$\bar{p}p \to e^+e^-$ and $\bar{p}p \to \pi^+\pi^-$ studies with PANDAroot

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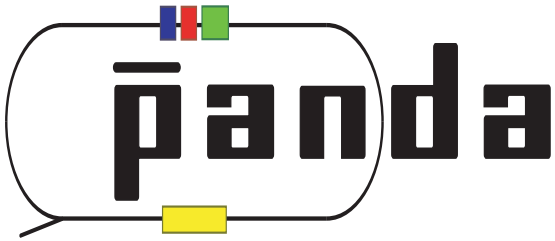


Outline

Feasibility studies for proton electromagnetic form-factors with the PANDA detector

Signal channel: $\bar{p}p \to e^+e^-$

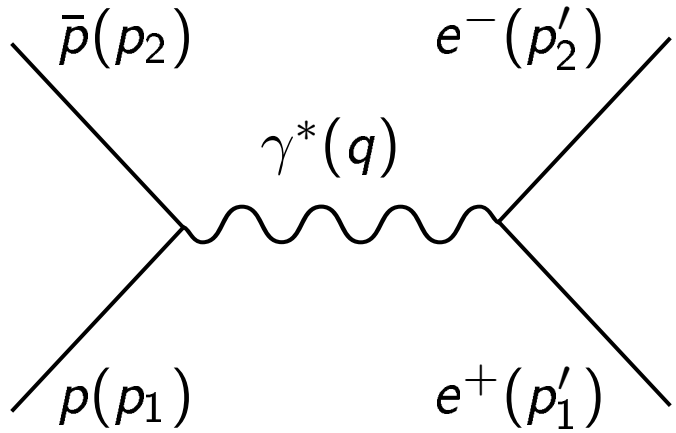
In one-photon exchange approximation:

$$\frac{d\sigma}{d\cos\theta} = C[|G_M|^2(1+cos^2\theta) + \frac{|G_E|^2}{\tau}(1-cos^2\theta)]$$

where $C = \frac{\pi\alpha^2(\hbar c)^2}{8m_p^2\sqrt{\tau(\tau-1)}}$

$\tau = q^2/m_p^2$

$\theta = angle(e^-\bar{p})$ in $\bar{p}p$ CMS frame



Background channel: $\bar{p}p \to \pi^+\pi^-$

$$\frac{\sigma(\bar{p}p \to \pi^+\pi^-)}{\sigma(\bar{p}p \to e^+e^-)} \sim 10^6$$

Simulations

Following channels were simulated

- $\bar{p}p \to e^+e^-$ [events: 1000000]
- $\bar{p}p \to \pi^+\pi^-$ [events: 1000000]

Kinematic parameters

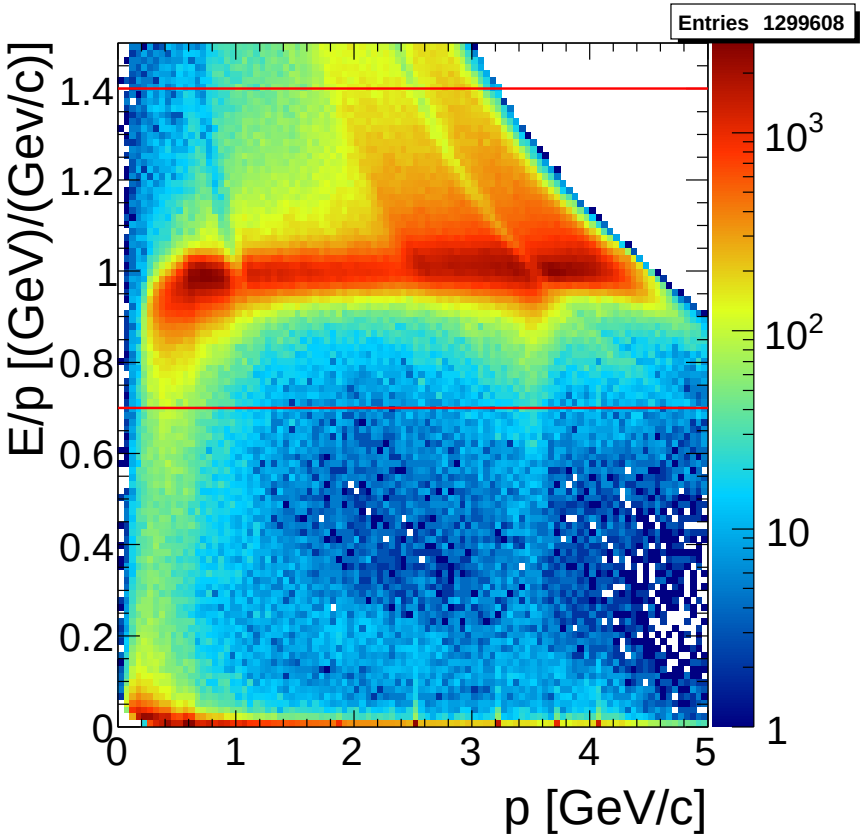
- $p(\bar{p}) = 4\,GeV/c$
- $-1 < \cos(\theta_{CM}) < 1$

Selection criteria for e^+e^-

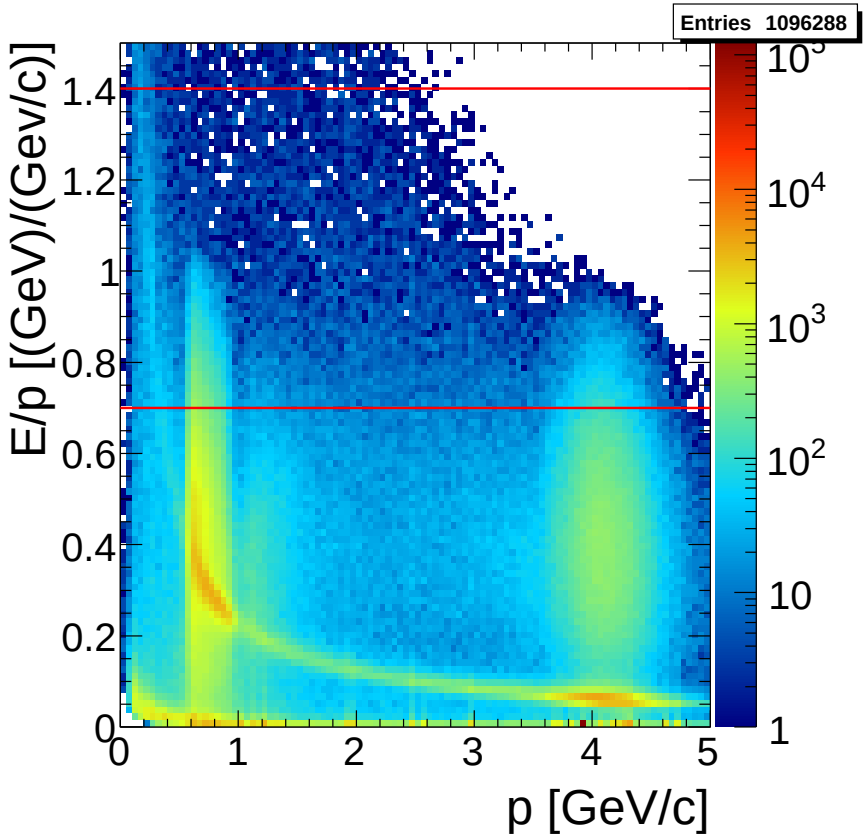
- Both positive and negative particle $0.7 < E/p < 1.4$
- Event must have only one positive and one negative particle after reconstruction
- Both positive and negative particle $\frac{dE}{dx}_{STT} > 5.8[GeV/g * cm]$
- Both positive and negative particle in CM frame
  $\sqrt{s}/2 - \lambda < E < \sqrt{s}/2 + \lambda$
  where $\lambda = (\sqrt{s}/2)/5$ For $P(\bar{p}) = 4\,GeV/c$,

  $\sqrt{s}/2 = 1.54\,GeV, \lambda = 0.31\,GeV$

Results from simulation using deposite energy from EMC and momentum provided by tracking

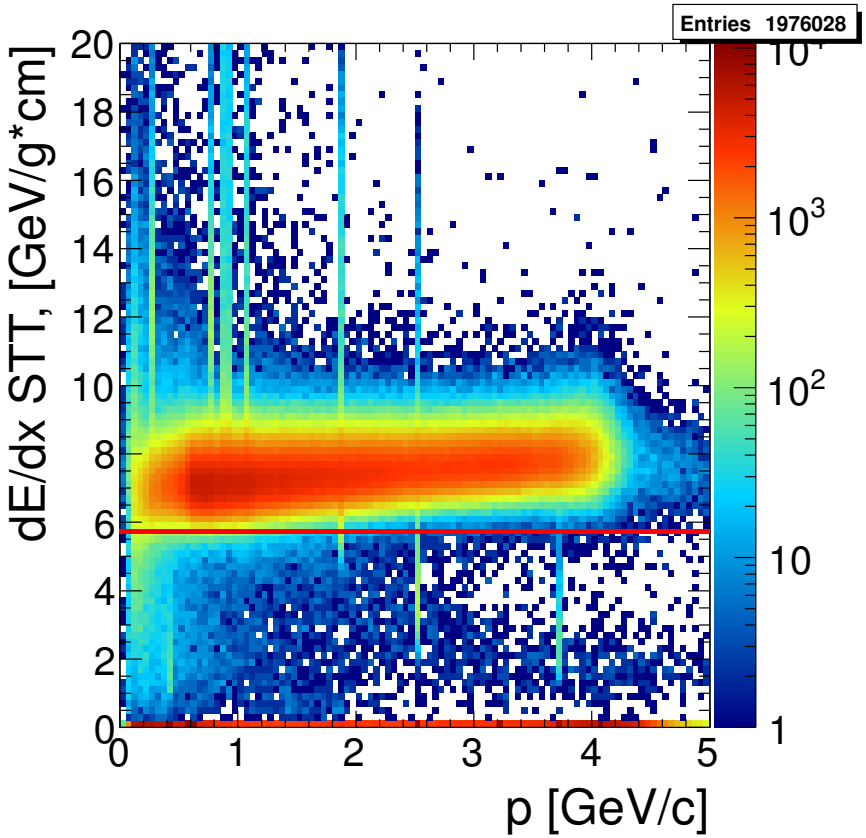


(a) $\bar{p}p \to e^+e^-$

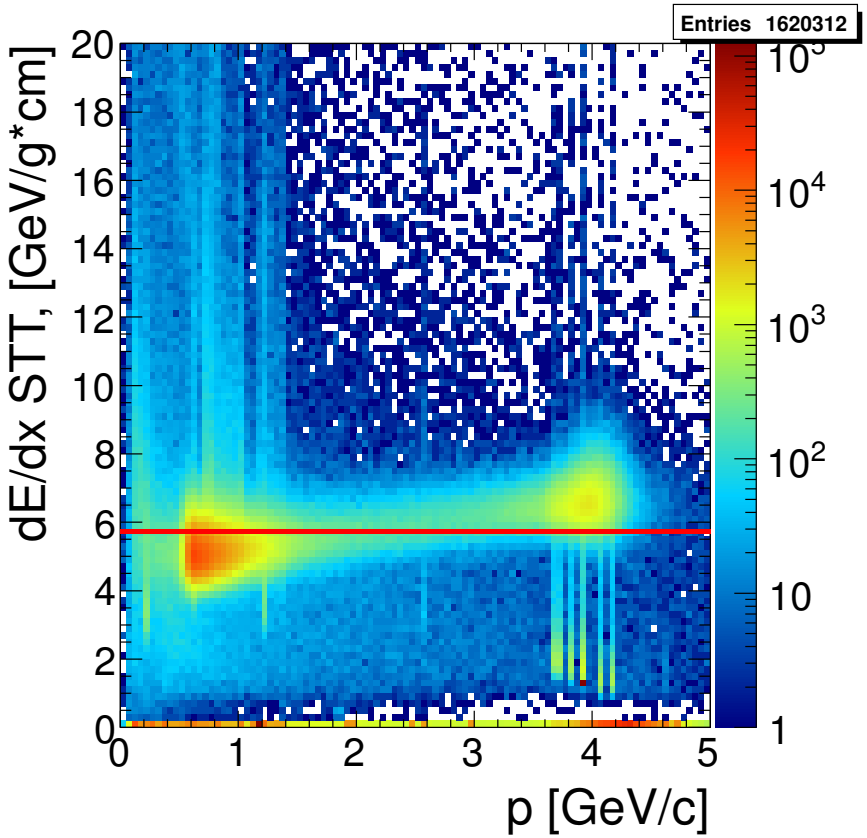


(b) $\bar{p}p \to \pi^+\pi^-$

Energy loss in STT

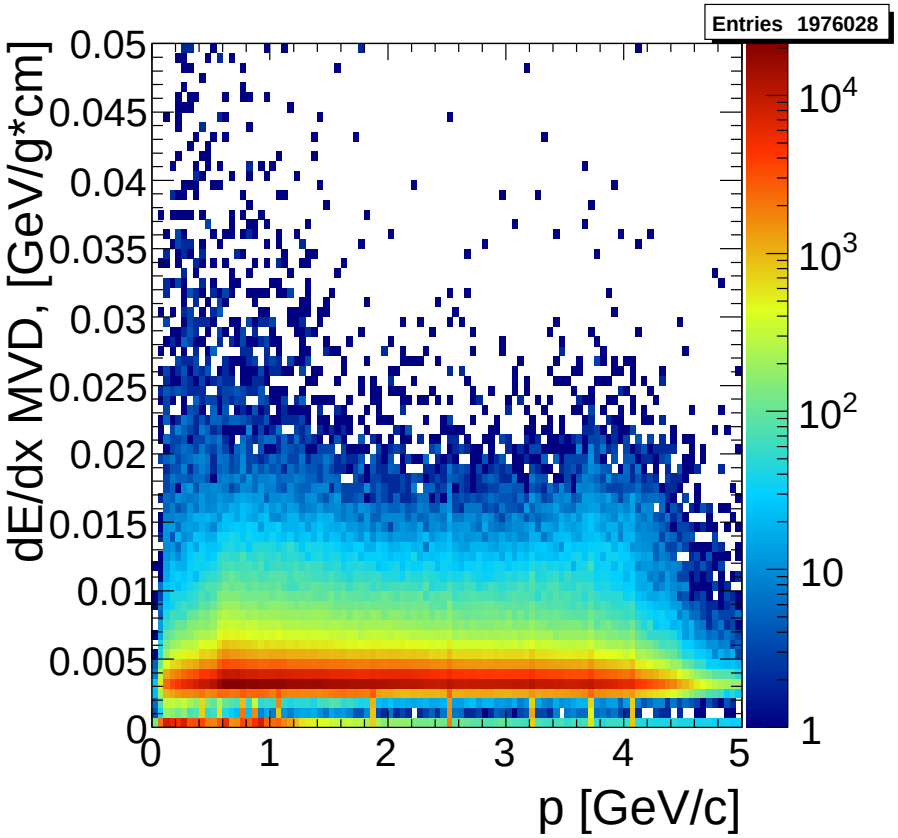


(c) $\bar{p}p \to e^+e^-$

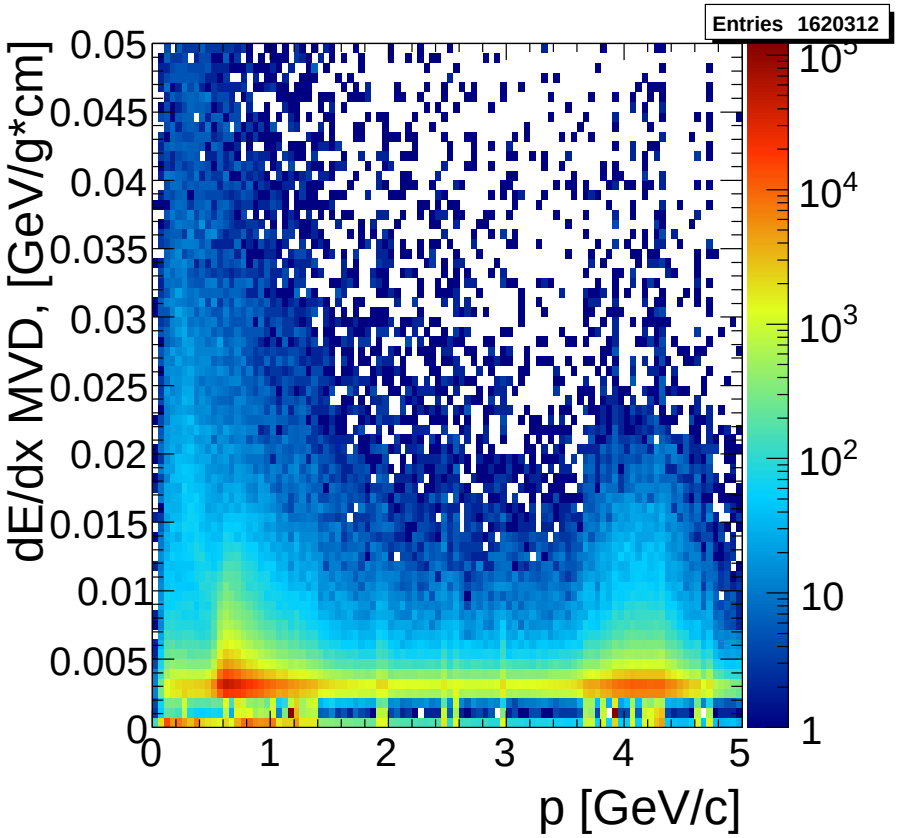


(d) $\bar{p}p \to \pi^+\pi^-$

Energy loss in MVD

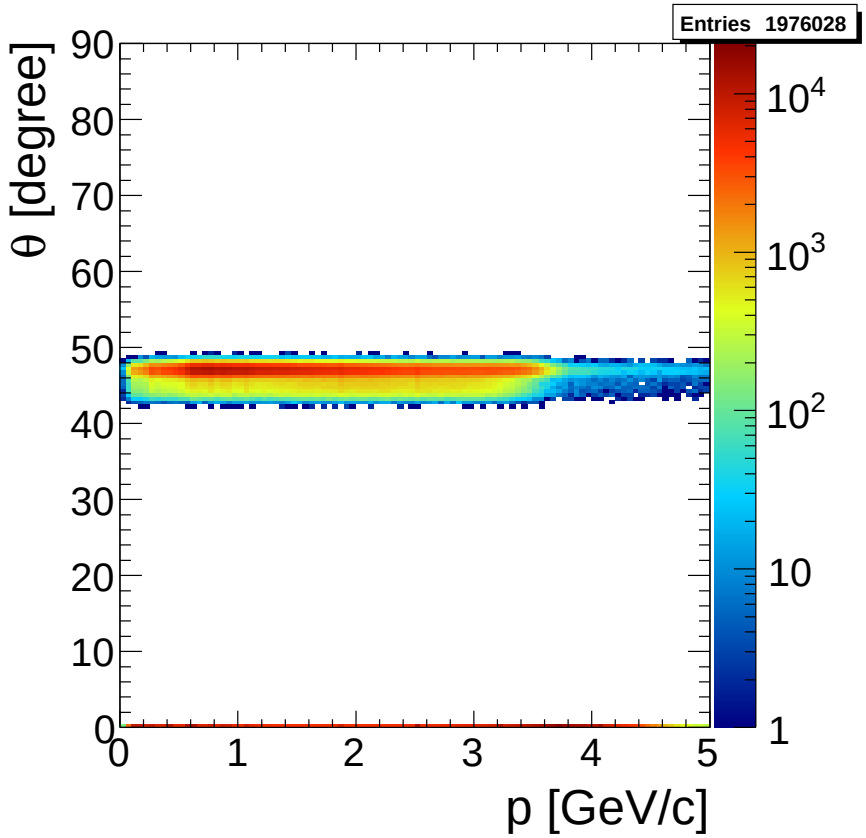


(e) $\bar{p}p \to e^+e^-$

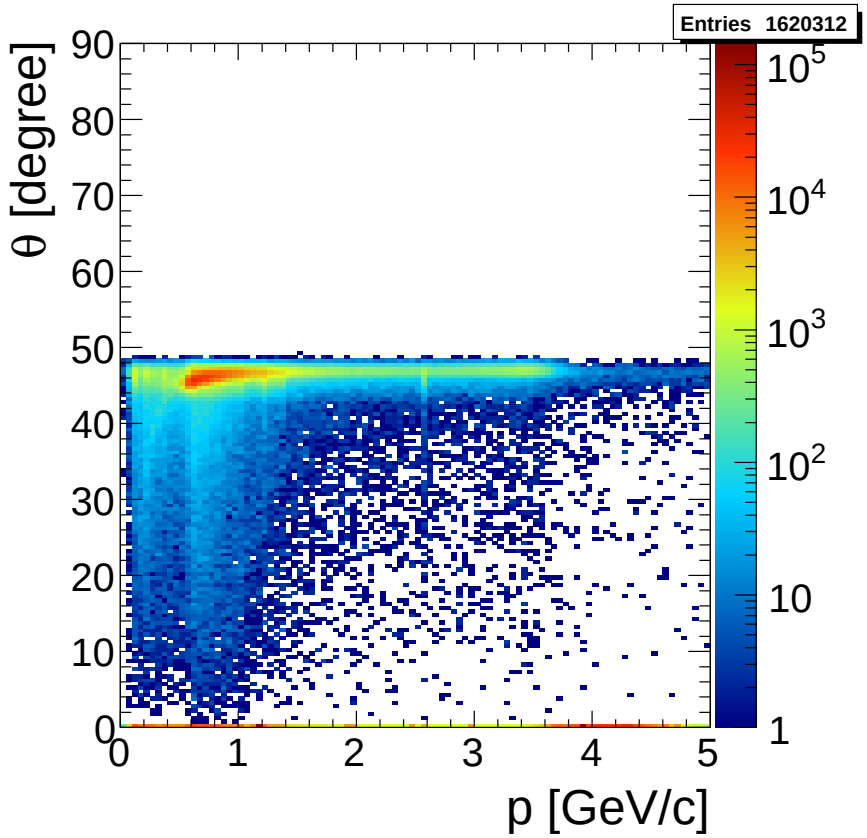


(f) $\bar{p}p \to \pi^+\pi^-$

Cherenkov angle provided by barrel DIRC

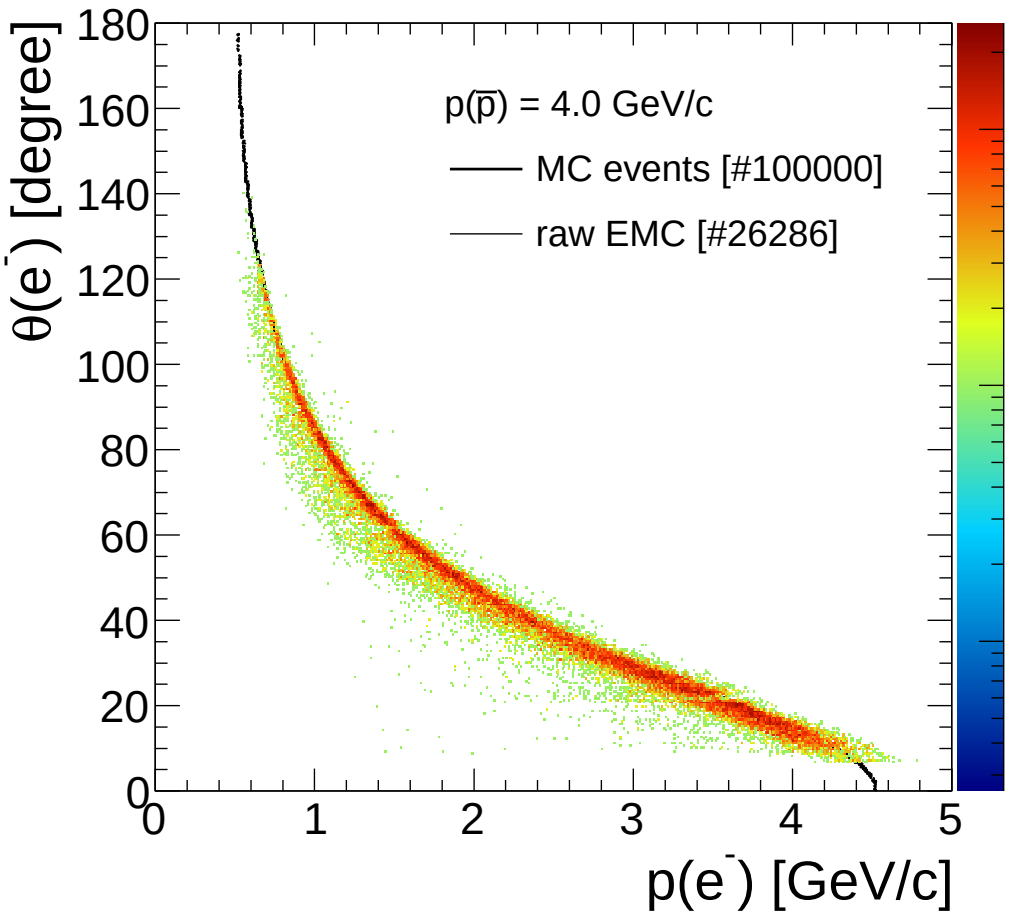


(g) $\bar{p}p \to e^+e^-$



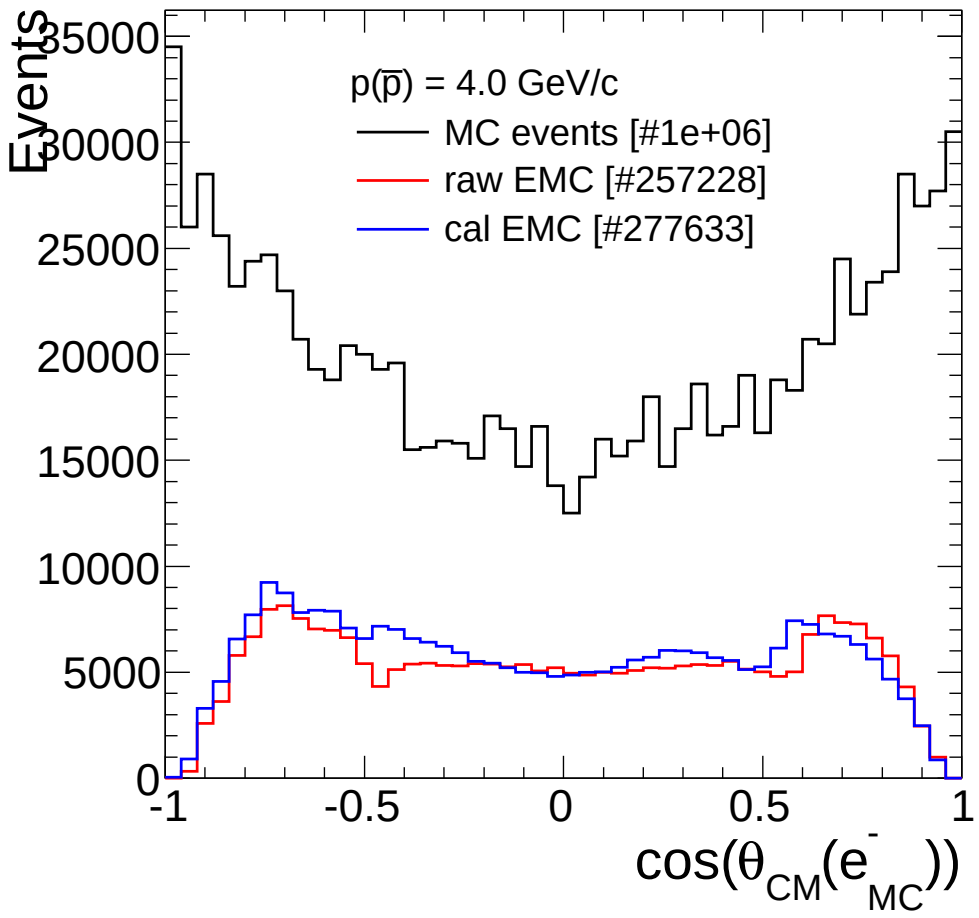
(h) $\bar{p}p \to \pi^+\pi^-$

θ angle of generated and reconstructed particles



(i) $\bar{p}p \to e^+e^-$

$cos\theta$ of generated and reconstructed particles in the CM frame



(j) $\bar{p}p \to e^+e^-$

Number of e^+e^- and $\pi^+\pi^-$ pairs left after the cuts

type of event	e^+e^-	$\pi^+\pi^-$
MC events	1000000	1000000
raw EMC + E/p cut	584309	715
cal EMC + E/p cut	568799	1088
raw EMC + all cuts	257228	0
cal EMC + all cuts	277633	0

Signal (e^+e^-) efficiency $25 - 27\%$
Background ($\pi^+\pi^-$) suppression 100% for 10^6 events

Conclusion and Outlook

Conclusion

- Developed set of cuts gives signal efficiency $25 - 27\%$
- Achived background rejection factor 10^6

Outlook

- Is it possible to get background rejection factor 10^8?
- Larger stastics for background channel