector geometry
- Absorbance (quartz, glue ...)
- 5x5mm resolution PMT
- Mirrors reflectivity

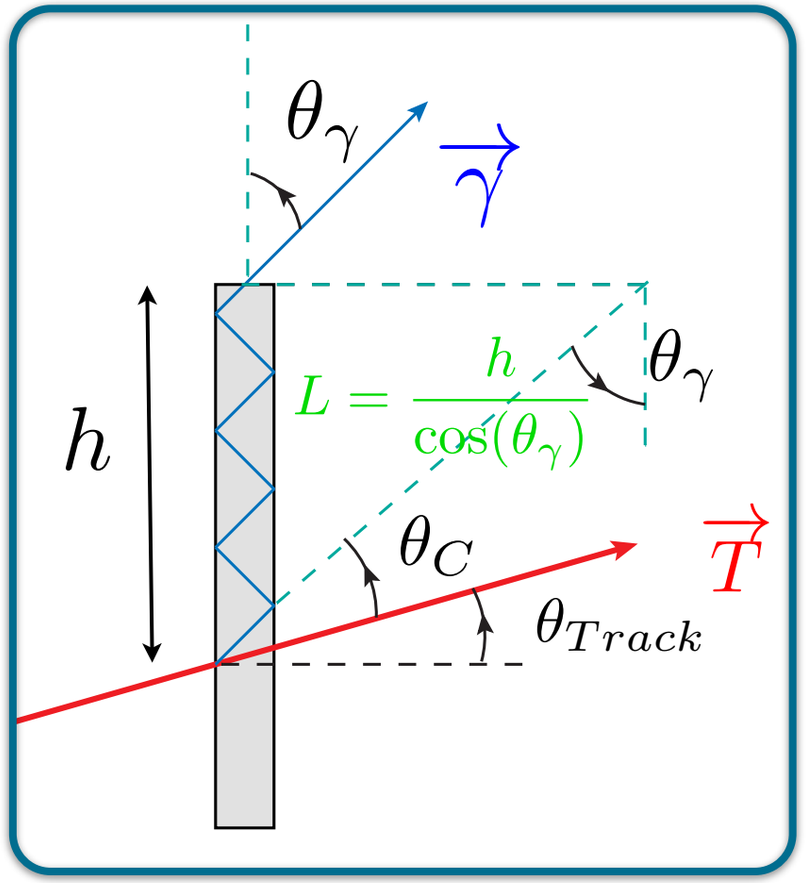
Preliminary reconstruction procedure

- Determine the angle between a measured photon in FDIRC with respect to a track: $\cos(\theta_C) = \vec{T} \cdot \vec{\gamma}$

- FDIRC has to translate a hit in a PMT pixel into a $\vec{\gamma}$-vector

- Each pixel can have several possible photons $\vec{\gamma_n}$

  Possible $\vec{\gamma_n}$ solutions from a given pixel are determined via a database from single photon simulations (16 millions photons per bar)



- $\cos(\theta_C) = \sum_{j \in P} \sum_{i=1}^{n} \vec{T} \cdot \vec{\gamma_{ij}}$, where P is the set of active pixels.

Preliminary reconstruction procedure

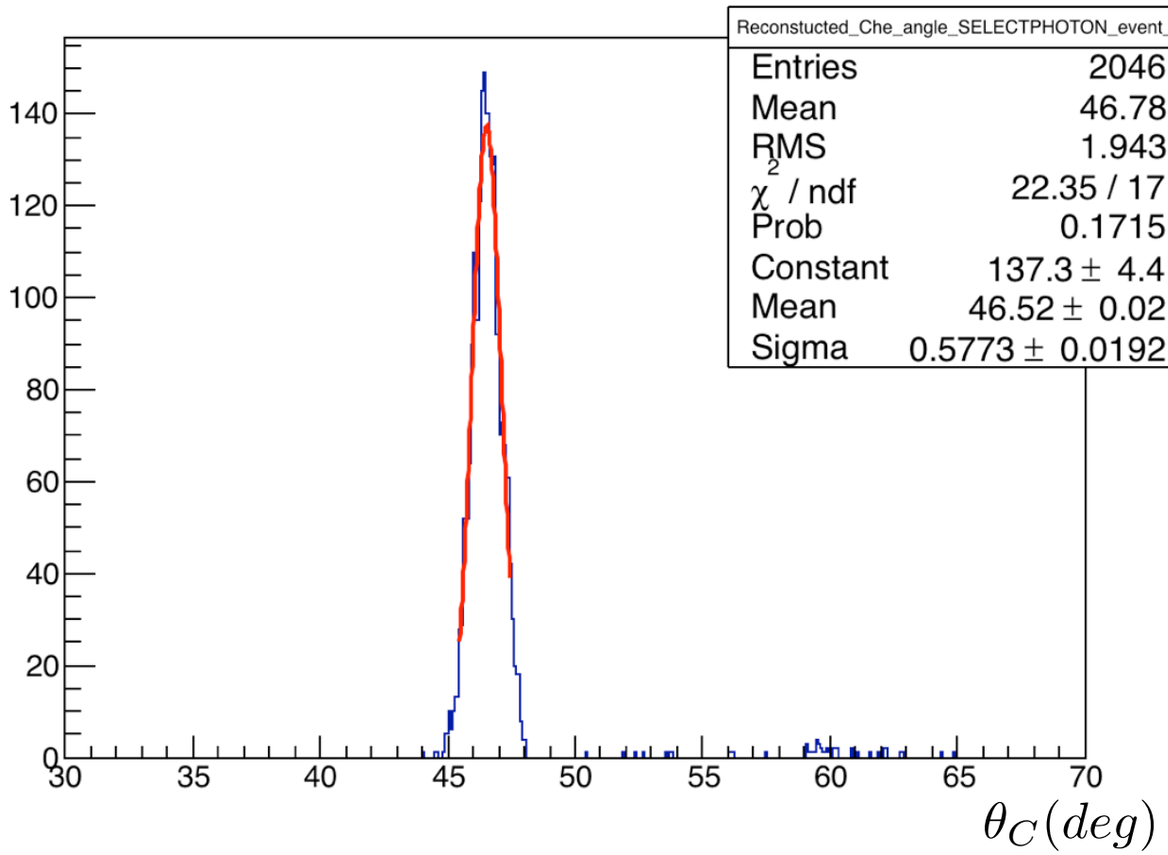
Comparing the reconstructed θ_C with a list of candidates:

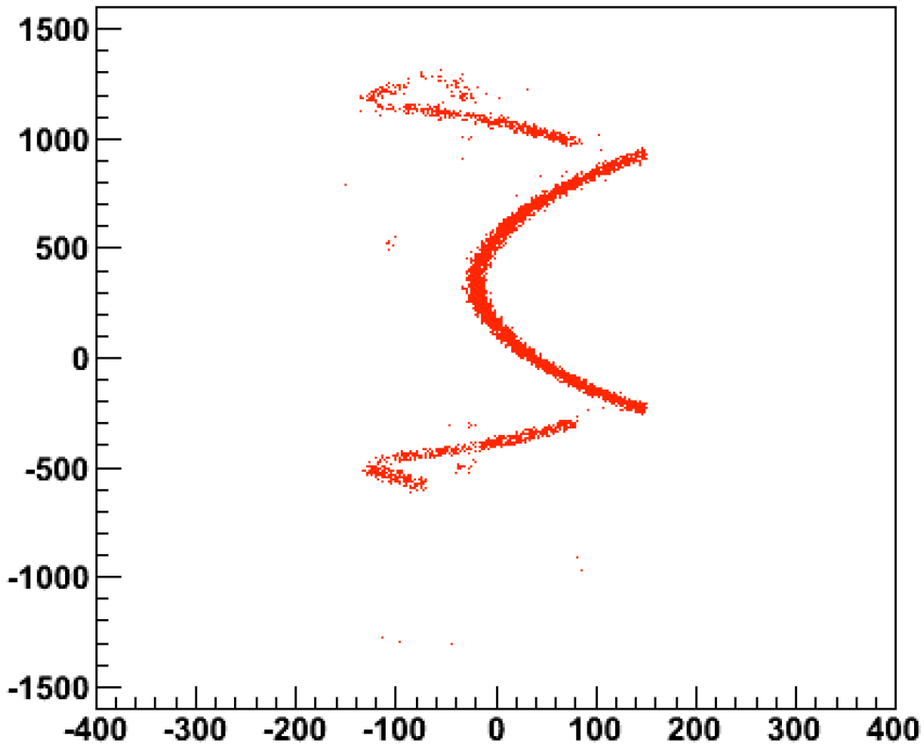
- $\cos(\theta_{C_{candidate}}) = \dfrac{1}{n\beta_{candidate}}$

with: $\beta_{candidate} = \dfrac{P_{mother}}{\sqrt{P^2_{mother} + M^2_{candidate}}}$

where: *candidate*= [pion, kaon]

One single perpendicular track:

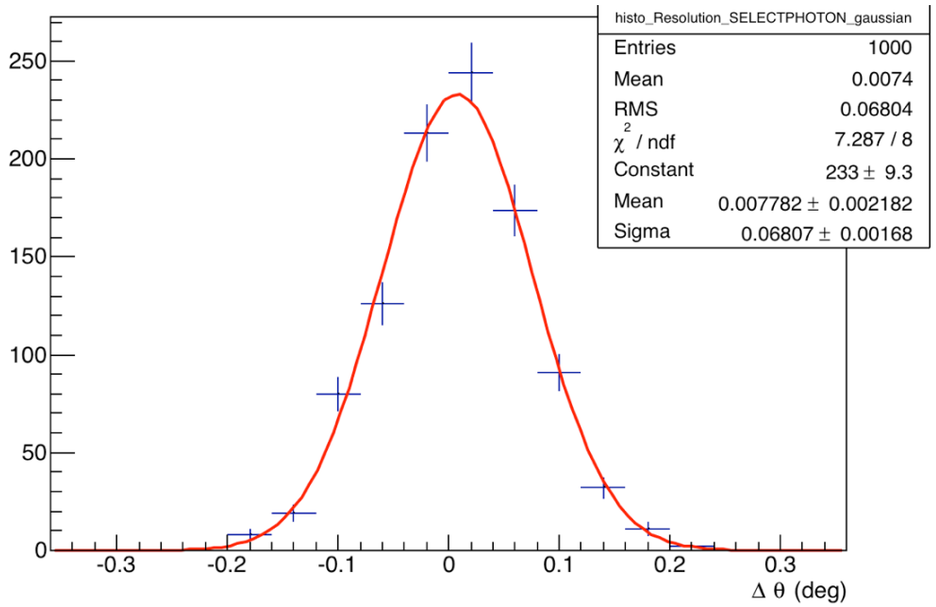




(Photon occupancy with accumulated statistics)

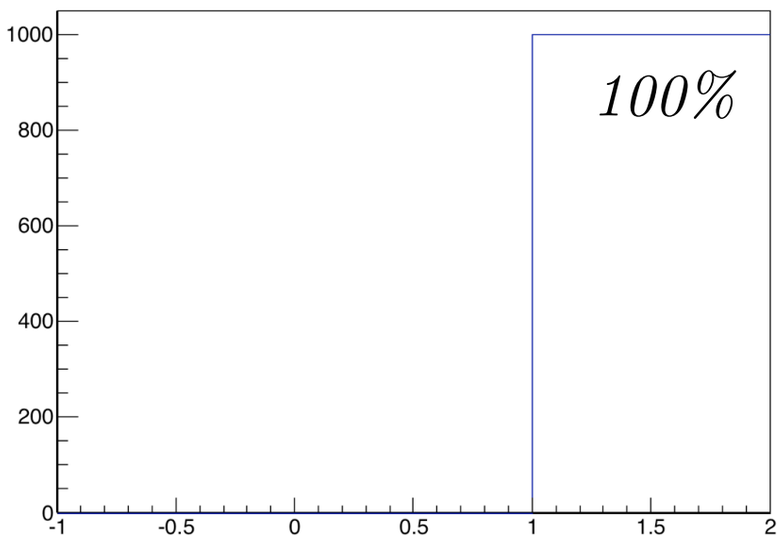
1000 perpendicular tracks @ 3GeV/c:

Expected - Reconstructed

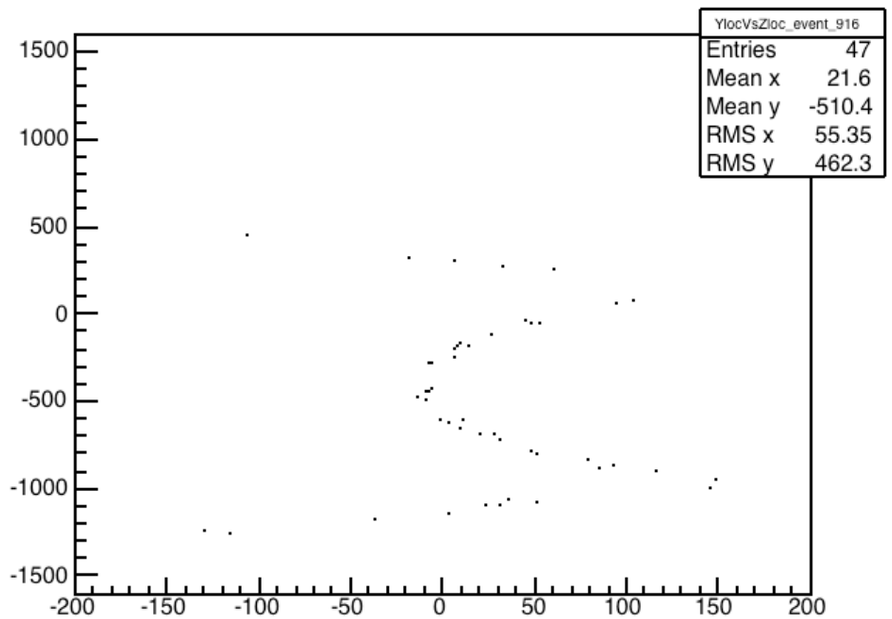


→ 1.2 mrad vs 2 in proposal (perp track)

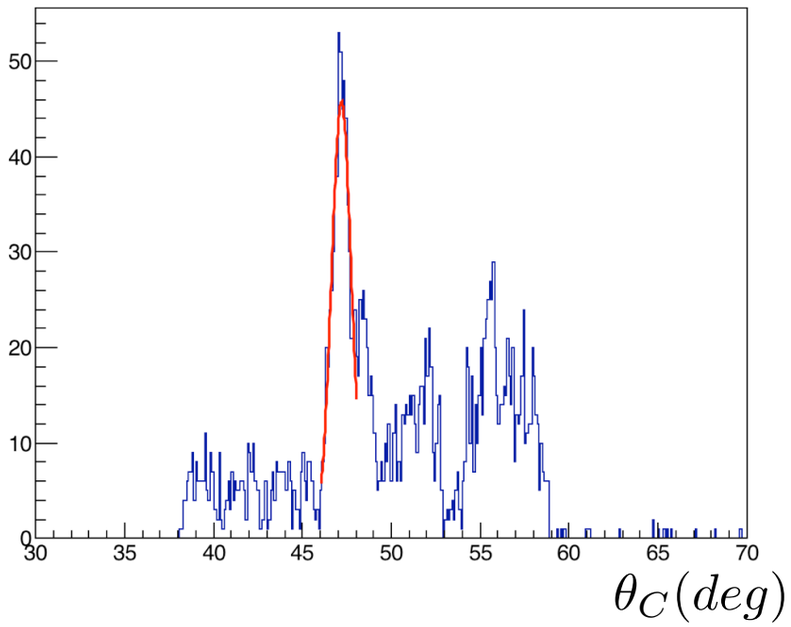
Matching Gen/Rec:

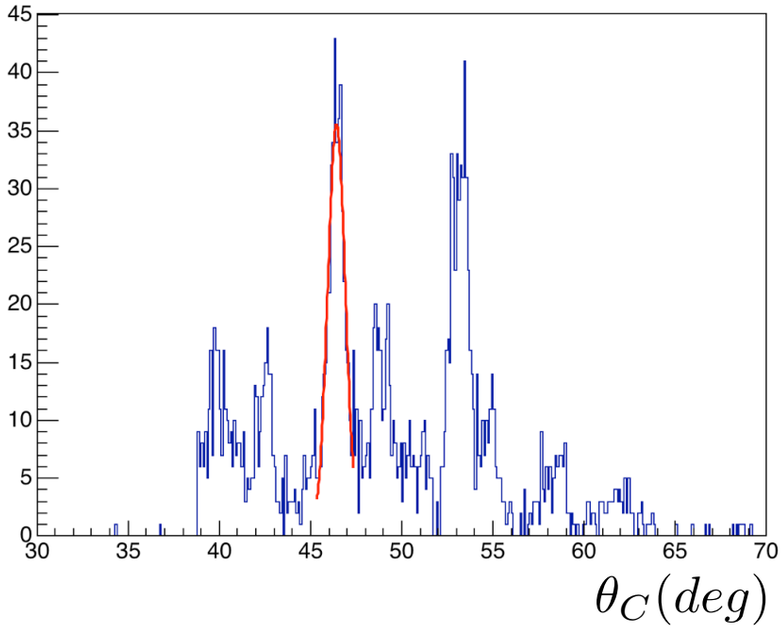


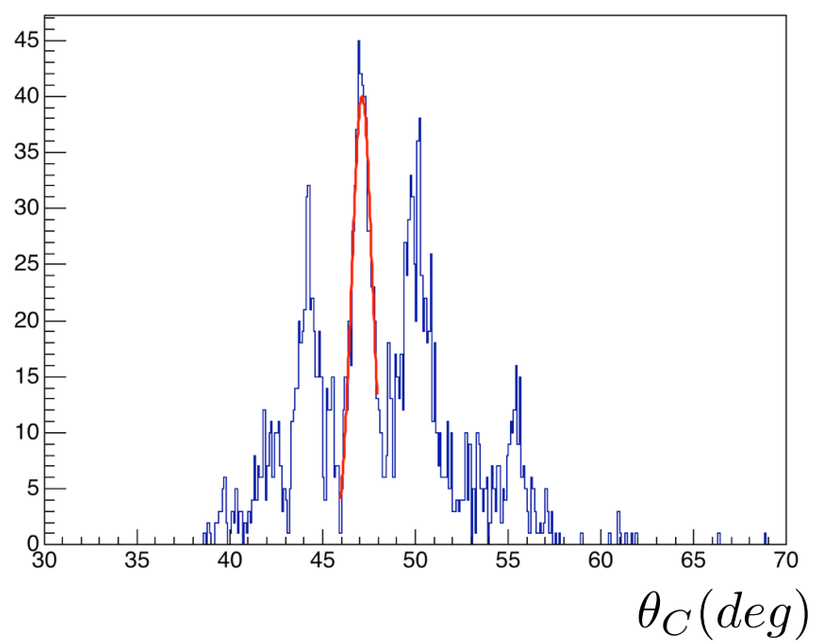
Single perp track occupancy example:

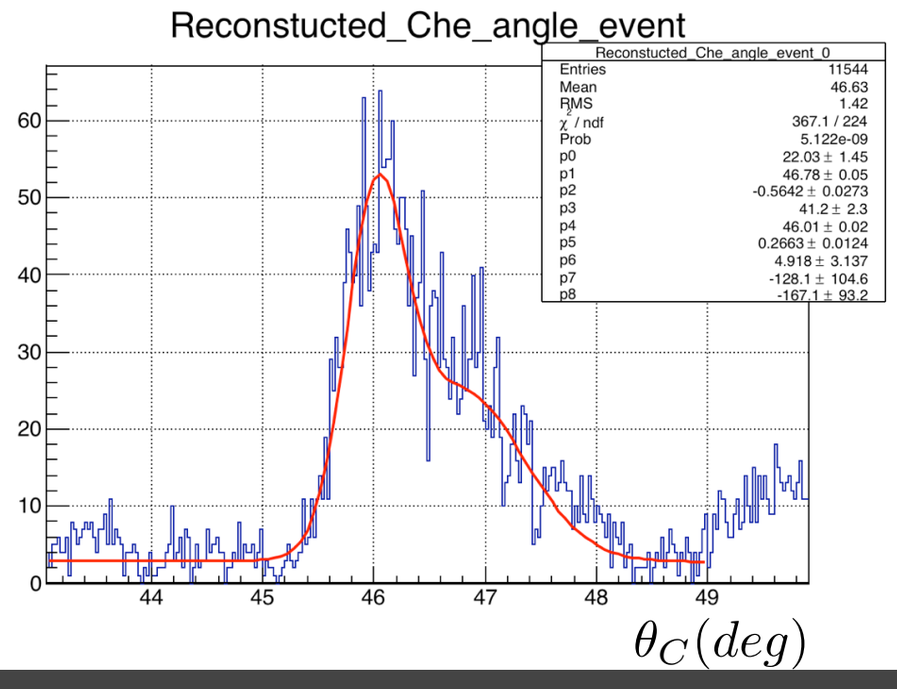


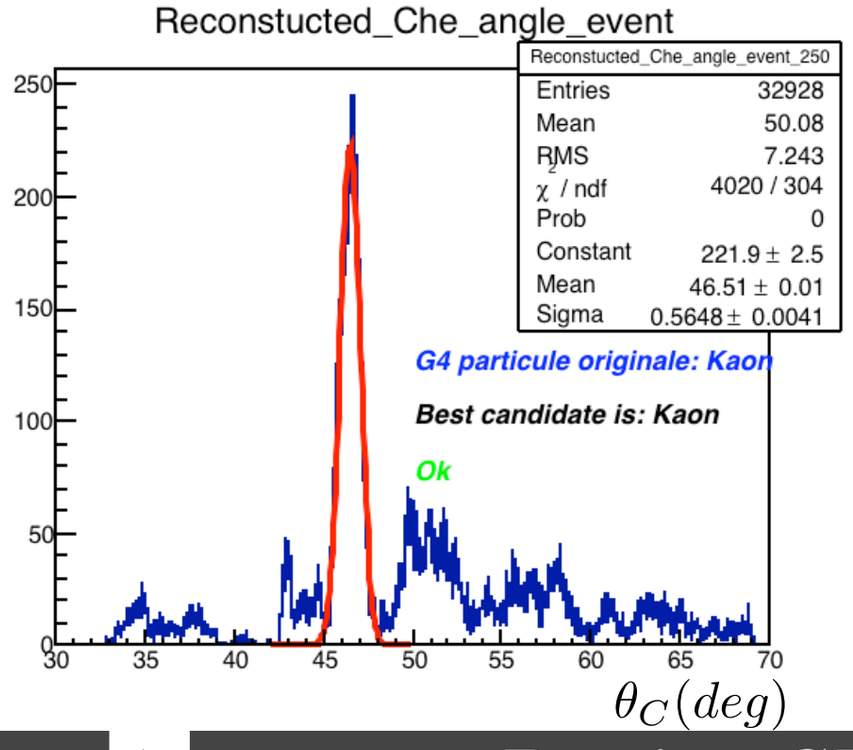
Example of reconstructed Cherenkov angle for non perpendicular tracks:











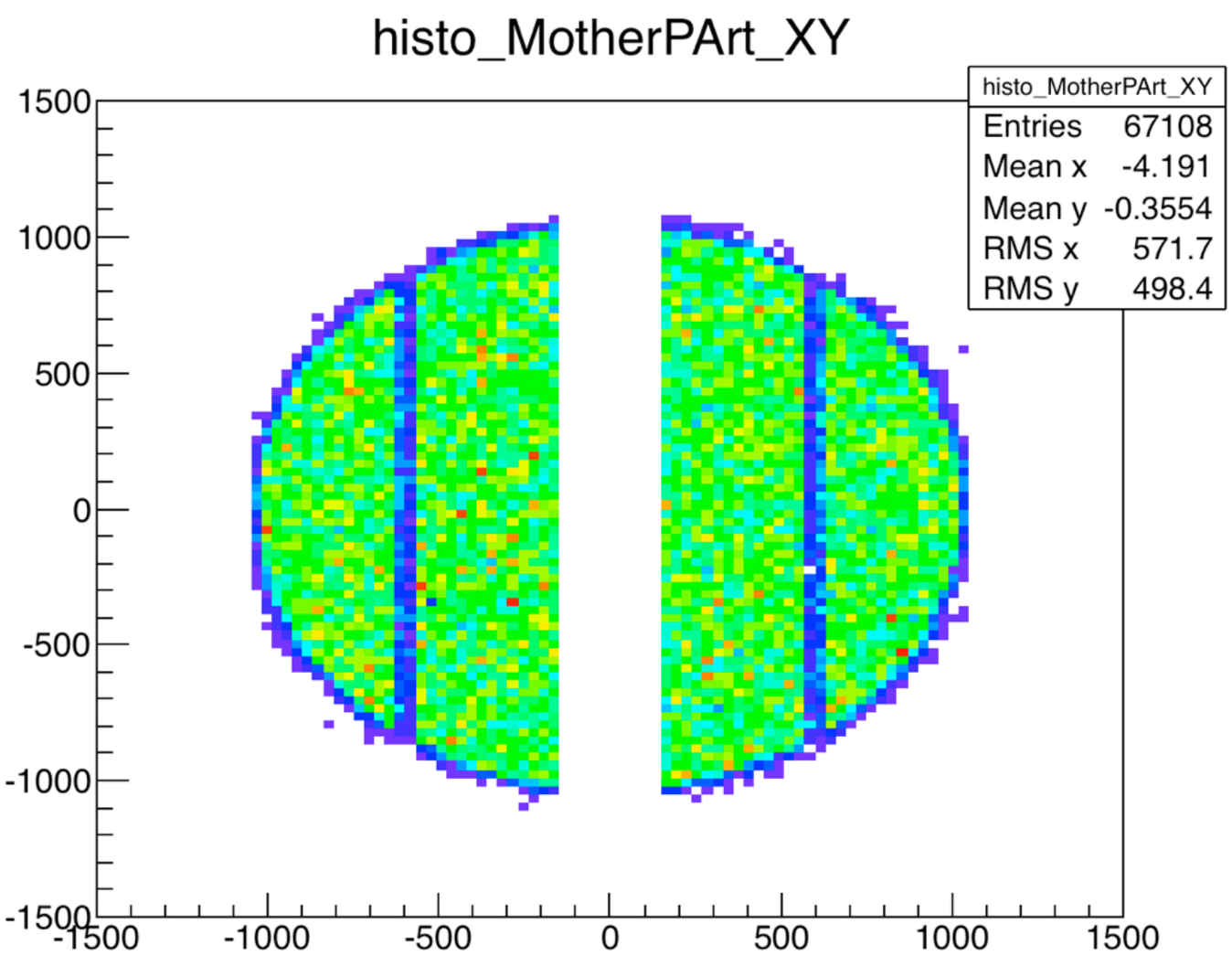
Theta incoming (deg): 10.6828
Phi incoming (deg): 0.0937222

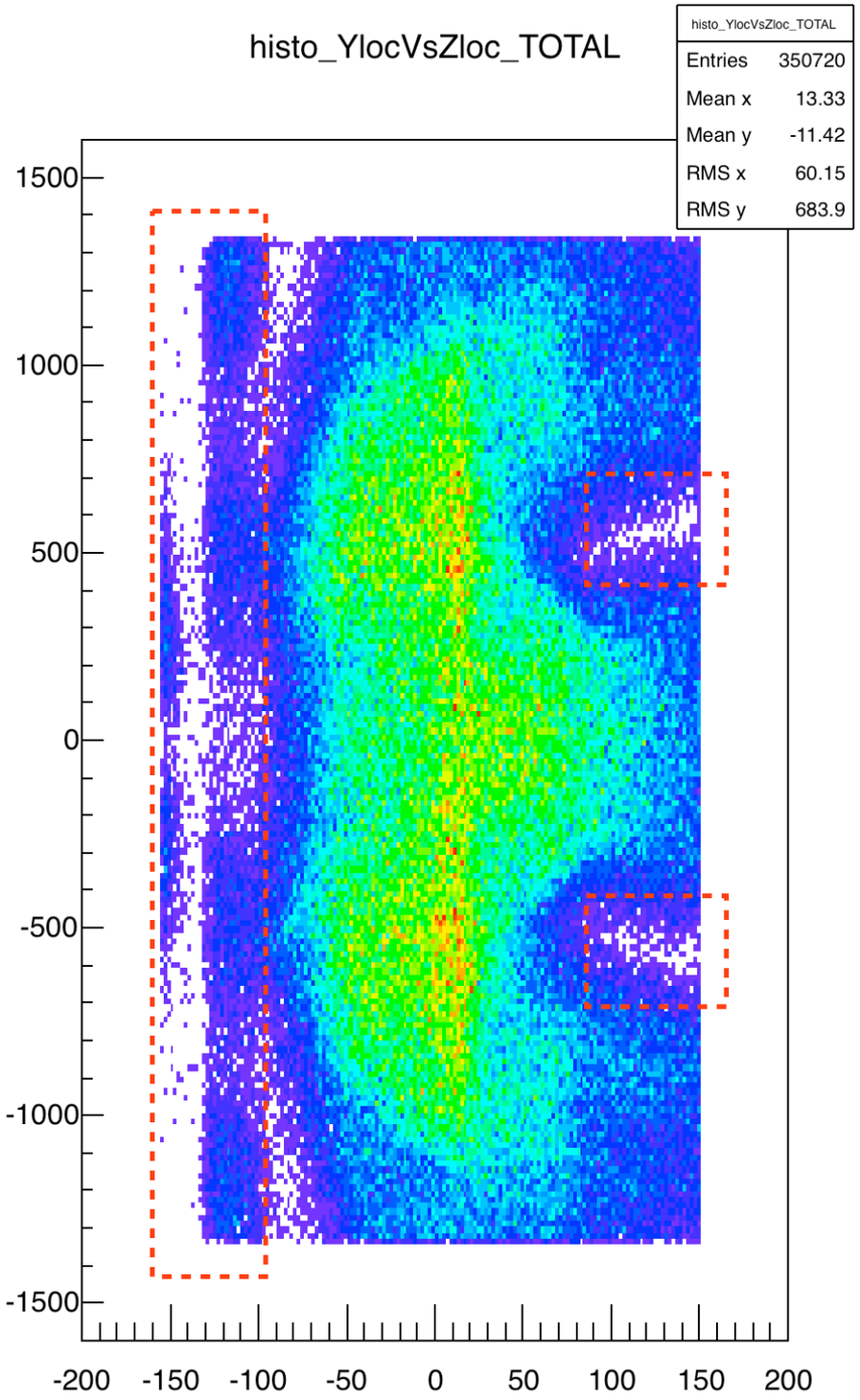
X pos incoming (mm): 999.265
Y pos incoming (mm): 0.117747

Ceantral pos of the hit bar: 989.075

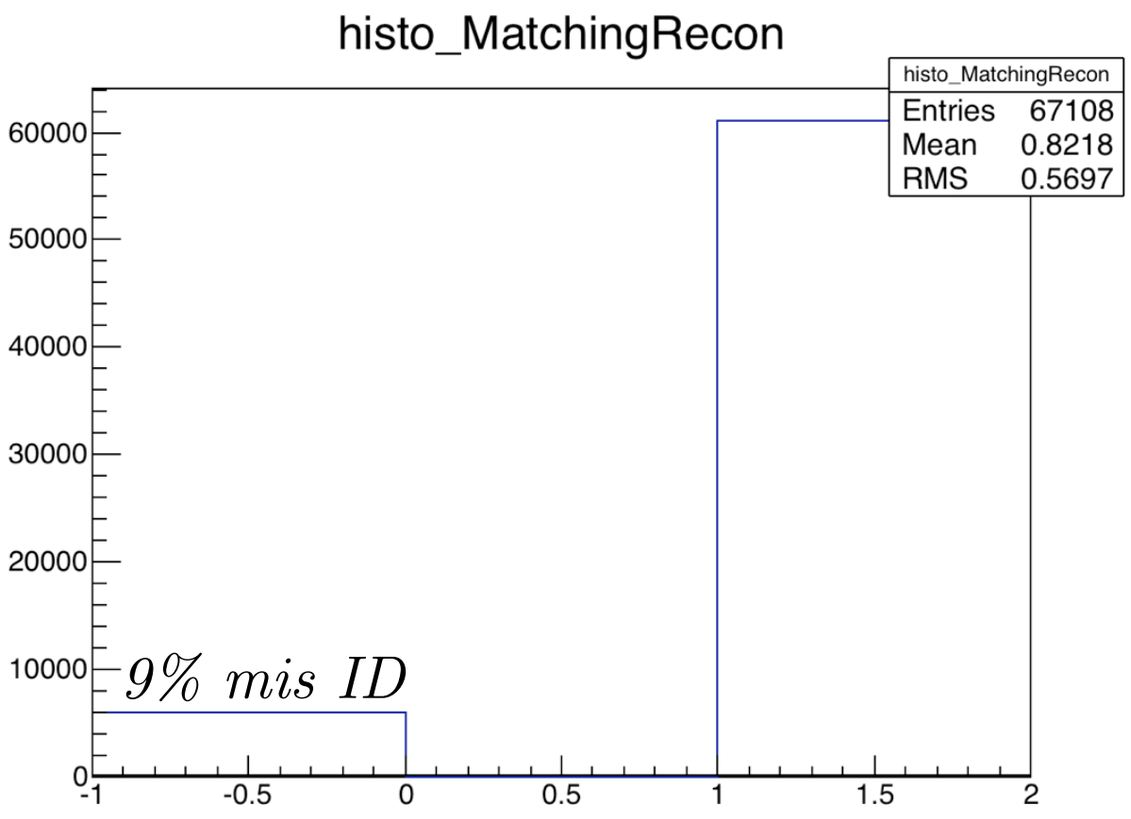
Initial C angle (mean): 46.4736
Candidate Pion angle: 47.041
Candidate Kaon angle: 46.3755

100000 random pion/kaon @ 3GeV/c:

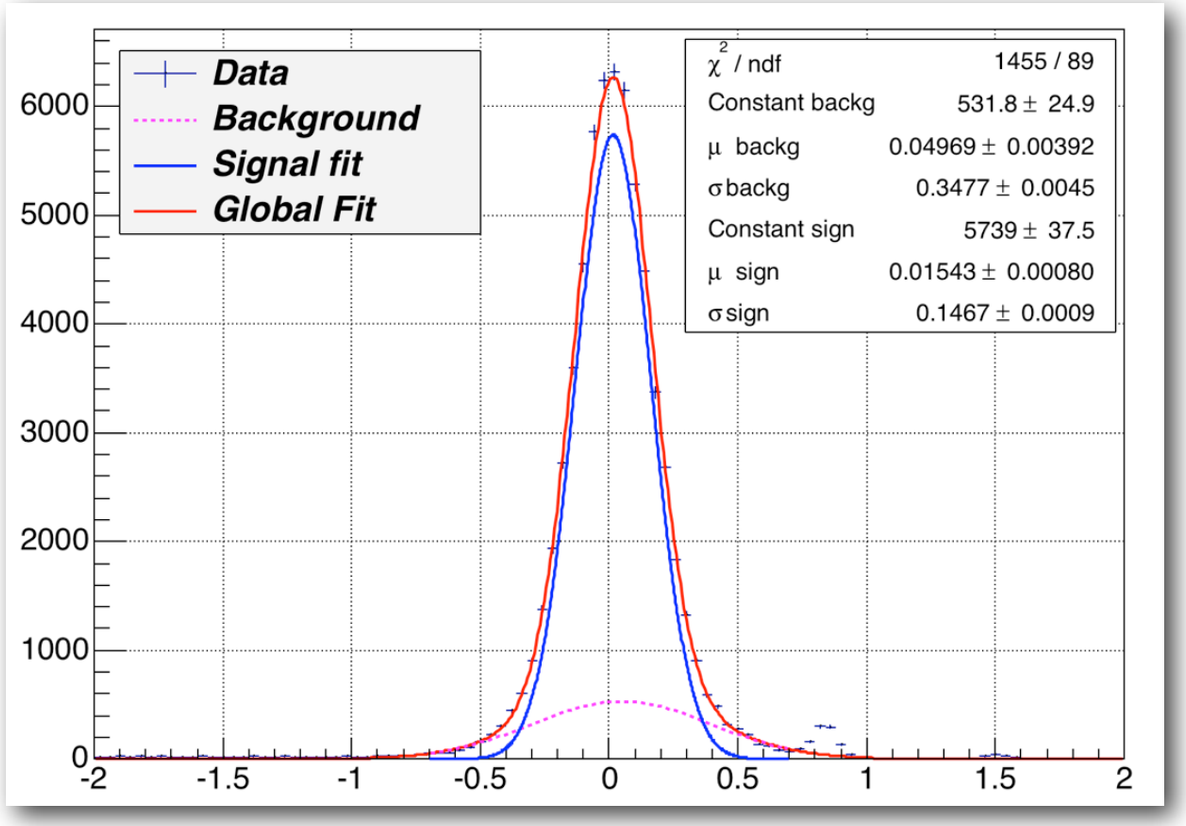




100000 tracks @ 3GeV/c:

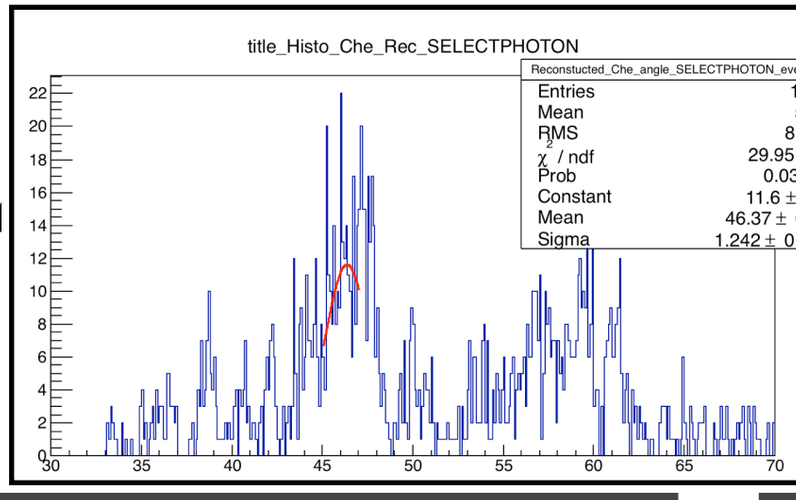


Expected - Reconstructed (deg)



→ 2.5 mrad vs 2 in the proposal

Complicated pattern

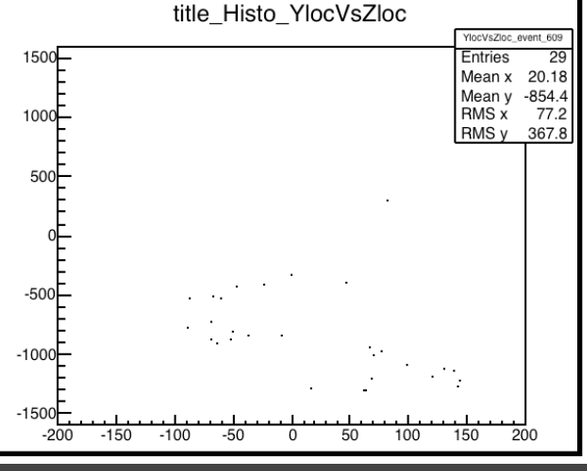


Theta incoming (deg): 9.88768
Phi incoming (deg): 133.891

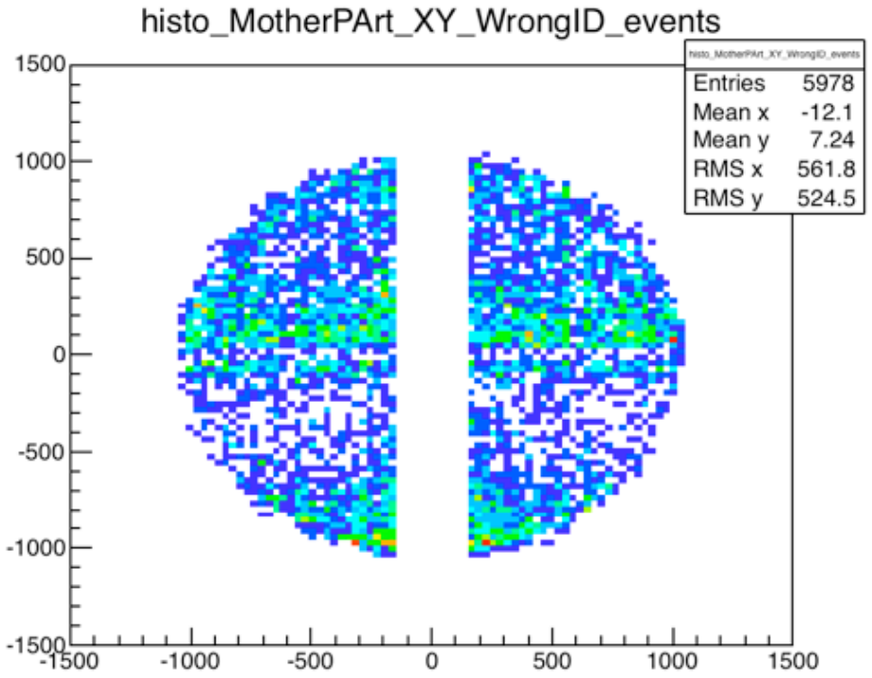
X pos incoming (mm): -648.19
Y pos incoming (mm): 684.118

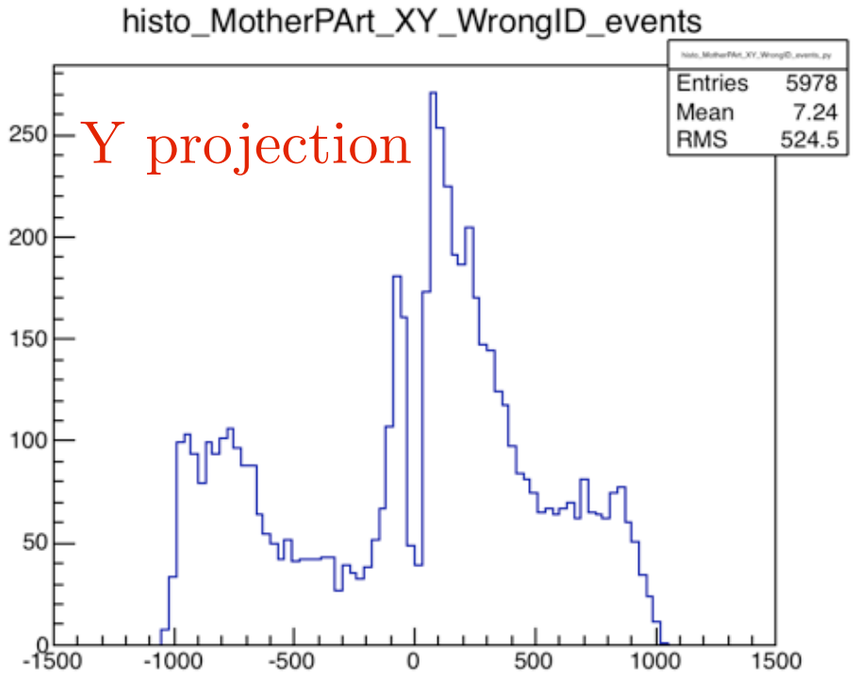
Ceantral pos of the hit bar: -637.575

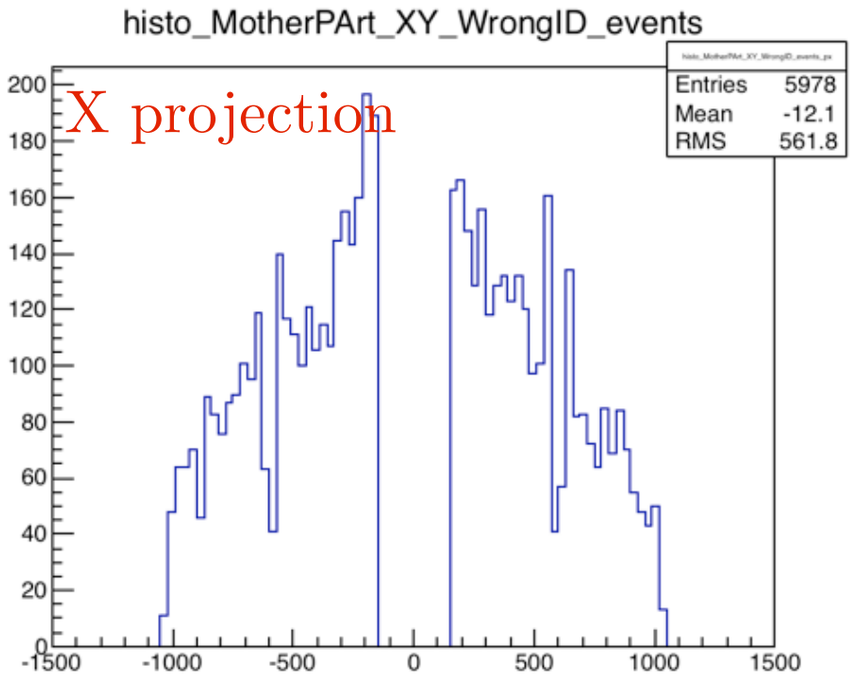
Initial C angle (mean): 47.1414
Candidate Pion angle: 47.0409
Candidate Kaon angle: 46.3737



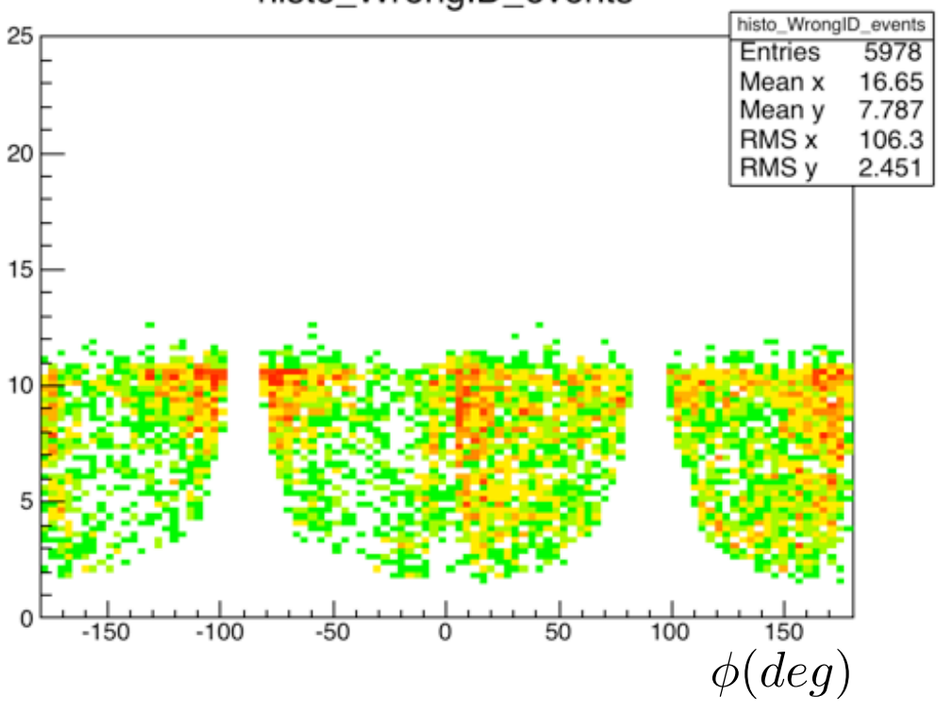
The 9% mis ID occupancy

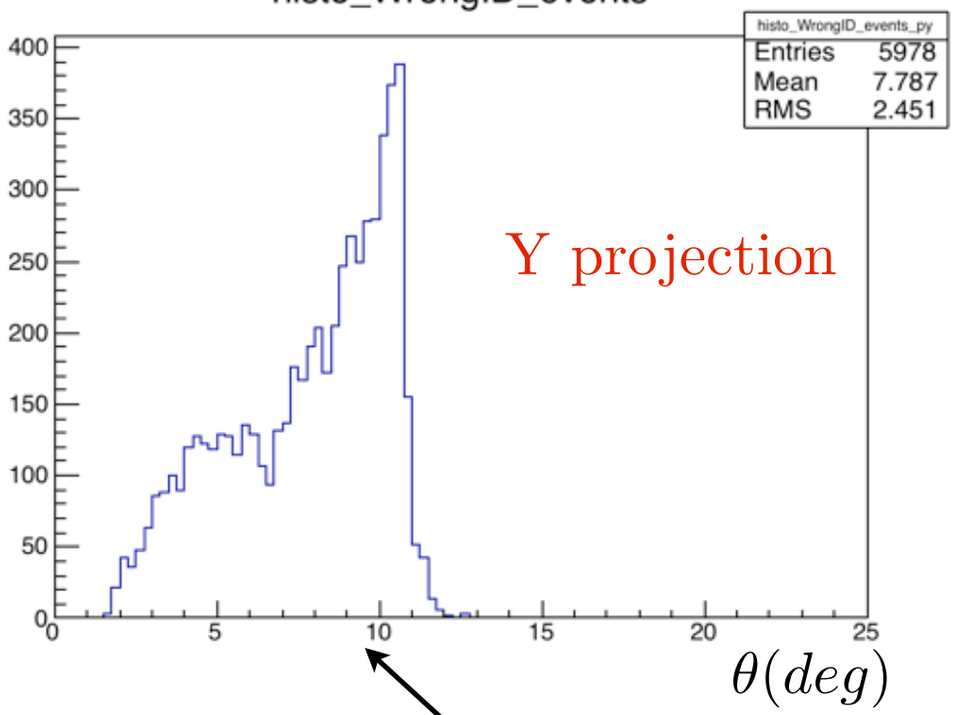




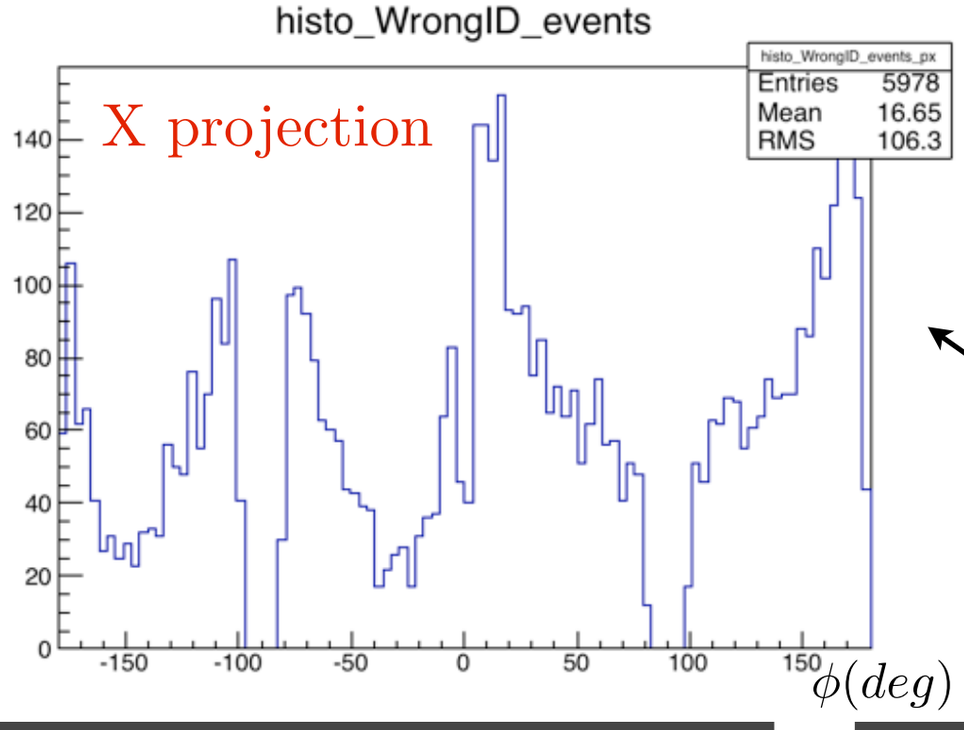


The 9% mis ID occupancy



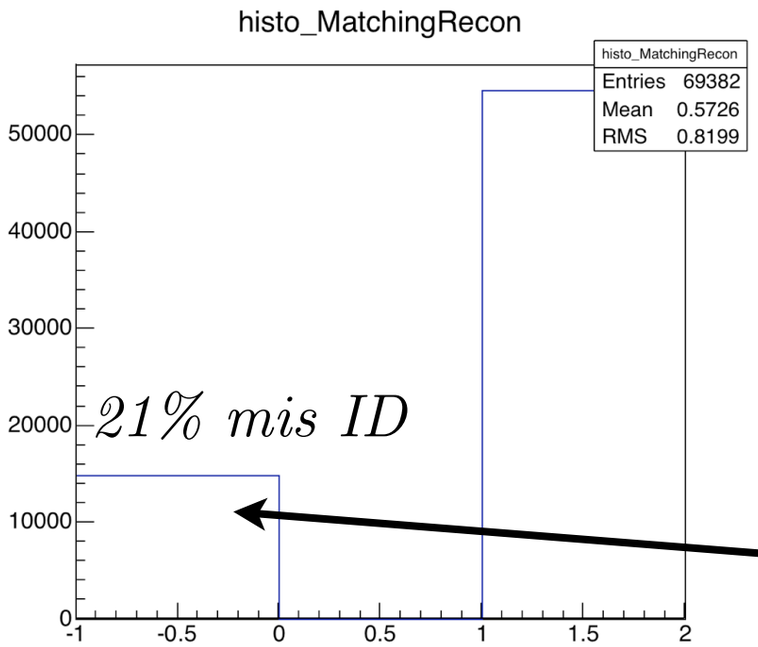


Pattern are more complicated as theta increases

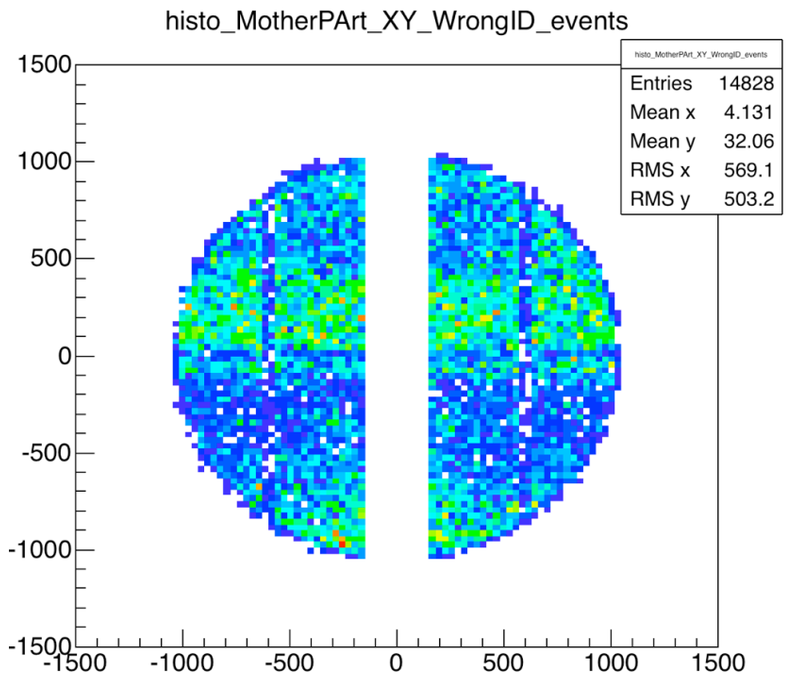


Understanding the phi dependance is work in progress

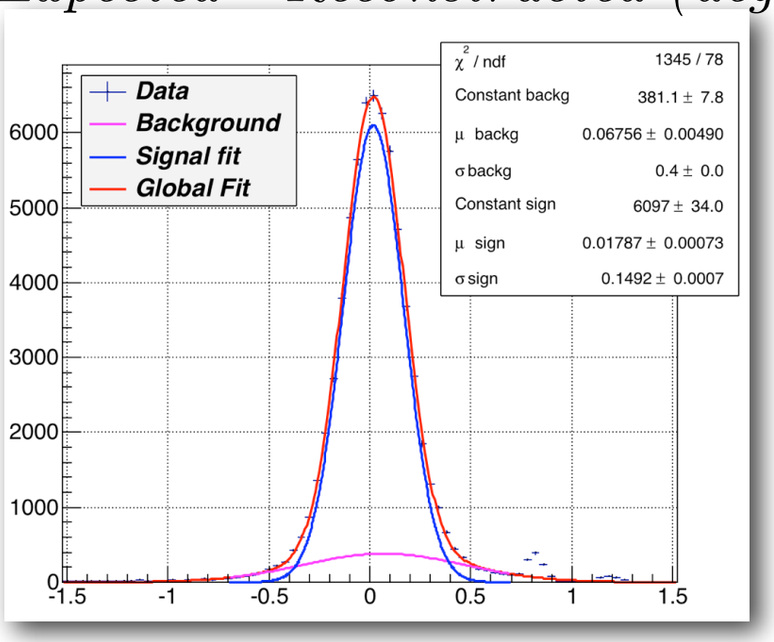
100000 tracks @ 4GeV/c:

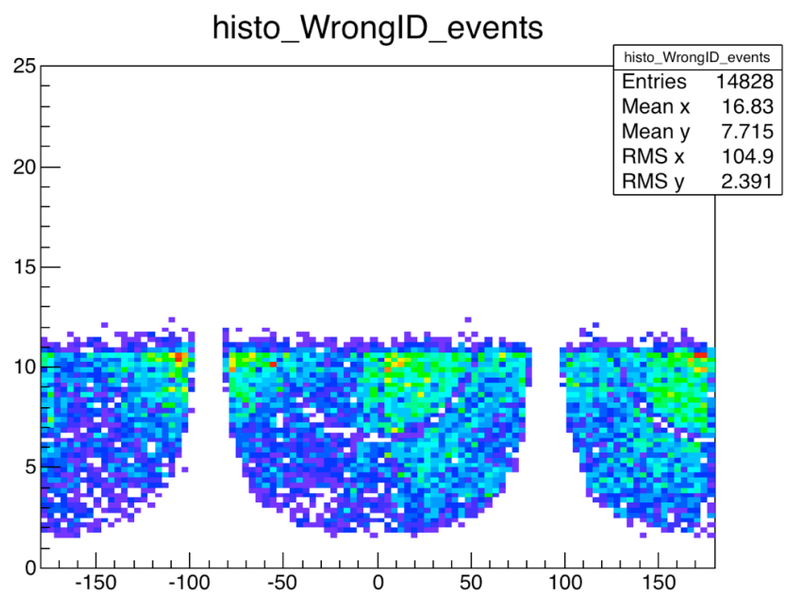


Same mis ID pattern:



Expected - Reconstructed (deg)





Conclusion

- Once the pixel database loaded, this reconstruction procedure runs at 30Hz right now, with no attempt to optimize the speed yet
- By optimizing the fitting procedure, one should be able to improve the results
- Bates will provide us the cost estimate by early next week
- Oil tests (mineral oil (SLAC), glycerol, Marcol 82 mineral oil ...) could be made on site (MIT) soon