Gap-X-Gap studies: 2-track and 4-track exclusive events

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Contents

- Our cuts
- 2 tracks events analysis
- 4 tracks events analysis:
  - events with displaced vertices
  - events with primary vertex only

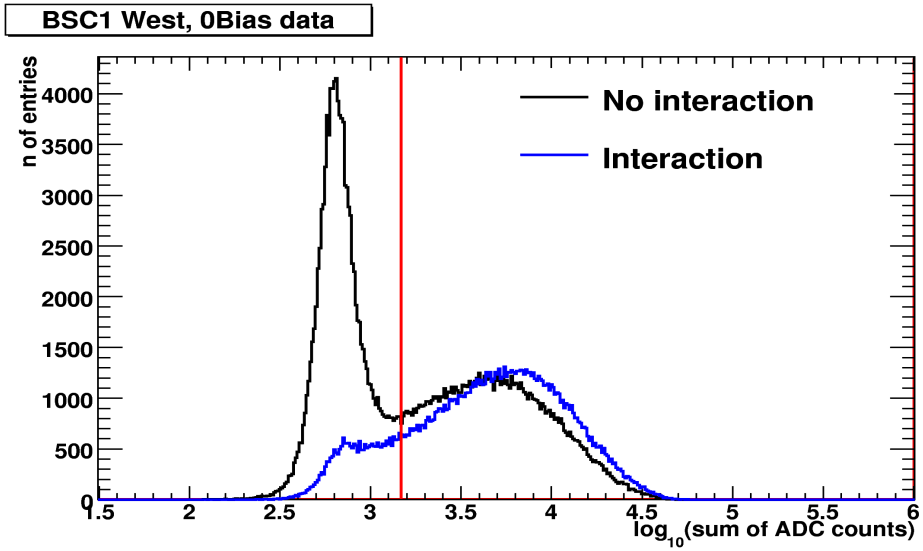
Triggers

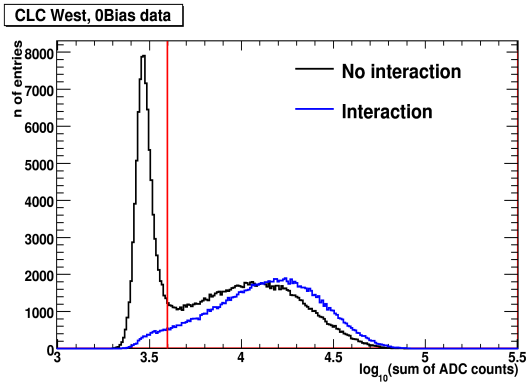
- BSC1 and CLC in veto both on west and east side
- Sum of E_t in Forward Plug < 0.75 GeV

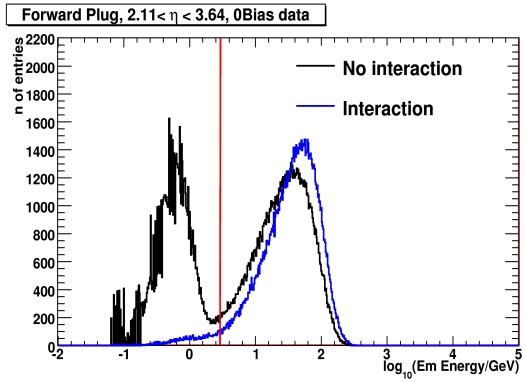
- **DIFF_TWO_CJET0.5_PLUGVETO_0.75**
  - **2 central towers with E_t > 0.5 GeV**
- DIFF_TRK2_PLUGVETO_0.75
  - 2 tracks with P_t > 2GeV
- DIFF_CJET5_PLUGVETO_0.75
  - 1 central jet with E_t > 5GeV

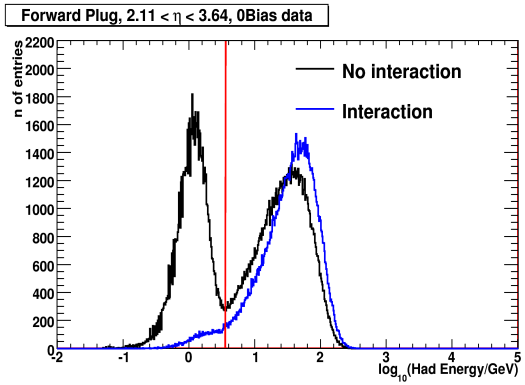
Offline gap cleanup - noise level

- 0Bias data separated into two samples
  - No interaction:
    - No tracks
    - No muon stubs
    - No hits in CLC
  - Interaction – rest



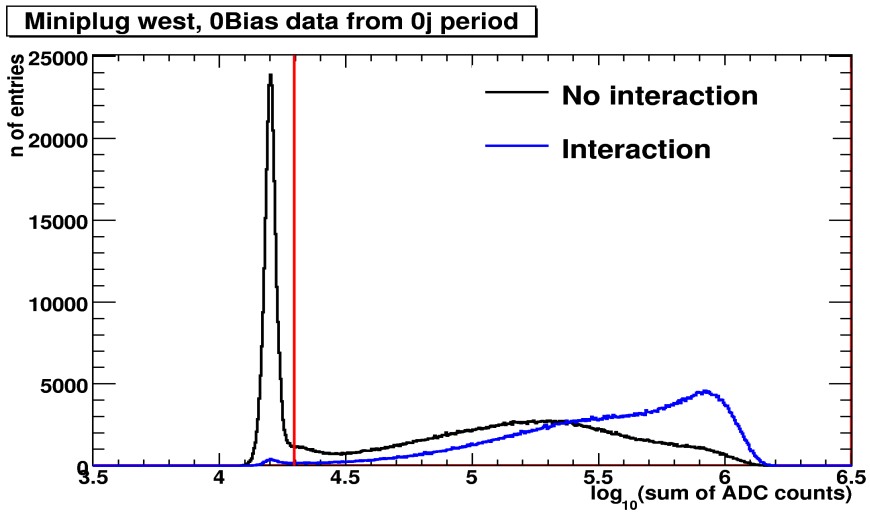


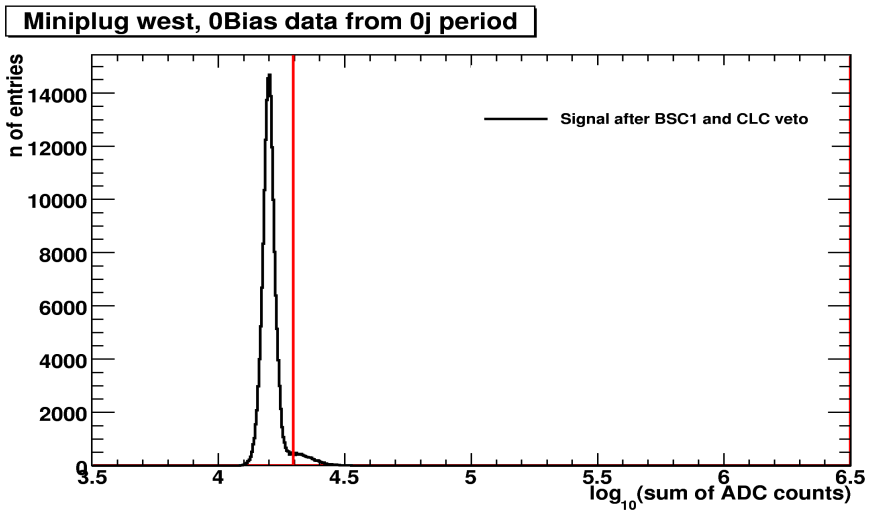




Gap between BSC1 and CLC

In similar way we used 0Bias data from 0j period to determine importance of 0.7 (5.4-4.7) rapidity units coverage gap between BSC1 and CLC after veto on them.

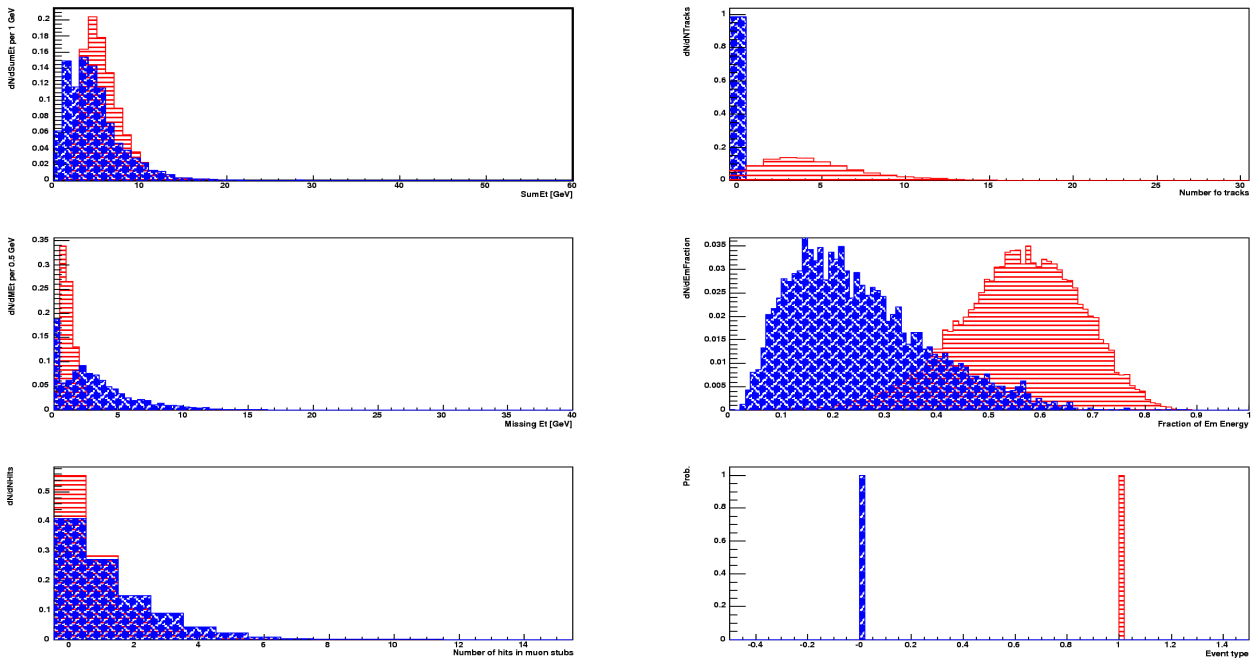




Neural Network cleanup

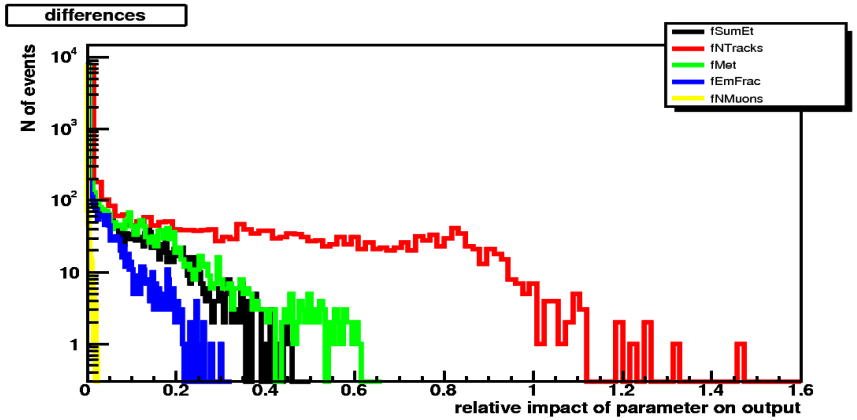
Scan over 20000 events - 24.10±0.35% are background events:

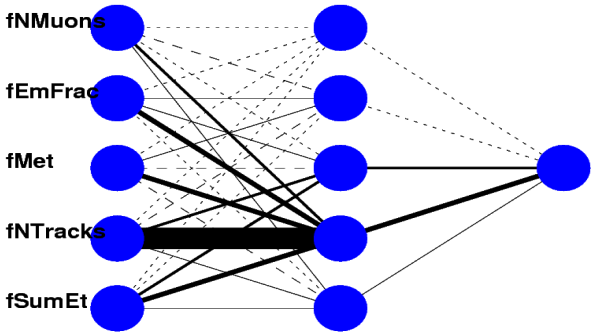
Beam Halo, Cosmics, Empty
Key variables :

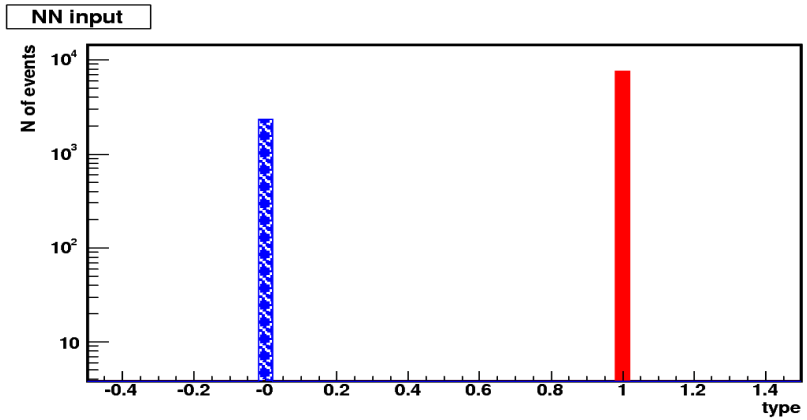


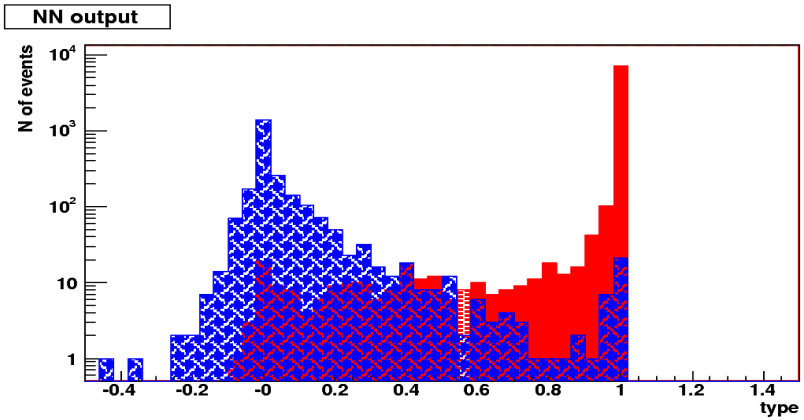
Neural Network cleanup

Results





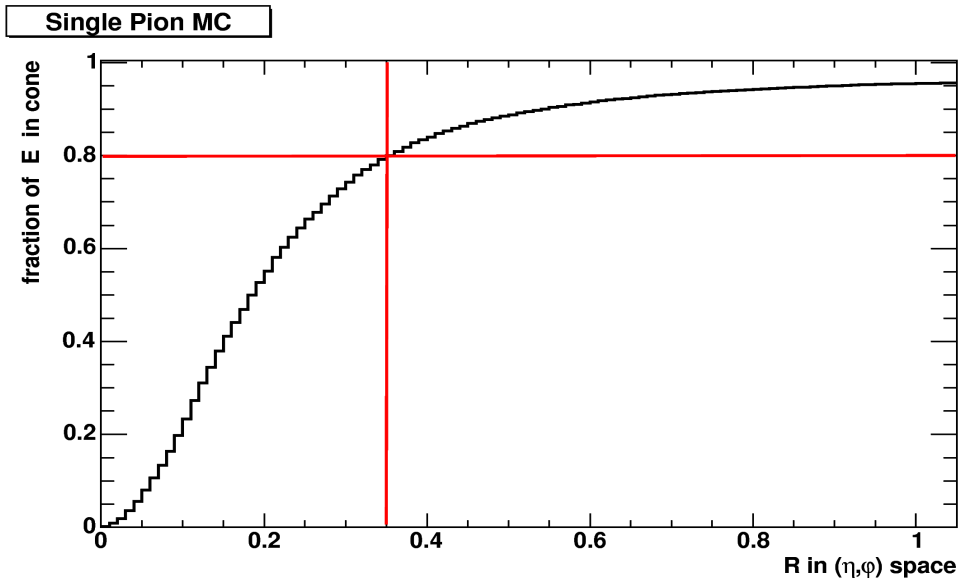


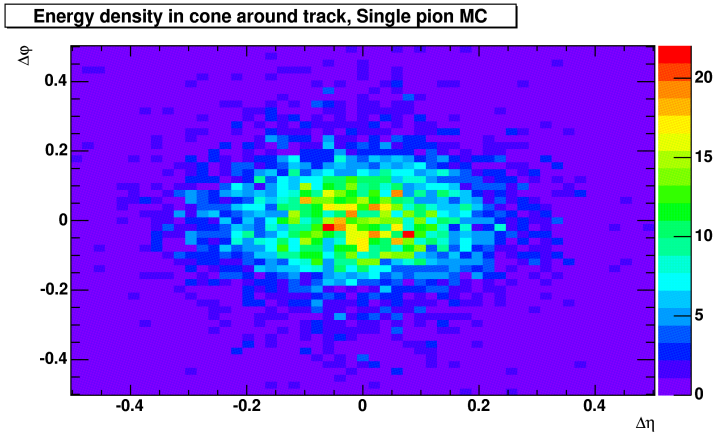


Exclusivity cuts

Require everything outside of cone in (phi,eta) space to be at noise level.

Cone radius for Fake Event MC:



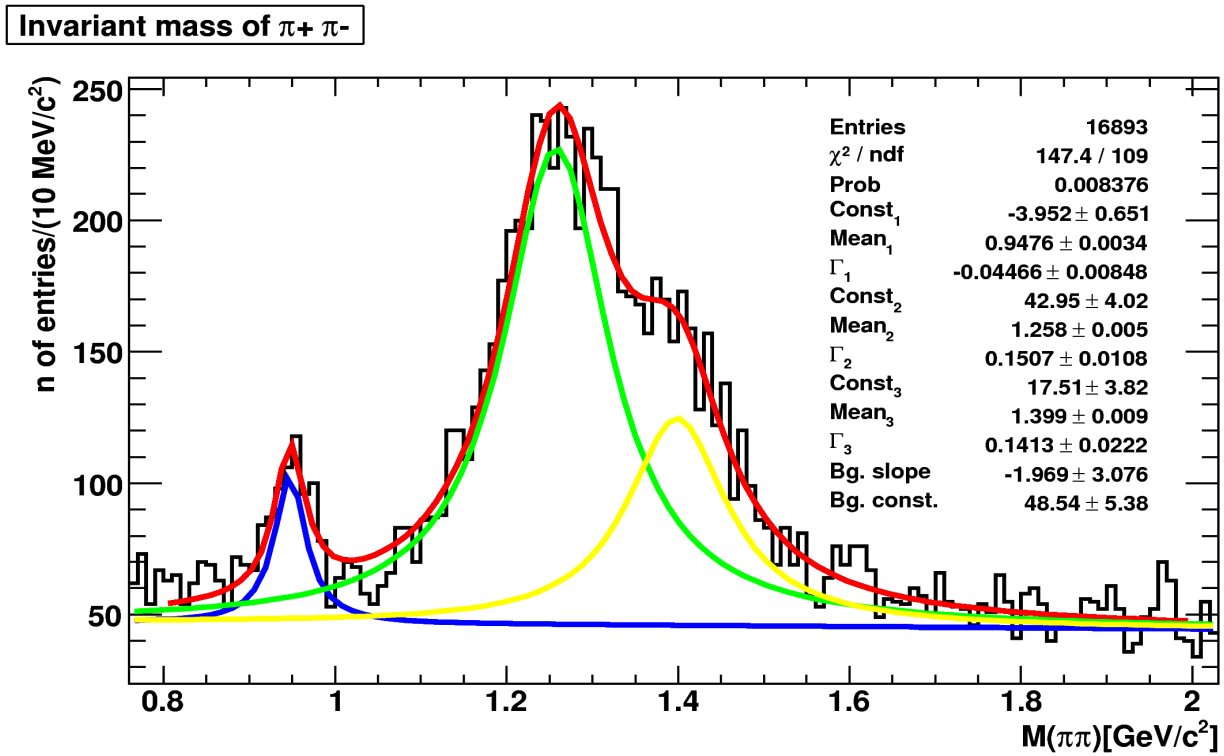


2 tracks events analysis

Table of cuts

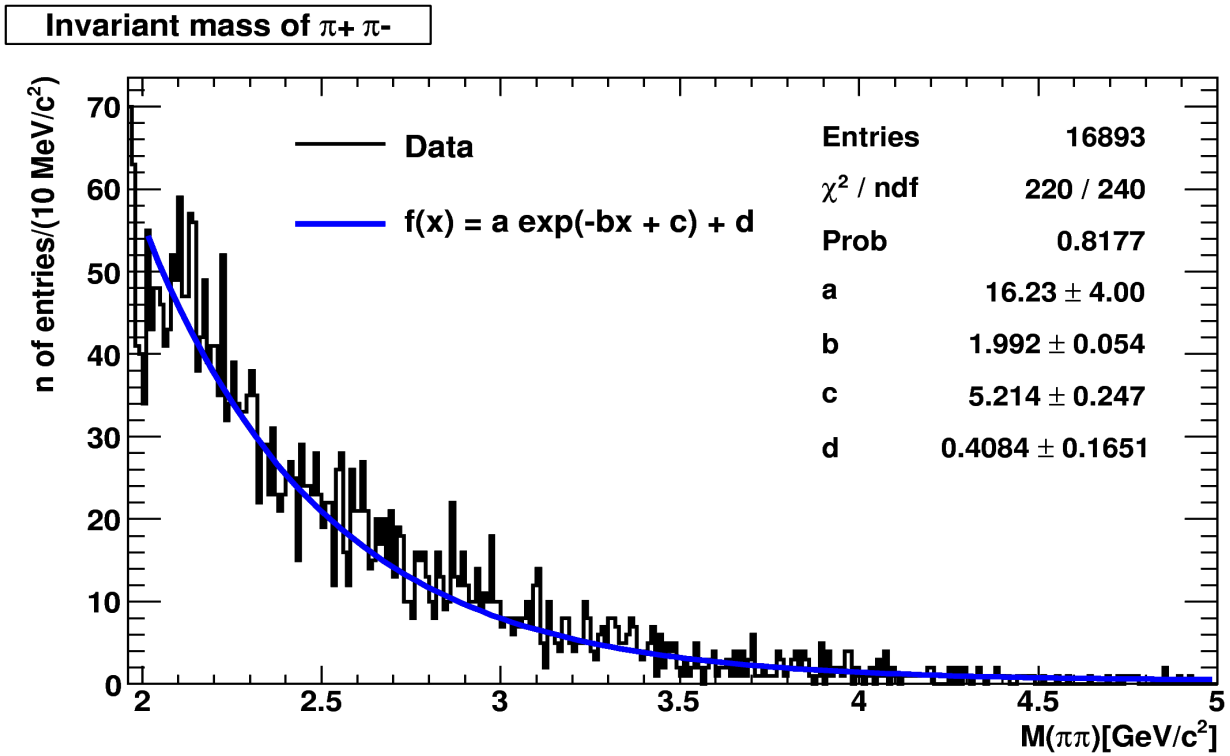
- gap cleaning + NN cleaning + 2 tracks with total charge = 0 : **229008**
- 2CJet>0.5 GeV and 2CEM>0.5 GeV triggers: **210775**
- |eta| < 1.2: **173525**
- no muons cut: **173175**
- 3D open angle < 3.1: **172567**
- |D0| < 1.0 mm: **130233**
- Pt of each track > 0.3 GeV/c: **113375**
- Vec sum of Pt < 2.0 GeV/c: **110860**
- exclusivity cut: **16893**

Invariant mass of π+π-



	M [MeV/c2]	Γ [MeV/c2]
f0(980)	980±10	40 to 100
f2(1270)	1275.1±1.2	185.1±2.9
f0(1350)	1200 to 1500	200 to 500

Invariant mass of π+π-

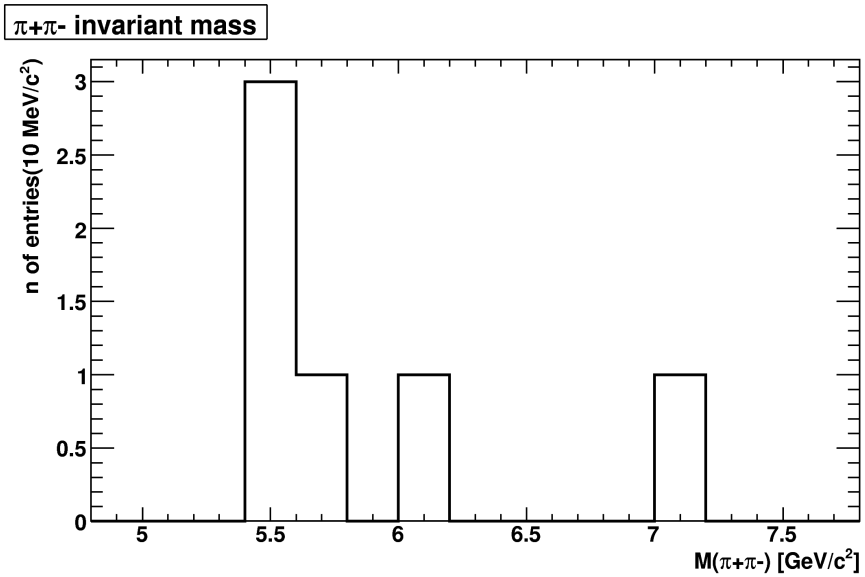


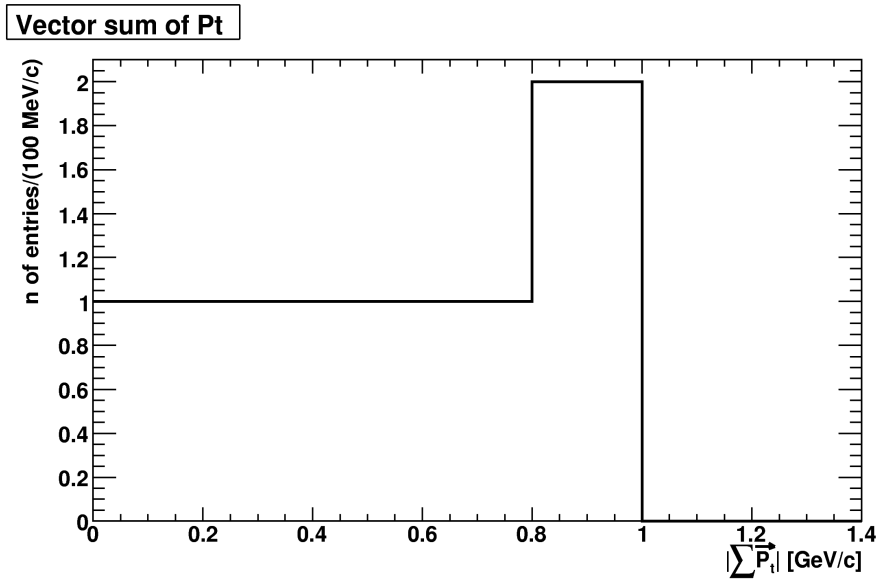
- Exponential tail in mass range 2 GeV/c^2 to 5 GeV/c^2

2 tracks – high mass studies

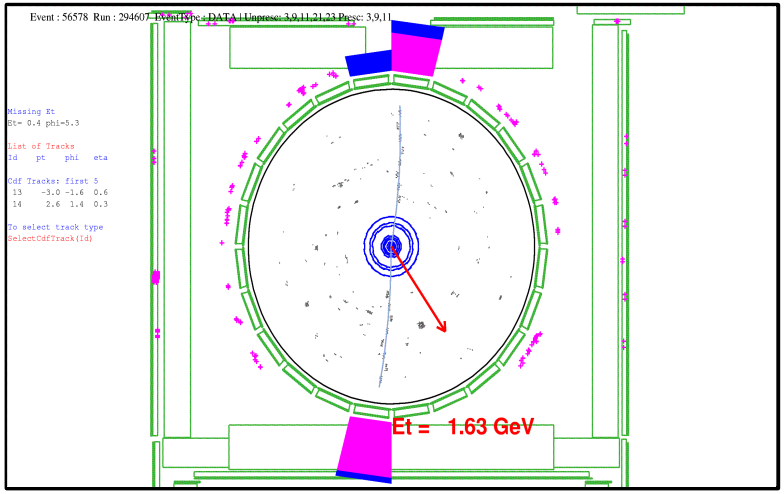
- NN clean + gap clean: **258298** (smaller sample)
- Total charge = 0: **168292**
- |eta| < 1.2: **140245**
- no muons cut: **139011**
- 3D opening angle < 2.8: **132954**
- |D0| < 0.3 mm: **129299**
- Exclusivity cut: **12642**
- Both tracks Pt > 2.5 GeV/c: **8**
- Both tracks have |eta| < 1.0: **6**

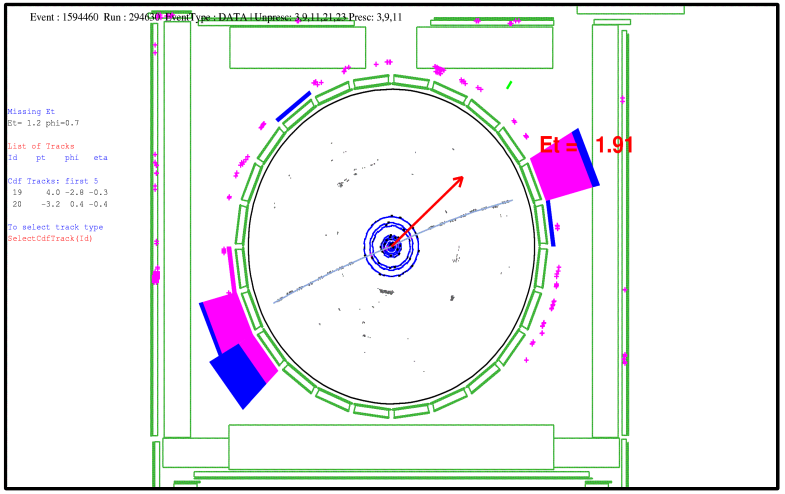
2 tracks – high mass studies

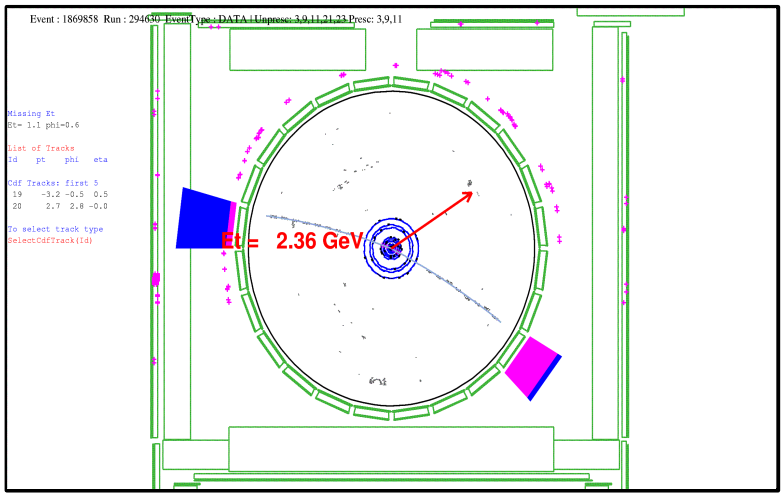


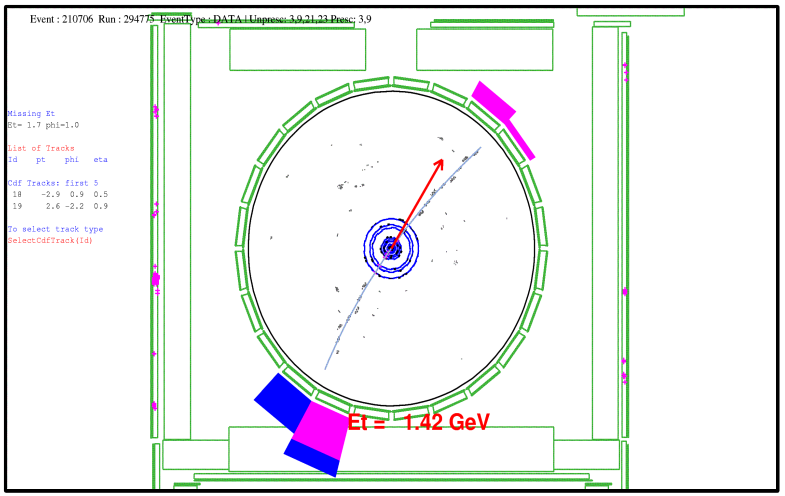


2 tracks – high mass studies

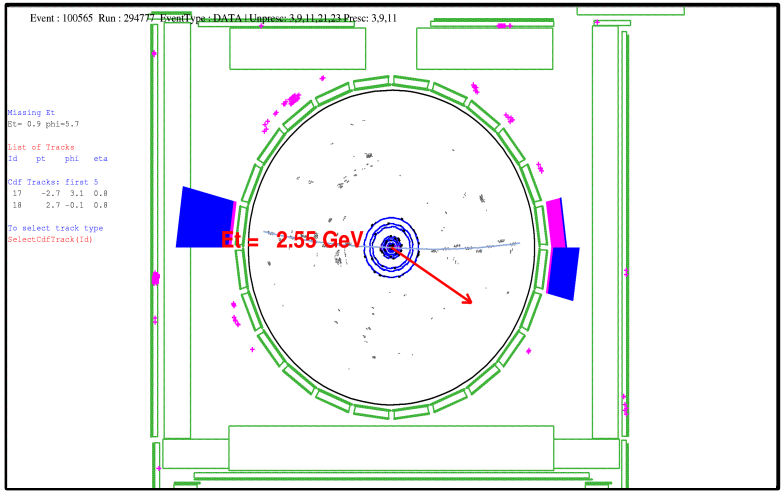


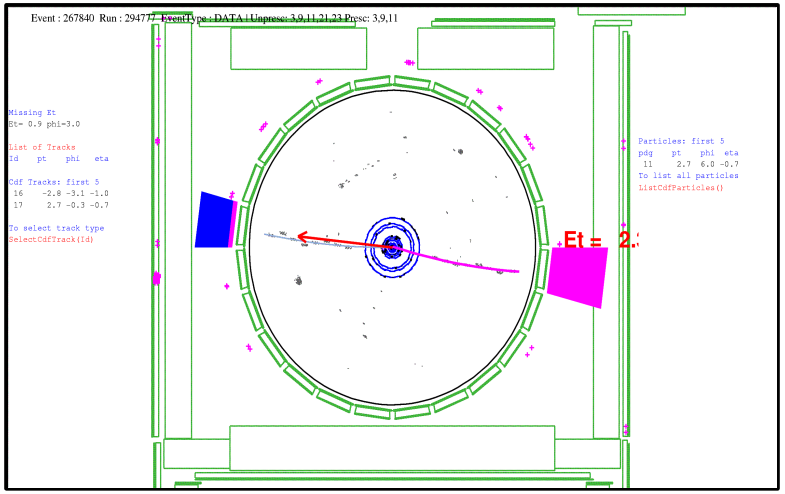






2 tracks – high mass studies





4 tracks events analysis

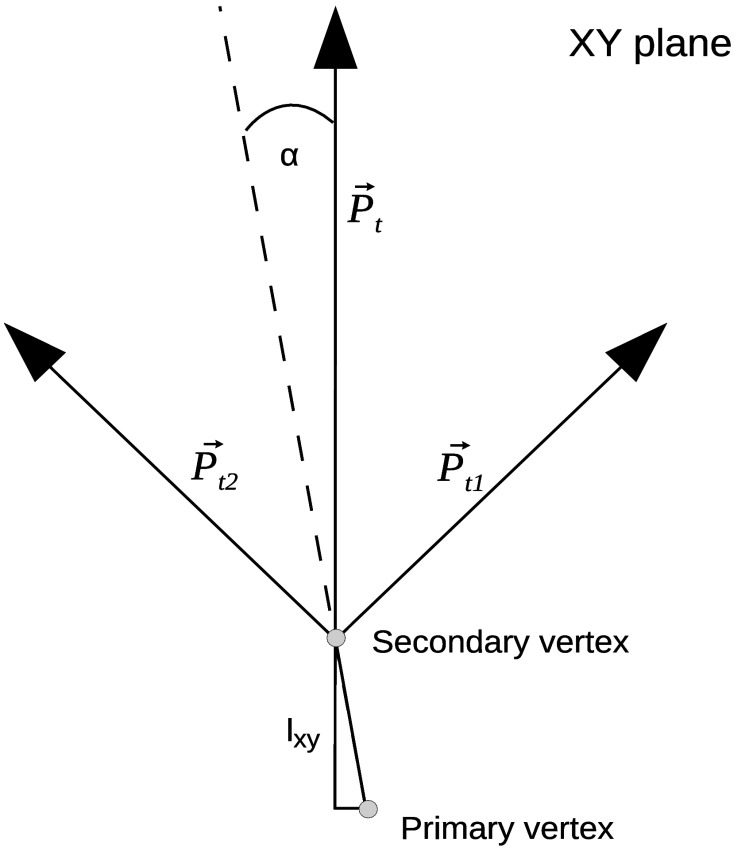
Events with displaced vertices

Table of cuts

- gap cleaning + NN cleaning + 4 tracks with total charge = 0 : **142919**
- 2CJet>0.5 GeV and 2CEM>0.5 GeV triggers: **128443**
- if there is 1 vertex: |Z|< 60 cm : **125117**
- no muons cut: **124962**
- Pt of each track > 0.3 GeV/c: **73246**
- Vec sum of Pt < 2.0 GeV/c: **68872**

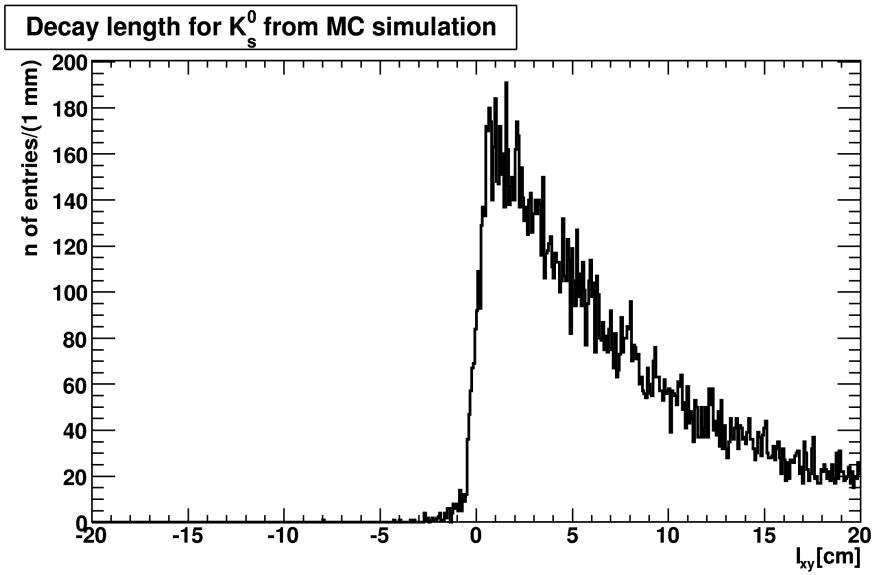
New parameters to cut on

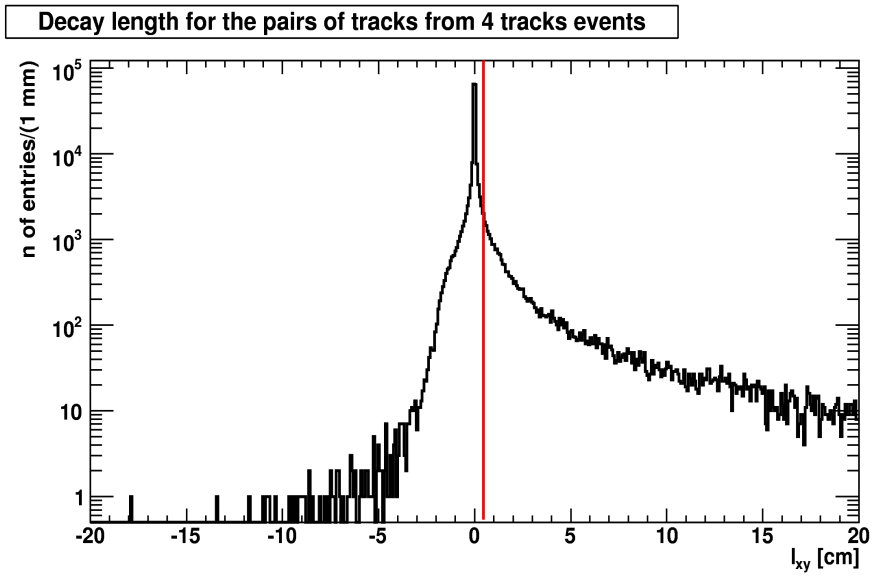
- Collinearity: α
- Decay length: l_{xy}



K^0_s searching

cuts on decay length



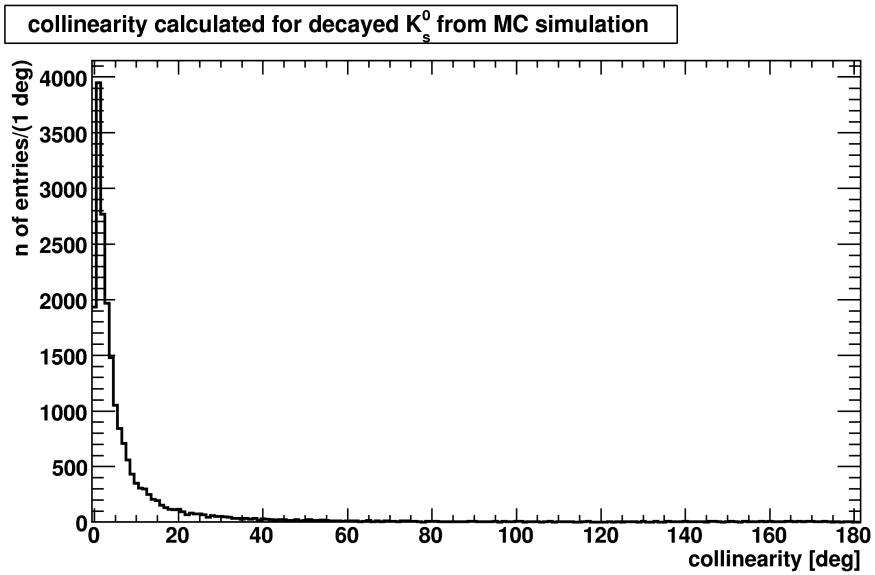


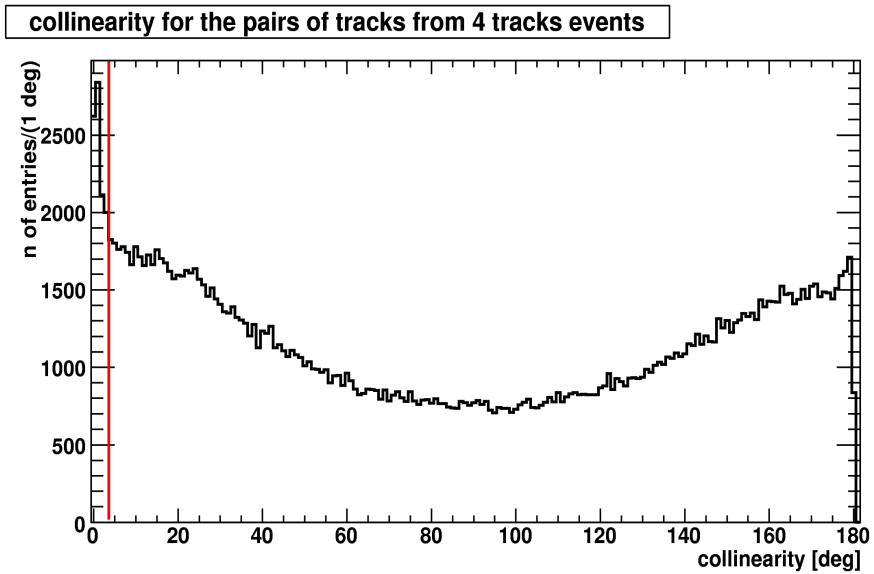
- MC simulation

- Data sample
- Our cut: 0.5 cm

K^0_s searching

cuts on collinearity



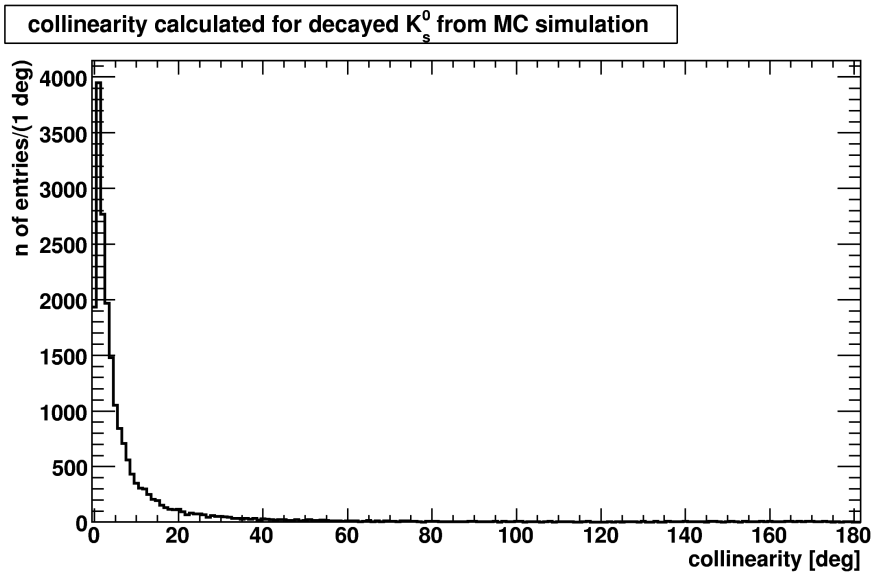


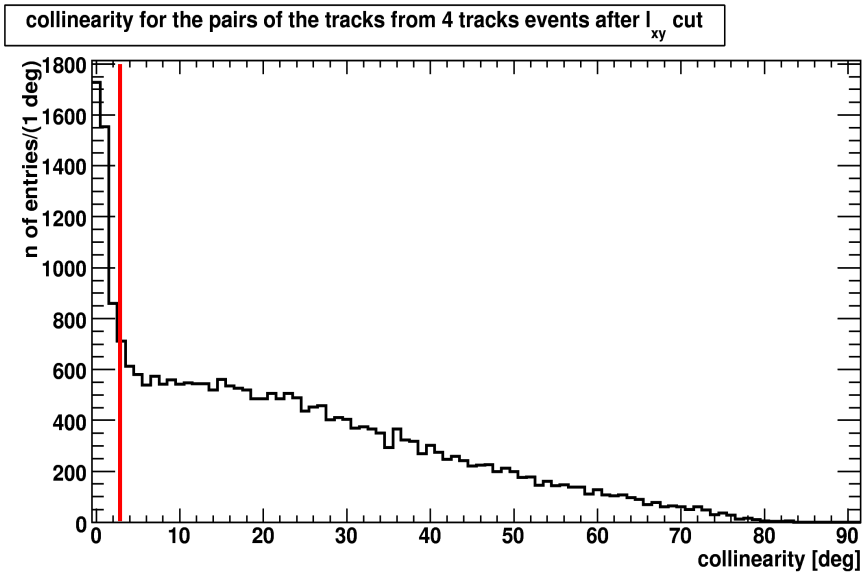
- MC simulation

- Data sample
- Our cut: 3 deg

K^0_s searching

cuts on collinearity



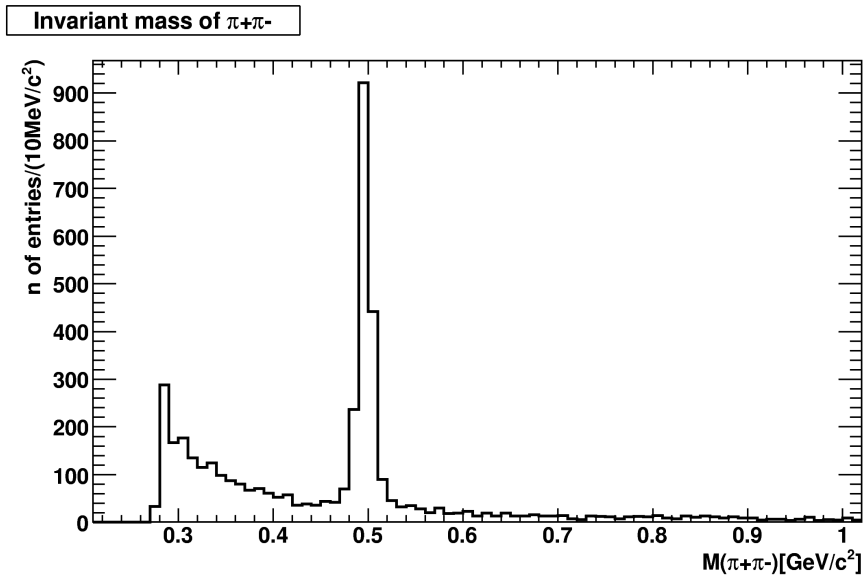


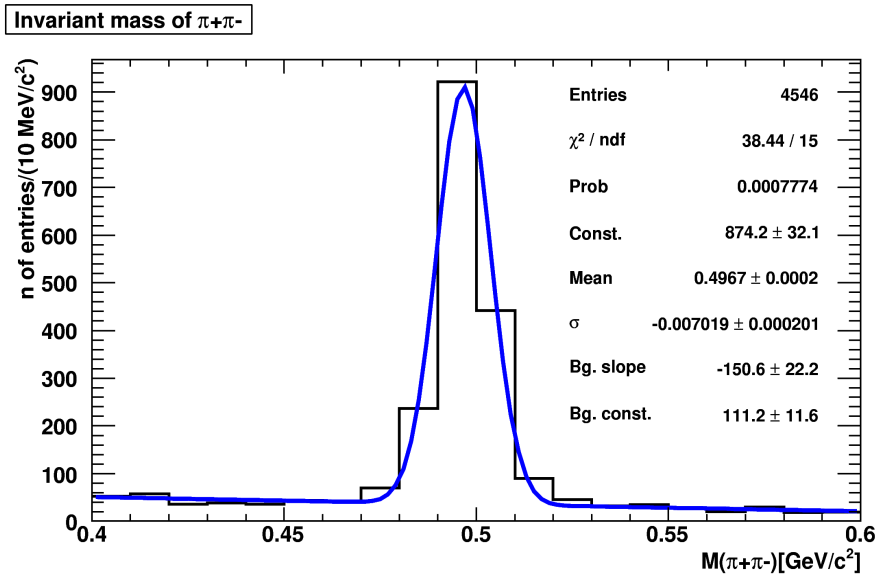
- MC simulation

- After l_{xy} cut
- Our cut: 3 deg

K^0_s searching

Invariant mass of π+π-

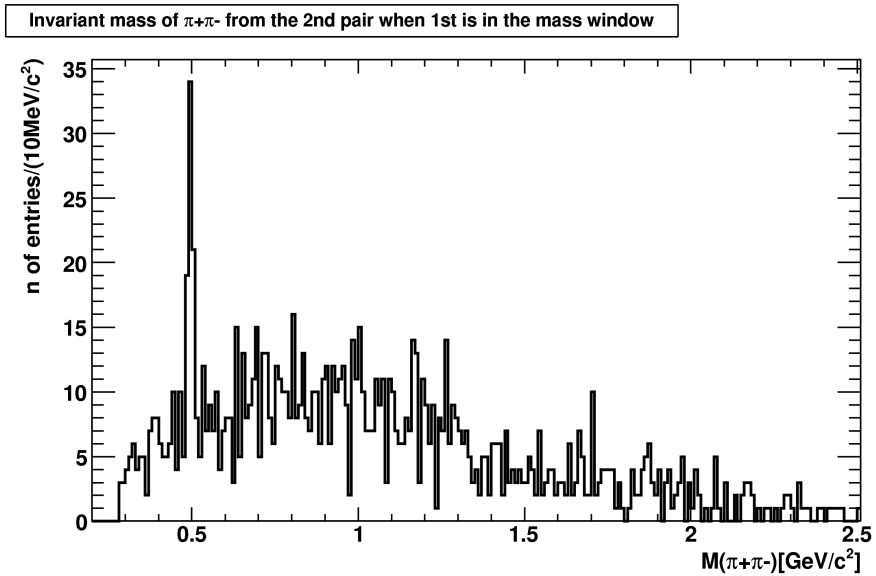


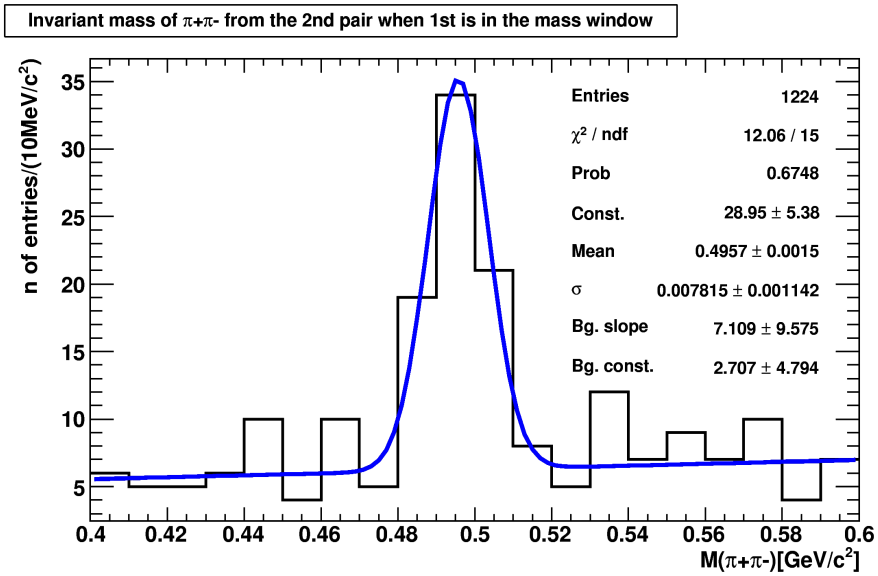


Mass window: $0.497 \pm 2 \cdot 0.007$ GeV/c^2

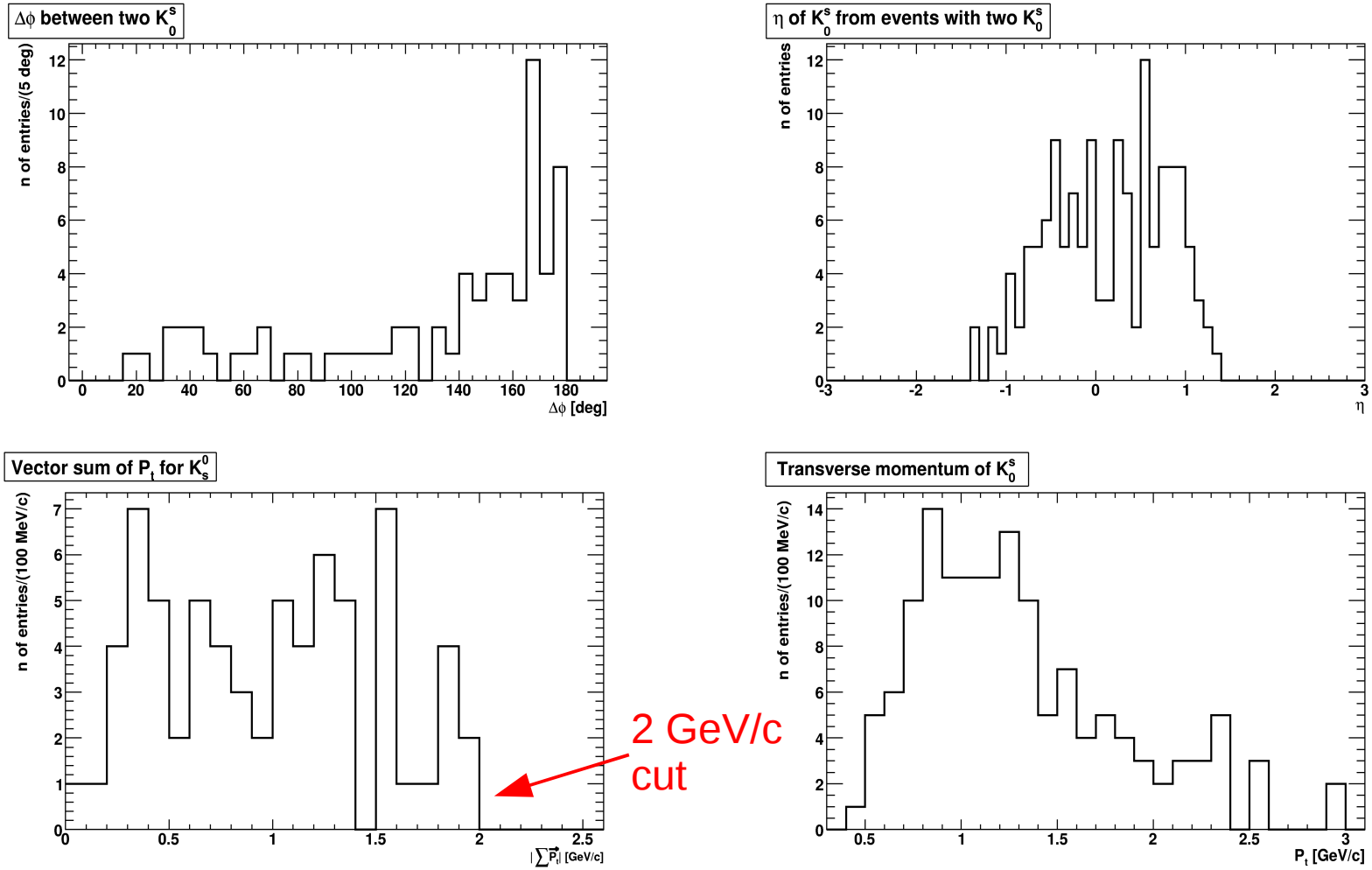
K^0_S searching

Invariant mass of π+π- - second pair
no l_{xy} and no α cuts



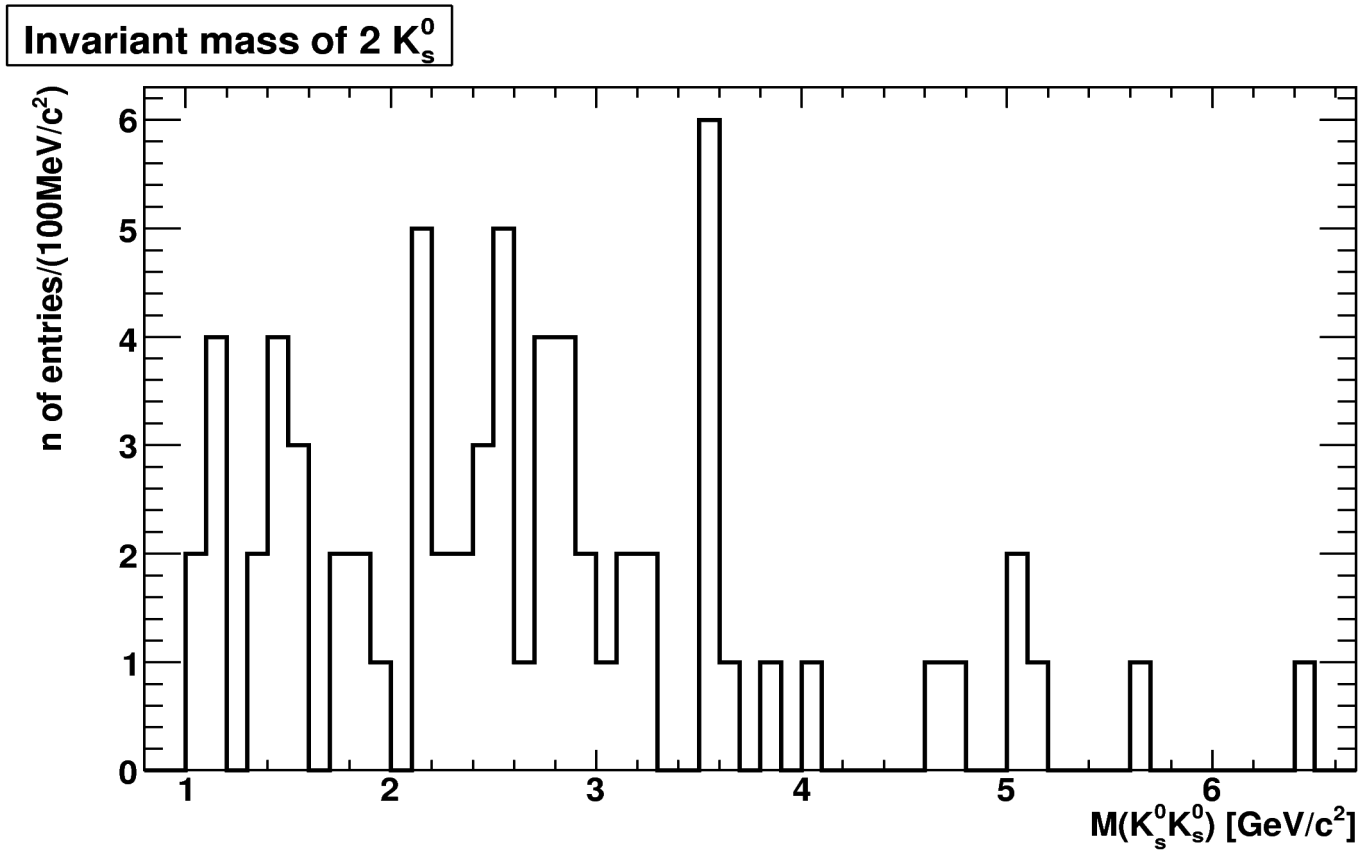


K^0_s searching - events with two K^0_s



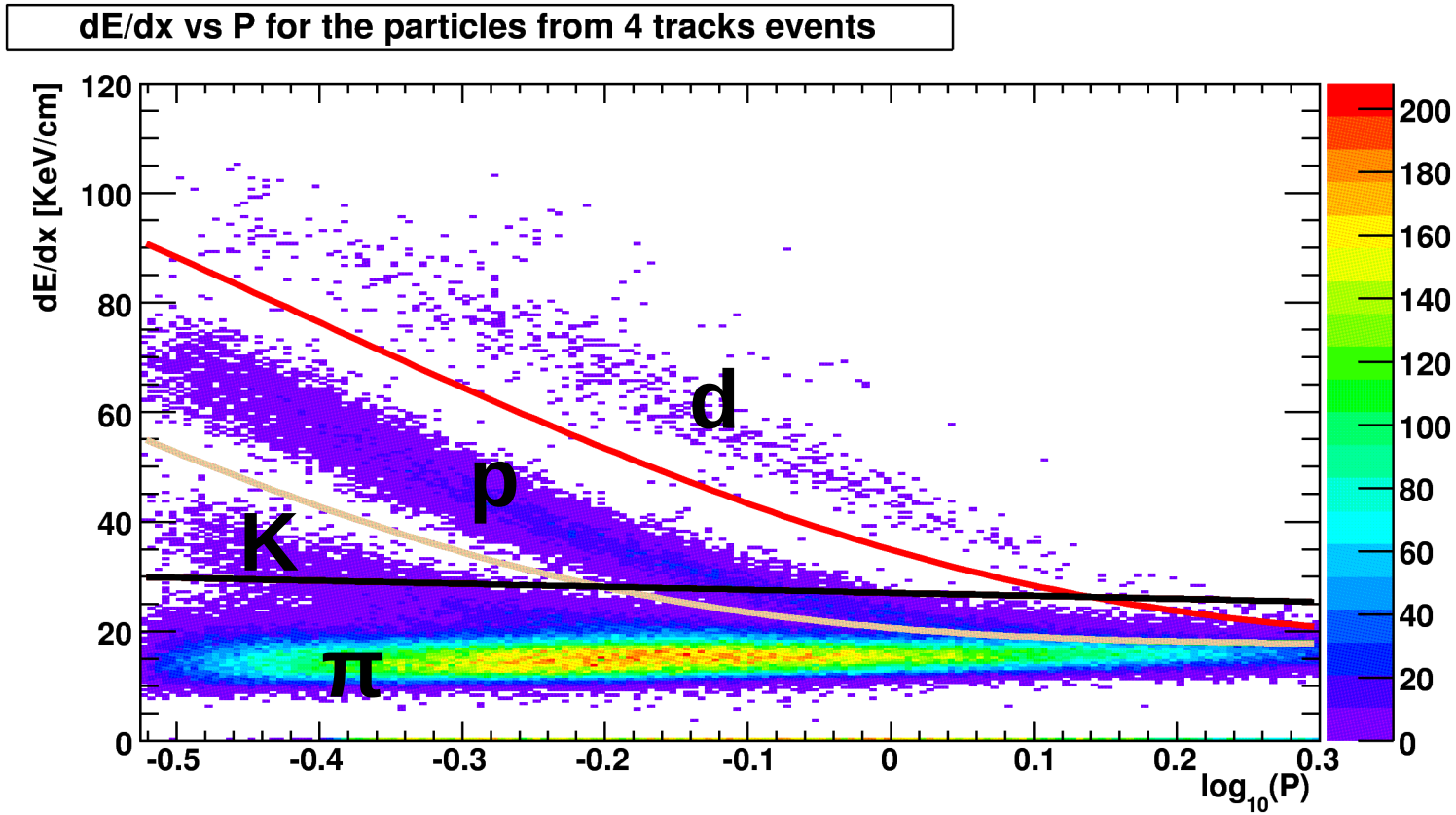
K^0_s searching

Events with two K^0_s



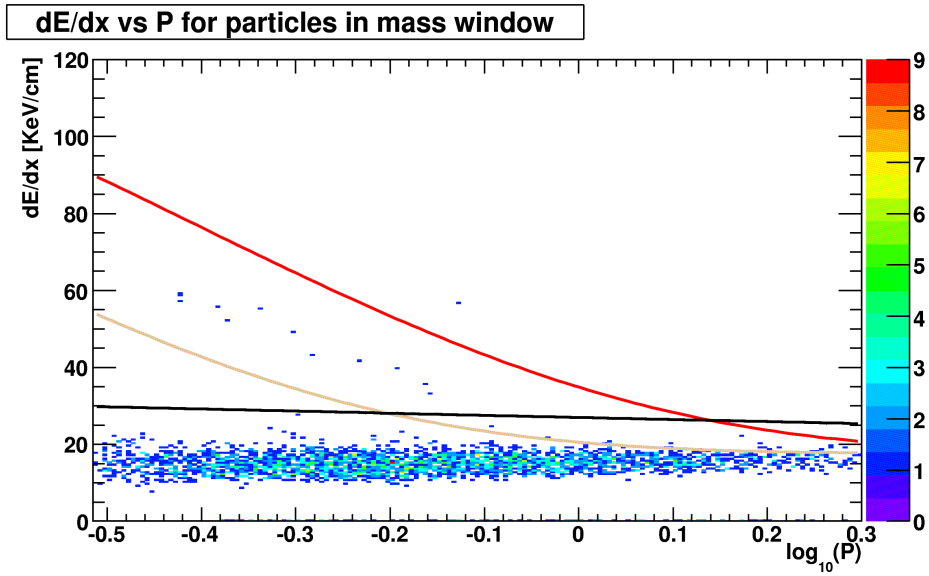
K^0_s searching

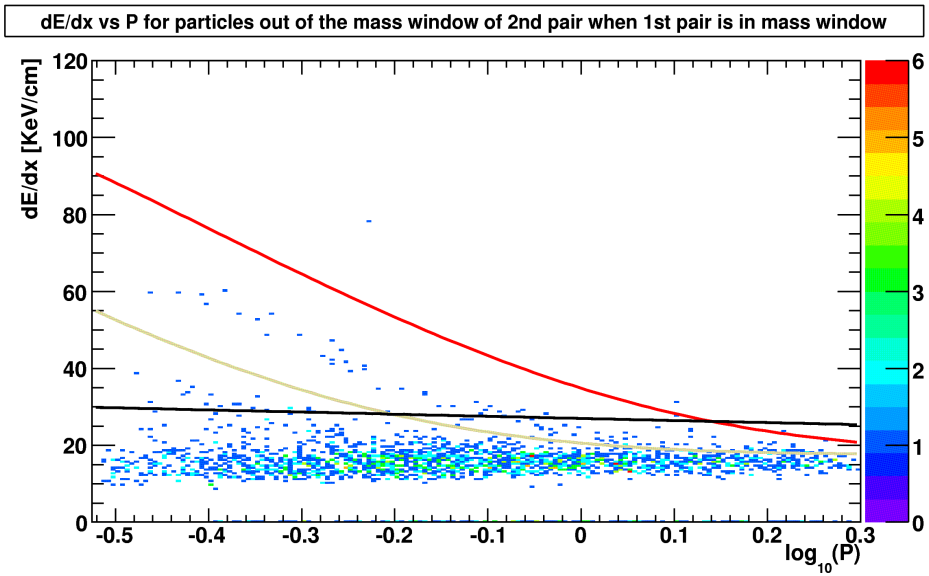
dE/dx method of ID



K^0_S searching

Events with one K^0_S (+ K and π)



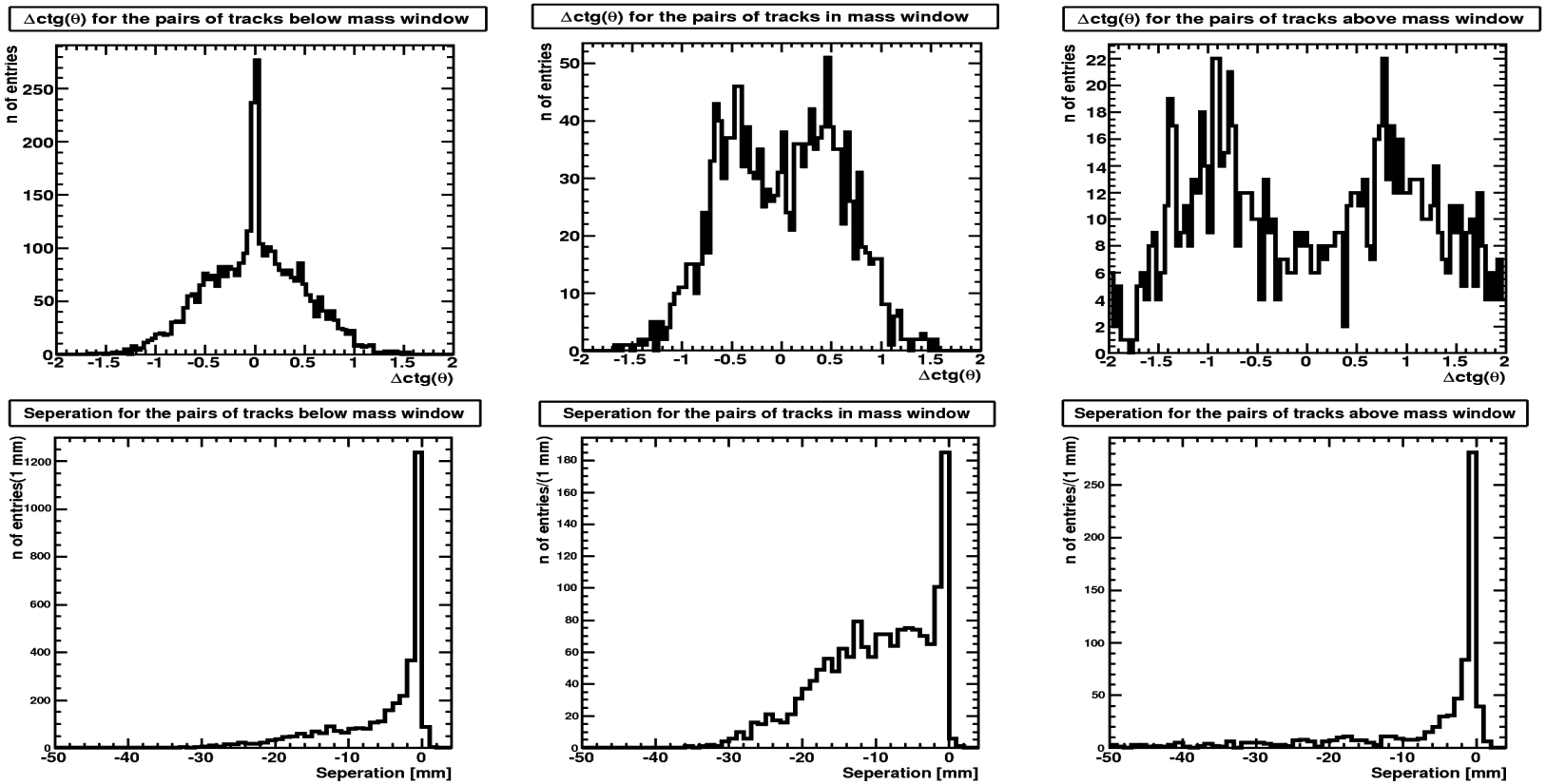


- Pair in the mass window (with l_{xy}, α and mass cuts)
- First pair is in the mass window.
- dE/dx vs P for particles from second pair that is out of mass window.

K^0_S searching

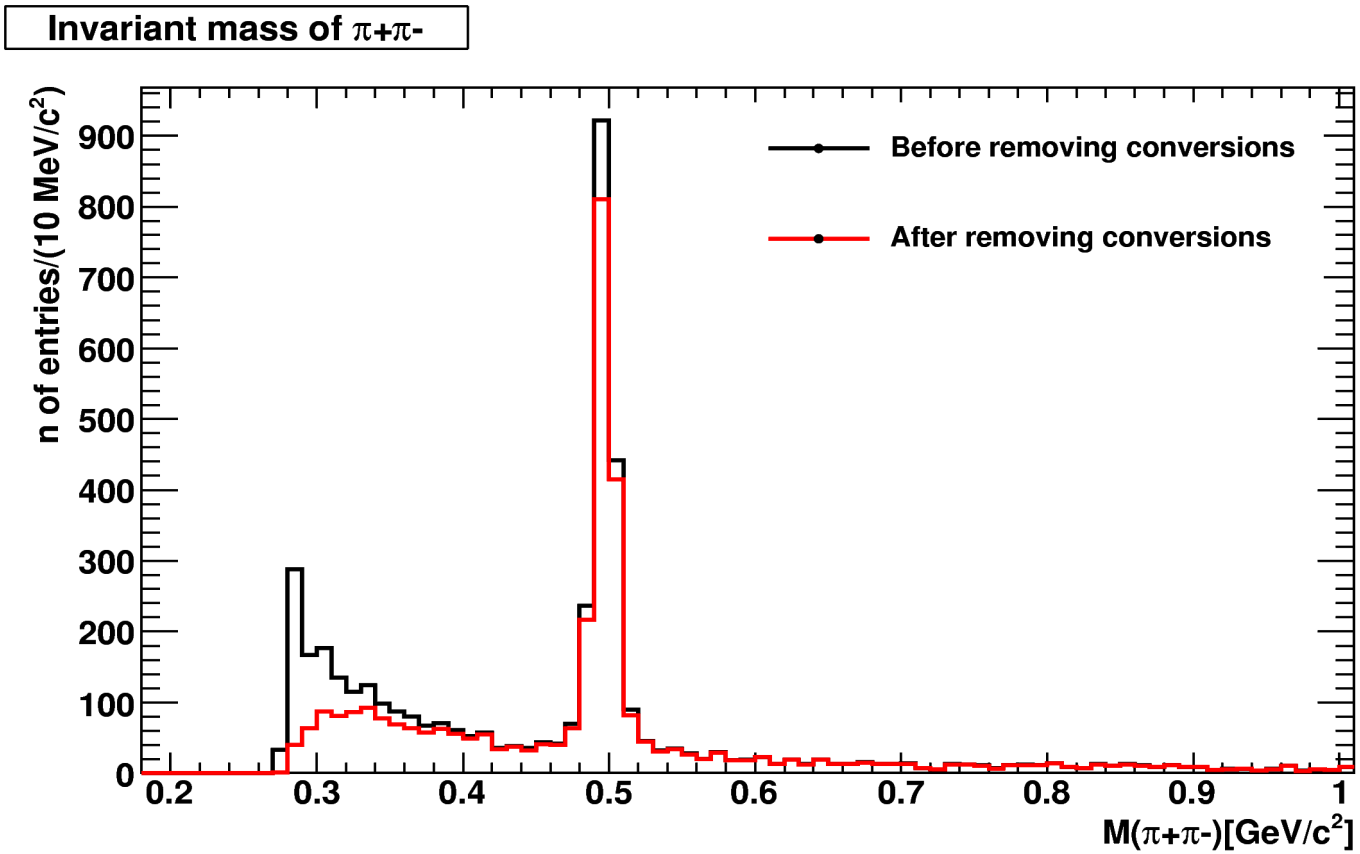
Background analysis – conversions

$M_{\pi\pi\ below} < 0.483 < M_{\pi\pi\ in} < 0.511 < M_{\pi\pi\ above}$ [GeV]



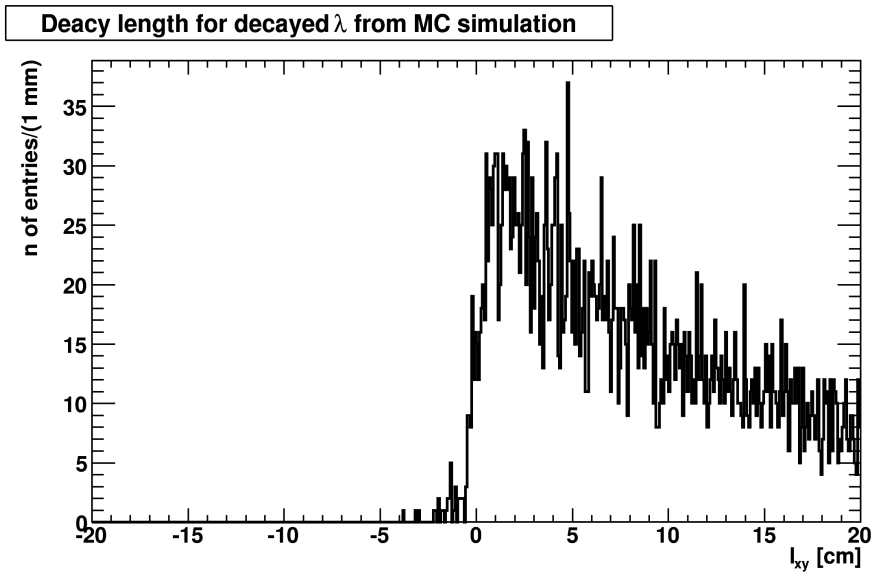
K^0_s searching

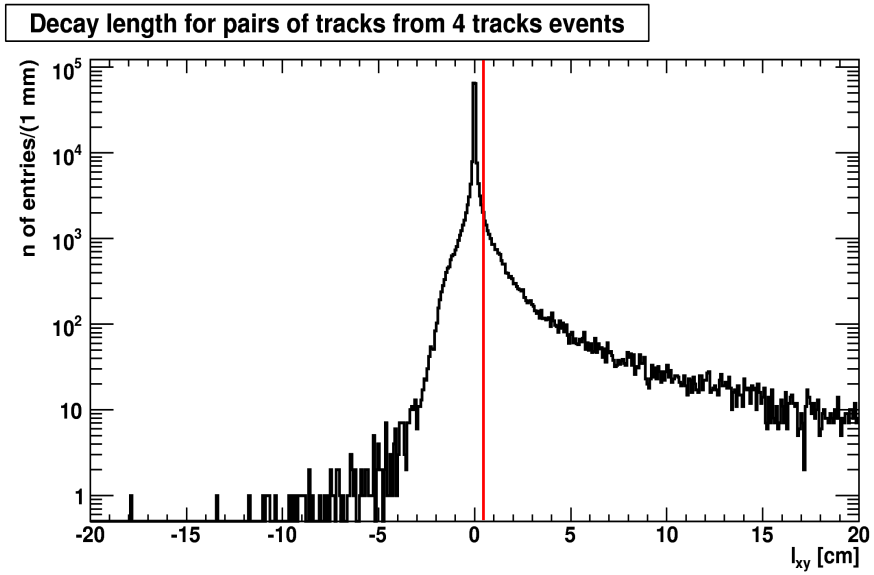
Background analysis - conversions



Λ searching

cuts on decay length



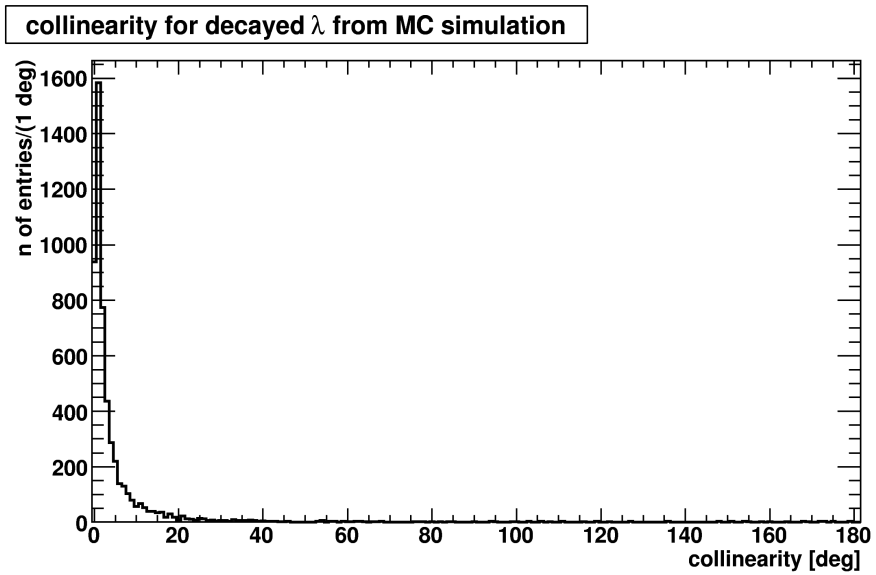


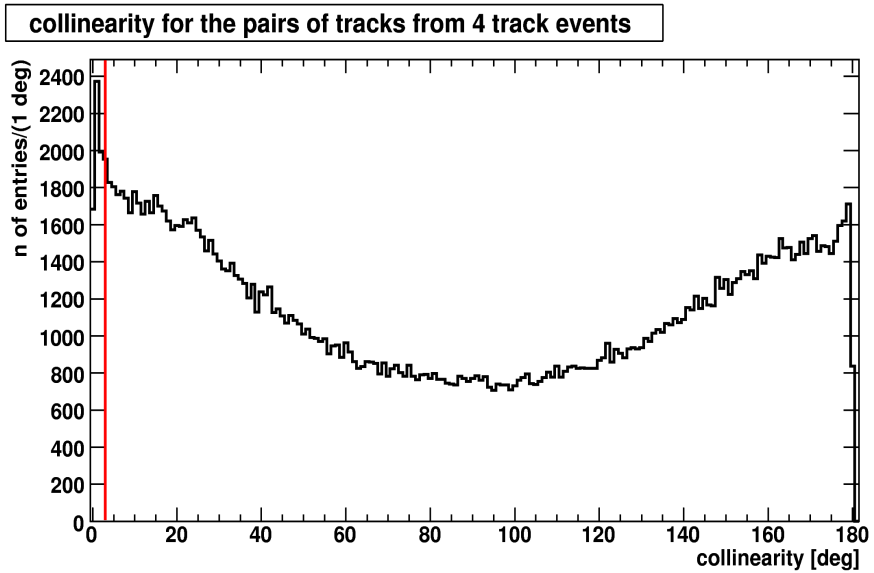
- MC simulation

- Data sample
- Our cut: 0.5 cm

Λ searching

cuts on collinearity



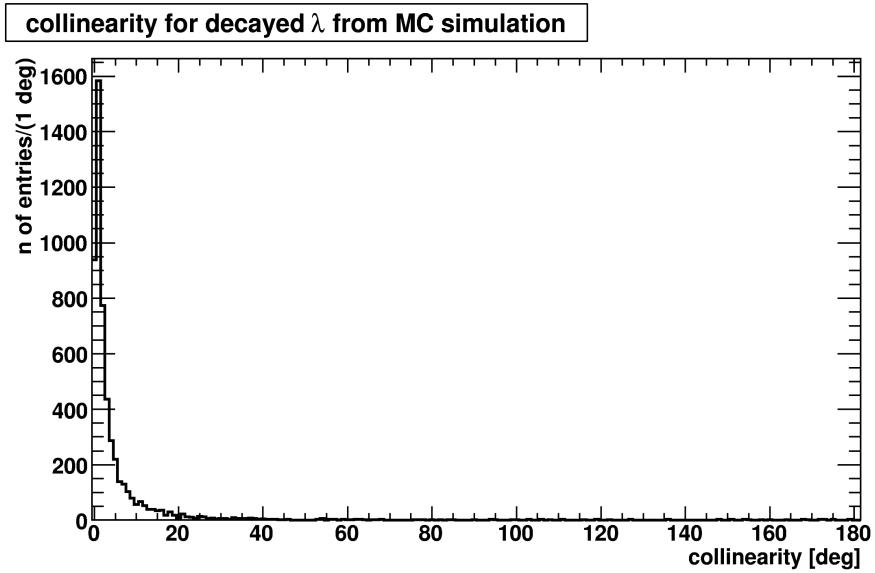


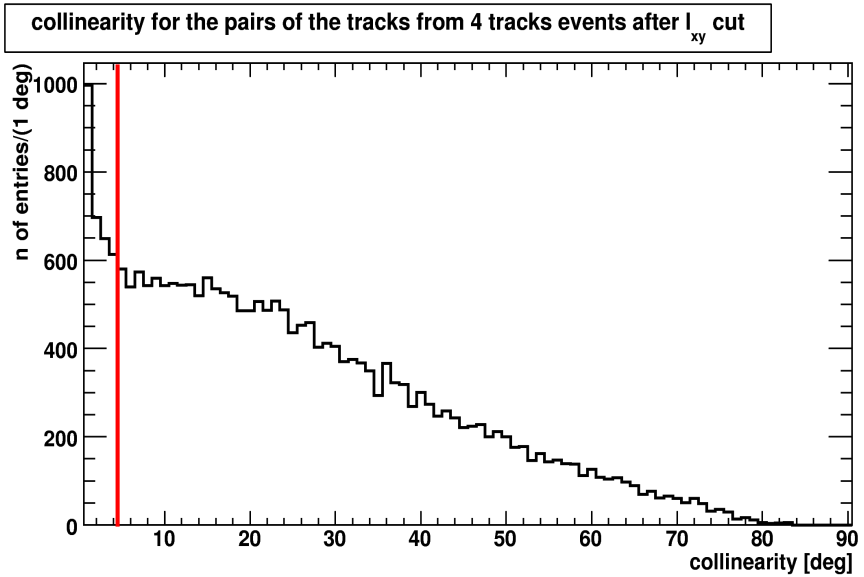
- MC simulation

- Data sample
- Our cut: 3 deg

Λ searching

cuts on collinearity



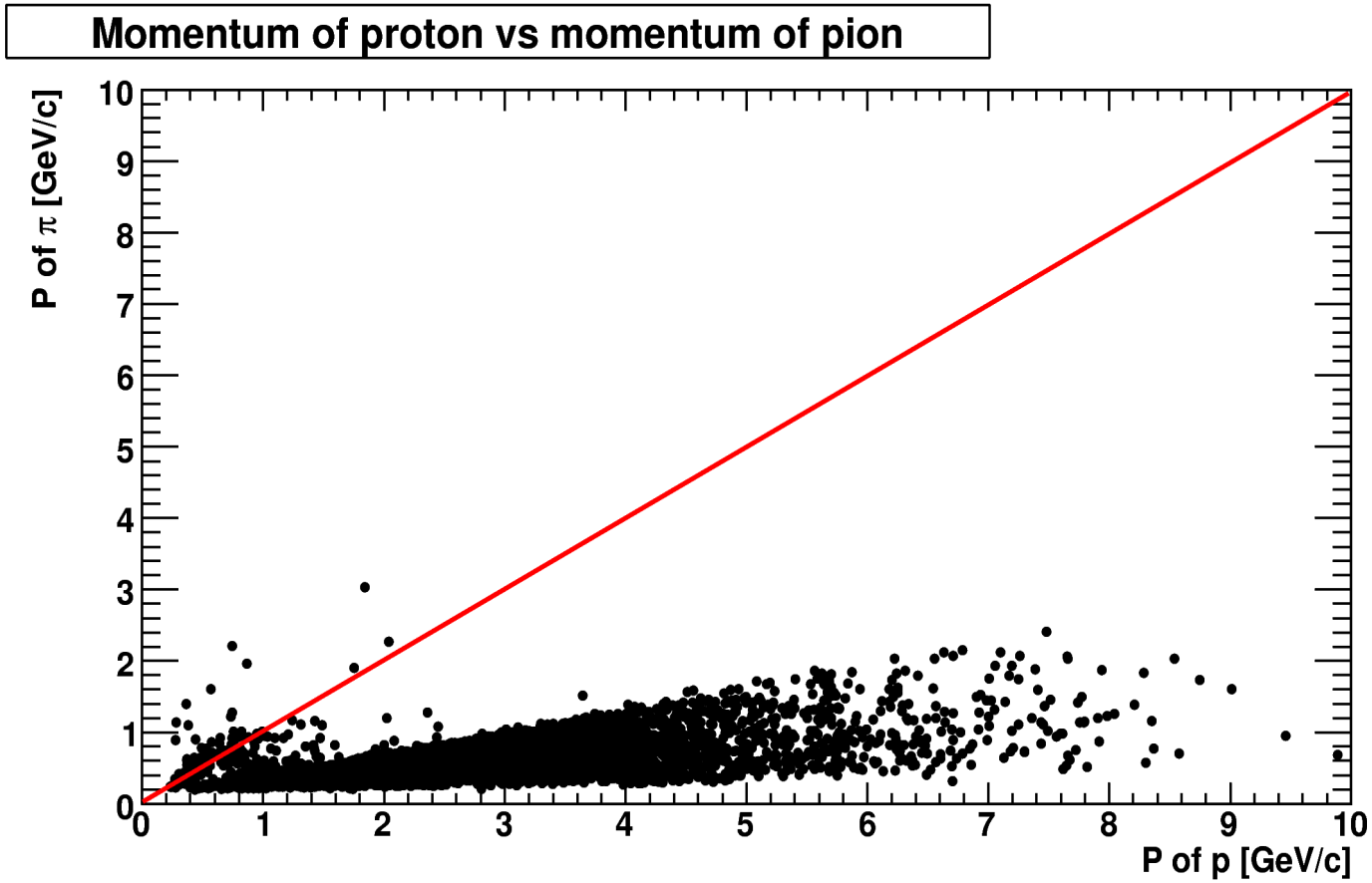


- MC simulation

- After l_{xy} cut
- Our cut: 3 deg

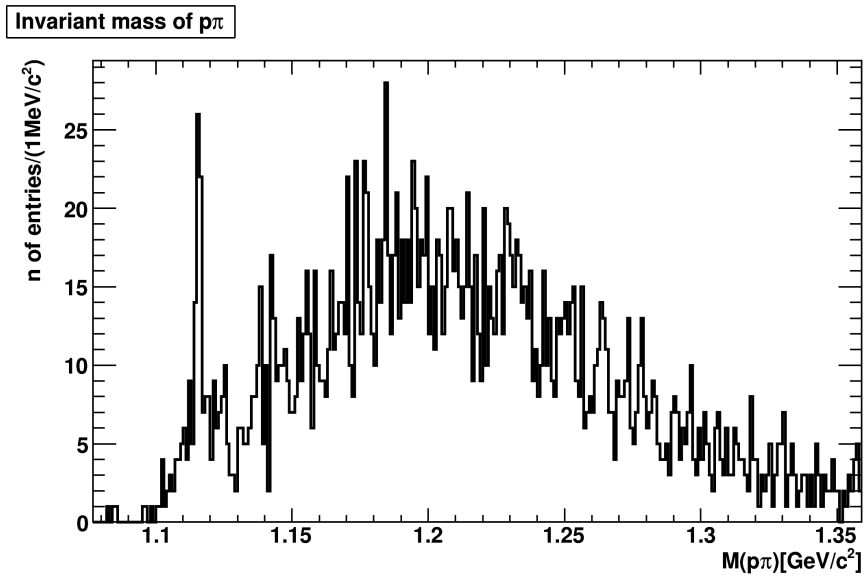
Λ searching

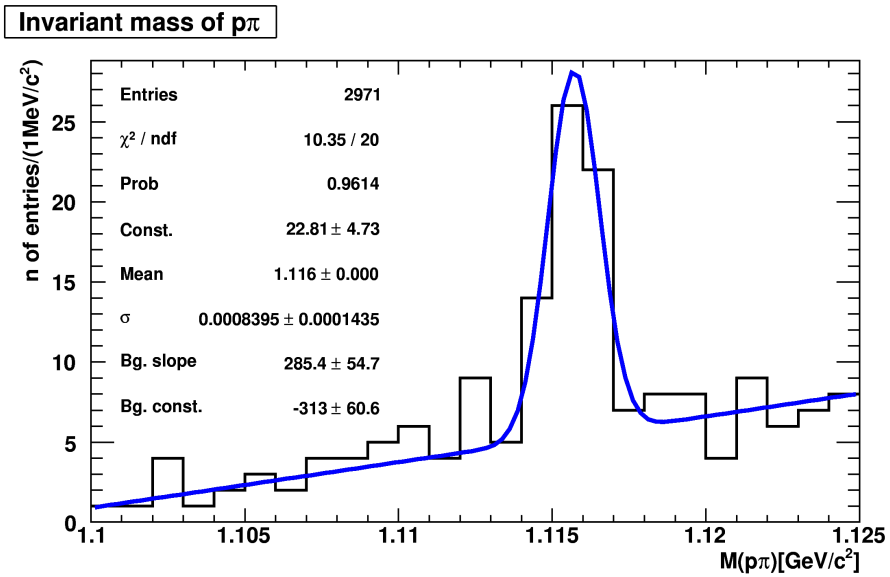
Momentum of pion vs momentum of proton – MC data



Λ searching

Invariant mass of pπ

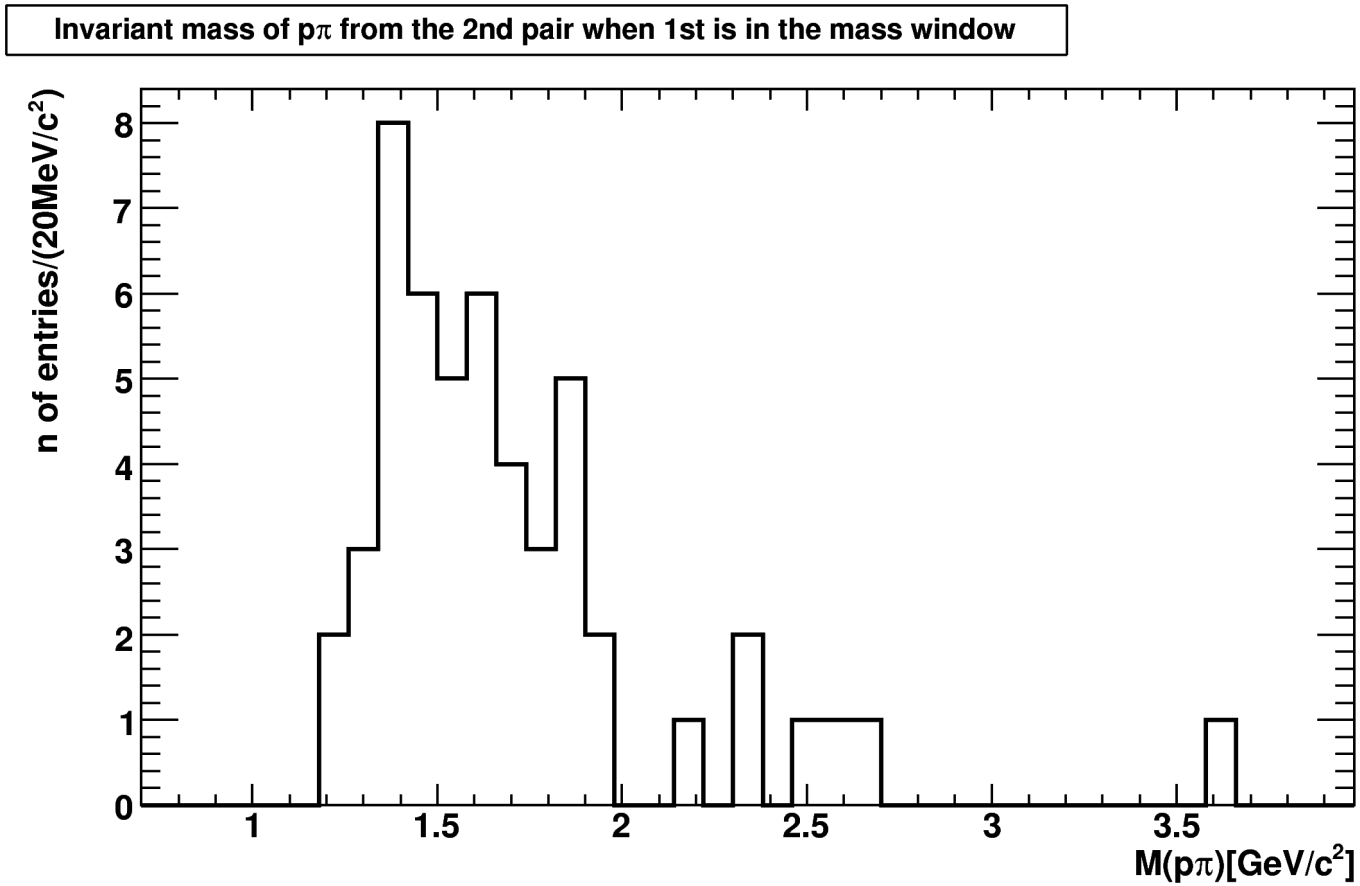




- All plots are made after removing K^0_s
- Mass window: $1.116 \pm 2 \cdot 0.0008$ GeV/c^2

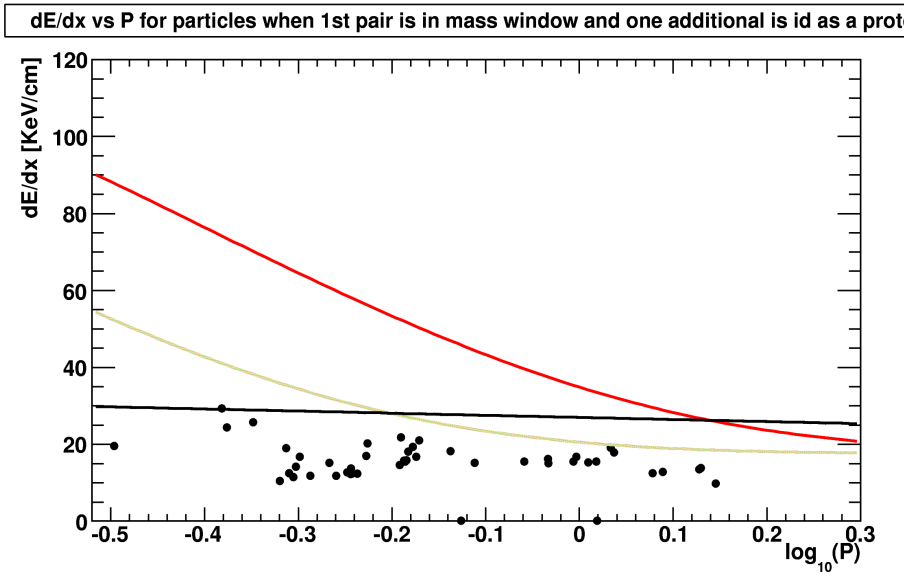
Λ searching

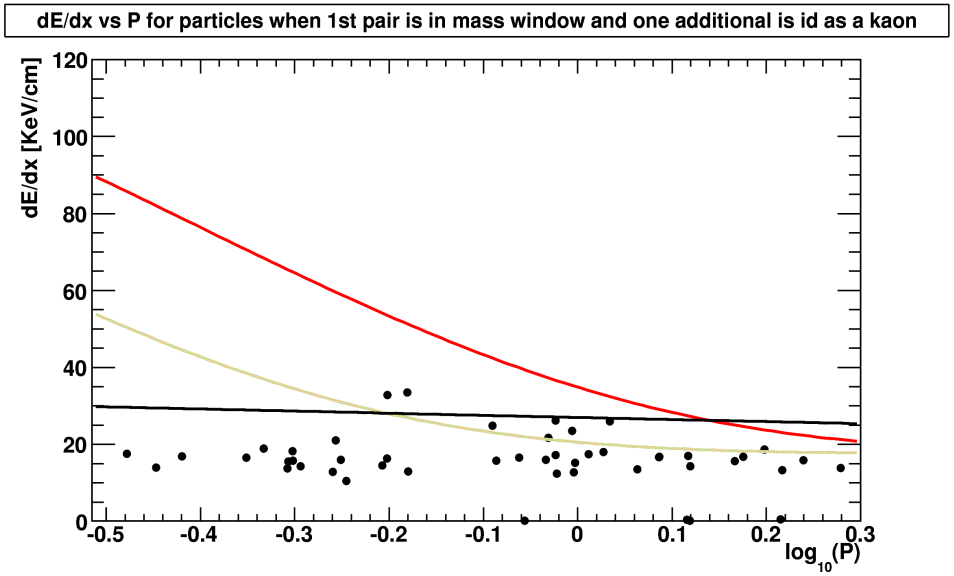
Invariant mass of pπ – second pair



Λ searching

Events with one Λ (+ p and K)



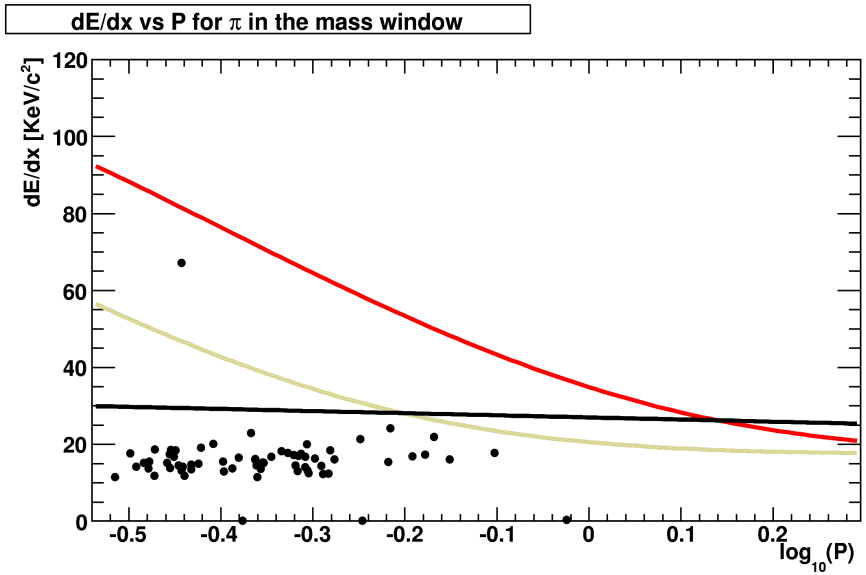


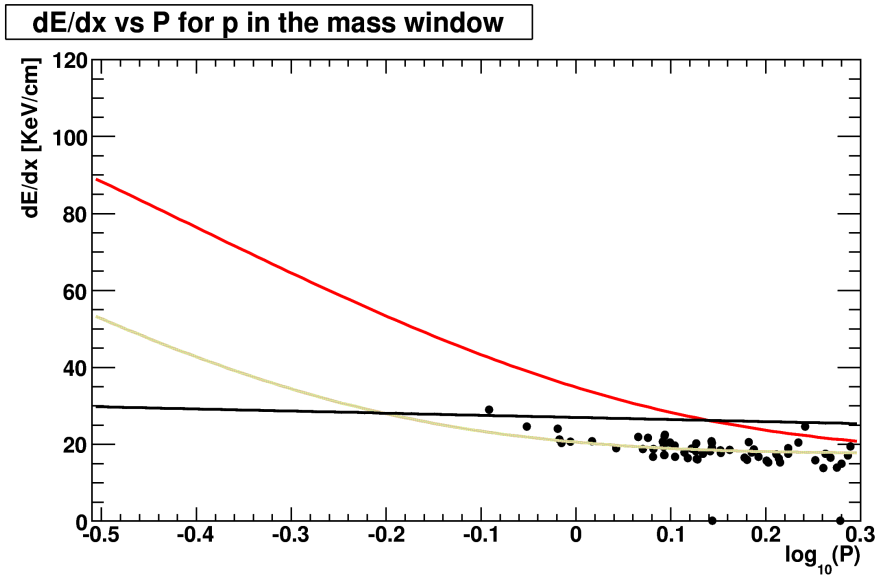
Particle assumed to be a kaon

Particle assumed to be a proton

Λ searching

Events with one Λ





Particle assumed to be a pion in mass window

Particle assumed to be a proton in mass window

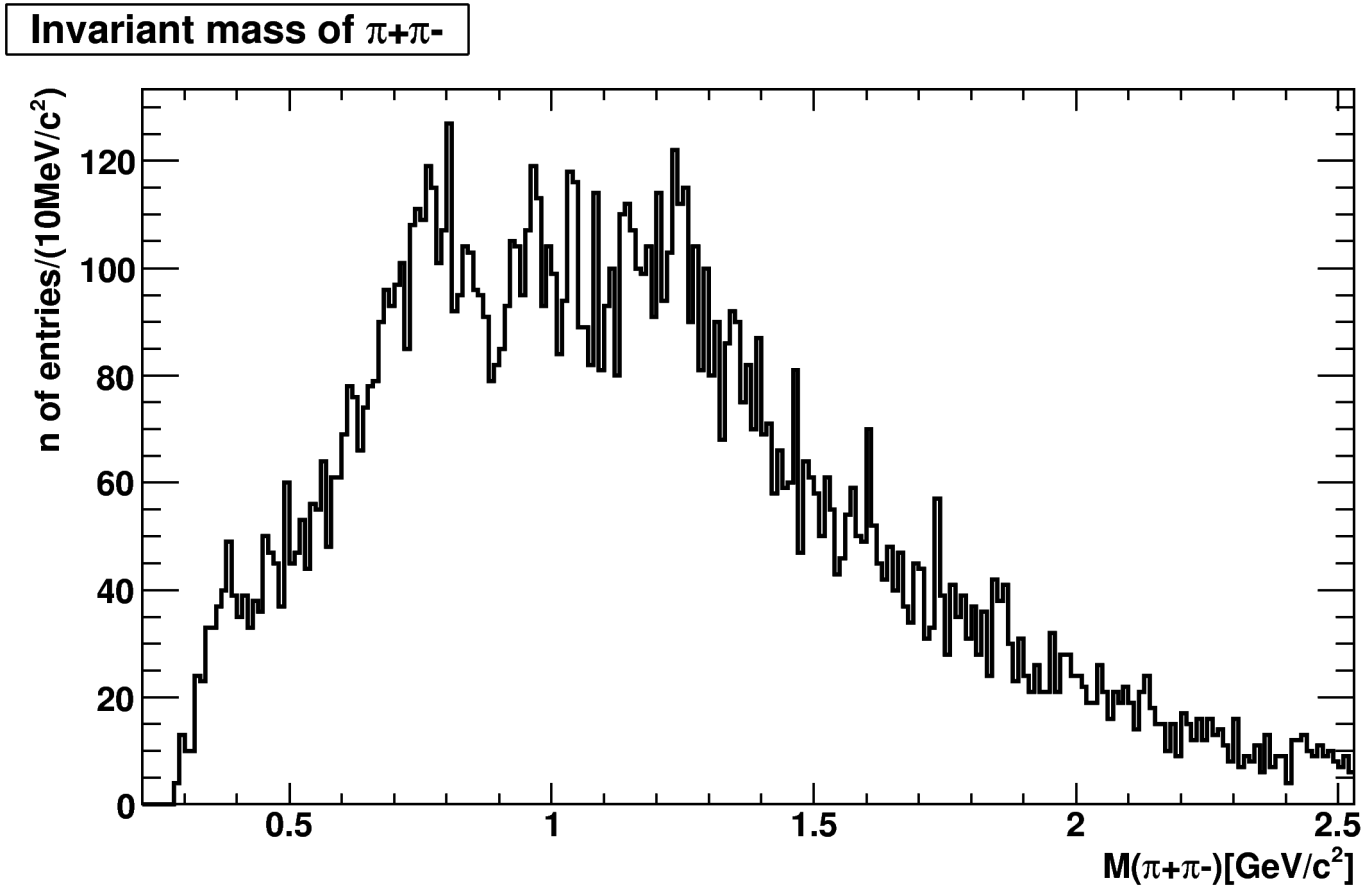
4 tracks events analysis

events with primary vertex only

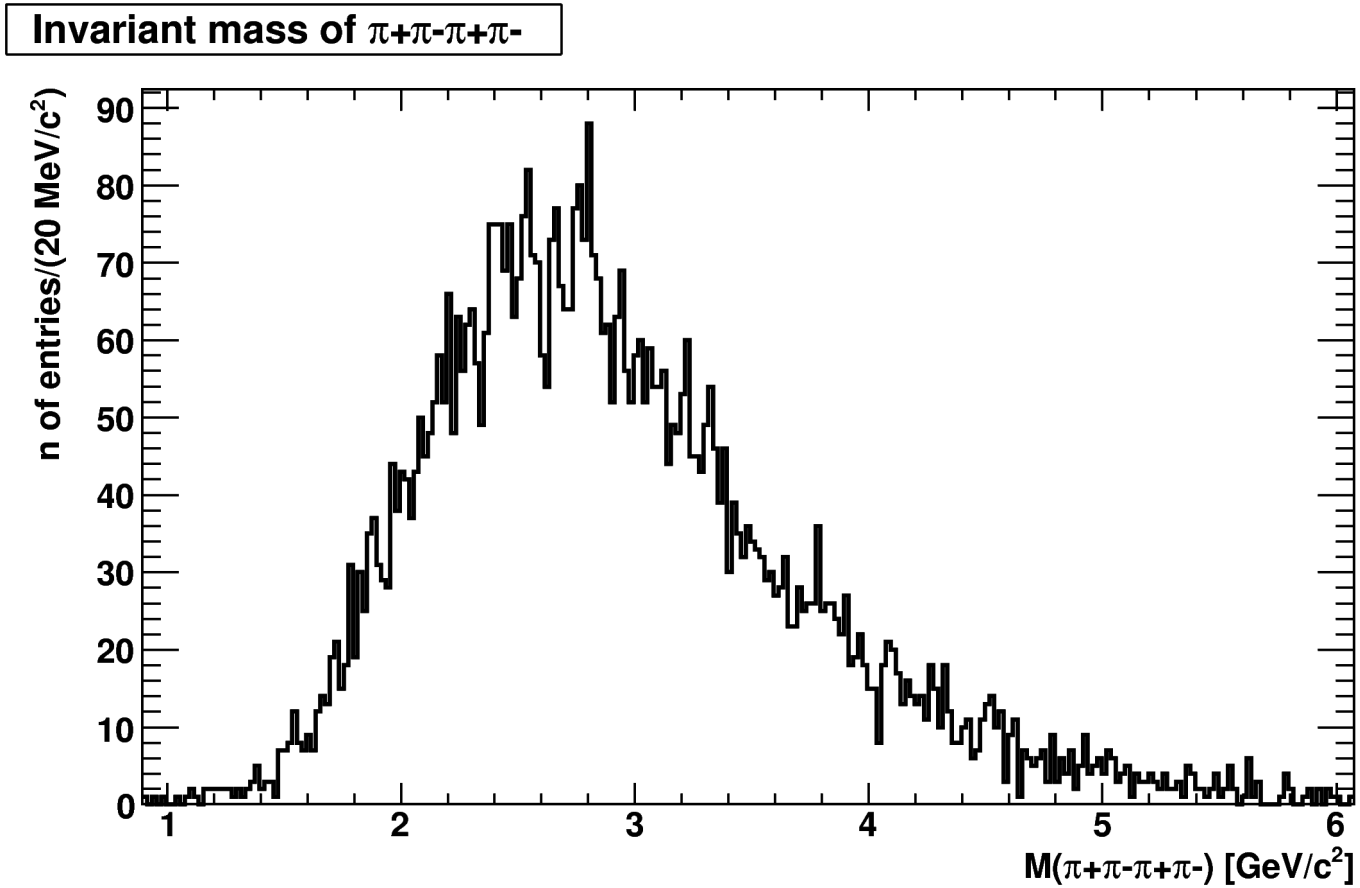
Table of cuts

- gap cleaning + NN cleaning + 4 tracks with total charge = 0 : 142919
- 2CJet>0.5 GeV and 2CEM>0.5 GeV triggers: 128443
- |eta| < 1.2: 85531
- no muons cut: 85425
- |D0| < 1.0 mm: 42255
- Pt of each track > 0.3 GeV/c: 26901
- Vec sum of Pt < 2.0 GeV/c: 25149
- exclusivity cut: 6796
- 1 Vertex: 6439
- |Z of Vertex| < 60cm: 6196

Invariant mass of π+π-



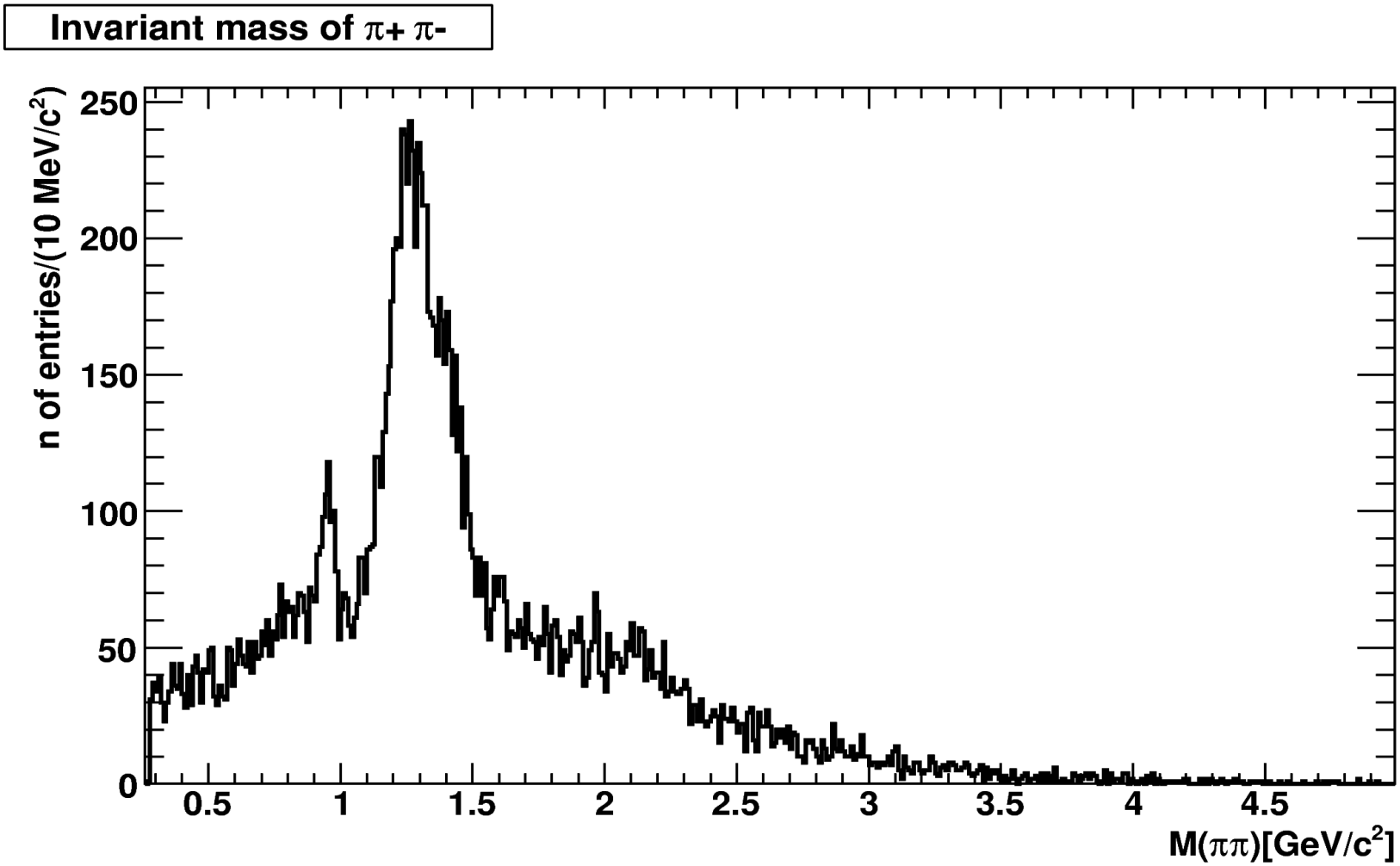
Invariant mass of π+π-π+π-



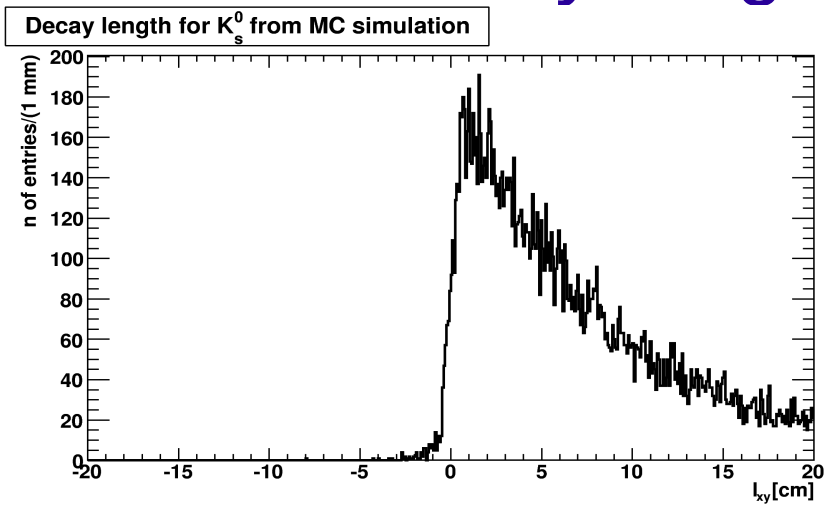
Thank you!

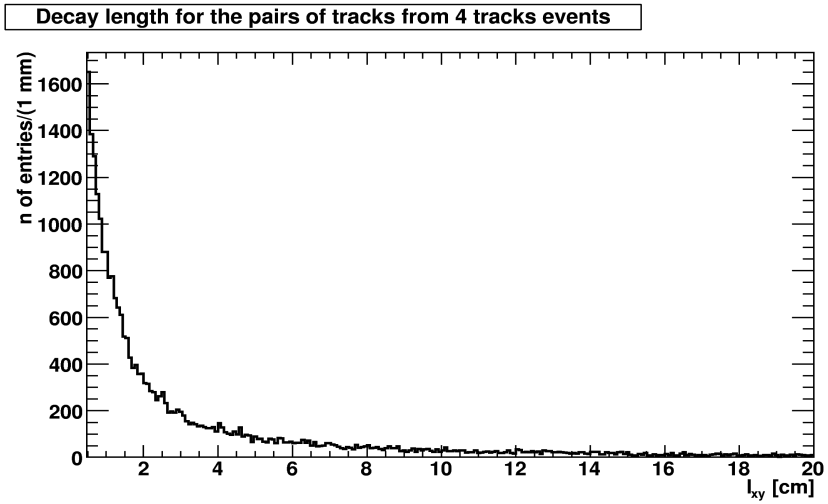
Backup slides

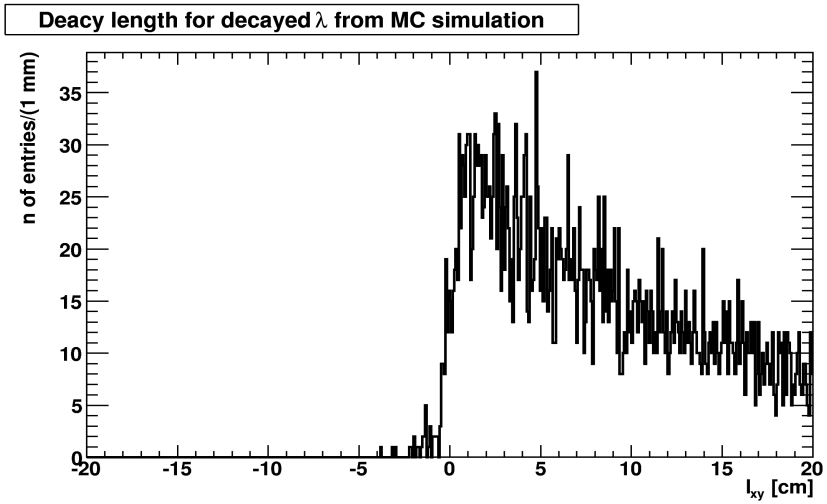
2 tracks events – mass

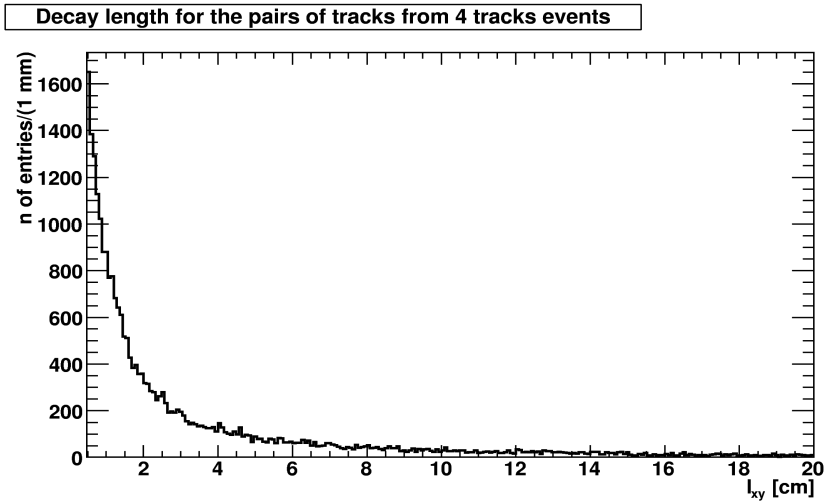


Decay length – linear scale

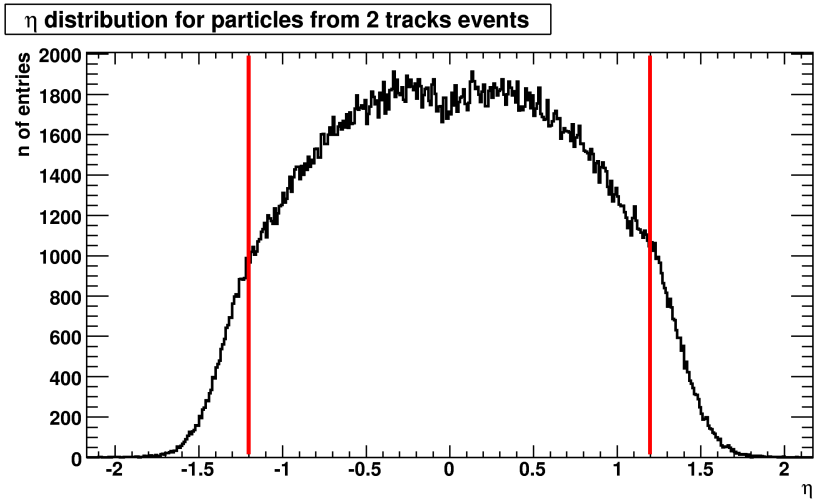


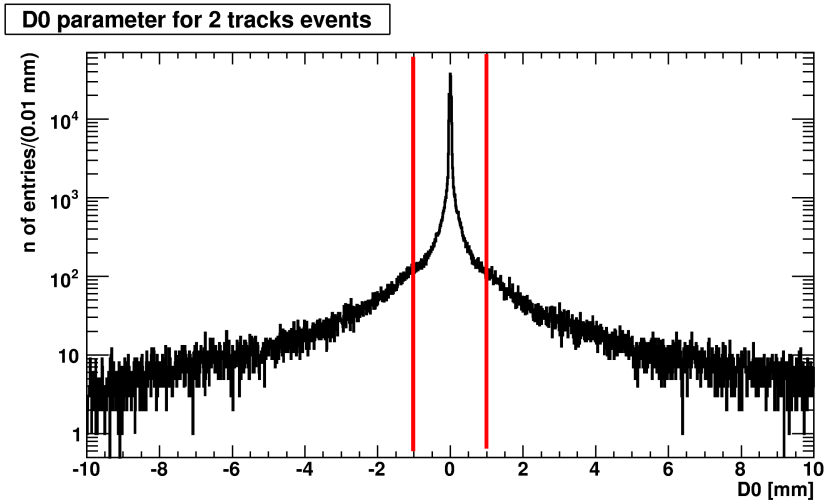


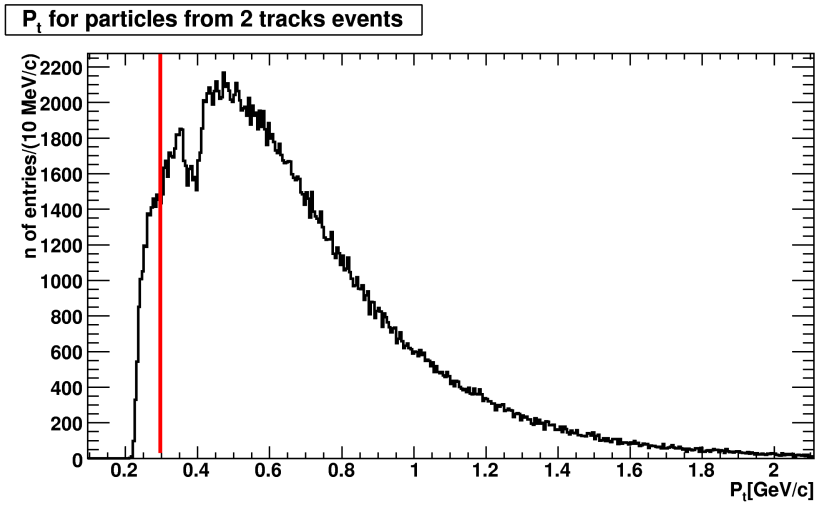


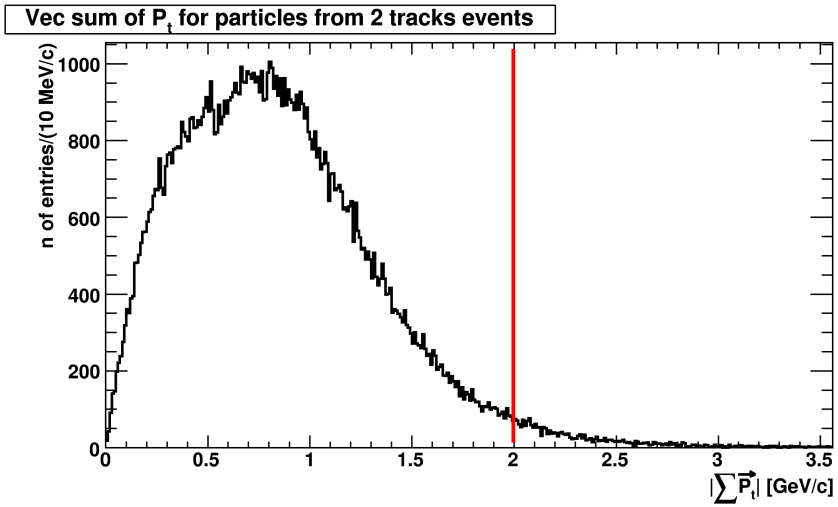


2 tracks events – cuts

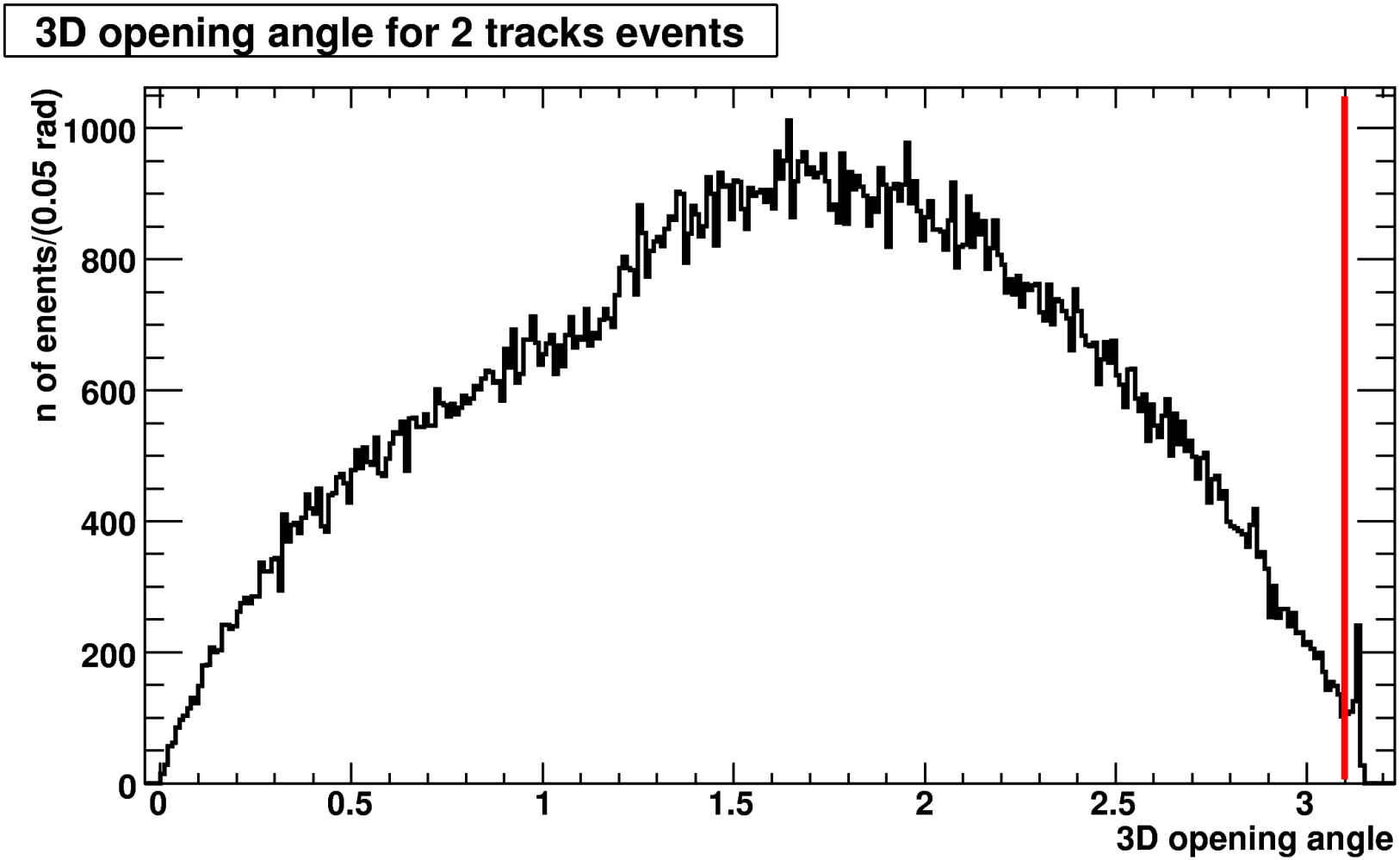
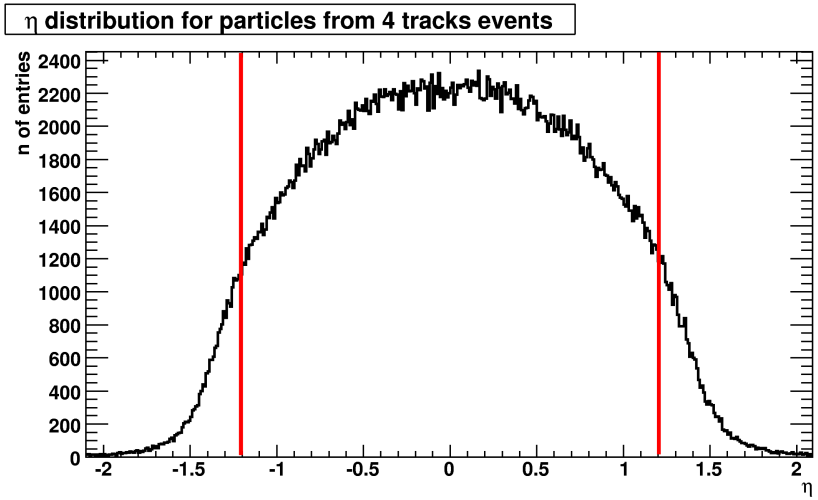
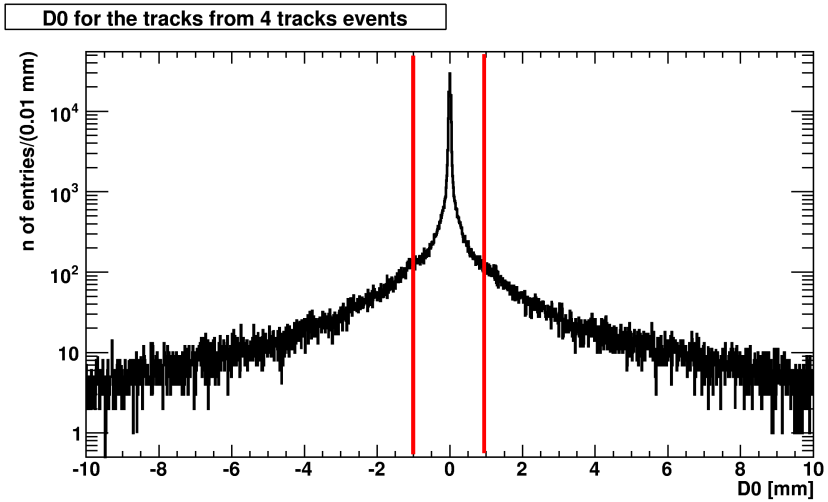
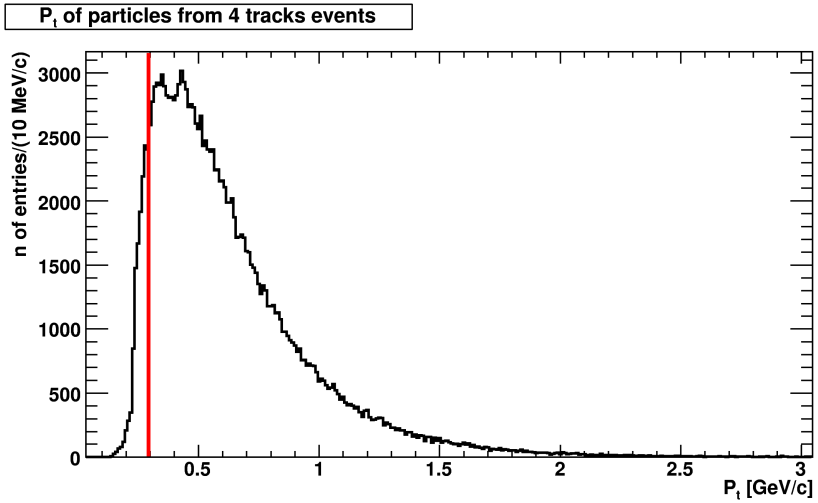
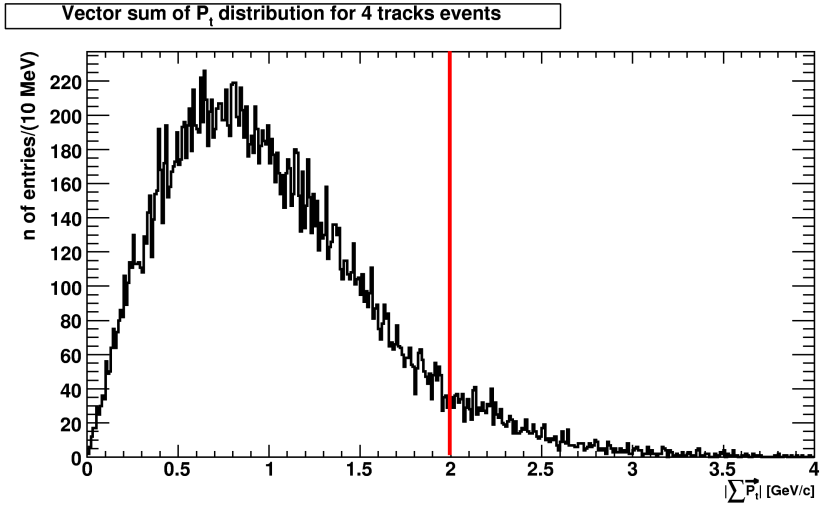








2 tracks events – cuts



4 tracks events – cuts