Gap-X-Gap update

1) Artur Święch:
    1) Triggers
    2) Offline cleanup
2) Dominik Wrana:
    1) Exclusive 2 tracks events
    2) Creating a vertex
    3) Central mass + Muons
3) Maria Żurek:
    1) ParticleID - AntiDeuterons
    2) Low mass exclusive events

Summary

- Forward gaps (|η|):
  - BSC1 (5.4-5.9)
  - CLC (3.7-4.7)
  - FwdPlug (2.11-3.64)
- Something Central
  - 2 Jets > 0.5 GeV
  - 2 Em showers > 0.5 GeV
  - Tracks > 1.5 GeV/c
- 4 904 855 events
  - 4605717 Gap data
  - 304994 Zero-Bias
- Integrated luminosity: 1,46 pb^{-1}

Trigger table

L2BIT	TRIGGER_NAME
0	L2_AUTO_L1_MB_XING [2]
1	L2_AUTO_L1_MB_XING_PS200K [1]
2	L2_AUTO_L1_TEN_TRK1.5 [1]
3	L2_CJET5_&_SUMET2_RL20HZ_L1_CLC_VETO [2]
4	L2_INCLUSIVE_ALL_2HZ [1]
5	L2_SUMET2_RL20HZ_L1_CJET5_&_CLC_VETO [2]
6	L2_SUMET2_RL25HZ_L1_TRK1.5_&_CLC_BSC1_VETO [2]
7	L2_SUMET2_RL25HZ_L1_TWO_TRK1.5_&_CLC_BSC1_VETO [2]
8	L2_SUMET2_RL60HZ_L1_TWO_CEM0.5_&_CLC_BSC1_VETO [2]
9	L2_SUMET2_RL60HZ_L1_TWO_CJET0.5_&_CLC_BSC1_VETO [2]

Offline cleanups

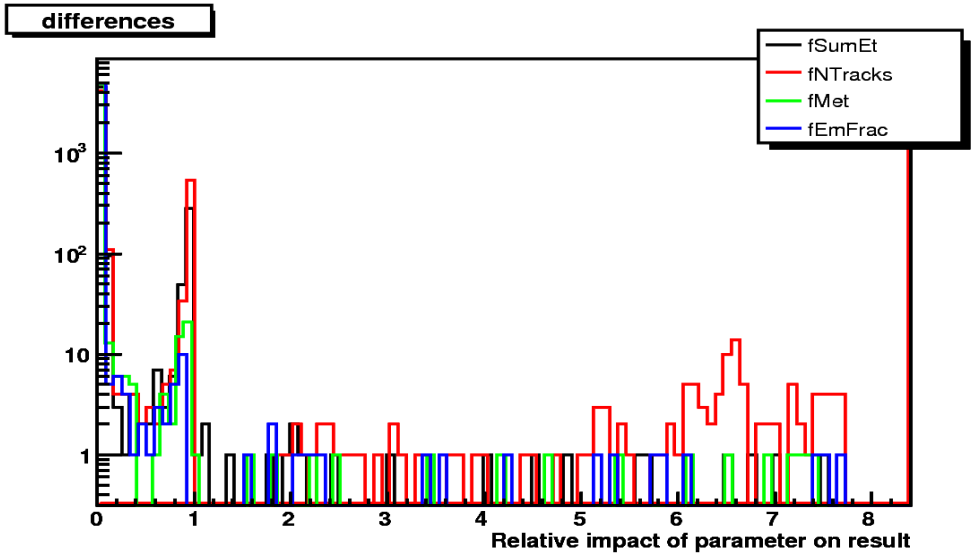
- Sum of BSC1 ADC counts E/W < 1500
- Sum of CLC ADC counts E/W < 4000
- Had Energy in FwdPlug E/W < 3 GeV
- Em Energy in FwdPlug E/W <3.5 GeV
- Same trigger in 292319

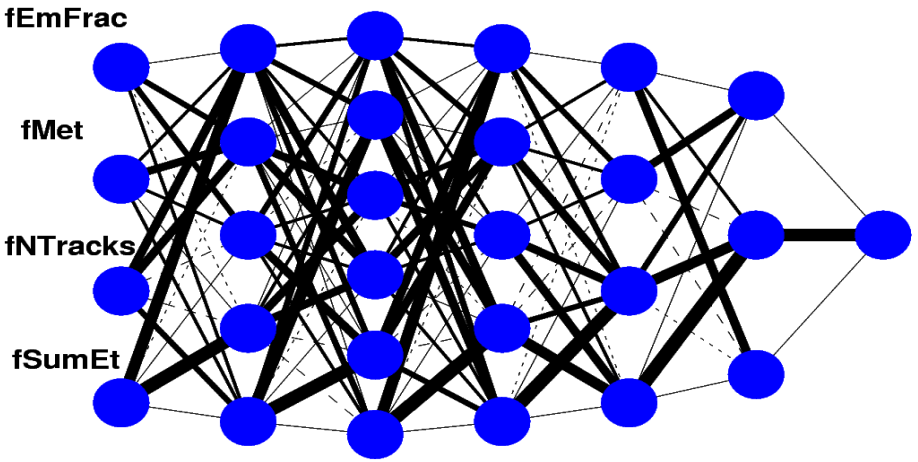
- 4 158 567 events
- 4 150 219 events
- 3 453 588 events
- 2 617 343 events
- **2 617 318 events**

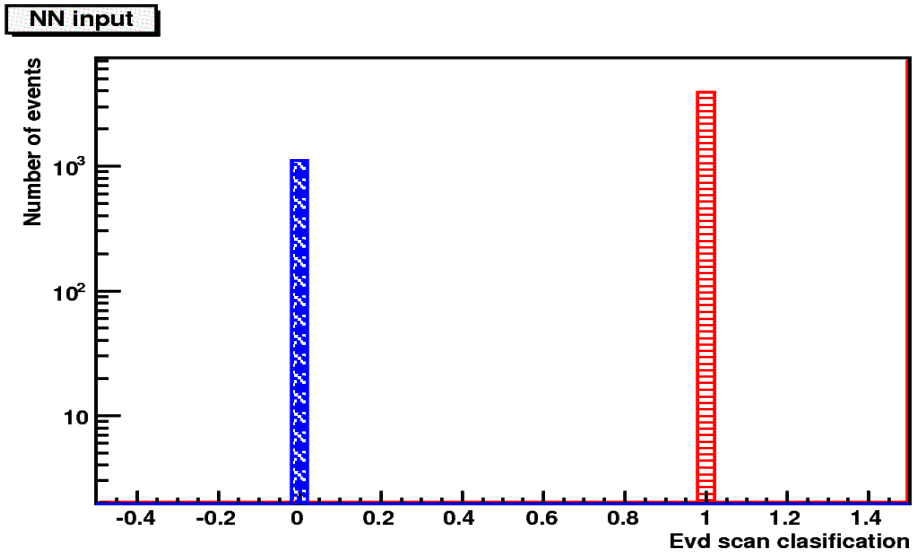
Crap cleanup

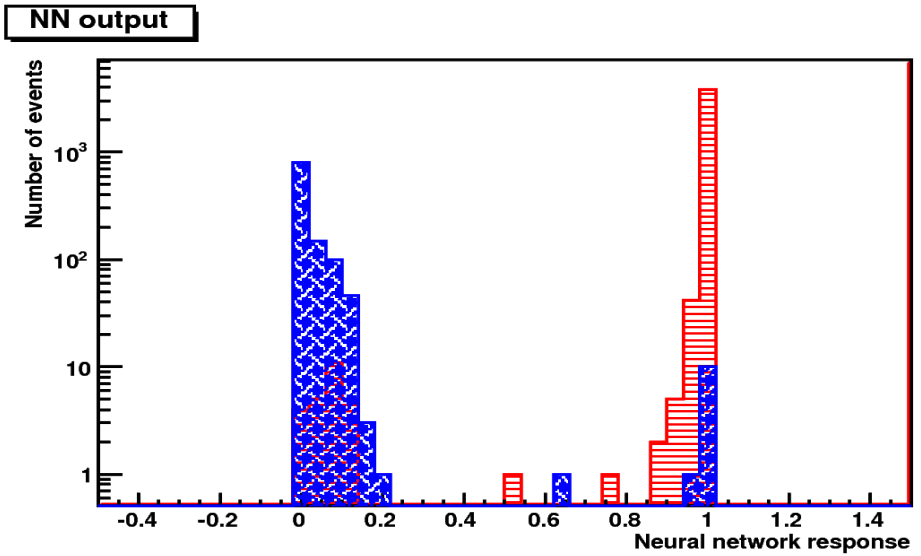
- Crap events:
  - Beam Halo
  - No-track cosmics
  - Empty events
- Neural Network input:
  - Ntracks
  - Missing Et
  - Sum Et
  - Em Fraction
- 5000 events classified using event display
  - 0 → Crap event
  - 1 → Good event
- Different topologies tested
  - trial-and-error method

Results


differences
fSumEt
fNTracks
fMet
fEmFrac
Relative impact of parameter on result


fEmFrac
fMet
fNTracks
fSumEt


NN input
Number of events
Evd scan clasification


NN output
Number of events
Neural network response

Results

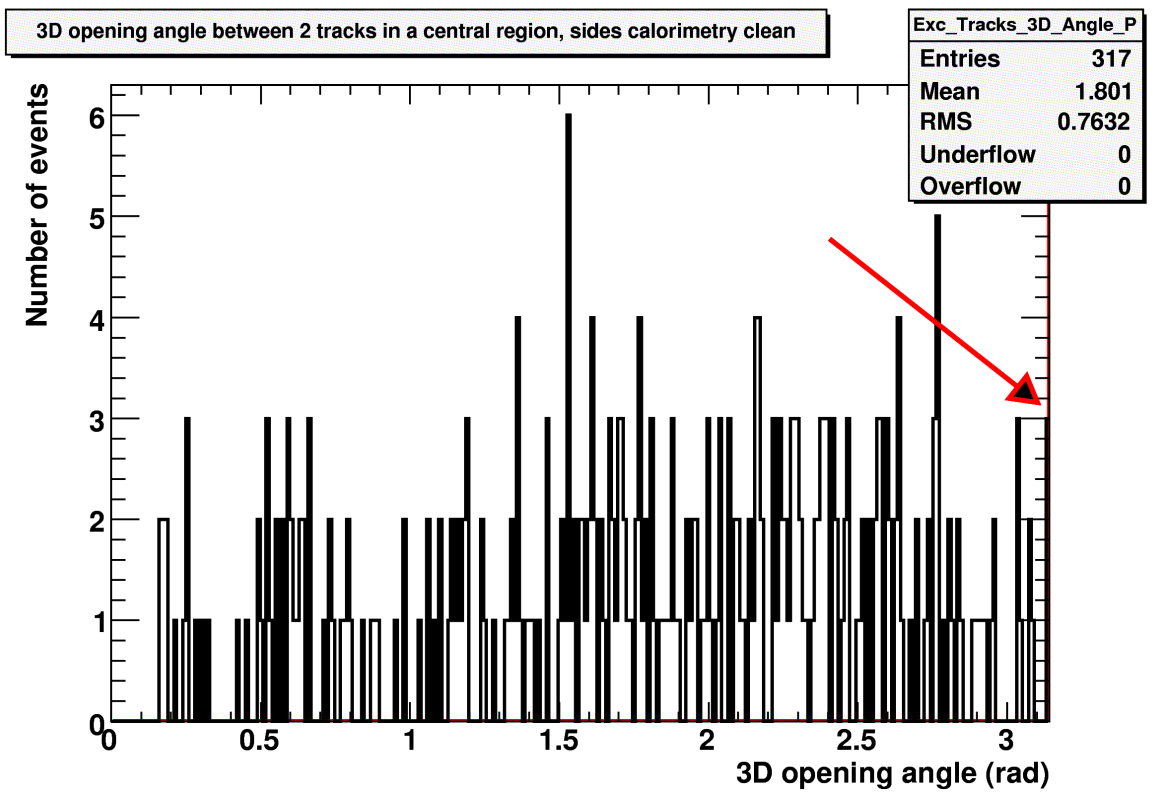
- 12 out of 1111 Crap events wrong (1.1%)
- 25 out of 3889 Good events wrong (0.6%)
- 37 out of 5000 All events wrong (0.7%)
- ~1.58M clean events (aproximation from 3% sample)

GXG results part 2

- Looking for exclusive 2 tracks events:
  - Cosmics veto (on 3D opening angle)
  - Good tracks picking
  - Side calorimeter cleanup
  - Central calorimeter cleanup
- Creating a vertex
- Update: Central mass + Muons

Dominik Wrana

3D opening angle



May data - #292319

3 events with angle > 3.1 → cosmics

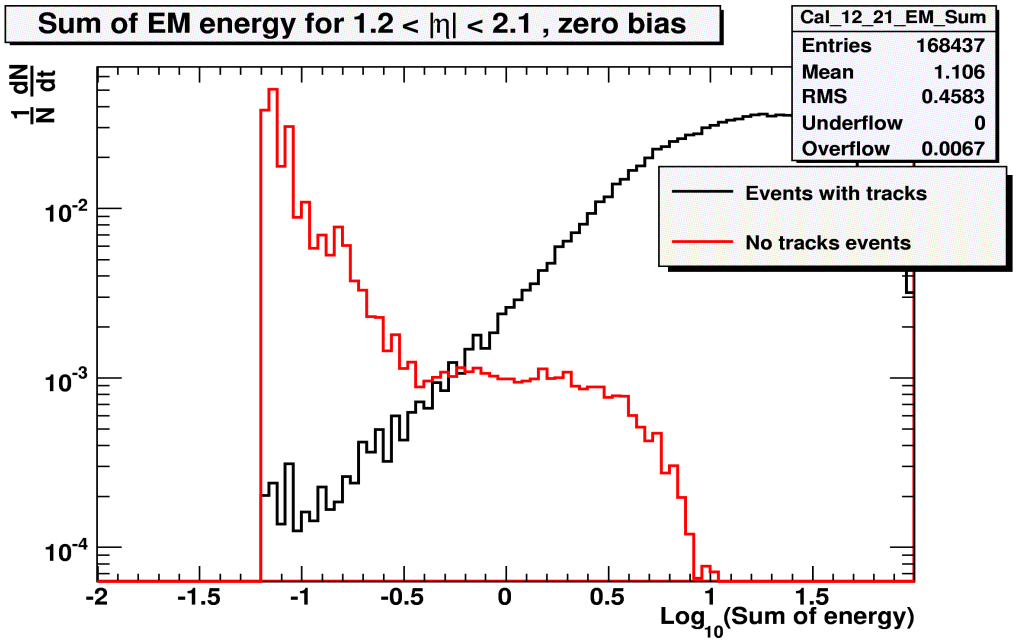
3D opening angle for exclusive 2 tracks events (central, without muons)

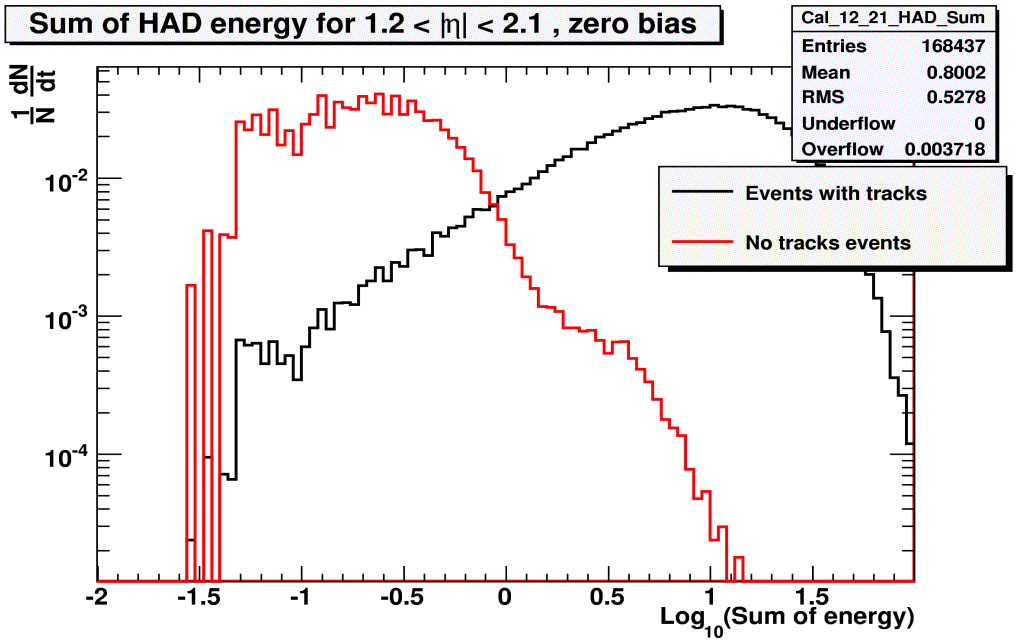
Picking good tracks
according to Sasha's code

- Pt > 0.3 GeV/c
- Pt < 980 GeV/c
- At least 2 segments in COT St with 5 hits
- At least 2 segments in COT Ax with 5 hits
- χ^2 of COT fit max of 3

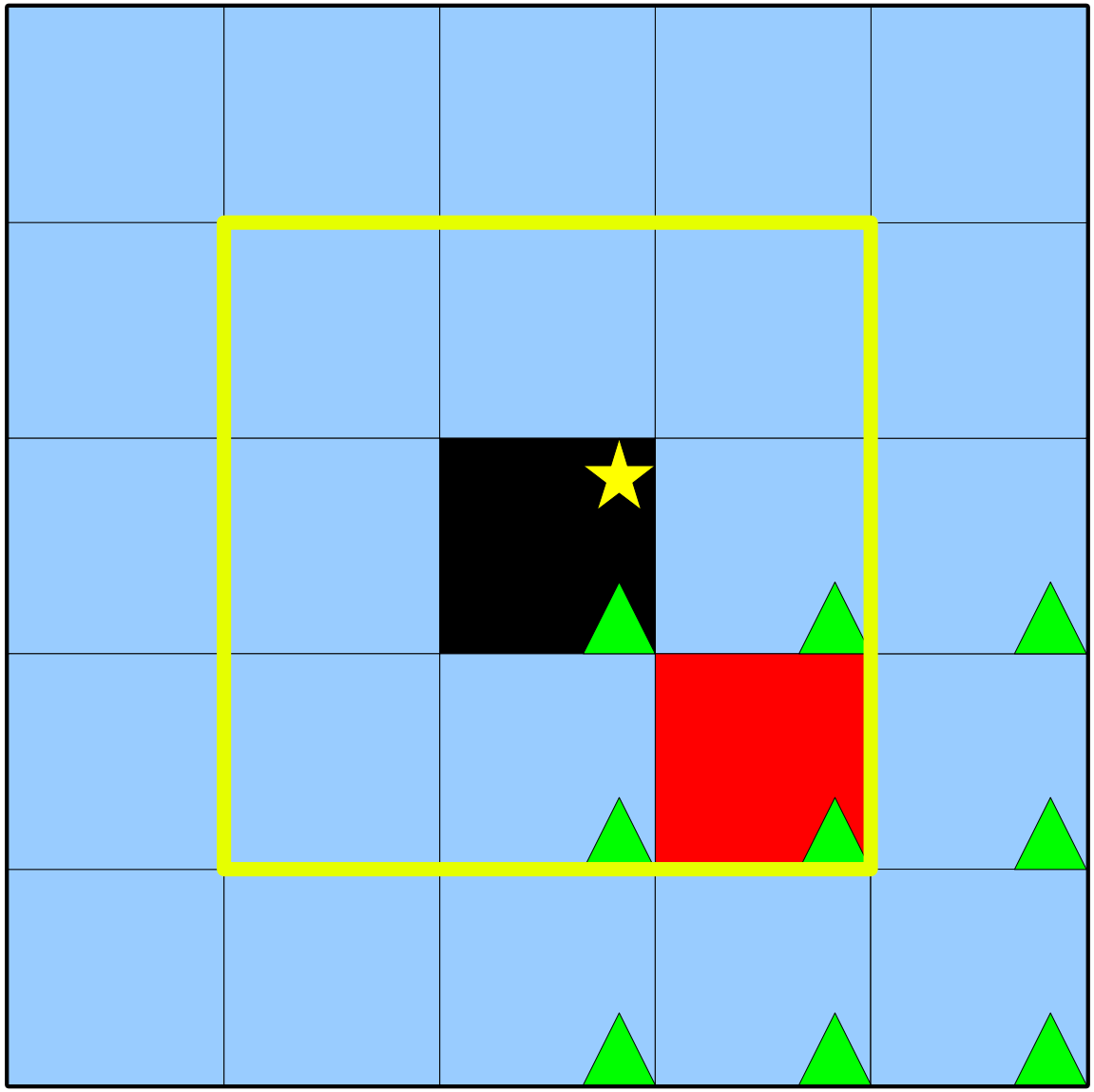
Side calorimeter cleanup

- |η| > 2.1 already cleaned - CLC, BSC1,FPlug cuts
- 2.1 > |η| > 1.1:
  - Sum of EM < 0.3 GeV
  - Sum of HAD < 1 GeV





Track energy in a calorimeter



(Extrapolated) Track hit

Tower hit

Hottest tower

Finally picked towers

~70% – the hit one is the hottest

Method of a central calorimeter cleaning

E_Track1 – energy from 9 towers around hottest one (with it) for 1st track

E_Track2 – energy from 9 towers around hottest one (with it) for 2nd track

E_Tracks = E_Track1 + E_Track2

E_All – energy from all towers in a central region

Cut (events rejected):

E_All – E_Tracks > 0.96 * 1 GeV

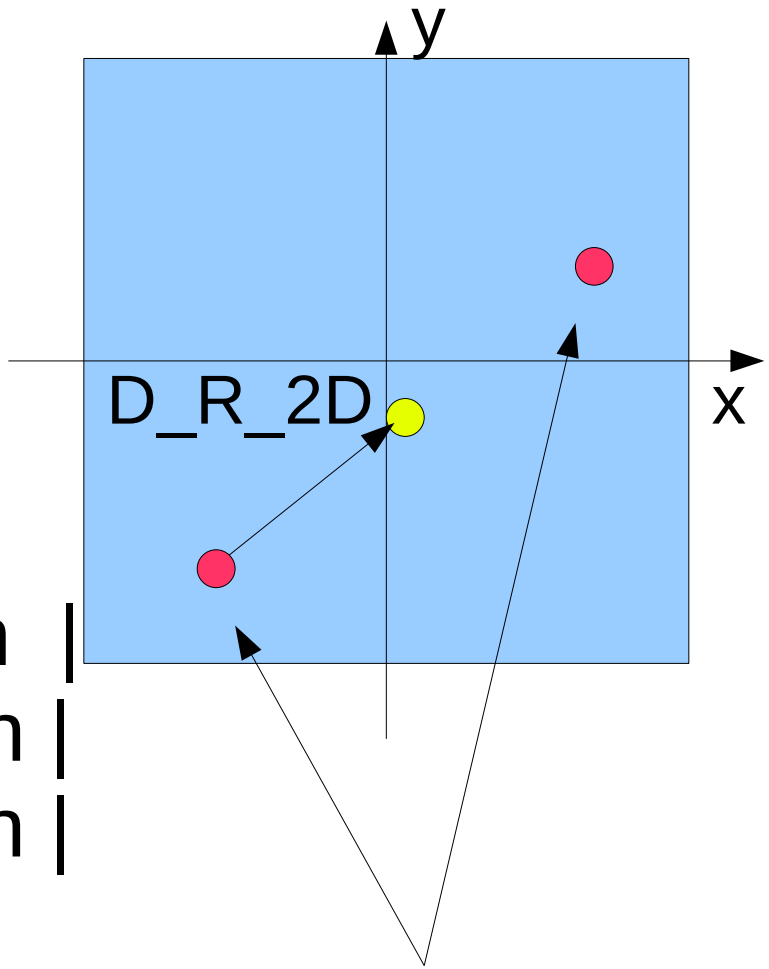
Noise level of the rest of the calorimeter

(0.94 * 1 GeV – 3 tracks events etc.)

Cuts to make a handmade vertex®

For each track:

- **D_Z0 < 3 cm**
- **D_R_2D < 0.6 cm**



Where:

D_Z0 = | Z0_Track - Z0_Mean |
D_X0 = | X0_Track - X0_Mean |
D_Y0 = | Y0_Track - Y0_Mean |

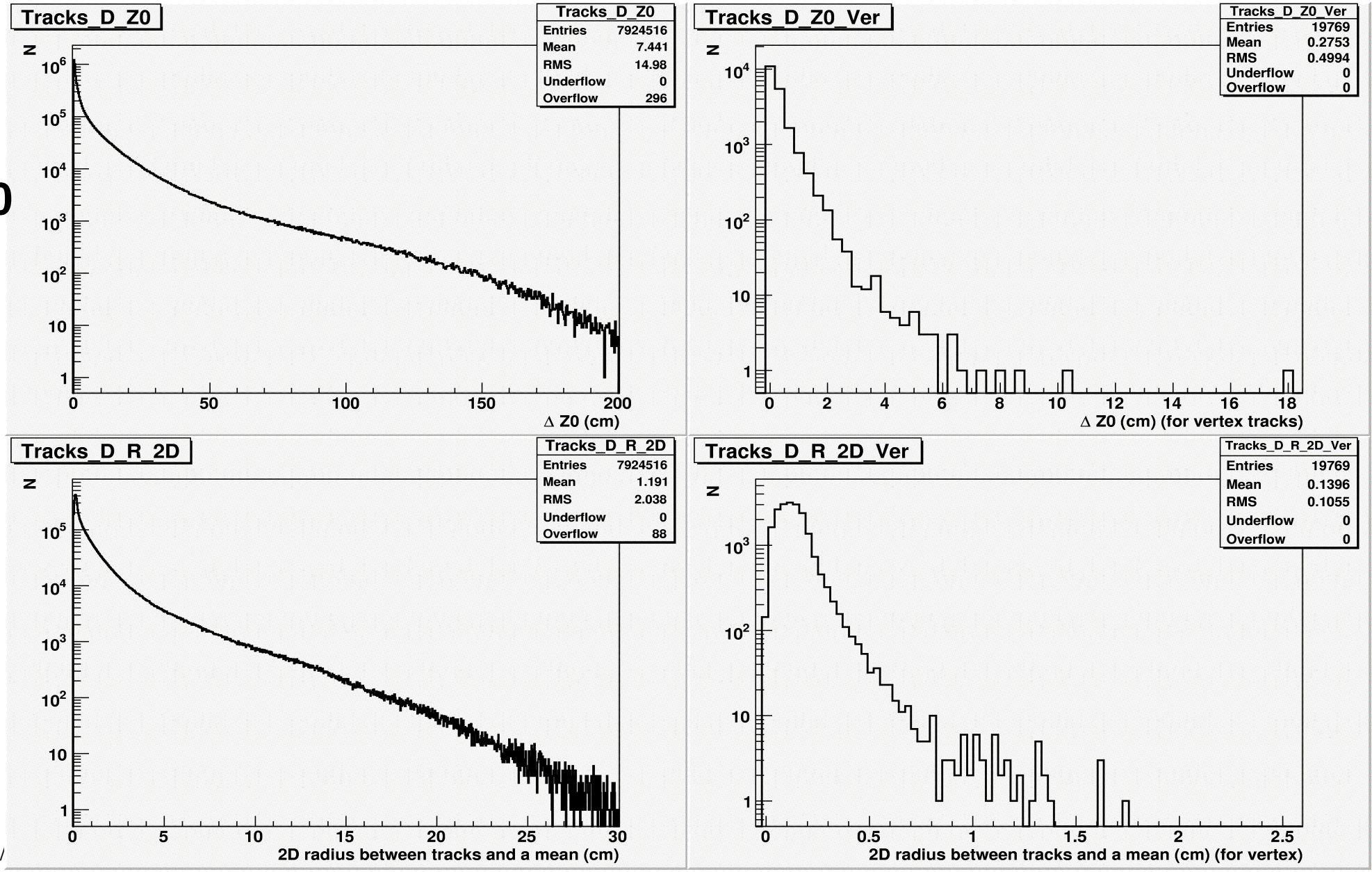
D_R_2D = sqrt(D_X0^2 + D_Y0^2) Track beginning

Handmade vertices

All sample | Vertices sample

D_Z0

D_R 2D

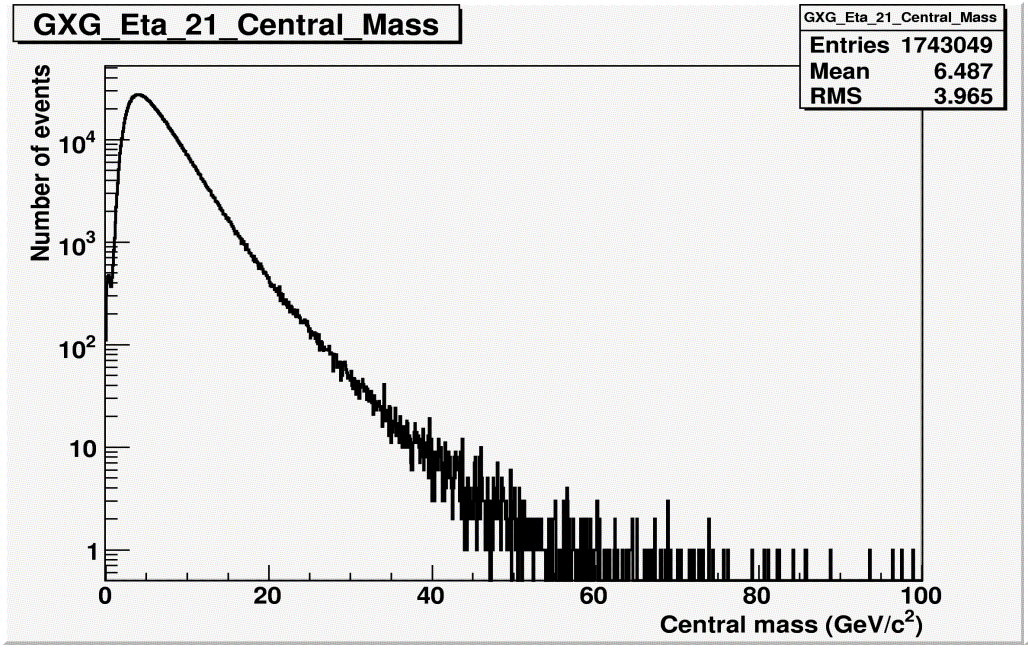


Central mass

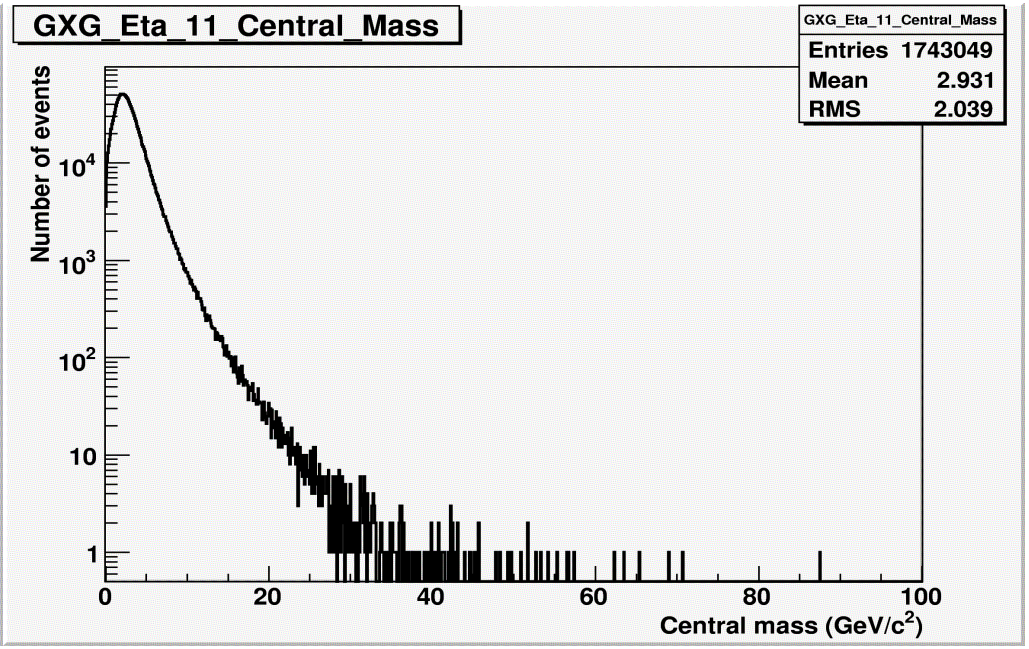
After:
- gaps cuts
- crap cuts

Central mass M:
M = sqrt(|ΣE|^2 - |vec ΣE|^2)

|η| < 2.1



|η| < 1.1



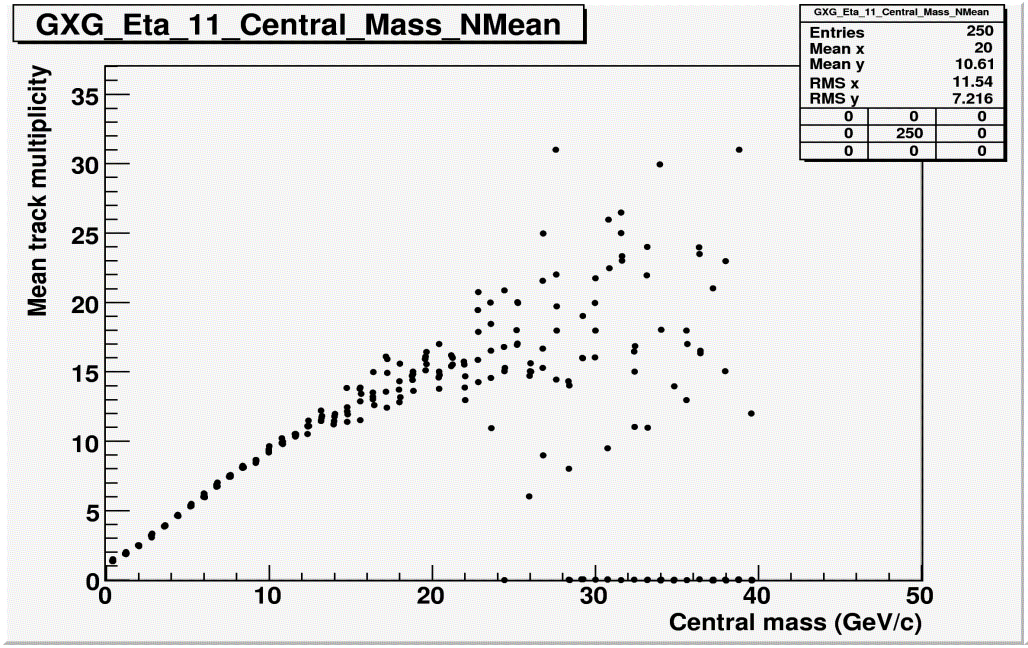
Central mass vs NMean

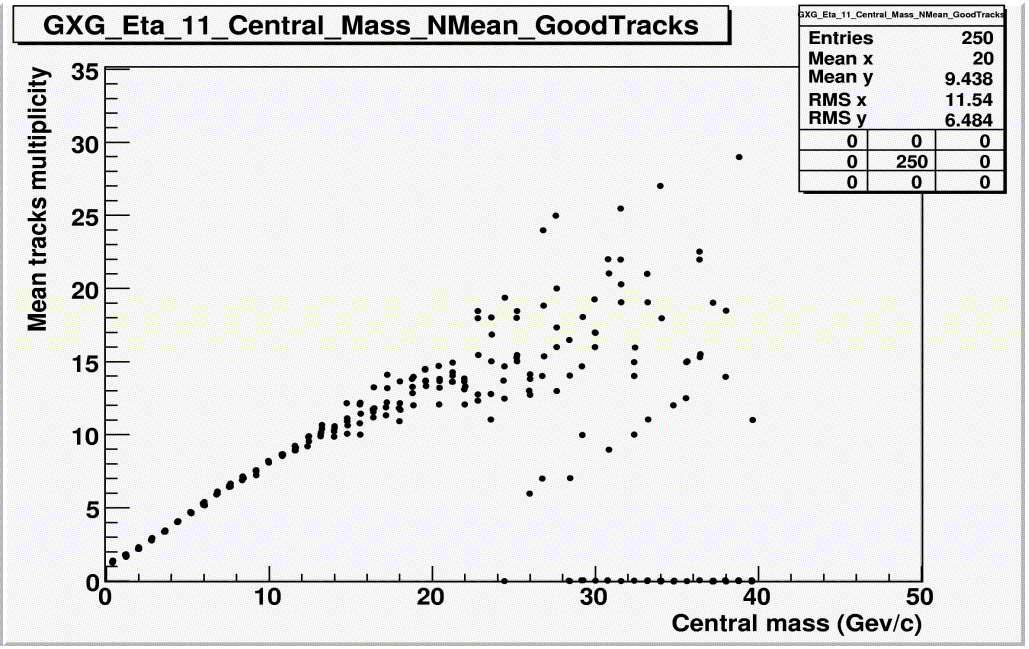
Average tracks multiplicity in a 0.8 GeV slices of M.

- gaps cuts
- crap cuts
- vertex® cuts
- |η| < 1.1

„**good tracks**”:
+ Pt > 0.4 GeV/c
+ good reconstruction

All tracks





Muons

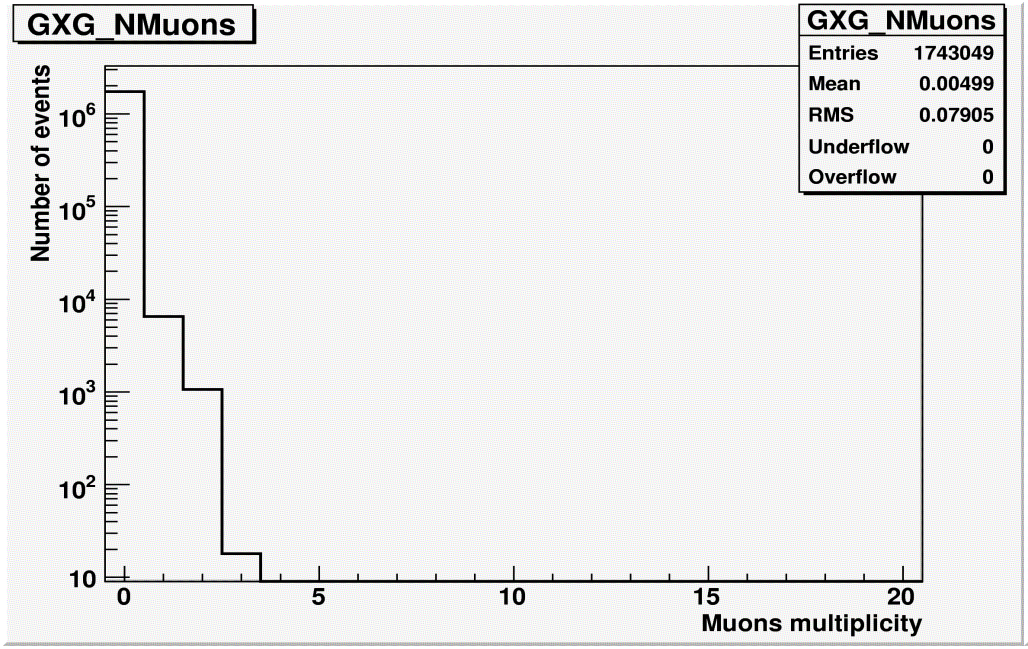
After:

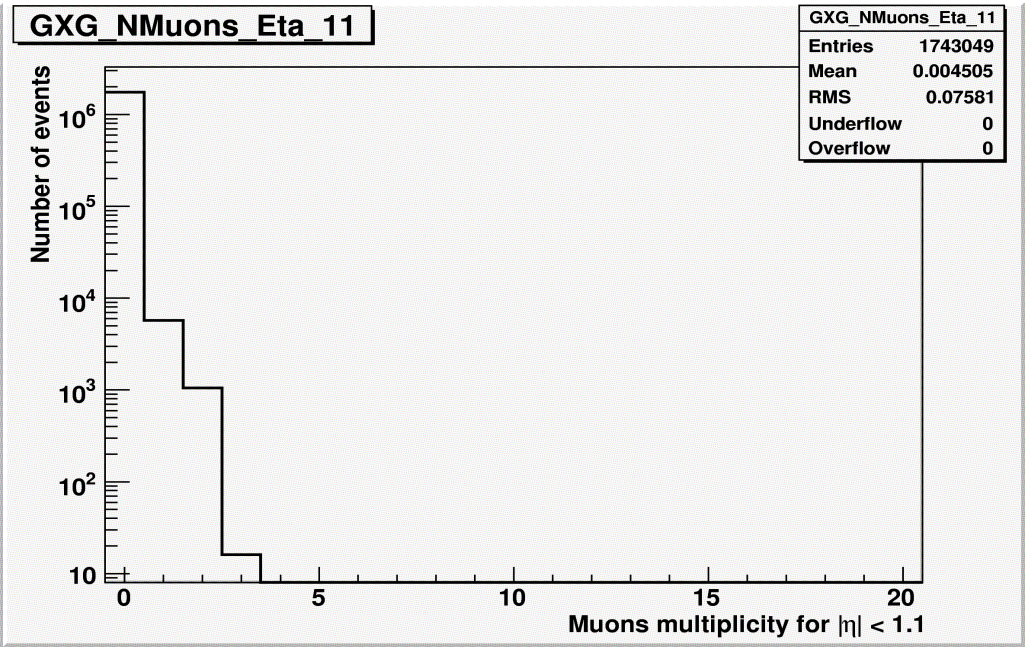
1) gaps cuts
2) crap cuts (neural net)
3) cosmics cuts

Trigger **1TRK1.5** only!

Muons multiplicity

Muons with |η| < 1.1 multiplicity

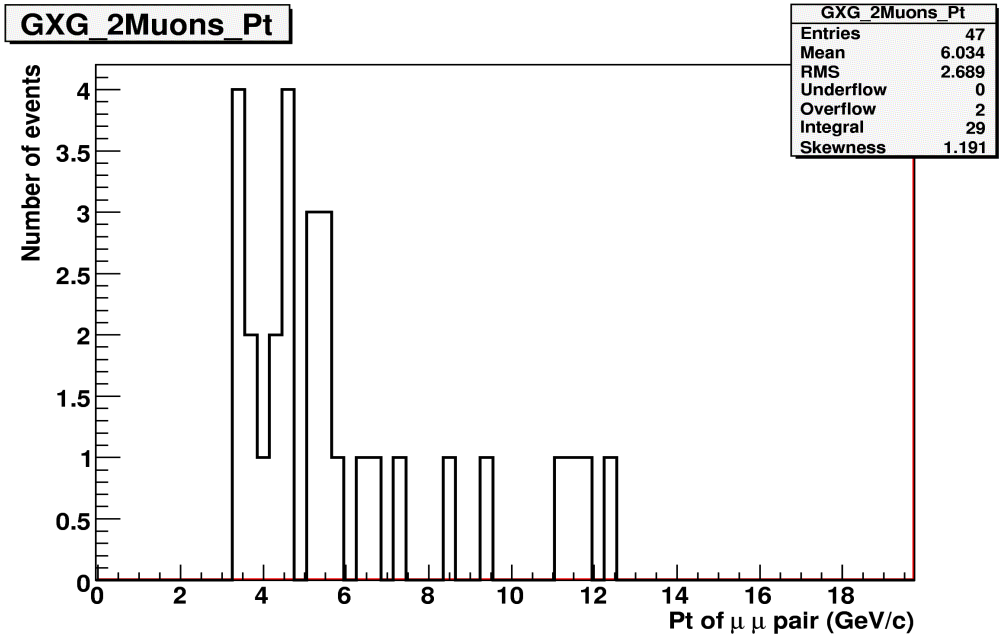




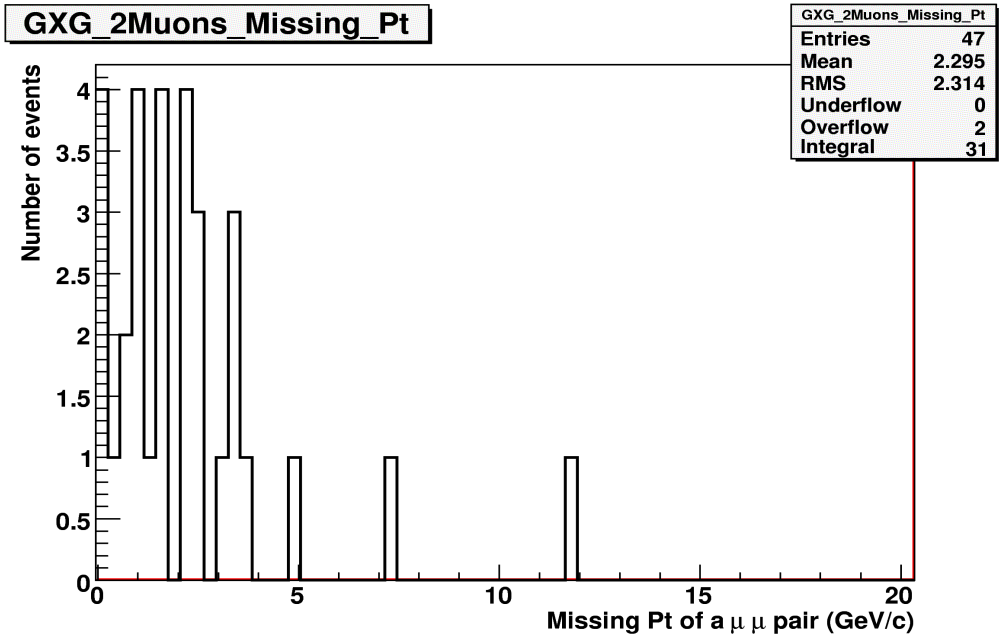
μμ pairs

|η| < 2.1

Pt of a pair (scalar sum)



Missing Pt (vector sum)

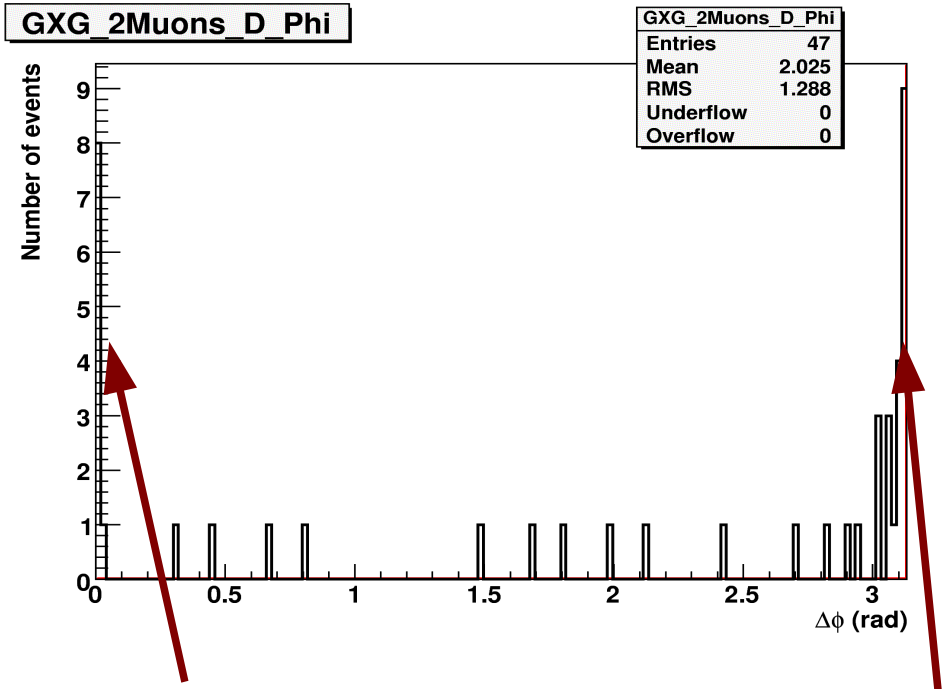


Pt and missing Pt of a μμ up to 300 GeV/c!

μμ pairs

|η| < 2.1

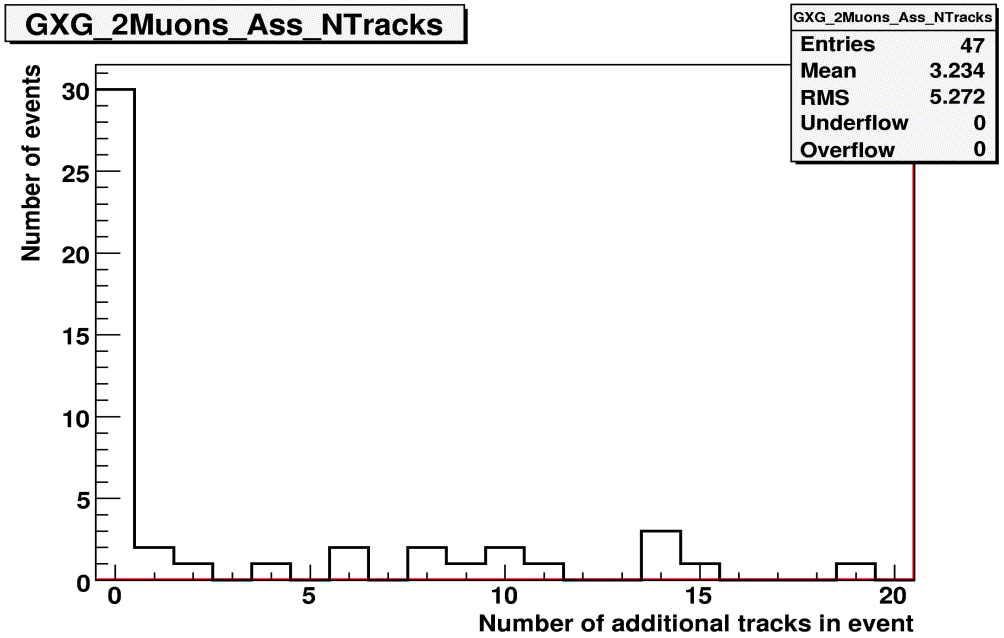
Δφ



Badly matched tracks

Cosmics?

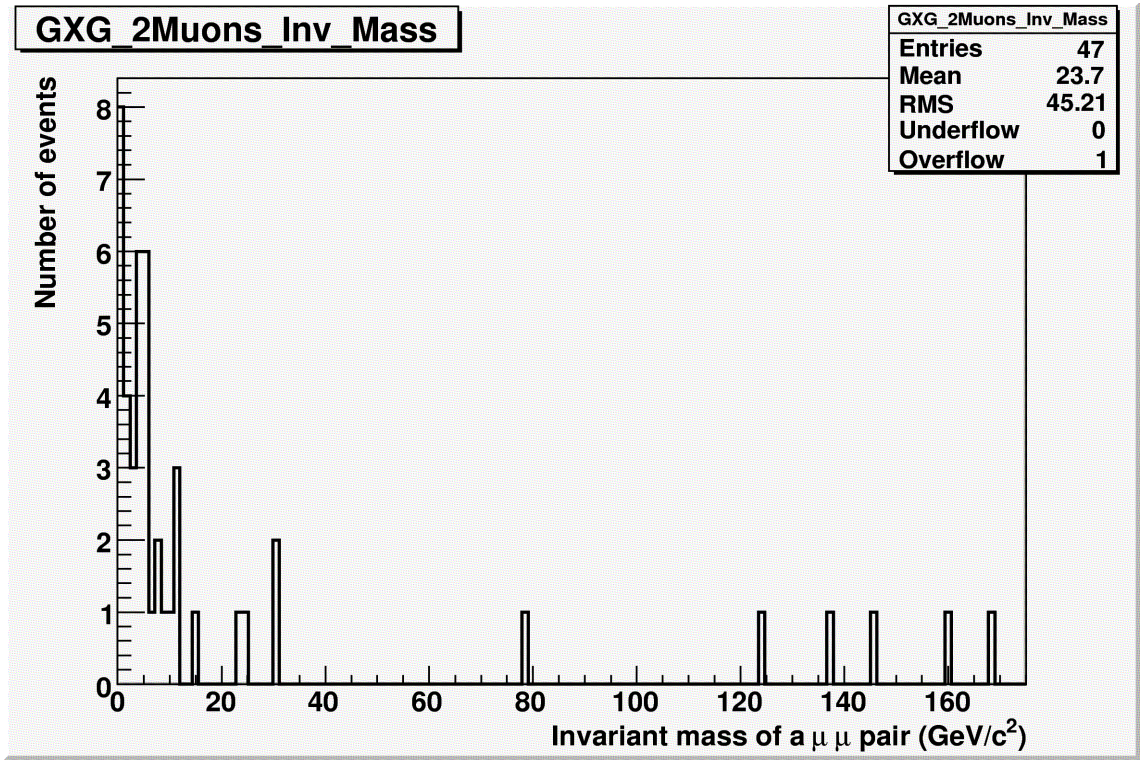
Number of other tracks in an event



- 30 events with dimuon pair only

μμ invariant mass

$|\eta| < 2.1$

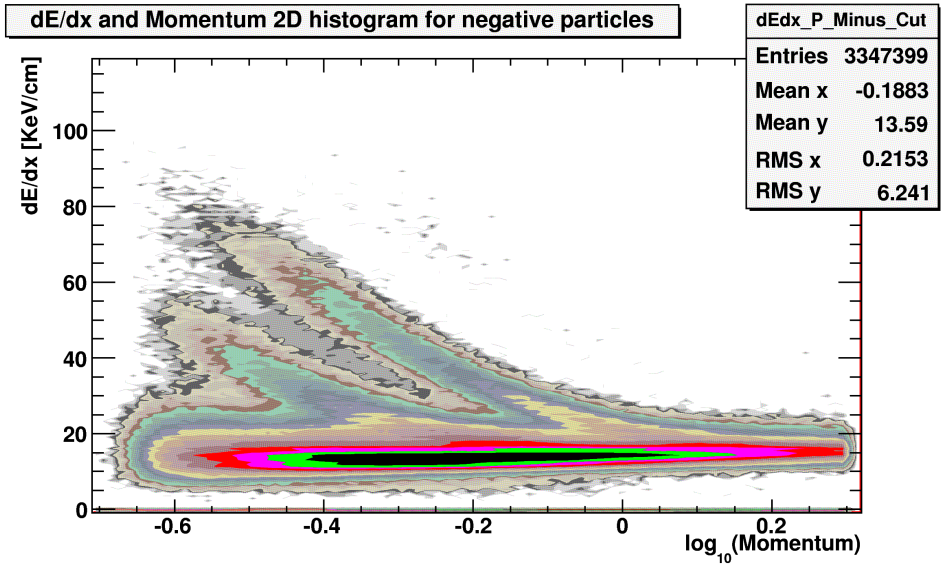


- a few muons with big invariant masses

μμ todo:

- classify big Pt & mass pairs:
  - ♠ still cosmics?
  - ♠ look at EVD
- improve tracks matching
- exclusive μμ
- single μ stuff

Particle identification
dE/dx



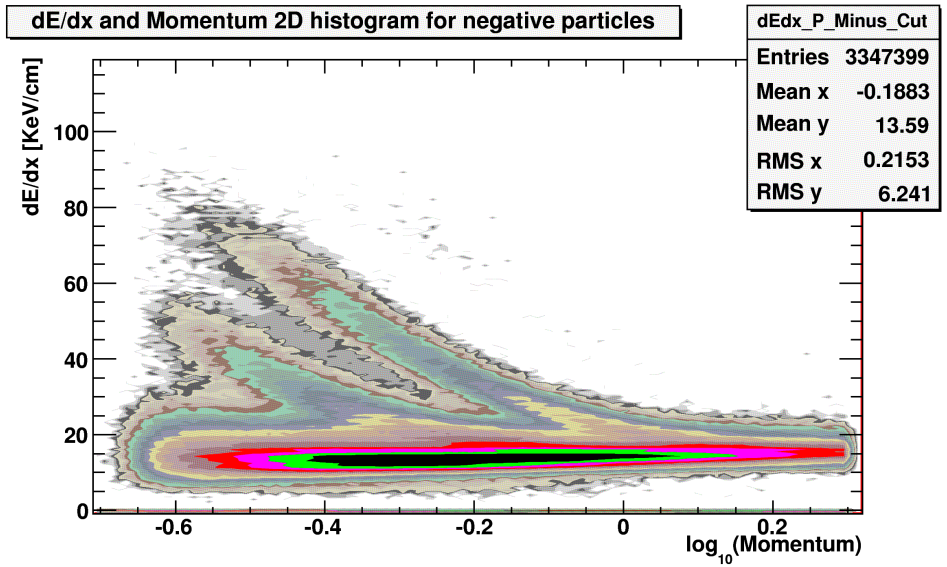
CDF universal curve parametrization:

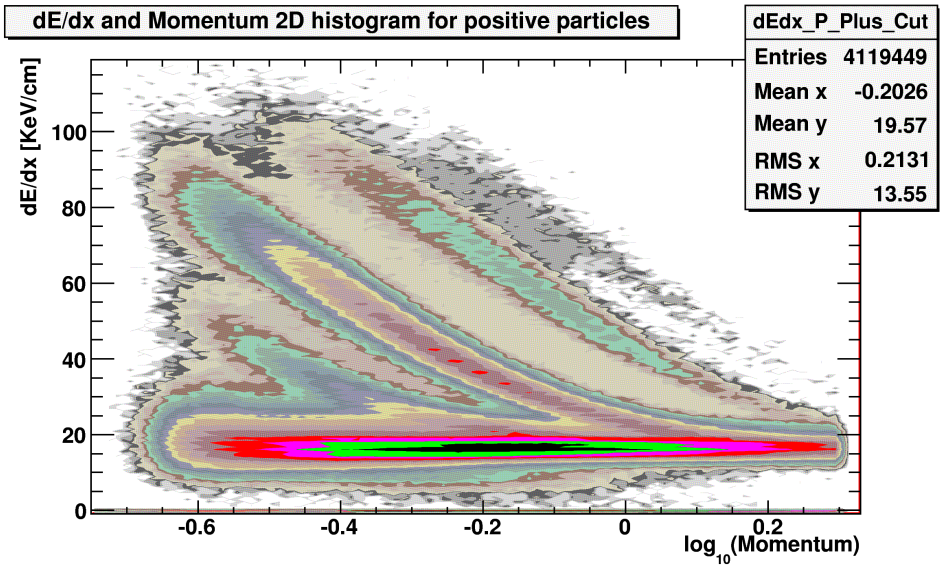
(c1*log(x/(x+b)) + c0)/(t*t) + a1*(t-1) + a2*(t-1)*(t-1) + c

x = momentum/mass;

t - betha

Particle identification
dE/dx





CDF universal curve parametrization:

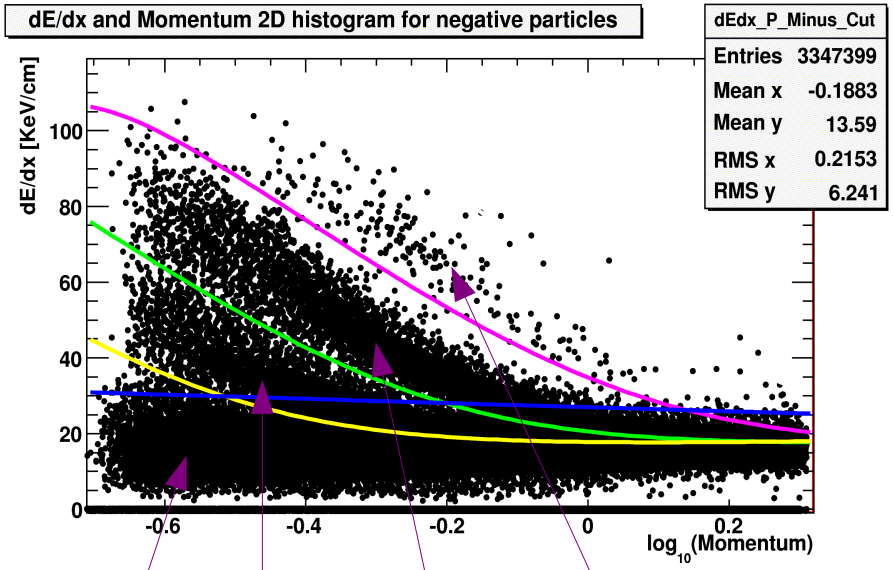
(c1*log(x/(x+b)) + c0)/(t*t) + a1*(t-1) + a2*(t-1)*(t-1) + c

x = momentum/mass;

t - betha

dE/dx – particle separation

Negative particles



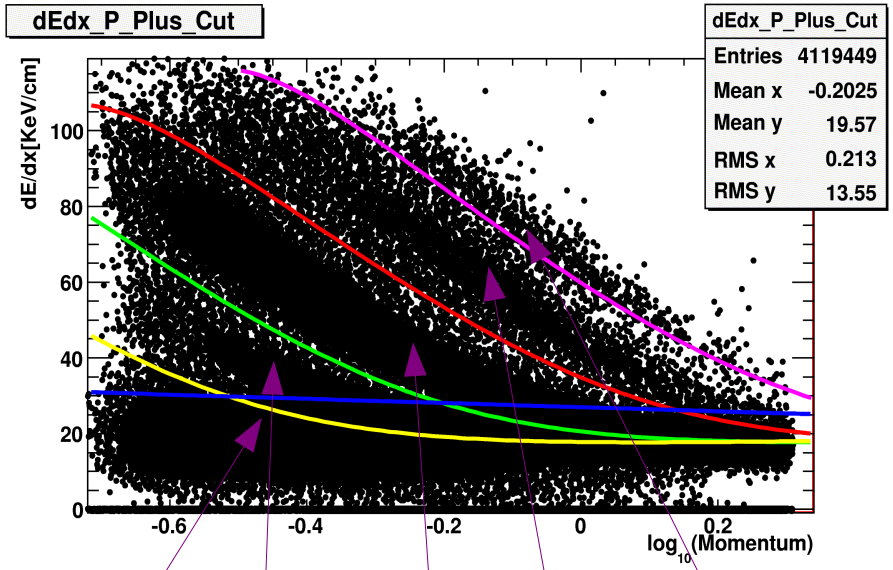
Pions-

Kaons-

Antiprotons

Antideuterons?

Positive particles



Pions+

Kaons+

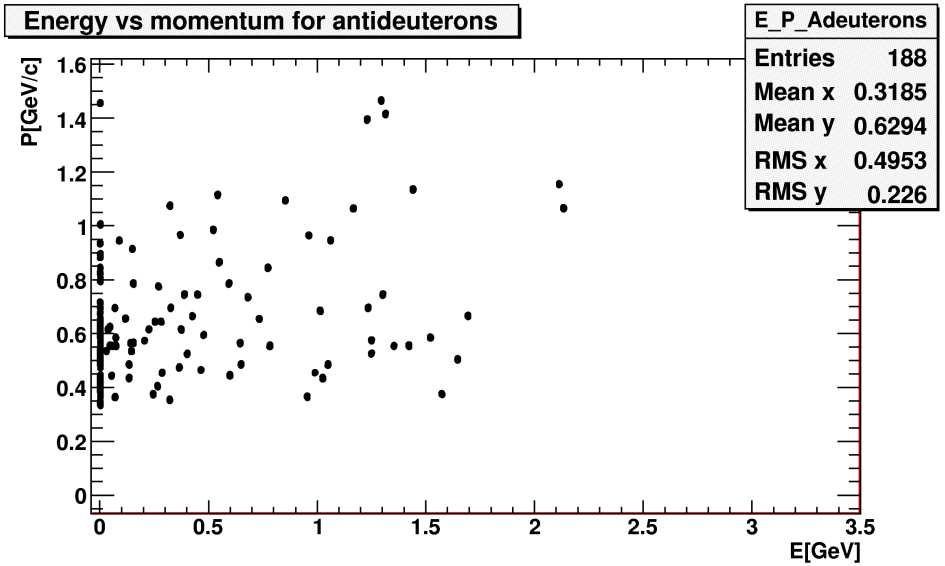
Protons

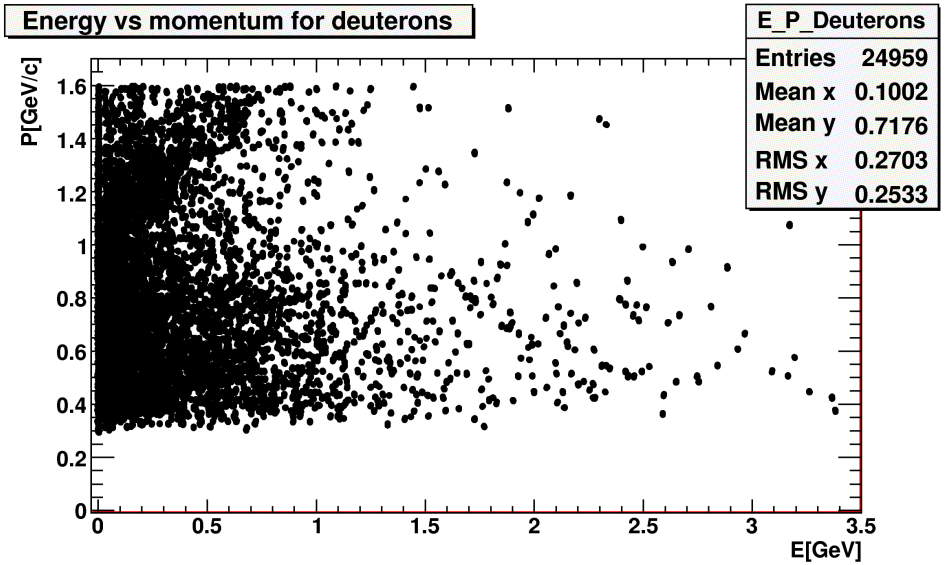
Deuterons

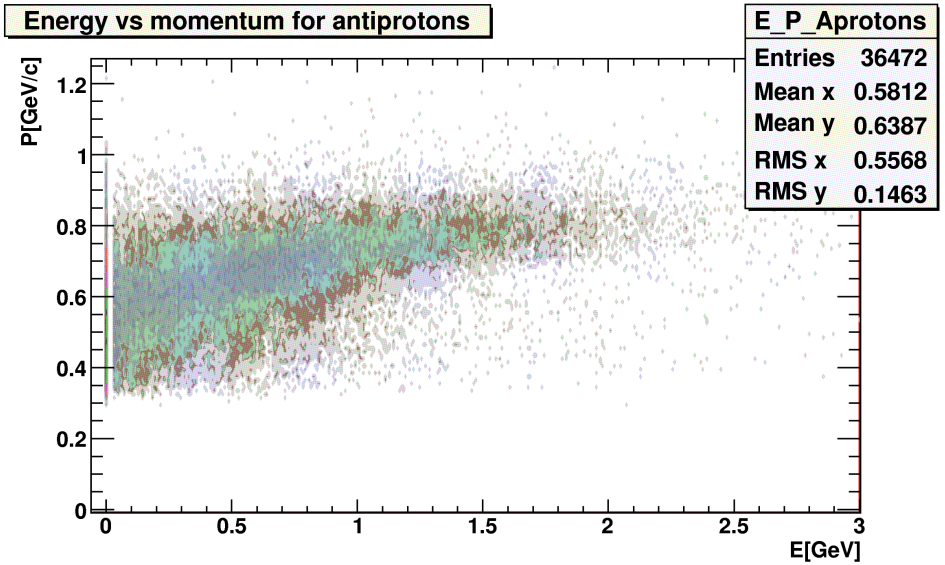
Tritons?

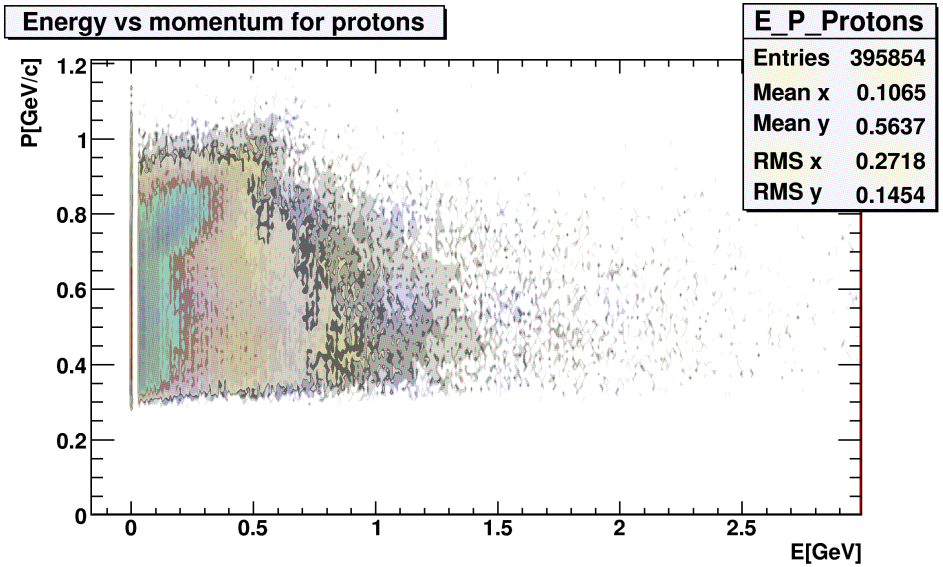
Energy vs momentum histograms

Negative and positive particles



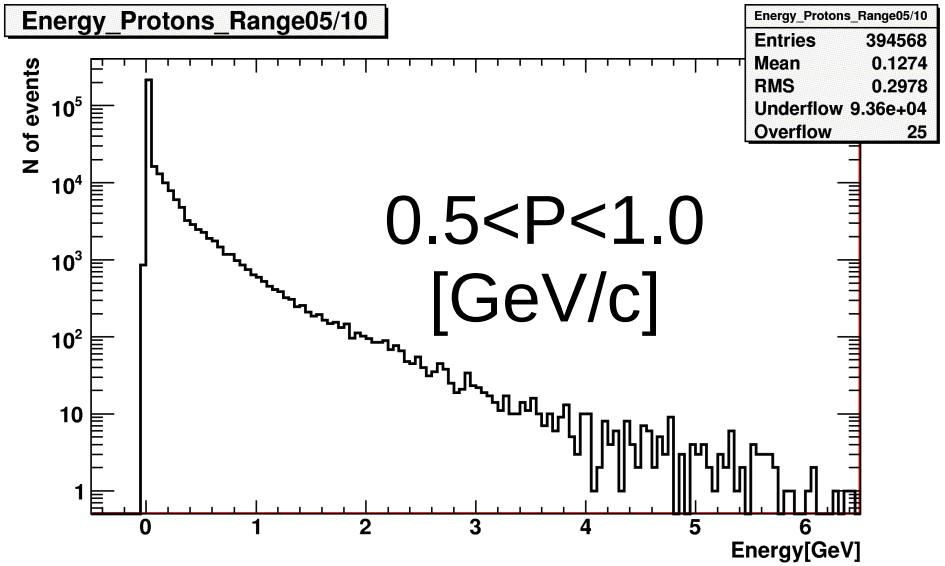


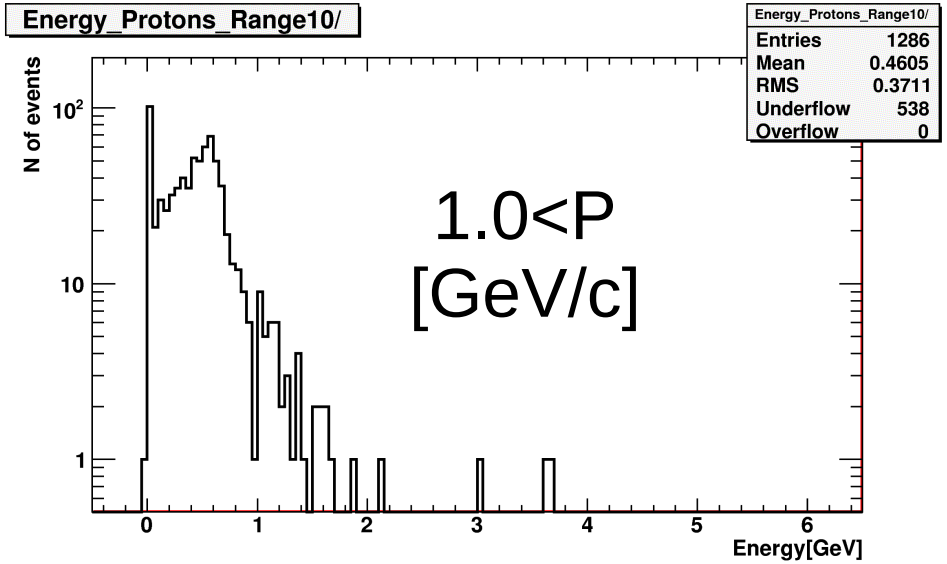


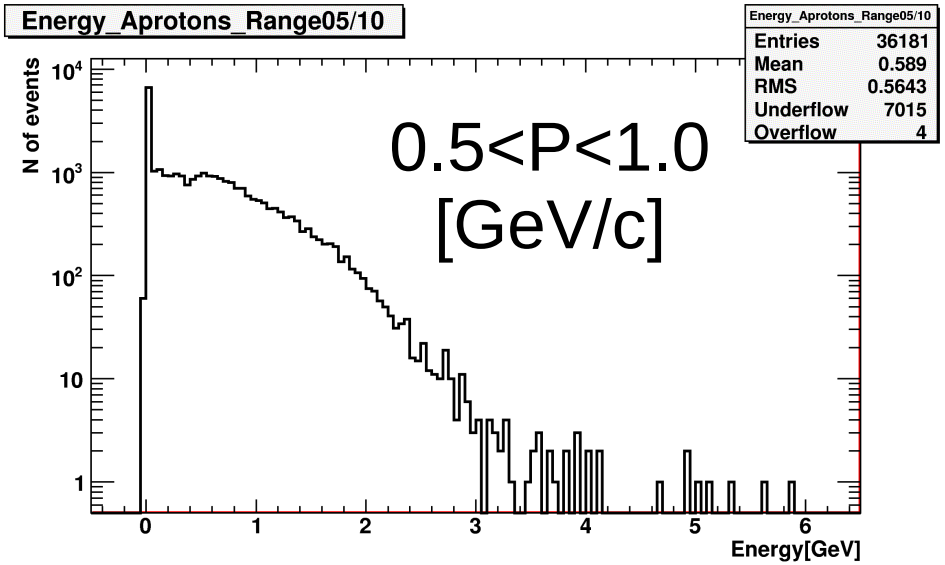


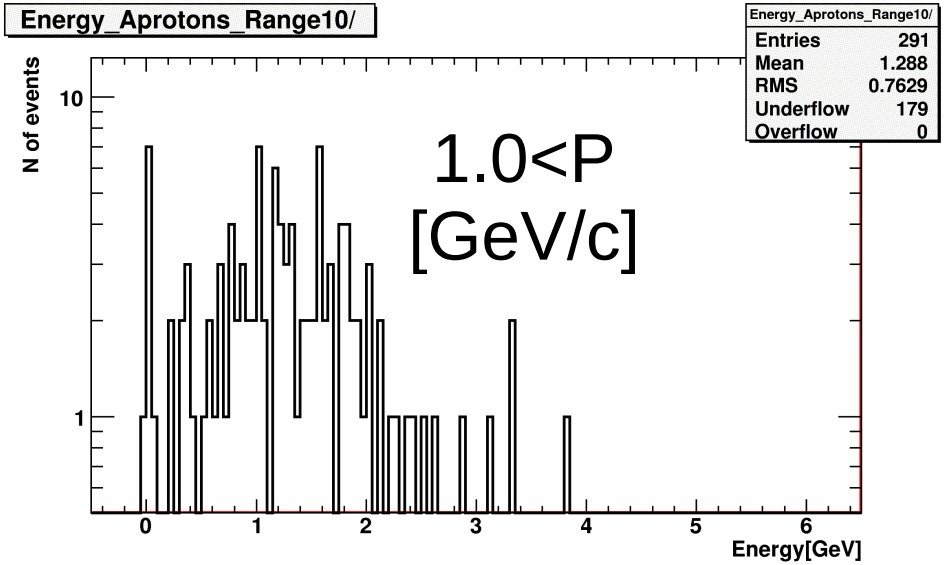
Protons and antiprotons

Energy for different ranges of momentum



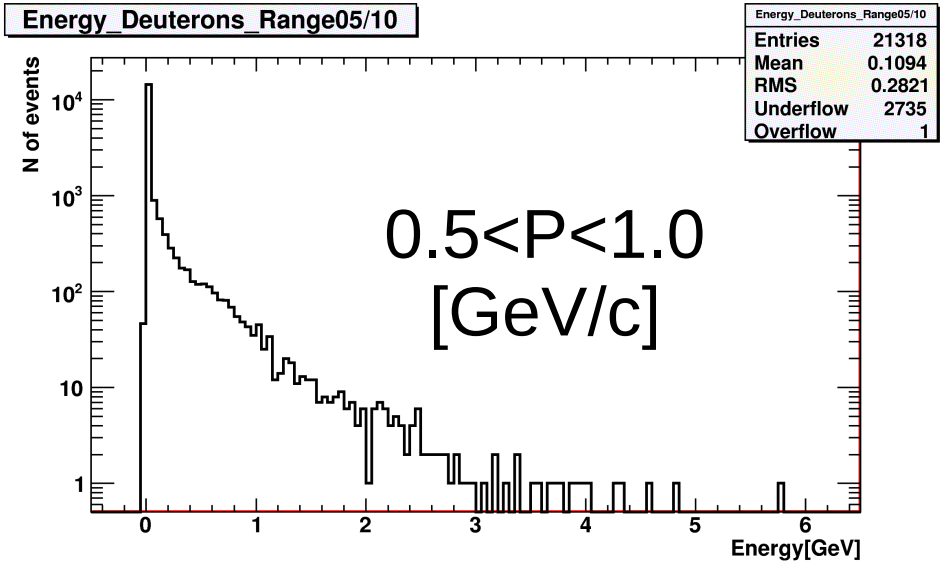


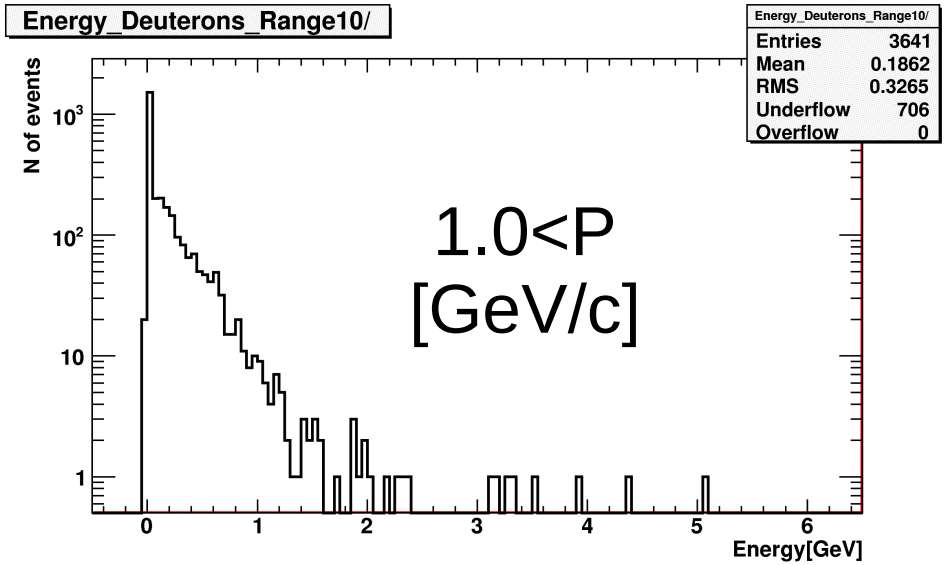


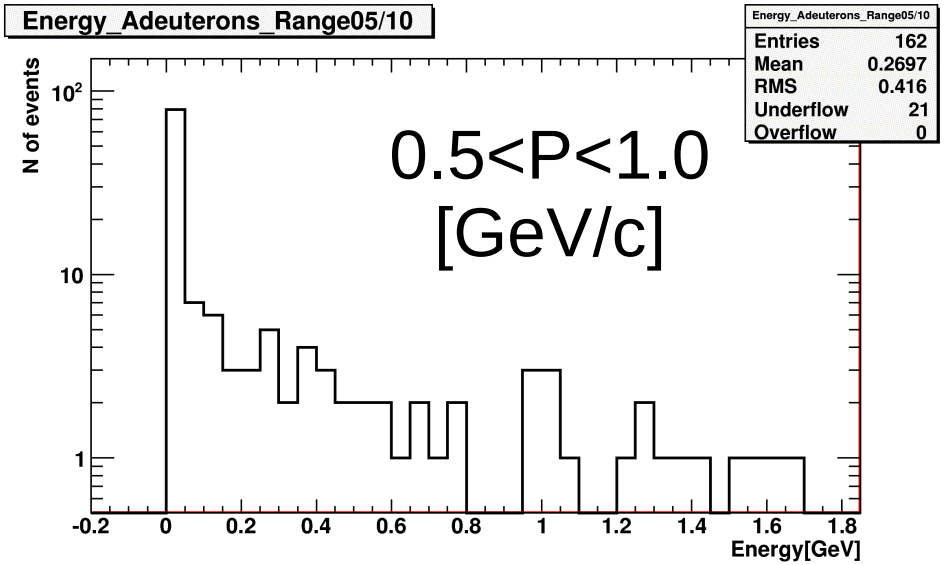


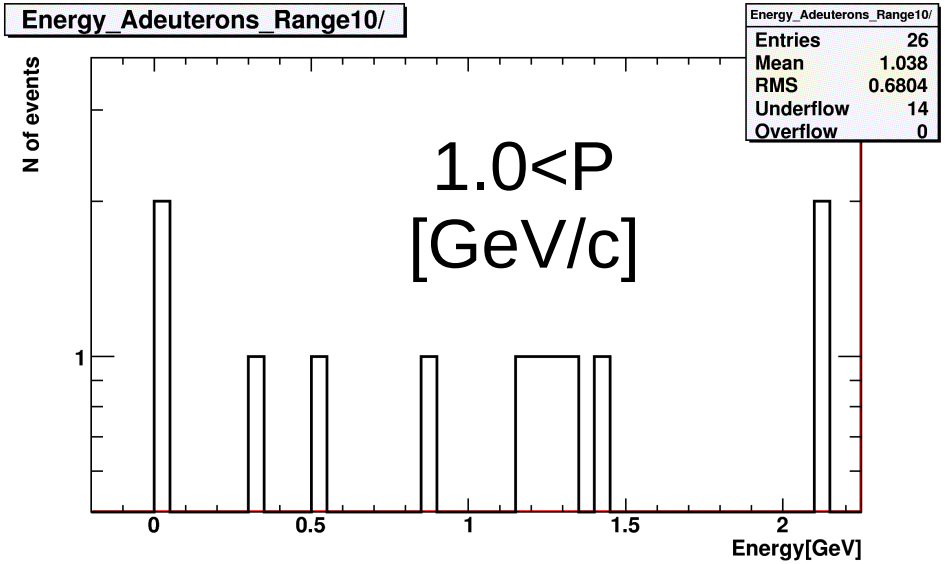
Deuterons and antideuterons

Energy for different ranges of momentum

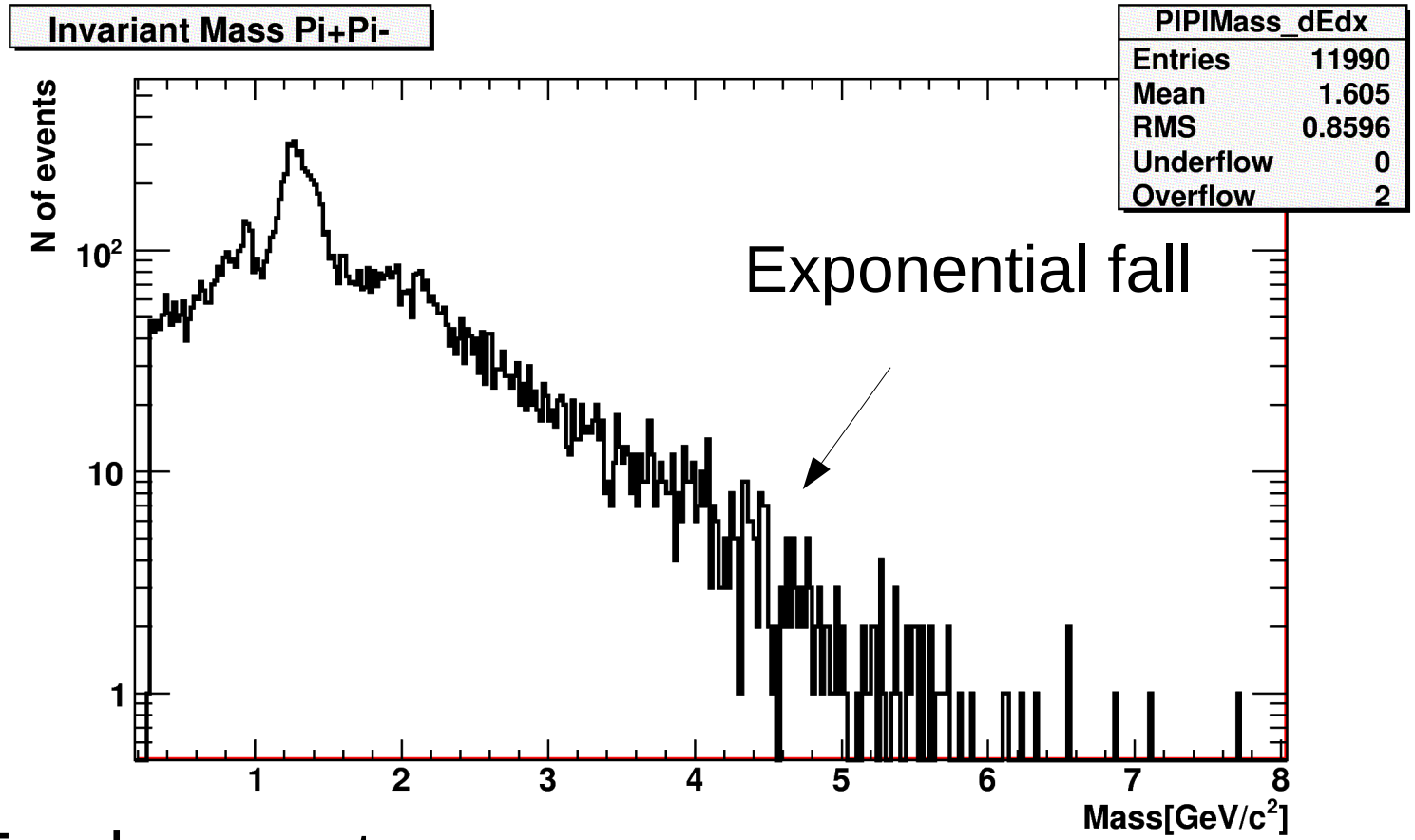








Invariant mass Pi+Pi-



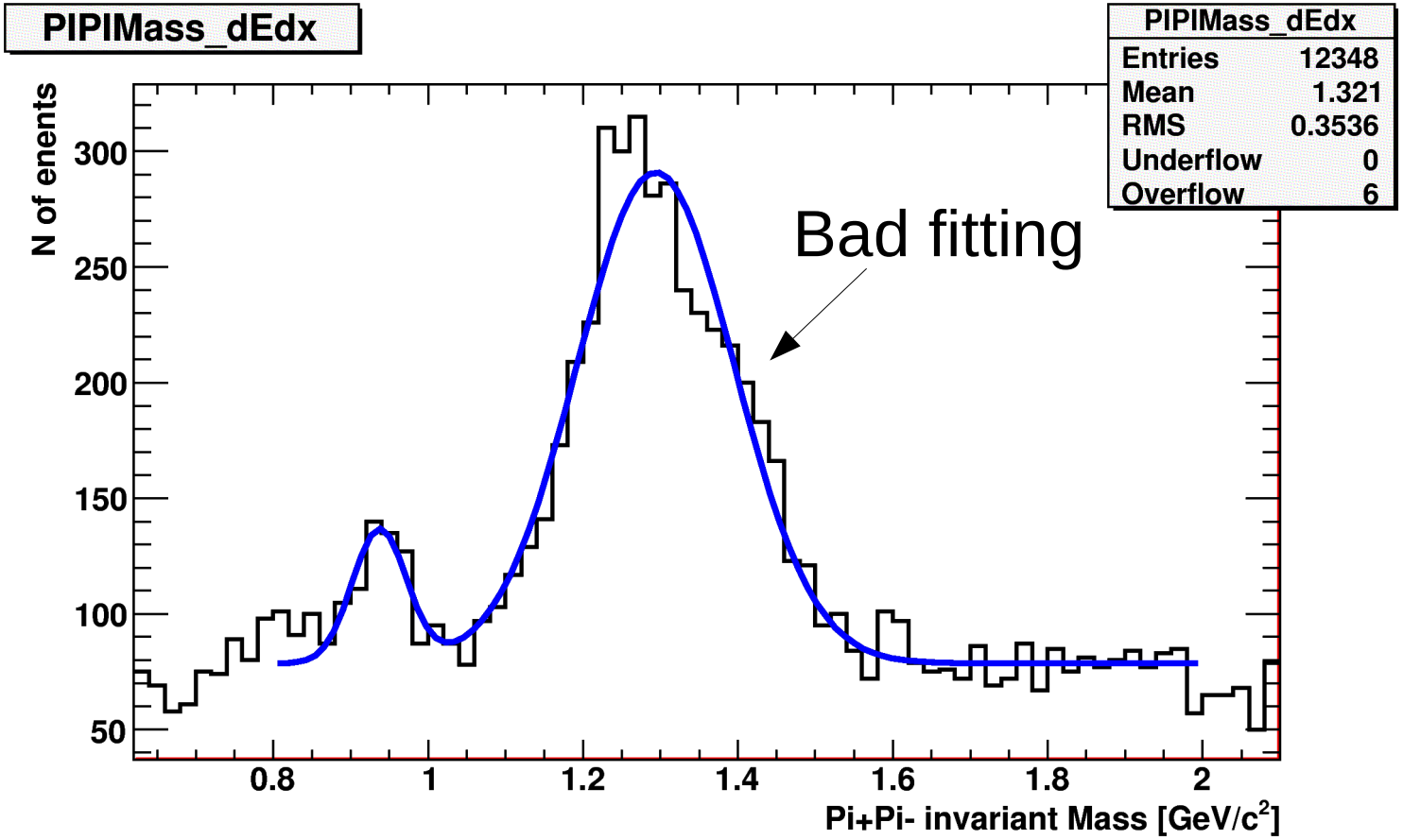
2 Tracks events

Particles identified as a pions

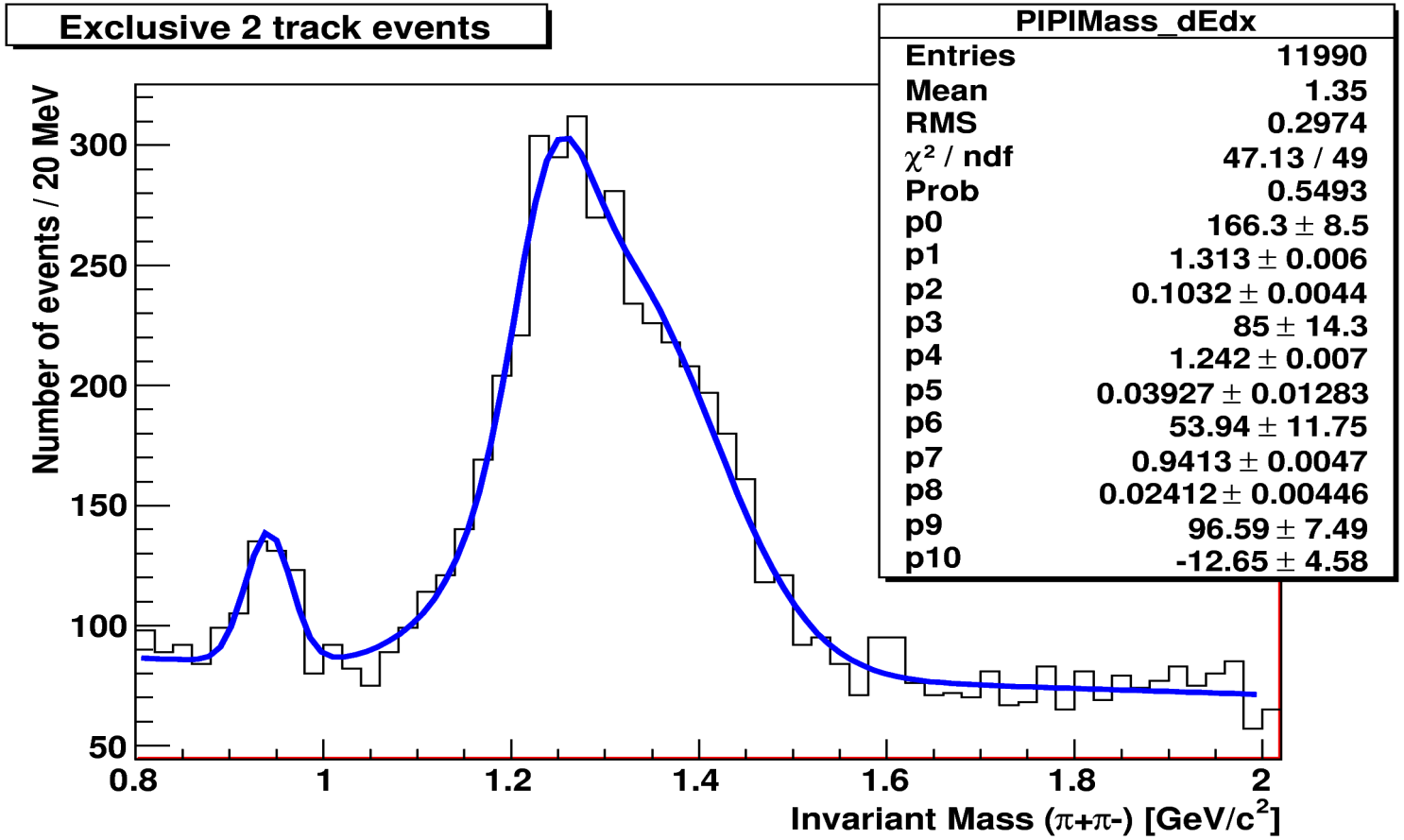
Total charge = 0

Central calorimeter cleaning (exclusive cleaning)

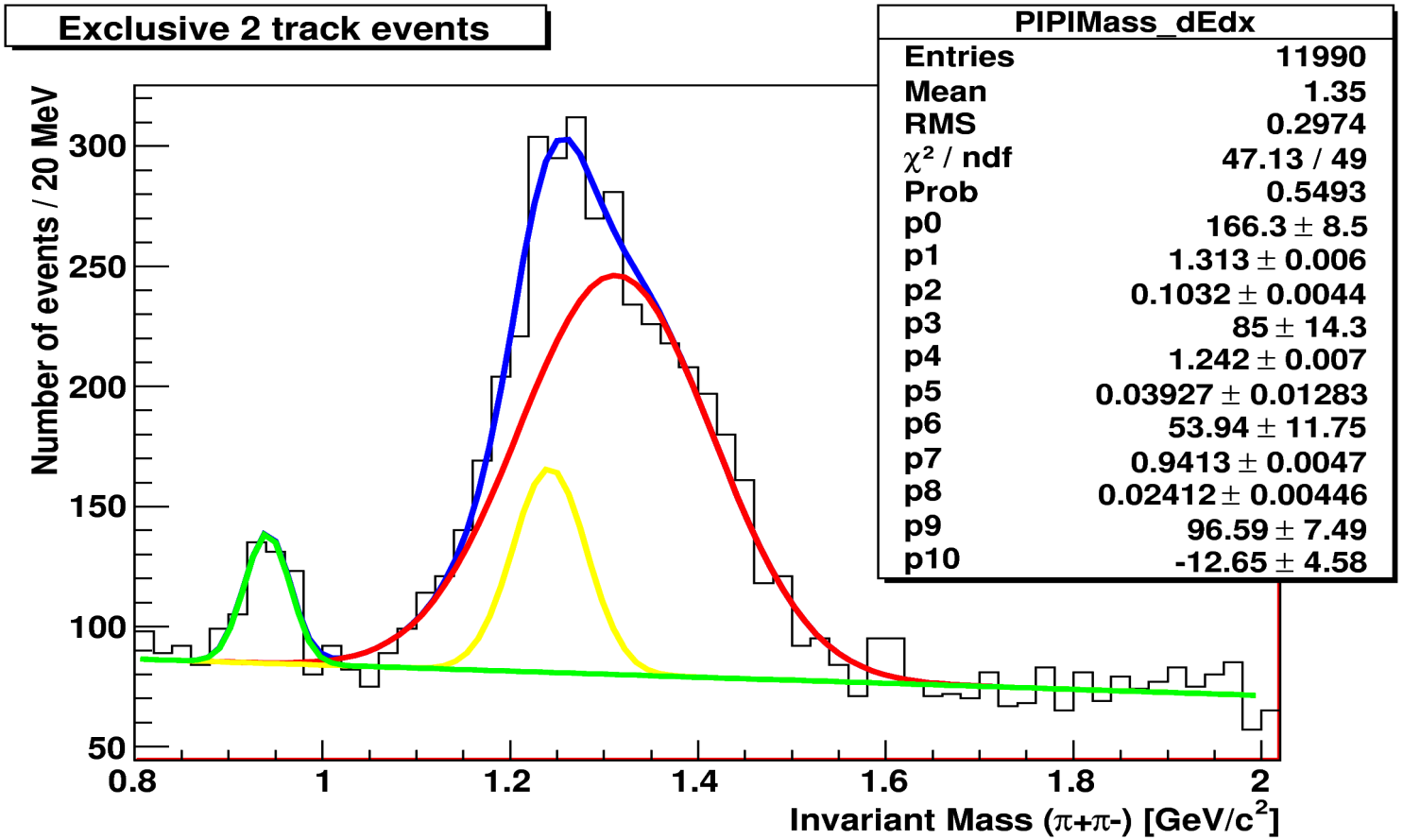
Invariant mass Pi+Pi- Fitting



Invariant mass Pi+Pi- Fitting

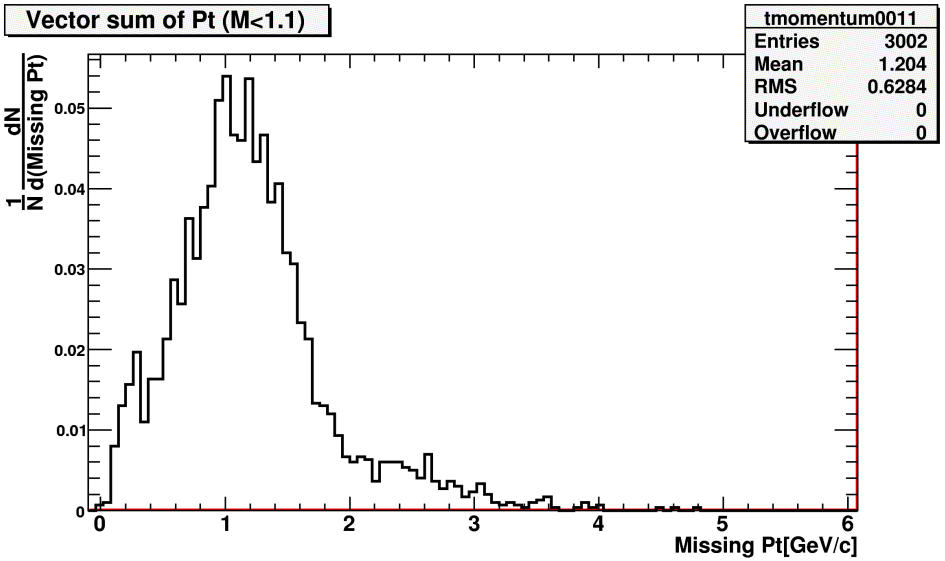


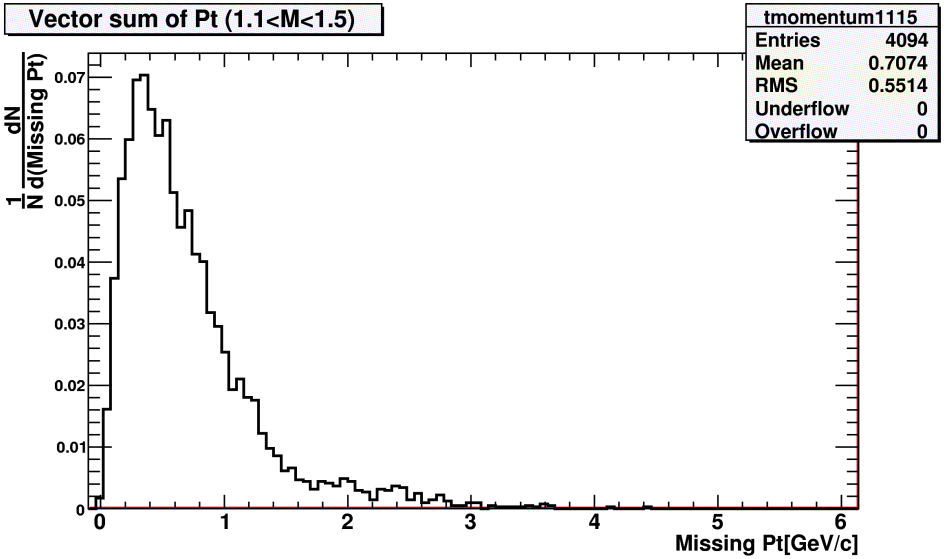
Invariant mass Pi+Pi-

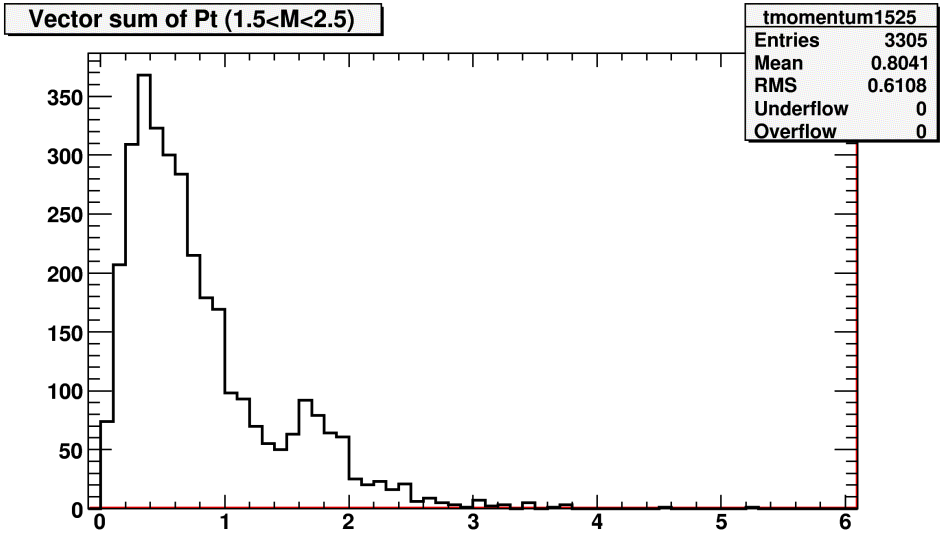


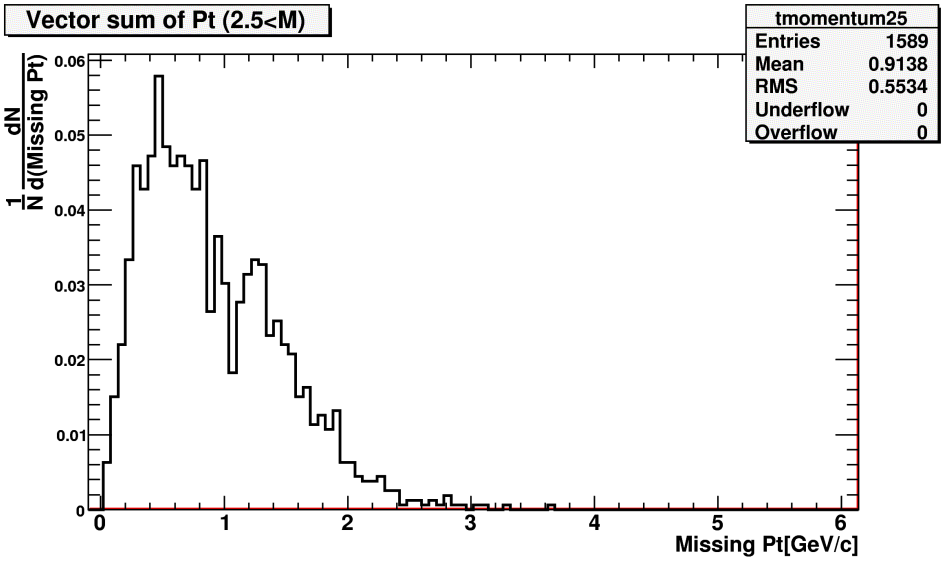
- <M> [MeV] Amplitude
- f0(980) 941(5) 54
- ?f2(1270) 1242(7) 85
- ?f0(1370) 1313(6) 166

Missing Pt for Pi+Pi- events

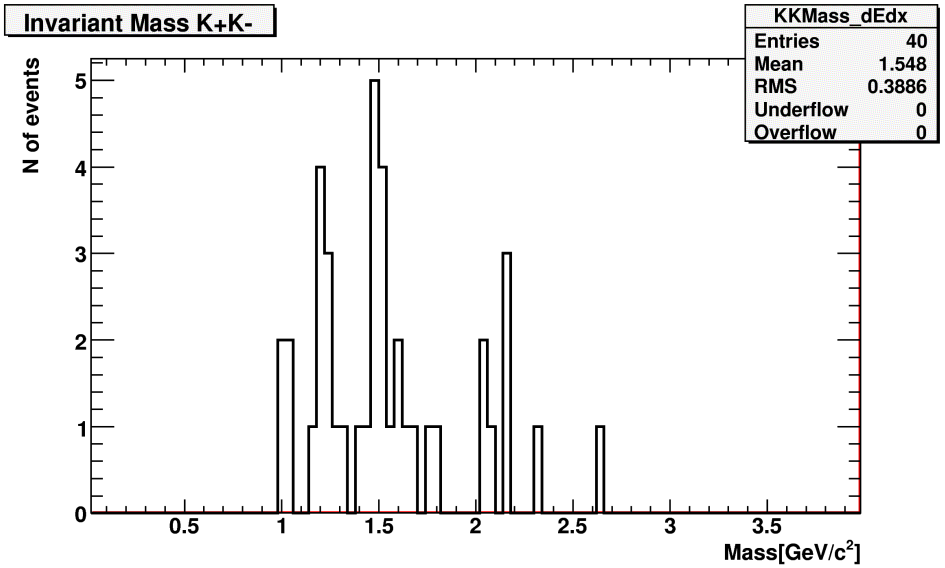


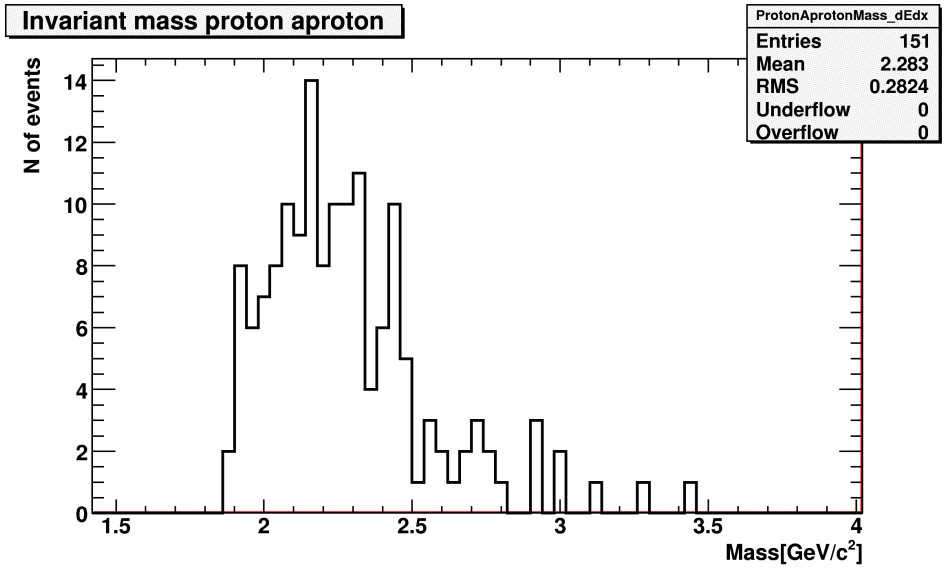






Invariant mass K+K- , pp_bar
2 track events

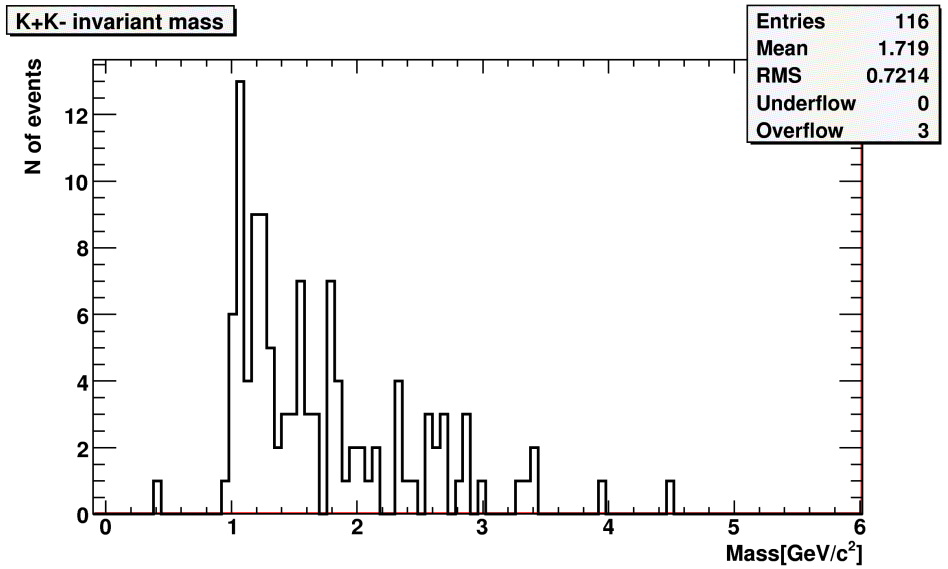


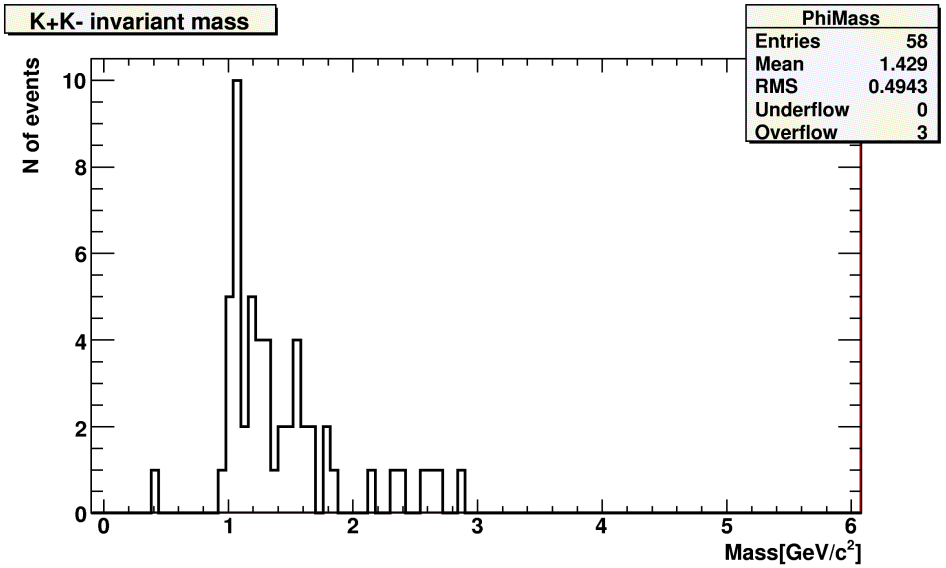


Invariant mass K+K-

Invariant mass pp_bar

4 tracks events



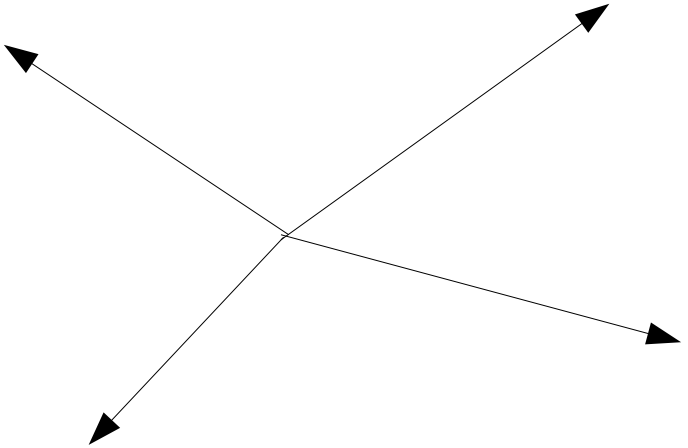


4 particles
1 identified as a kaon
Assuming other are kaons

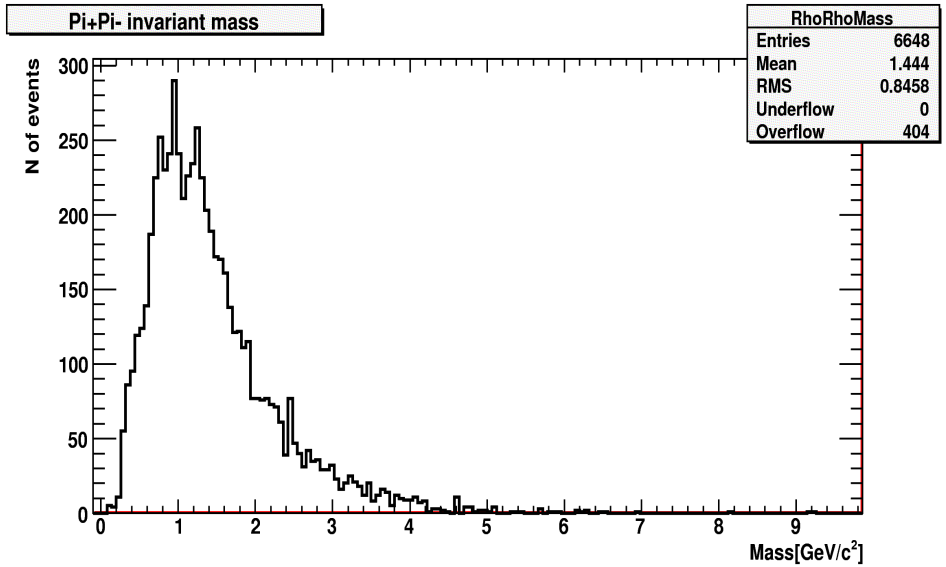
4 particles
1 identified as a kaon
Assuming other are two pions and one kaon

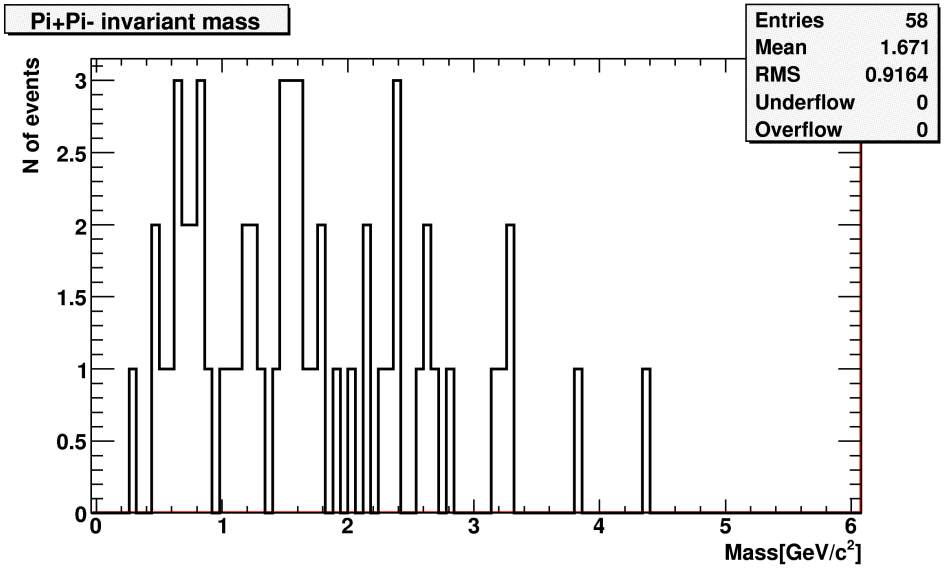
4 tracks events

- Total charge = 0
- Central calorimeter cleaning
- dE/dx identification
- ~2000 exclusive events



4 tracks events

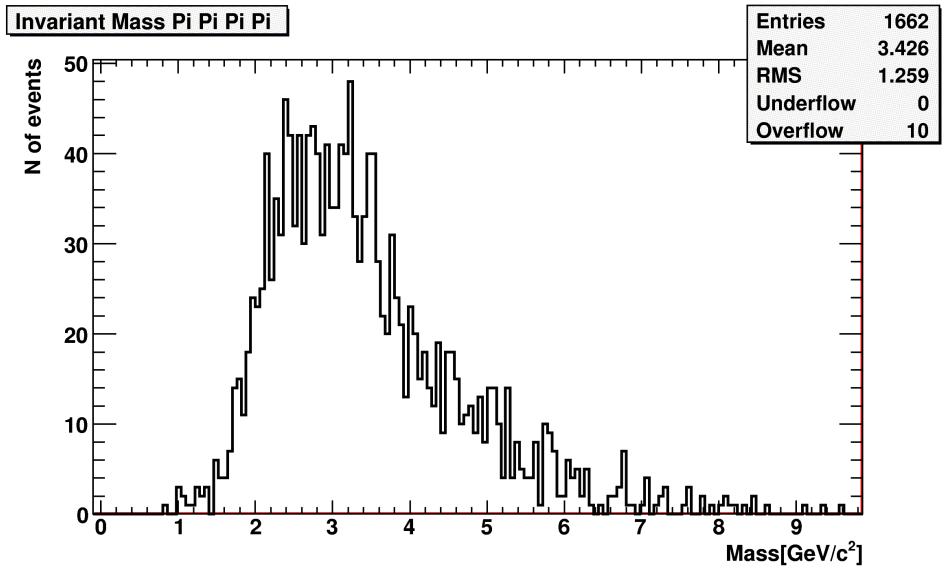


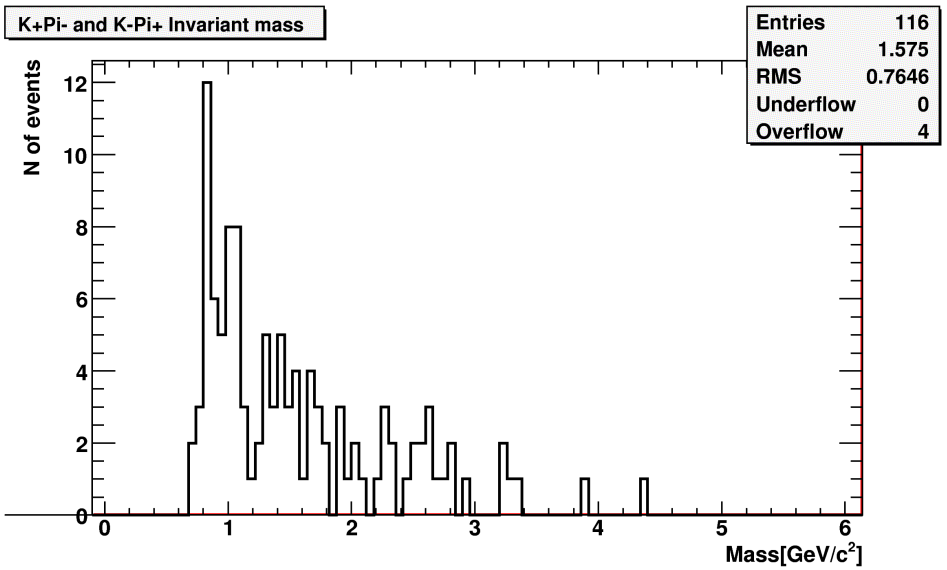


4 particles
1 identified as a pion
Assuming other are pions

4 particles
1 identified as a pion
Assuming other are two pions and one kaon

4 tracks events





4 particles
1 identified as a pion
Assuming other are pions

4 particles
1 identified as a kaon
Assuming other are two pions and one kaon