PANDA STT response studies

Binsong MA

Institut de Physique Nucleaire, ORSAY

Collaboration meeting at GSI, 06/03/2012

- Preliminary studies of STT response to π^- and e^- :

→ Acceptance considerations: select STT hits associated primary Monte-Carlo track

→ secondary particles study

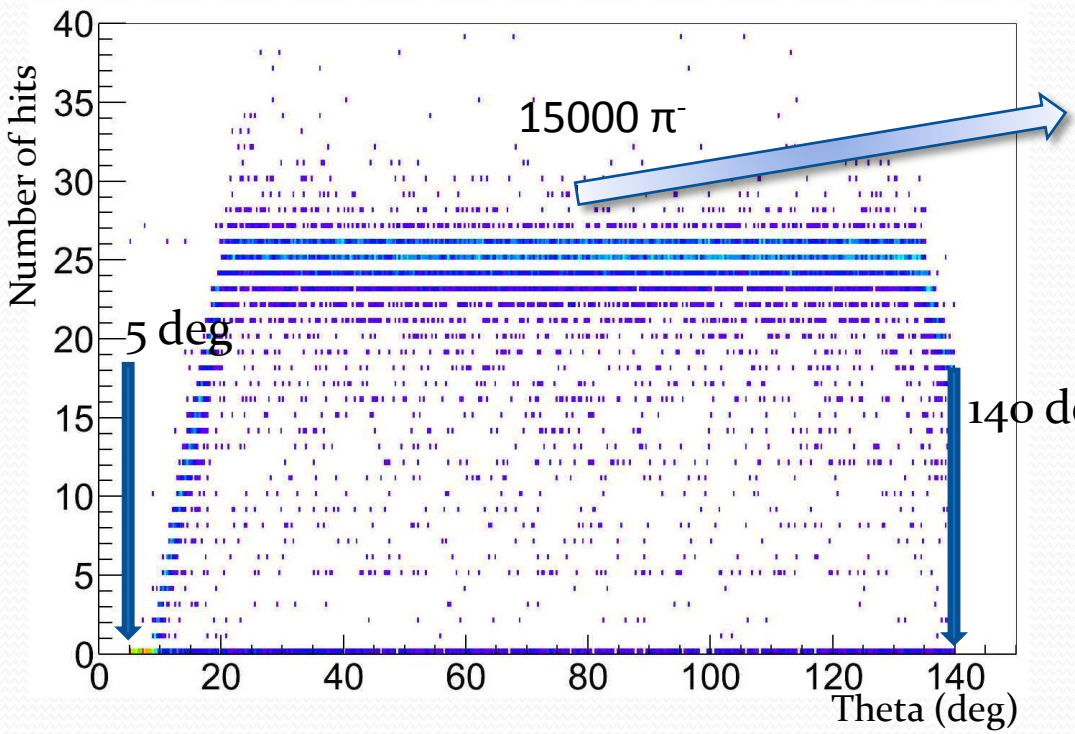
- Track finder efficiency study

→Study the tracking system (with STT) efficiency for e^-, μ^- and π^-, and then compare the 3 efficiencies.

→Try to understand the reasons of the efficiency losses for these 3 particles.

STT acceptance consideration for π^-
(STTHit in function of theta)

info from PndSttHit class(simulation level), only hits associated with the primary π^- are selected



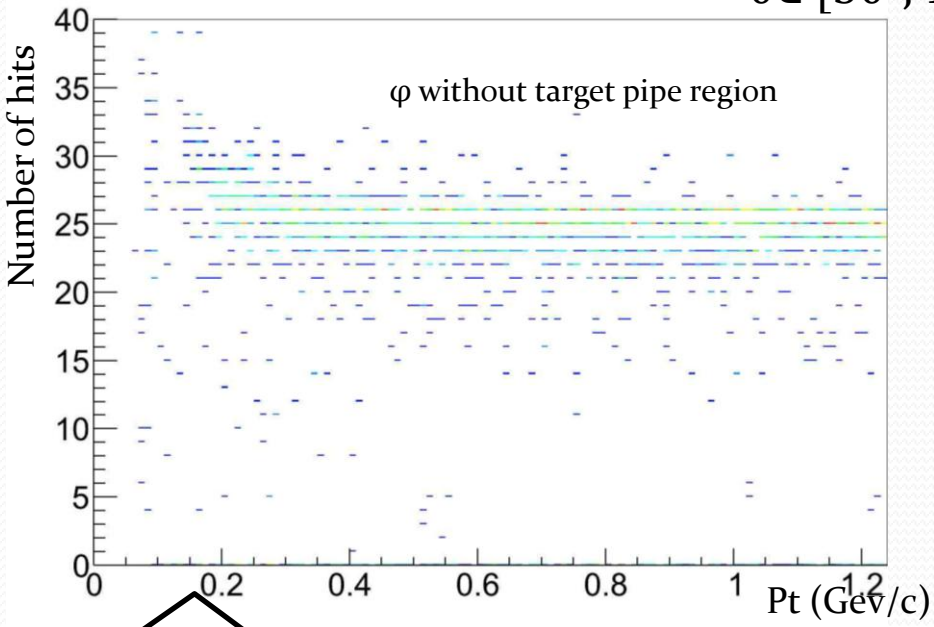
Generate 15000 π^- single tracks, with $0.05<p<5$GeV/c, $0°<\varphi<360°$, $5°<\theta<140°$

Number of hit depends on θ

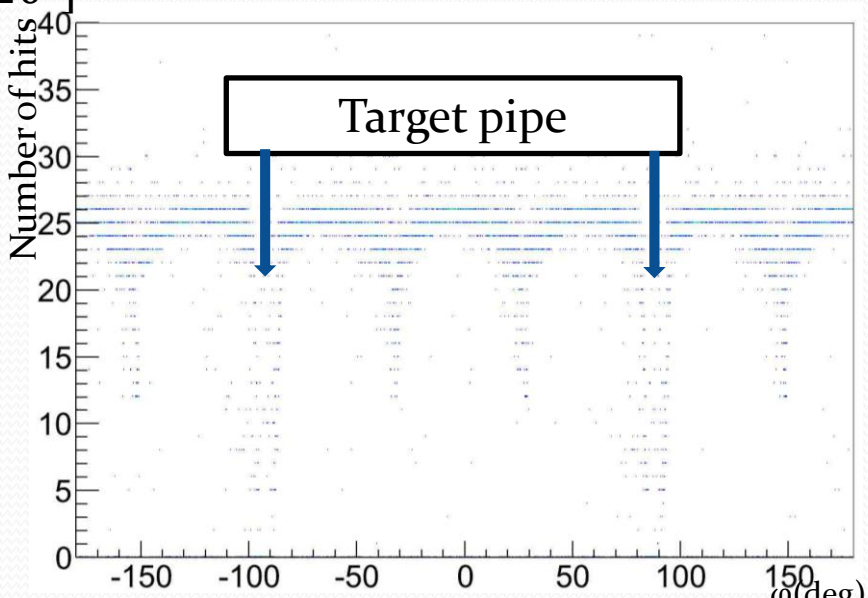
in the 30-130 deg range acceptance is flat with a constant mean number of STT

STTHit in function of momentum and φ

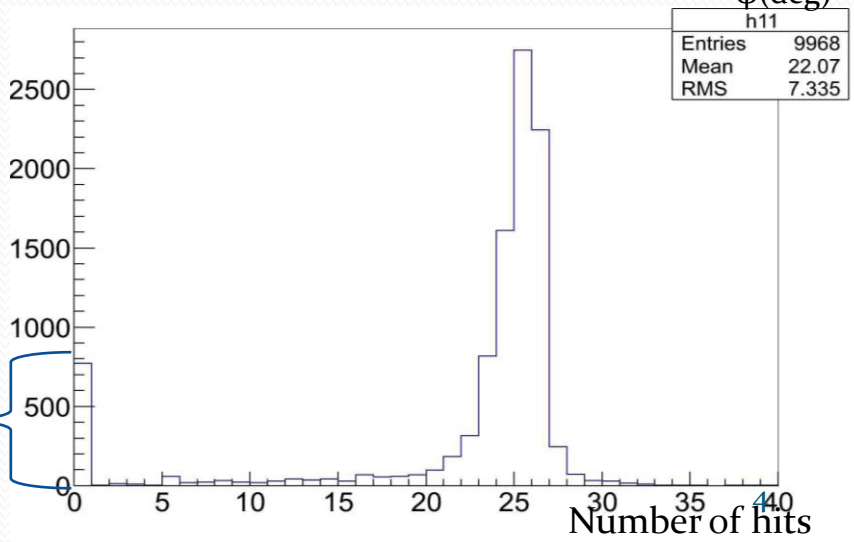
θ∈ [30°, 120°]



Low Pt region, more hits found



No hit events: target pipe and very low momentum

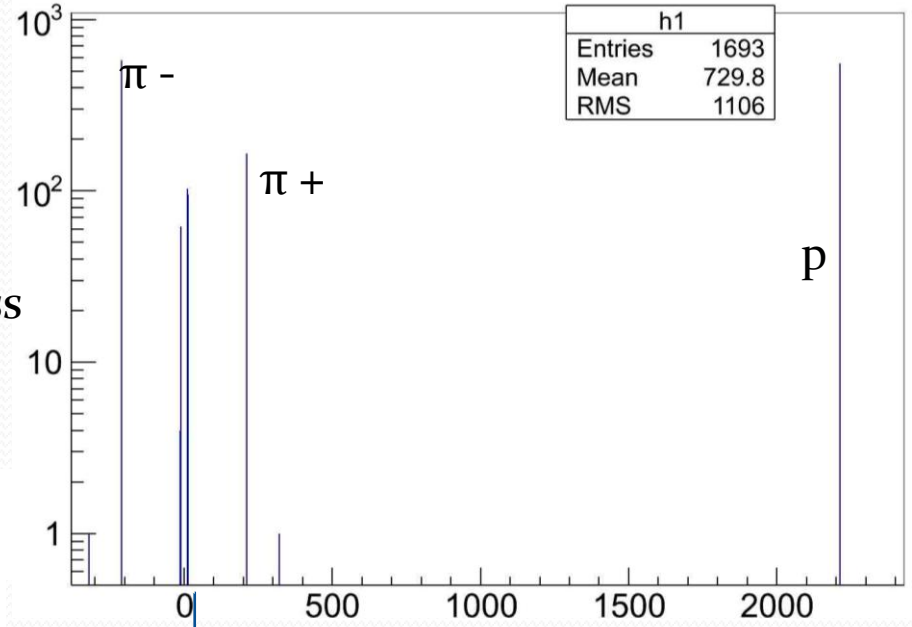


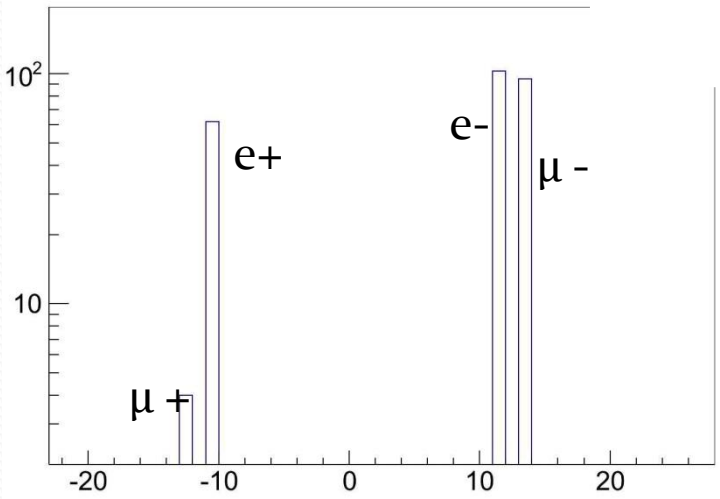
The secondary particles for π^-

15000 π^- single tracks, with
$0.05<p<5GeV/c$,
$0°<\varphi<360°, 5°<\theta<140°$

Study from the PndPidCandidate class

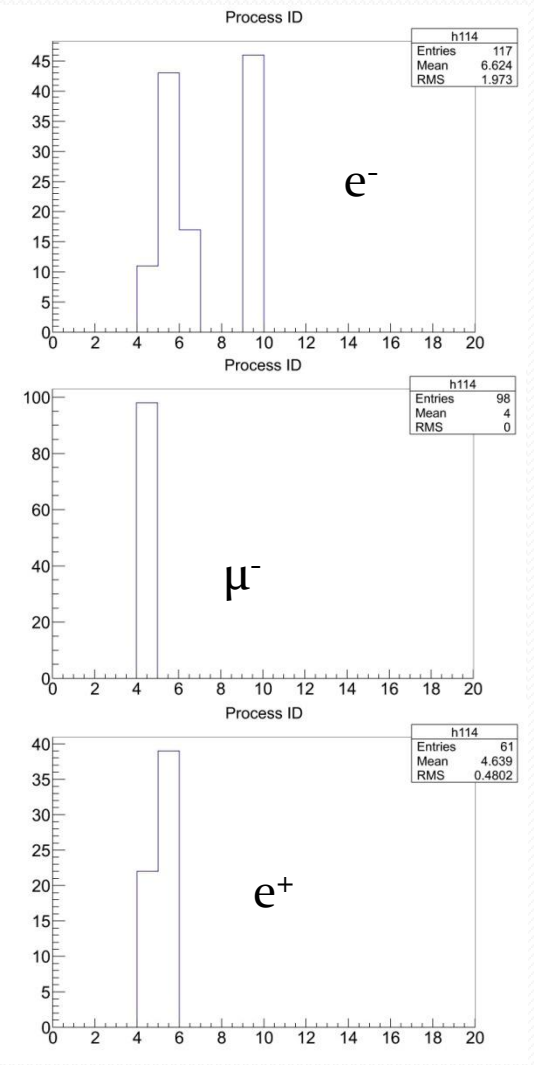
Tracks due to secondaries : 11.4%

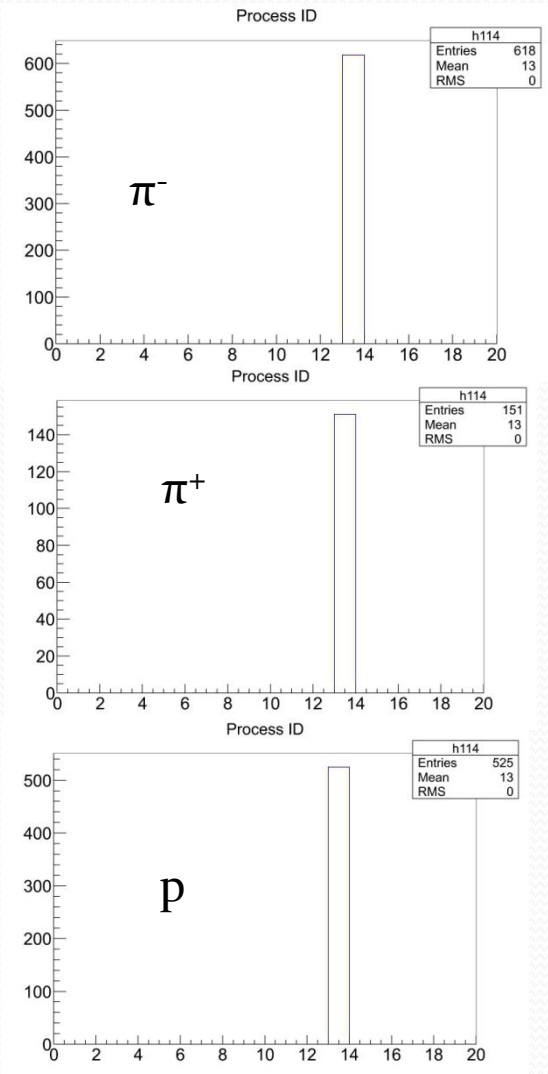




p : 554 (3.7%)
π^-: 578 (3.9%)
π^+: 165(1.1%)
μ^-: 95(0.6%)
.....

Origins of secondary particle(from primary π^-)





Process ID: read out from UniqueID

ID = 4 : particle decay
- → $\pi^- \rightarrow \mu^- \nu_\mu$bar
- → $\pi^0 \rightarrow \gamma\gamma \rightarrow e^+e^-\gamma$
- → $\mu^- \rightarrow e^- \nu_\mu\ \nu_e$bar
- → $\mu^+ \rightarrow e^+ \nu_e\ \nu_\mu$bar

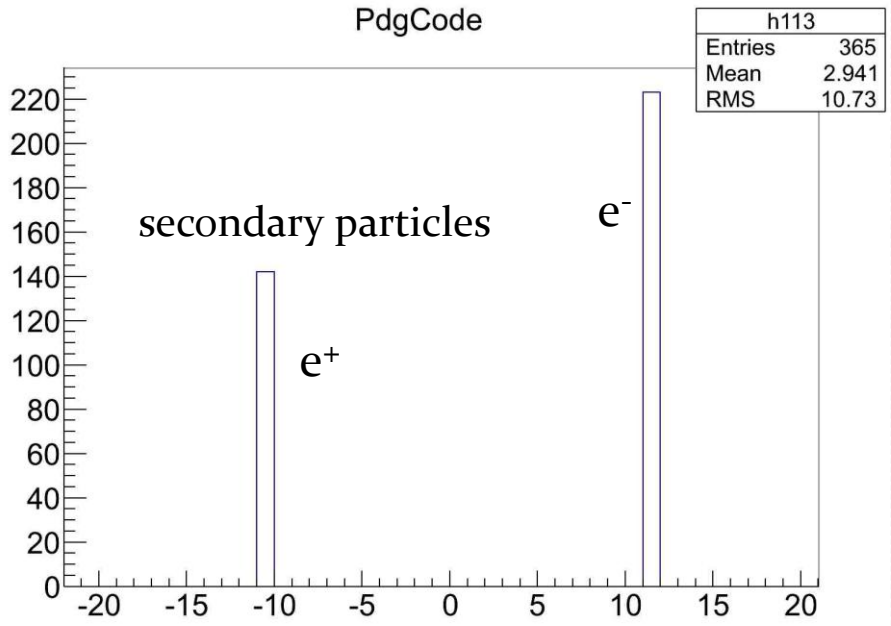
ID = 5 : pair production

ID = 6 : compton scattering

ID = 9 : delta ray

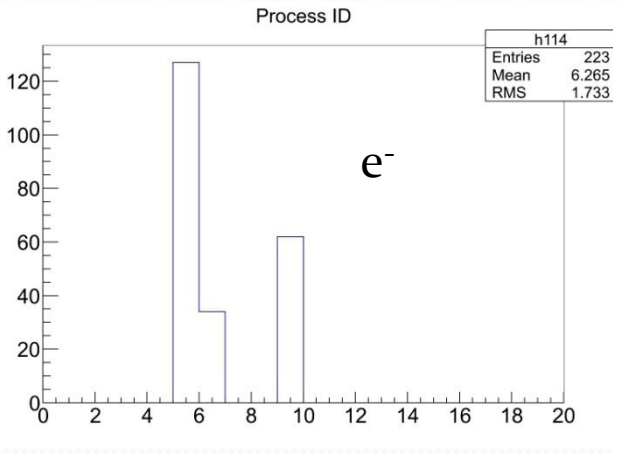
ID = 13: hadronic interaction
- → π^- A -> k(π) +……
- → π^- A-> np + ……

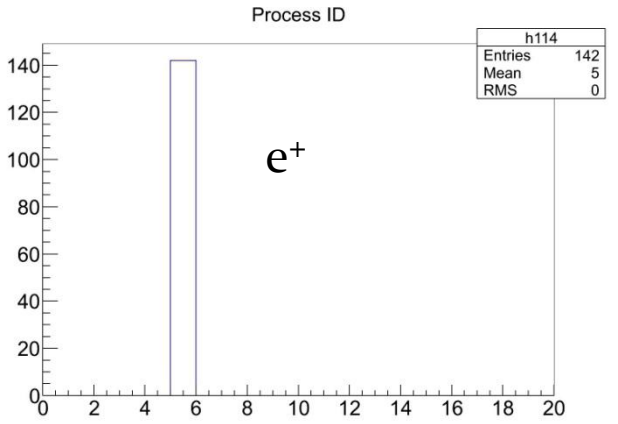
Simulation for electrons



Generate 15000 e^- single tracks, with $0.05<p<5GeV/c$, $0°<\varphi<360°$, $5°<\theta<140°$

Tracks due to secondaries : 2.4%





ID = 5: pair production
ID = 6: compton scattering
ID = 9: delta ray

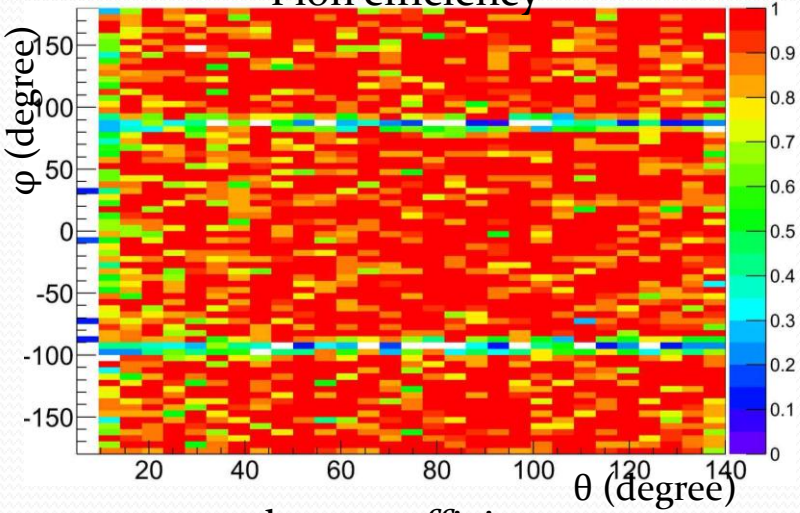
Procedure for efficiency calculation

- Generate e^-, μ^- and π^- single tracks, 15000 each, with $0.05<p<5GeV/c$, $0°<\varphi<360°$,$5°<\theta<140°$
- Run reconstruction with μ hypothesis
- Consider only tracks with most of the points belonging to the primary MC track
- Do the track_check (find the track with the nearest P_{rec} to P_{MC}) for each event.
- Calculate efficiency.
- Study the inefficiency to understand the reasons.

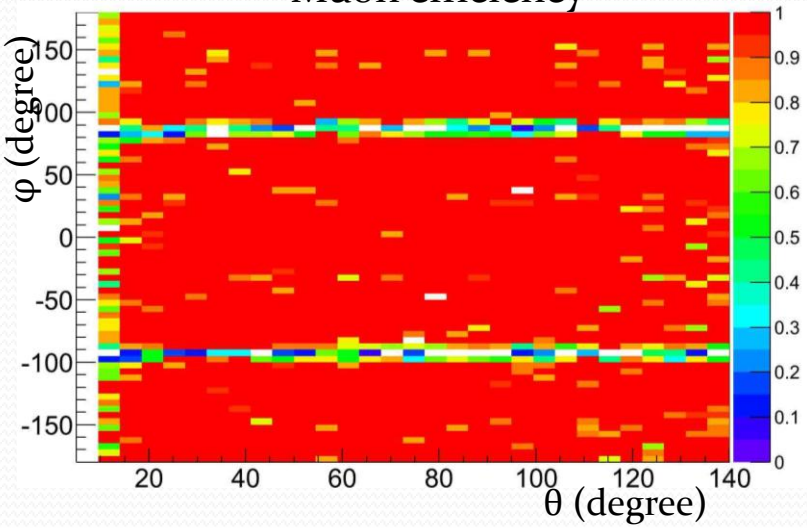
Angular dependence of efficiency

Transverse momentum(P_t) > 150MeV/c

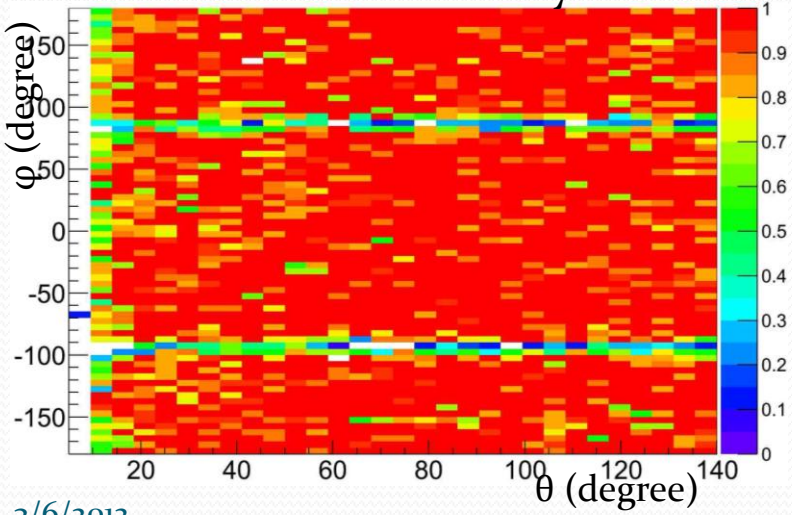
Pion efficiency



Muon efficiency



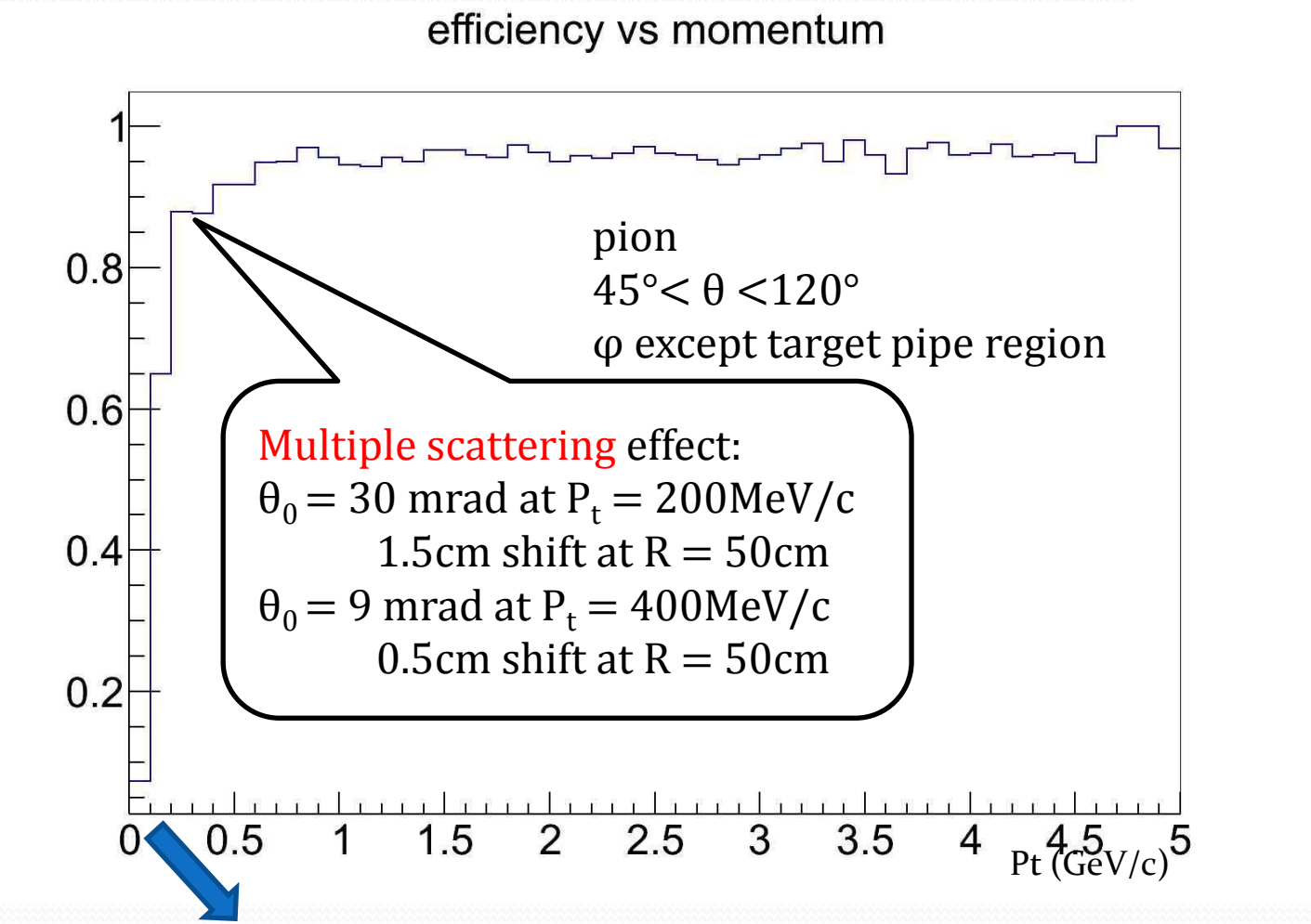
electron efficiency



$\varepsilon(p, \theta, \varphi) = N_{rec}(p, \theta, \varphi)/N_{MC}(p, \theta, \varphi)$

Inside STT acceptance, efficiency is homogenous for $20° < \theta < 120°$.

Momentum distribution of efficiency



Acceptance effect: $Pt_{min} = 150MeV/c$ to reach the ECAL

Efficiency comparison

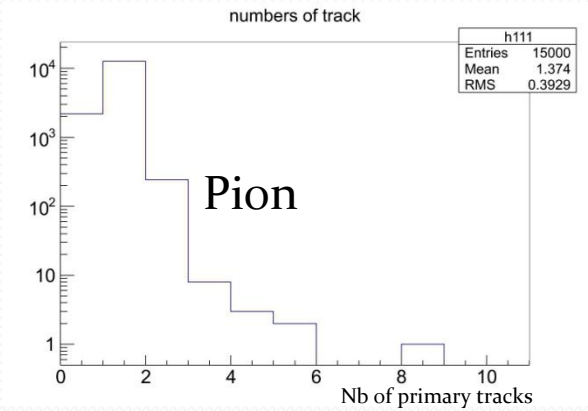
- Conditions: $\theta \in [45°, 120°]$, $\varphi \in [-180°,120°] \cup [-75°, 75°] \cup [120°,180°]$, Pt >150 MeV/c
- geometrical acceptance = 100%

particle	π^-	e^-	μ^-
efficiency	95.6%	98.6%	99.2%

Value form TDR:
(all phi, P = 1GeV/c):
$\theta = 50°$: 95.45%
$\theta = 90°$: 93.82%

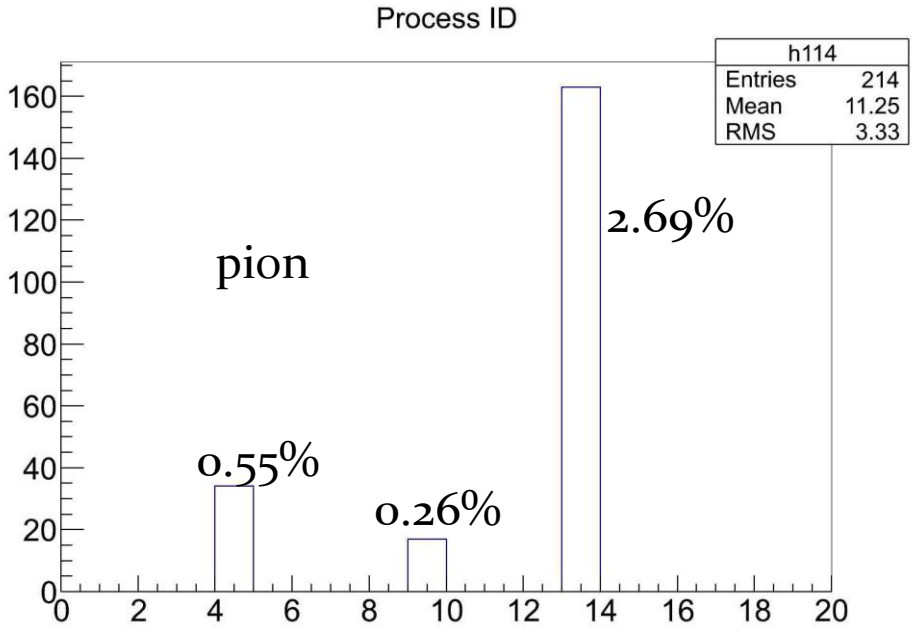
Understand of the origin of this inefficiency and the difference between the different particles

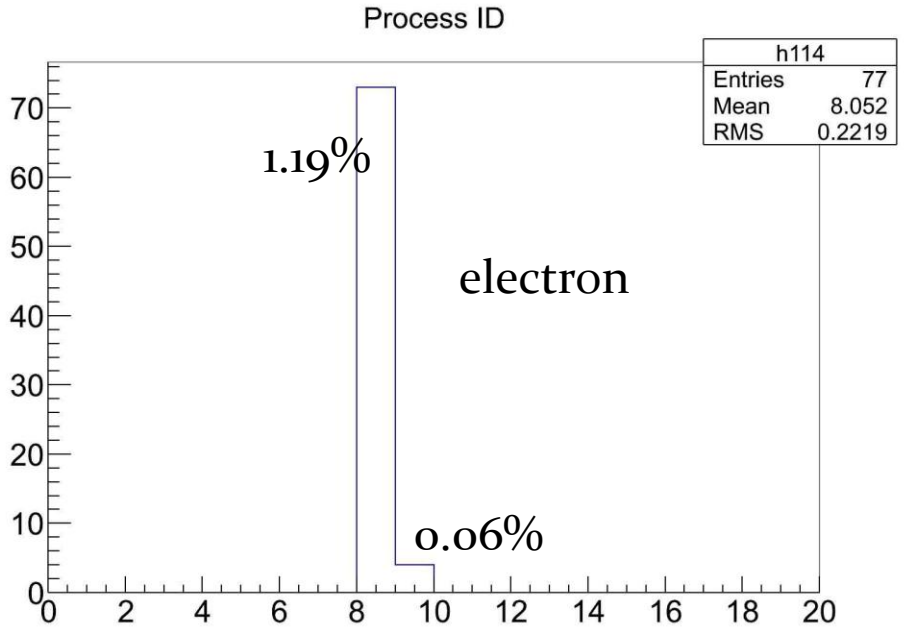
Study of events with no track associated to MC



Interaction with detectors

Readout from TMCProcess(root) class





ID = 4: particle decay
ID = 8: bremsstrahlung
ID = 9: delta ray production
ID = 13: hadronic interaction

For pion: strong interaction and electromagnetic interaction,
For electron: only electromagnetic interaction
For muon: interaction negligible

Other reasons

There are also some particles(let's call the number of this particle $N_{non\text{-}eff}$) passing all the tracking system, but were not reconstructed.

Then, we normalize this number with the number of particle who did not interact with the detectors(N_{event}-$N_{interaction}$).

The contributions of this part are:

Particle	π^-	e^-	μ^-
$N_{non\text{-}eff}/(N_{event}-N_{interaction})$	1.1%±0.17%	1.2%±0.24%	0.8%±0.1%

So, if we do not consider the particle interaction, these three efficiencies are the same.

Conclusion

- Angles and momentum acceptance of detectors checked
- Global understanding of the origin of secondaries
- After reconstruction ~11.4% of secondaries for π^-
  ~2.4% of secondaries for e^-
- The tracking system efficiency checked
- The efficiencies for e^-, μ^- and π^- are different due to the different interaction.
- There are also some unknown reasons for the efficiency losses, but this part is small(about 1% for each particle) independent of the type of particle.
- On-going work: electron momentum resolution.