IPN
INSTITUT DE PHYSIQUE NUCLÉAIRE
ORSAY

Early studies of STT response for π^- and e^- with PANDAroot

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Simulation for π^- and e^-

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

→ Acceptance considerations: select STT hits associate with π^- from MC track

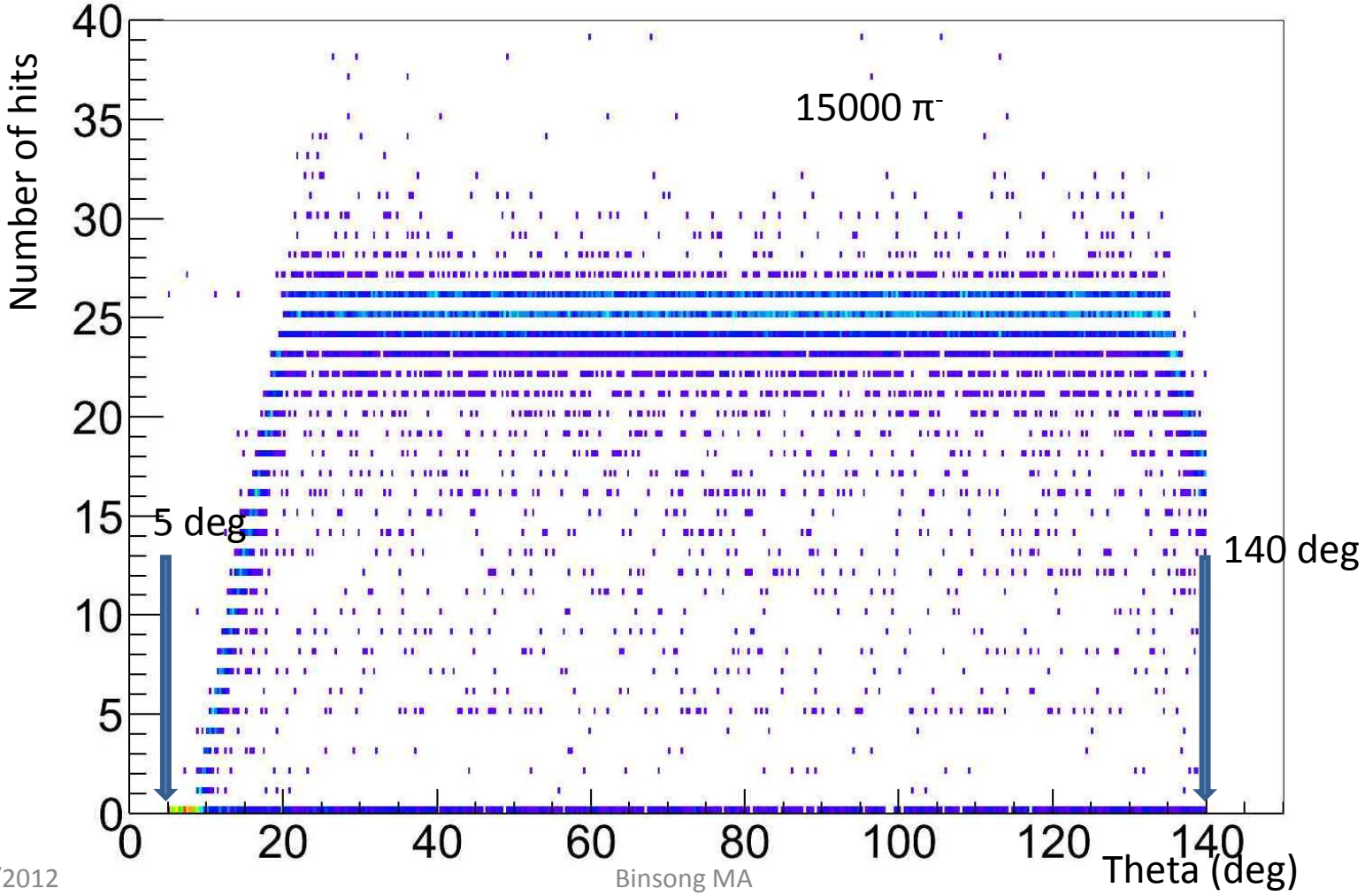
→ secondary particles study (π^- and e^-)

→ tracking system efficiency (π^-)

- 15000 events π^- and e^- with pgun mode (single particle events)
- Momentum: from 0.05 GeV/c to 5 GeV/c
- Theta : from 5° to 140°
- Phi: [0°,360°]

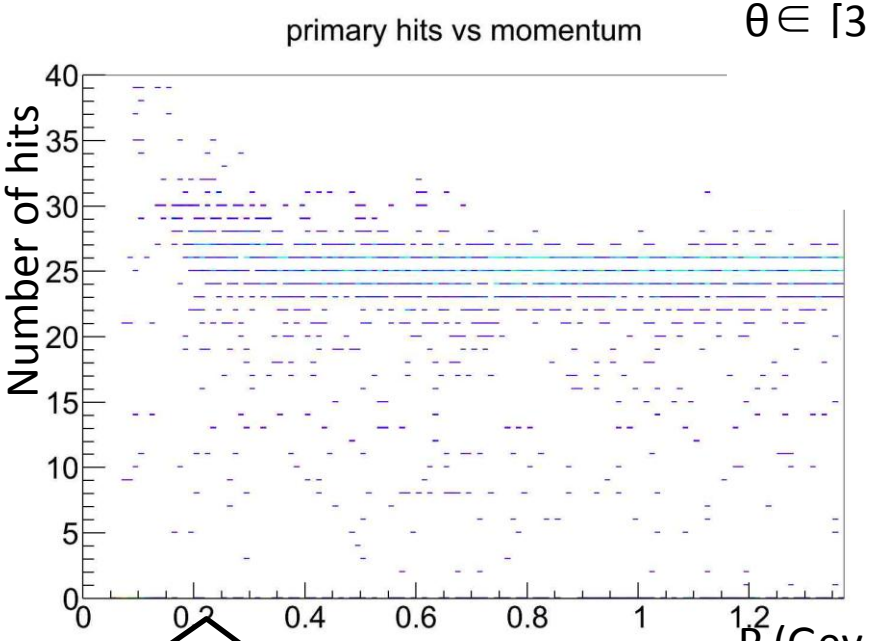
Numbers of STT hits for π^-

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

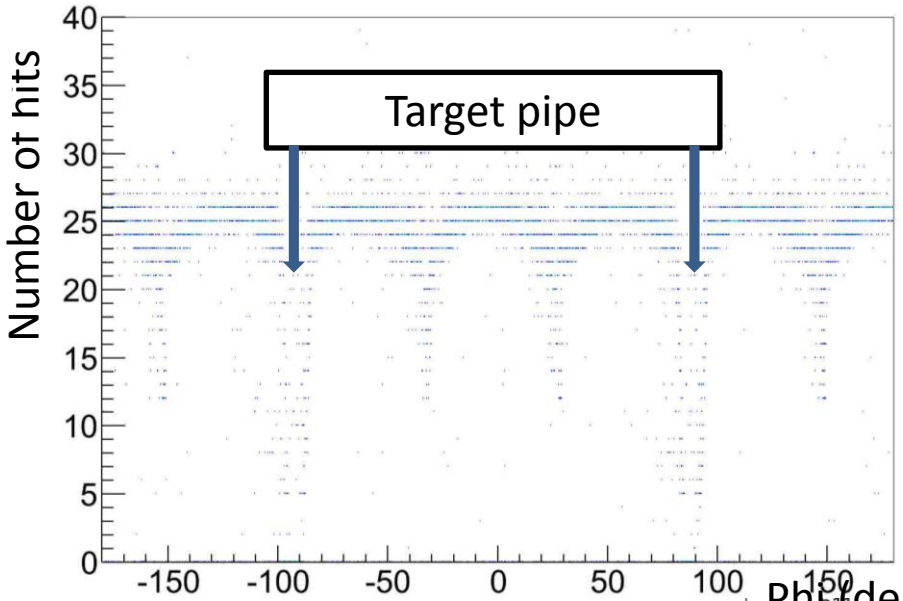


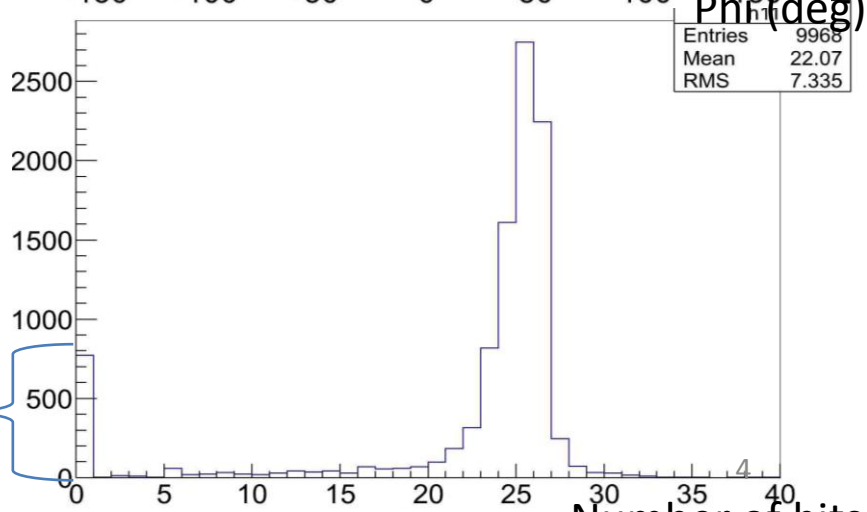
Dependence on momentum and ϕ

θ∈ [30, 120]



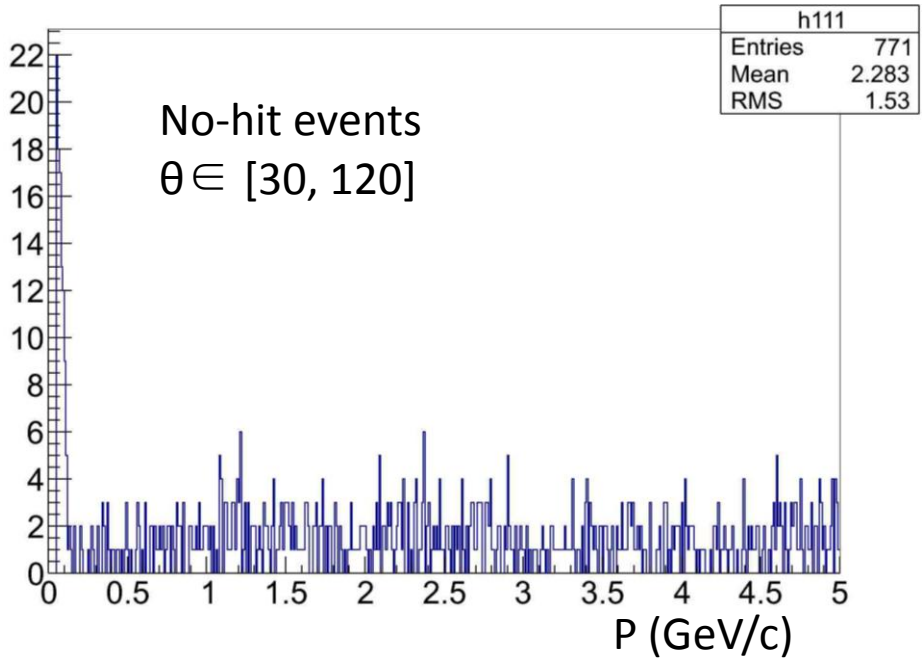
Low P region, more hits found (or less hits)

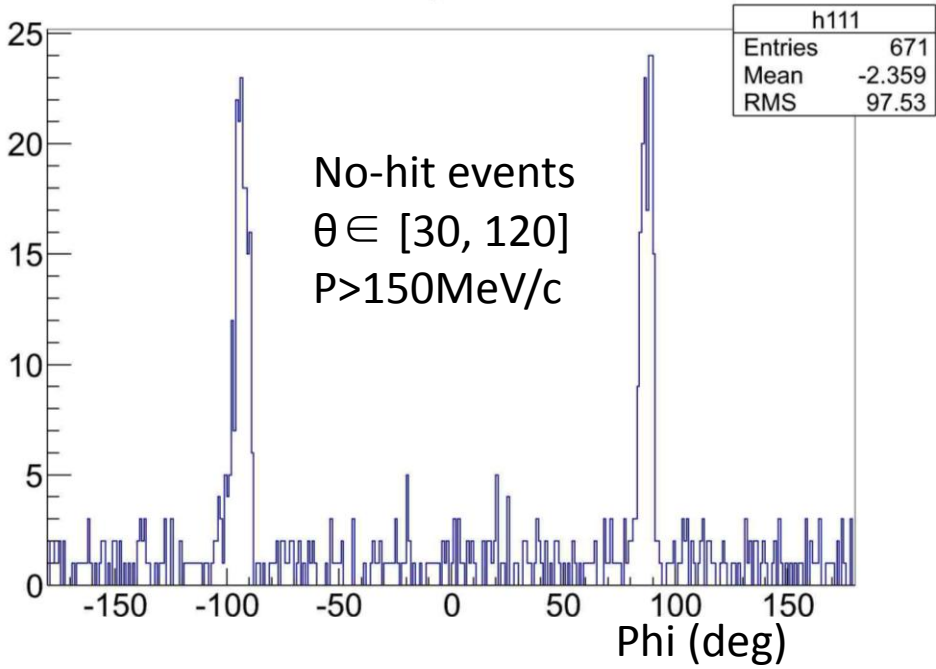




No hit events: 7.7%

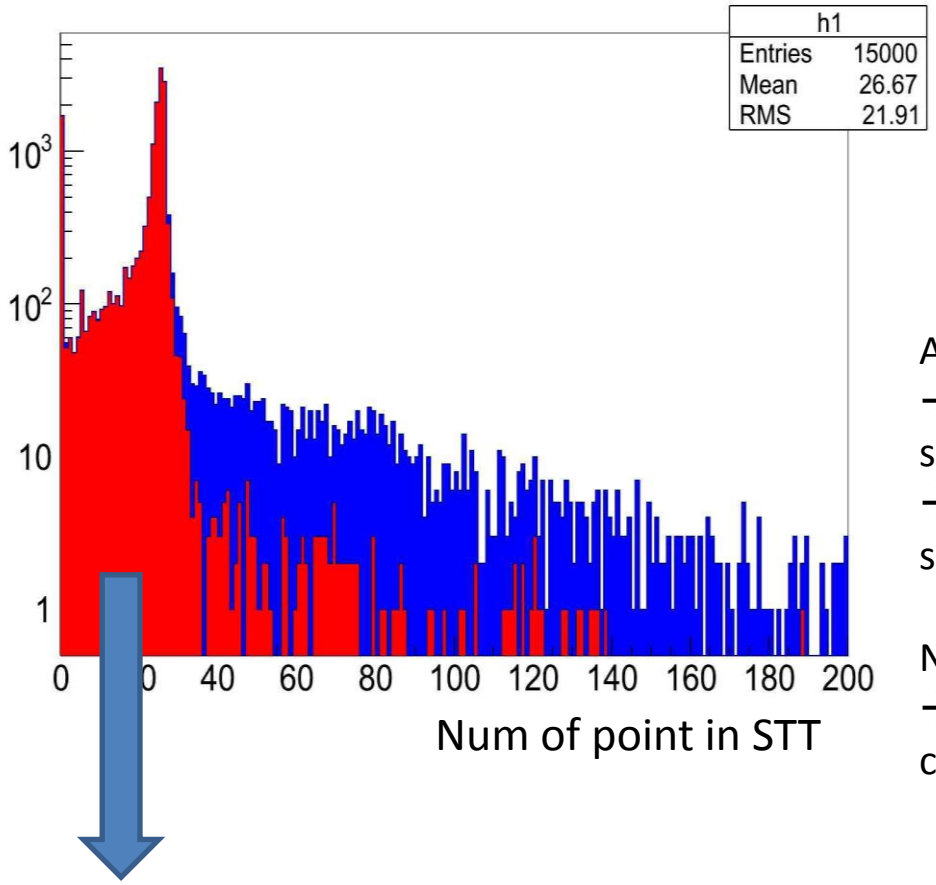
P and ϕ of no-hit events





Very low P particles(100/771 = 12.9%)
Particles drop in target pipe ((150+143)/771 = 38%)
Other reason: 49%

Secondary particle(from π^-) study



Red: points associate with primary π^- MC track

At the level of MC simulation(PndSttHit class):
→14.8% of events reaching STT with at least 1 secondary
→particle.29.1% of hits from STT associated with secondaries

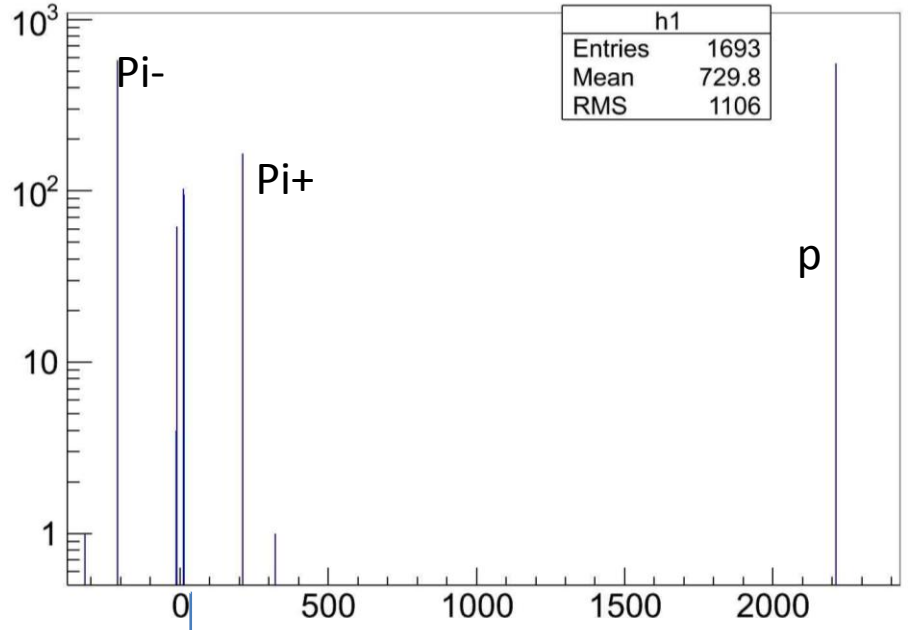
Nature of the reconstructed secondary particles?
→ Investigation in PndPidCandidate class (at least 1 charged track reconstructed)

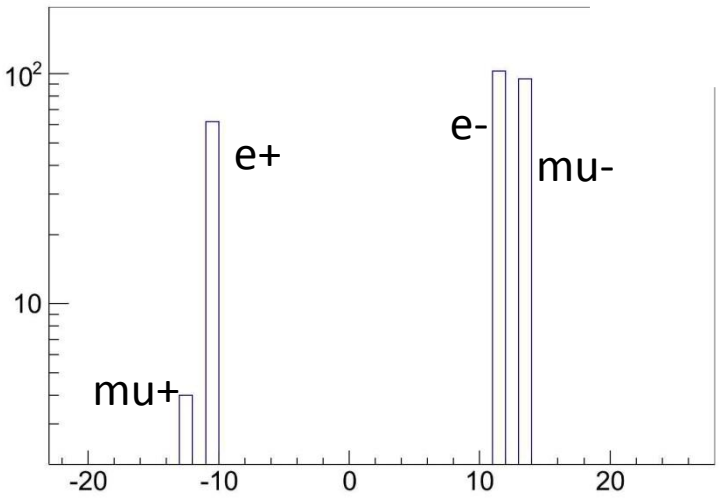
The secondary particles

Study from the PndPidCanditate class

Total numbers of track found: 14803

Numbers of track from primary π^- : 13110



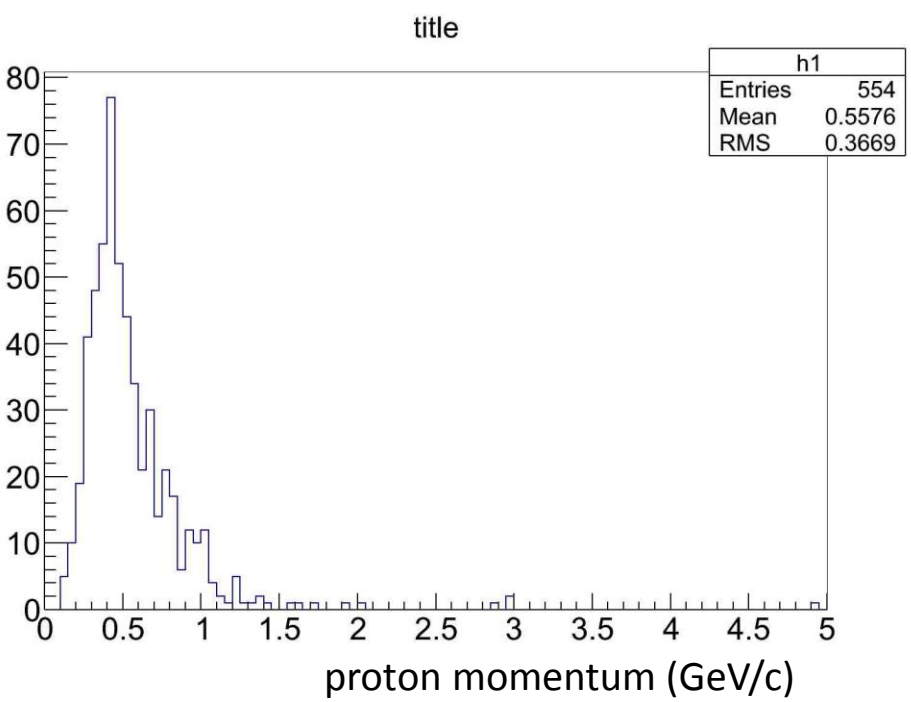


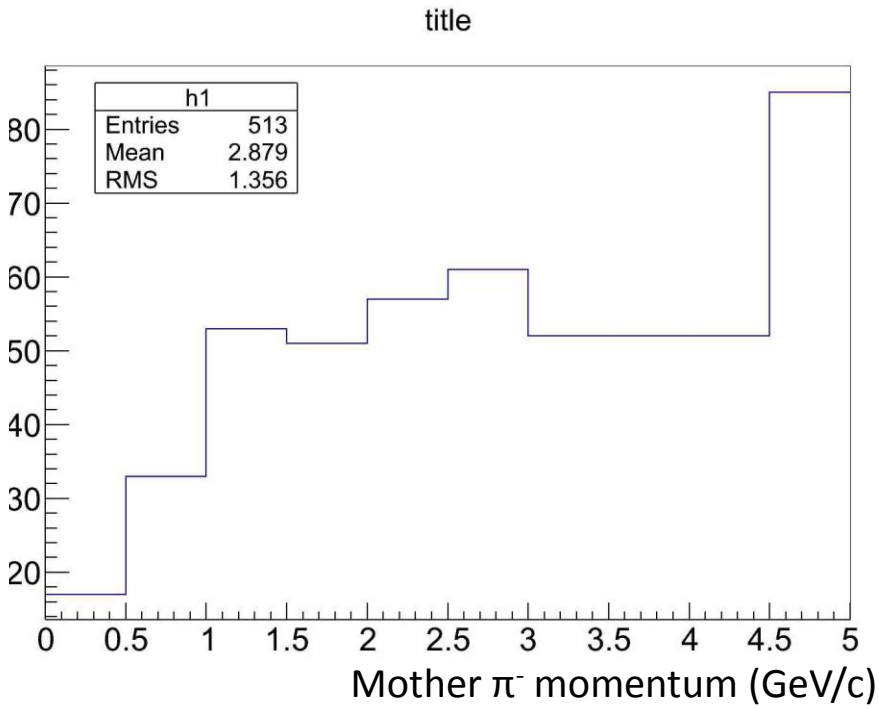
P : 554 (3.7%)
Pi-: 578 (3.9%)
Pi+: 165(1.1%)
Mu-: 95(0.6%)
…….

Origins of secondary particle

- Possible reactions producing secondary particle
- → $\pi^- \rightarrow \mu^- \nu_\mu bar$ (decay)($c\tau$= 780cm)
- → $\pi^- A \rightarrow k(\pi) +$…… (multi pion product)($\sigma \backsim$ 1 barn)
- $\pi^0 \rightarrow \gamma\gamma \rightarrow e^+e^-\gamma$ (conversion)(P = 2%~10%)
- $\pi^+ \rightarrow \mu^+ \nu_\mu$ (decay)
- → $\pi^- A \rightarrow np +$ …… (absorption)(σ~500mb)
- → $\pi^- A \rightarrow \pi^- A$ (elastic scattering)(σ~200mb)

Secondary proton study

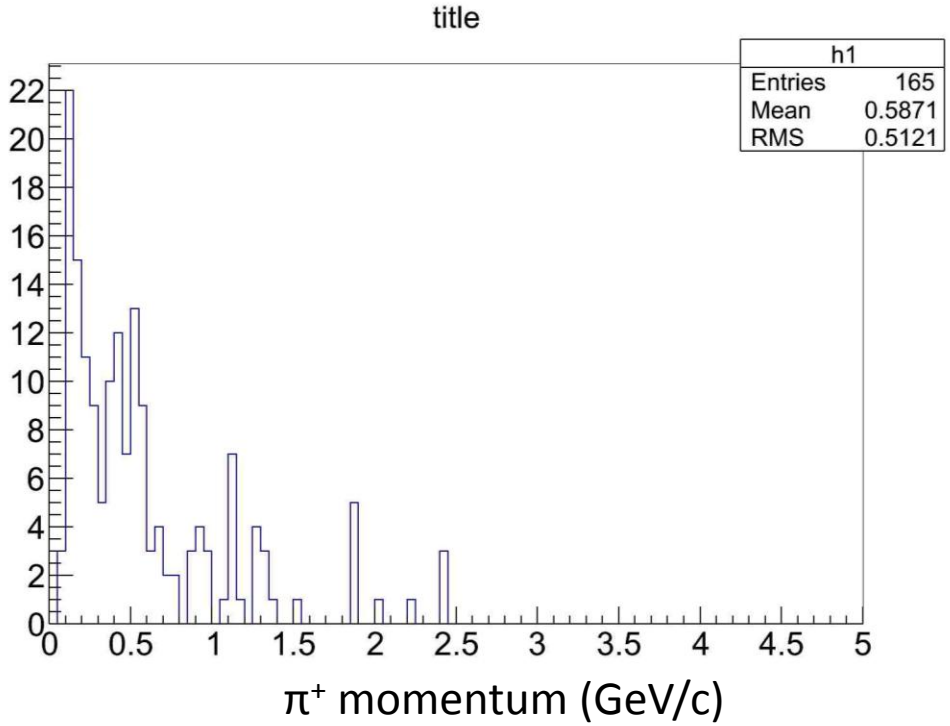


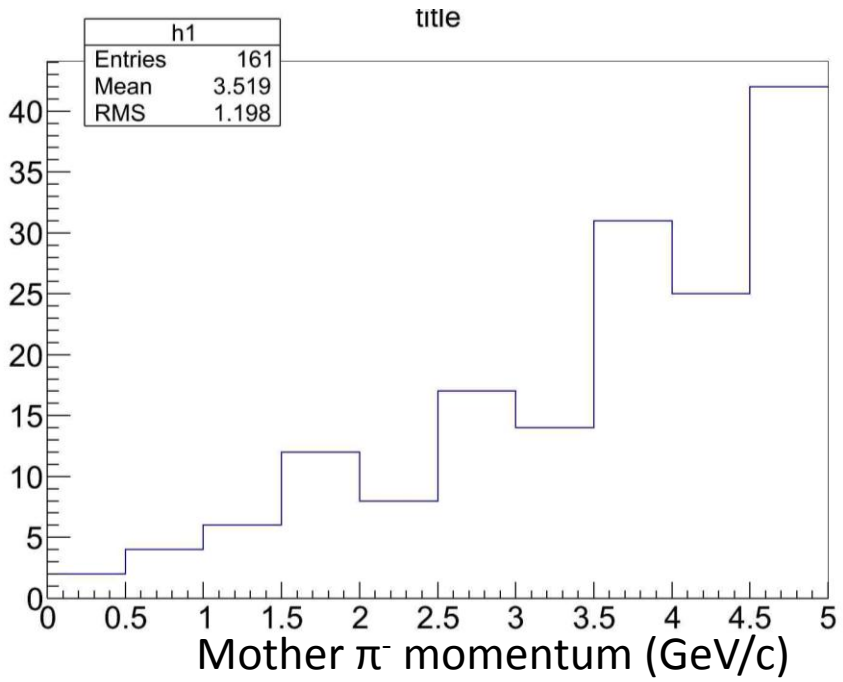


Low energy protons: <Tp> = 90 MeV

Contribution important for pions above 700 MeV/c

Secondary π^+ study

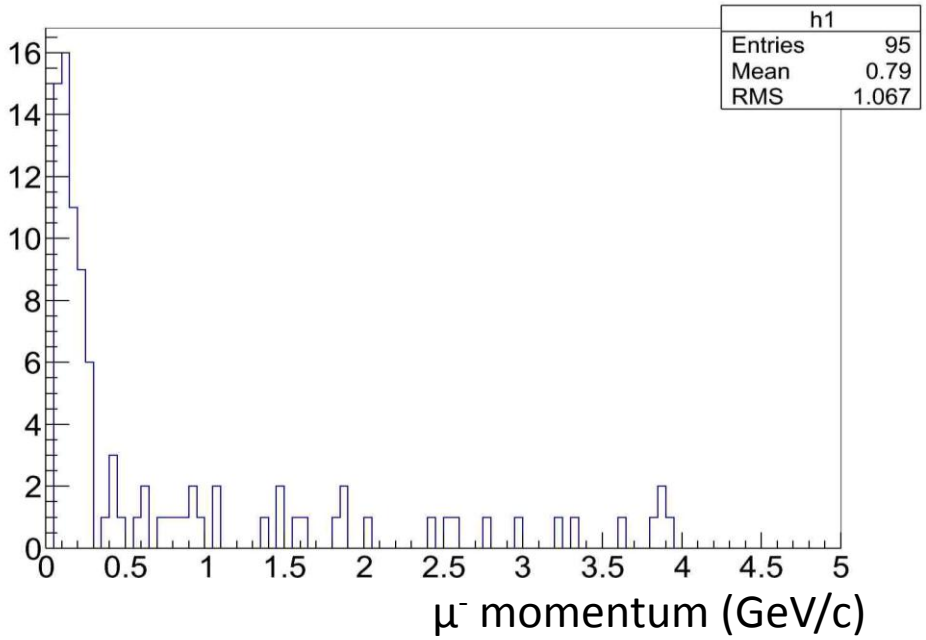


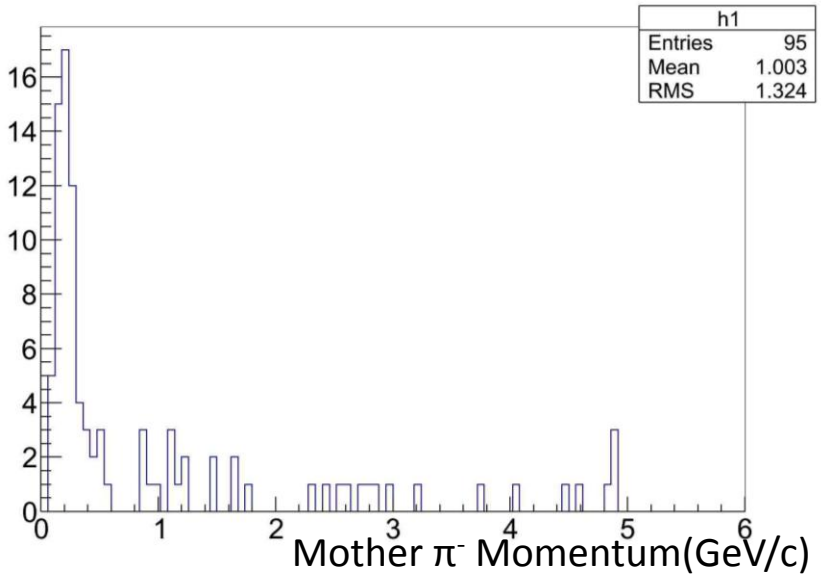


Low energy π^+ from multi-pion production

Rapid increase with P_{π^-}

Secondary μ^- study



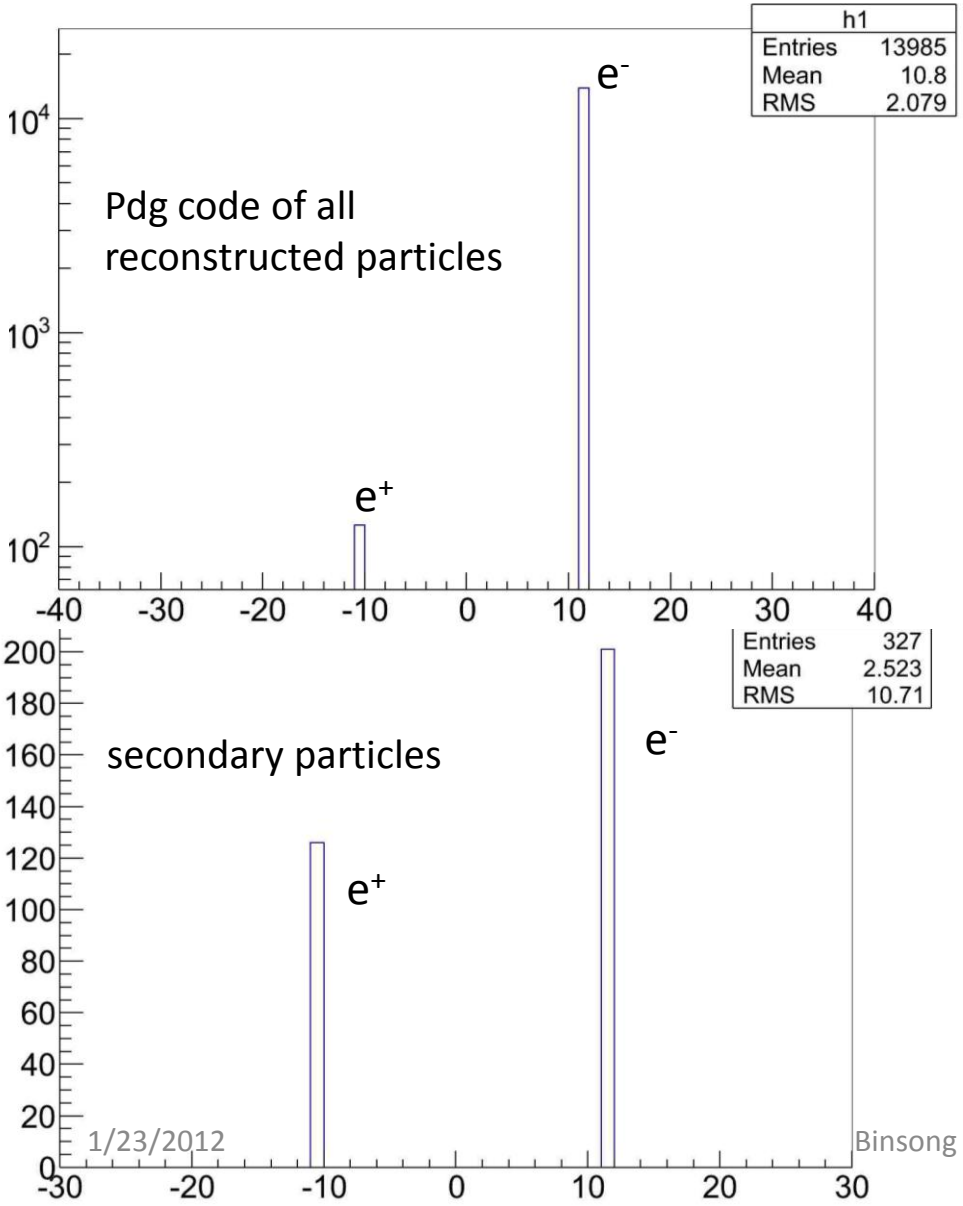


Prob(π^- decay): $p = 1 - \exp(-D/(\sqrt{(\gamma^2-1)}*c\tau))$

P(MeV/c)	At MVD entry	At STT entry	At STT exit
50	1%	4%	20%
>= 1000	0.25%	1%	5%

→ 0.6 % survive the reconstruction

Simulation for electrons

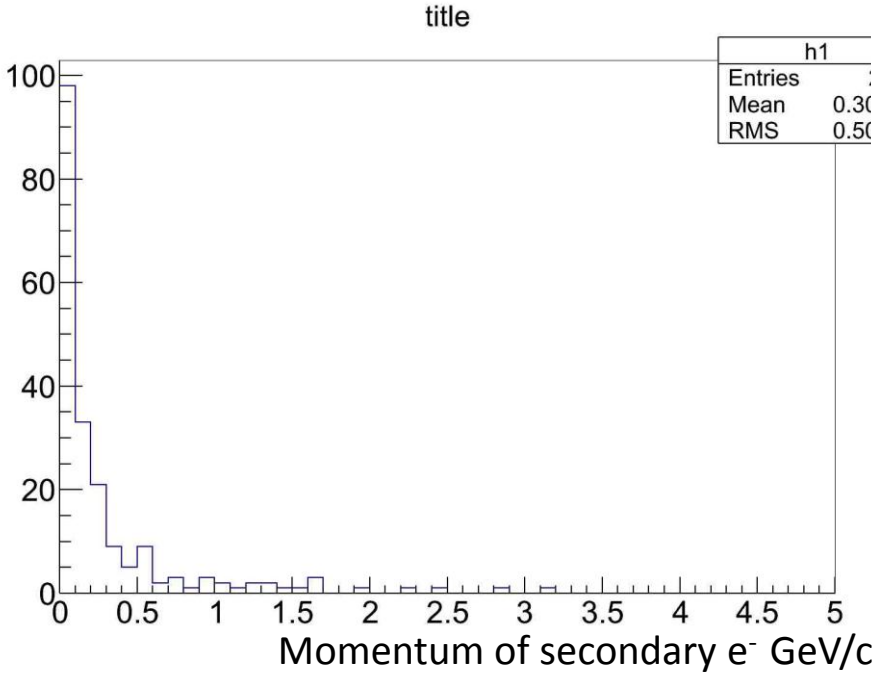


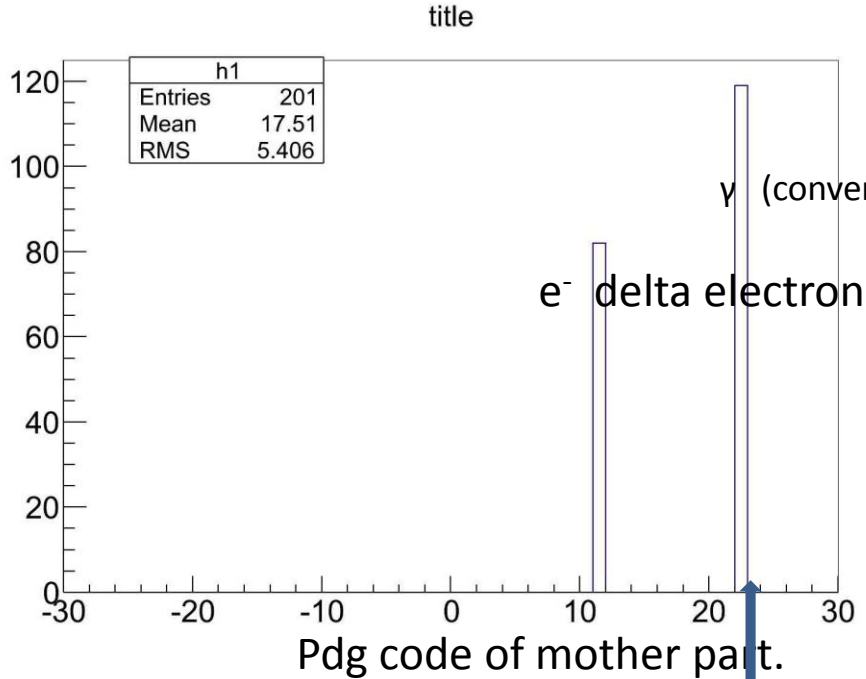
Based on reconstructed primary electrons

Reconstructed primary electron: 13658

Possible natures of secondary particles:
$e^- A \rightarrow e^- A \gamma$
$\gamma \rightarrow e^- e^+$ (conversion)
δ electrons

Secondary particles study





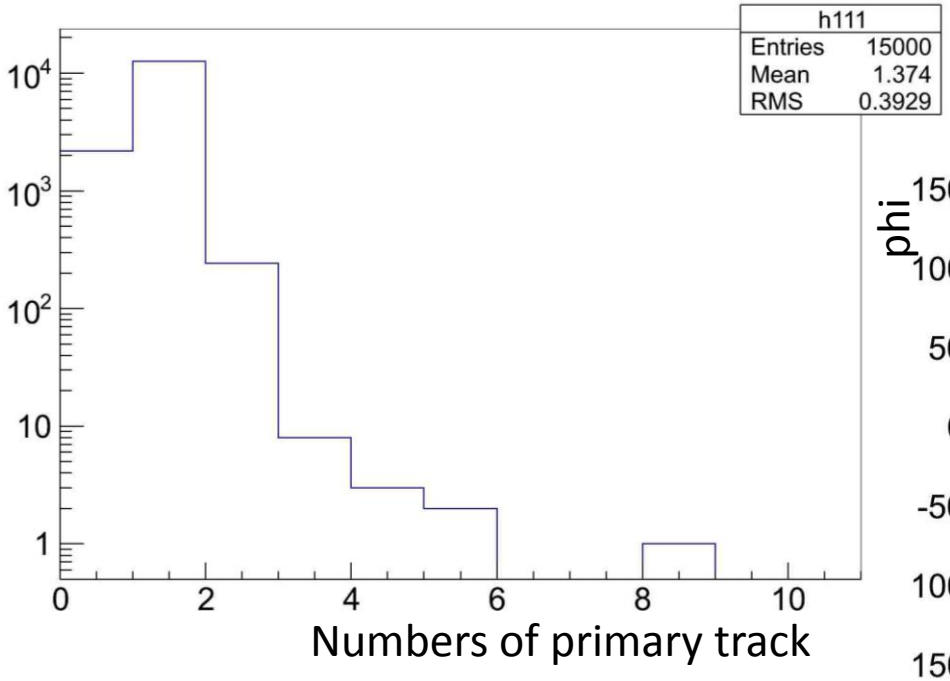
γ (conversions)

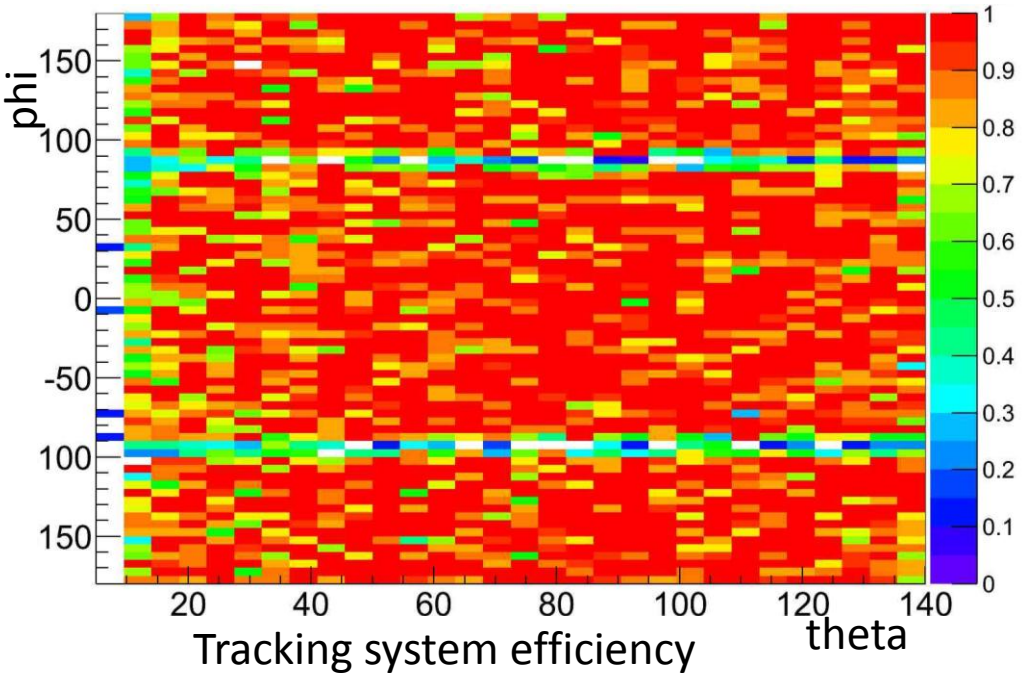
e⁻ delta electron

Very low energy secondary electrons

The same numbers of e^+

Tracking system efficiency study (π^-)





After reconstruction:
Numbers of events with at least 1 track associated to primary pion: 12818 (85.45%)

Conclusion and future work

- Simulation of π^- and e^- [50MeV/c, 5GeV/c]
- Production of secondary particles in MVD not negligible, 29.1% of STT points due to secondary particles (π^-)
- Global understanding of the origin of secondaries
- After reconstruction ~11.4% of secondaries for π^-
  ~2.4% of secondaries for e-
  dominated by low energy particle.
- Efficiency with π^- checked.
- Future work: continue to study the efficiency with more events
  momentum resolution