# Phase2
# Track Analysis

Purpose:

Study Vertex Distributions
from Luminosity runs

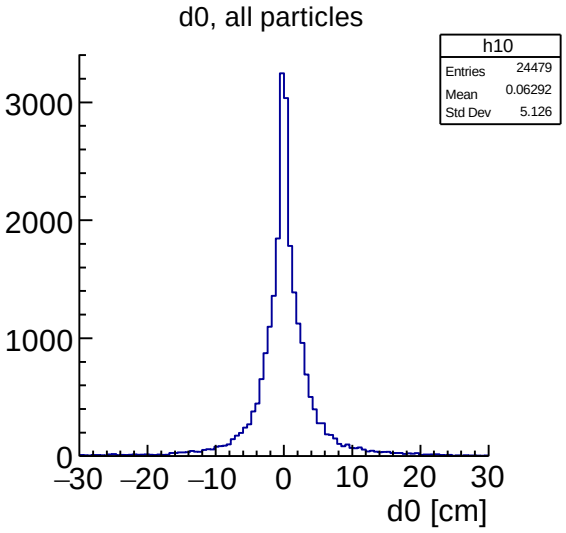
# Data Preparation

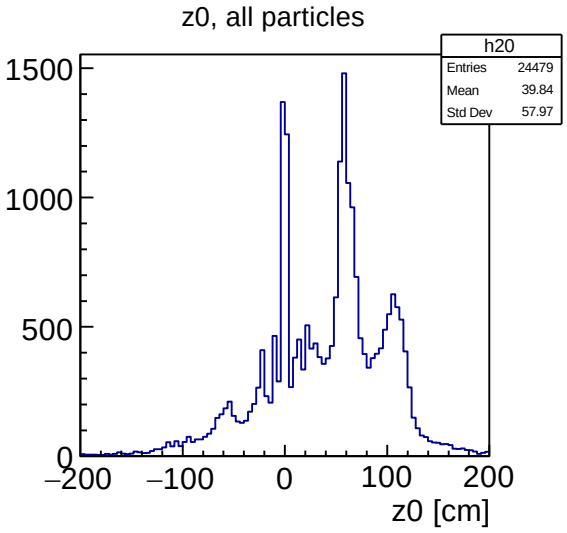
Data reconstruction: BASF2 release-02-00-01 (Prod 5)
Run at KEK, input: DST
prepare a „mini-DST“ with the following variables
list_of_variables = [
'expNum', 'runNum', 'evtNum', 'nTracks', 'E', 'px', 'py', 'pz', 'p', 'cosTheta', 'dr', 'd0', 'phi0', 'omega', 'z0', 'tanlambda', 'pionID', 'muonID', 'electronID', 'protonID'
]

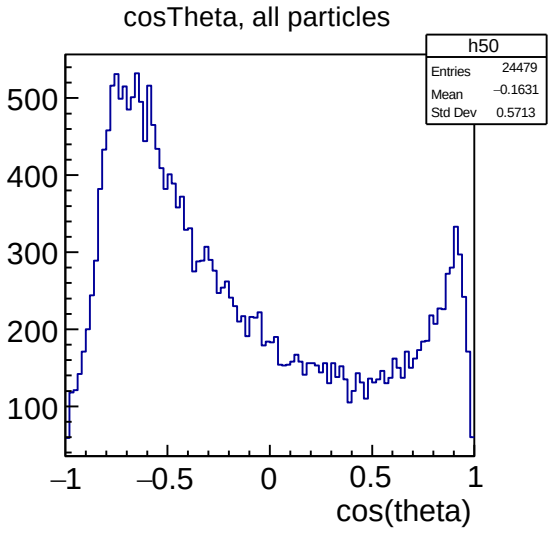
Select runs towards the end of Phase 2
(inproved injection)

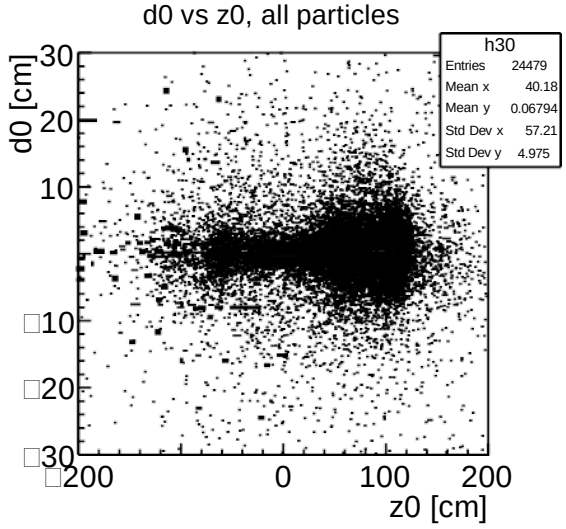
| Run | Date | Curr.[mA] | # Bunches | Size y[µm] | CDC [µA] | vac [$10^{-8}$ Torr] |
|---|---|---|---|---|---|---|
| 4814 | 06/29 | 240/230 | 789 | 101/108 | 24.2 | 3.0 / 6.7 |
| 5187 | 07/04 | 217/226 | 395 | 68/145 | 19.6 | 1.9 / 4.3 |

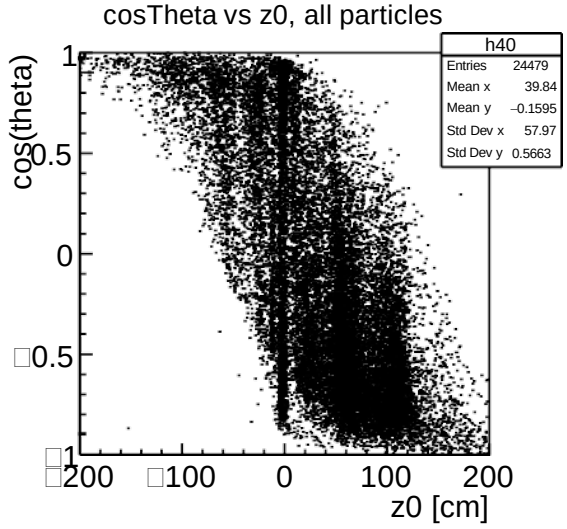
# Run 4814

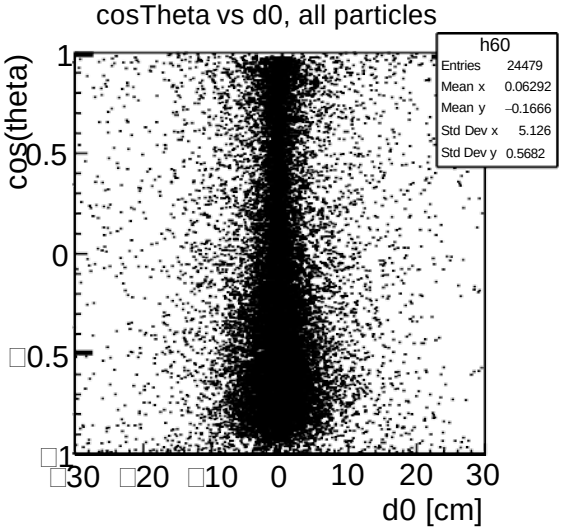

d0, all particles
h10
Entries 24479
Mean 0.06292
Std Dev 5.126
d0 [cm]


z0, all particles
h20
Entries 24479
Mean 39.84
Std Dev 57.97
z0 [cm]

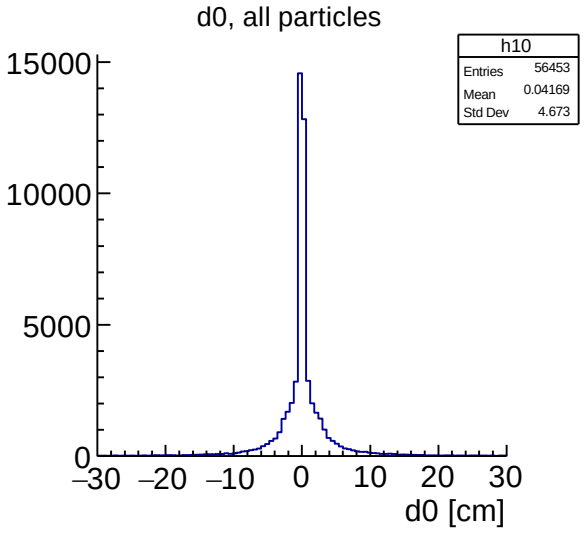

cosTheta, all particles
h50
Entries 24479
Mean −0.1631
Std Dev 0.5713
cos(theta)

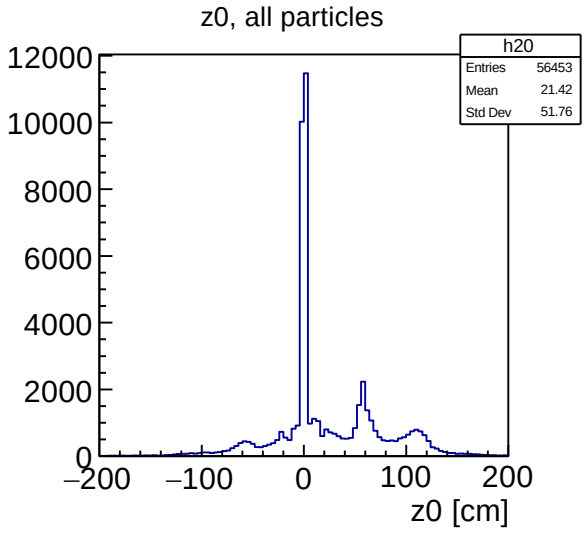

d0 vs z0, all particles
h30
Entries 24479
Mean x 40.18
Mean y 0.06794
Std Dev x 57.21
Std Dev y 4.975
d0 [cm]
z0 [cm]

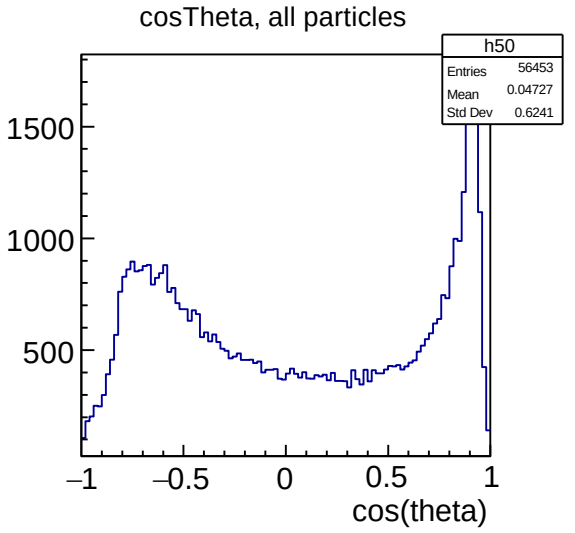

cosTheta vs z0, all particles
h40
Entries 24479
Mean x 39.84
Mean y −0.1595
Std Dev x 57.97
Std Dev y 0.5663
cos(theta)
z0 [cm]

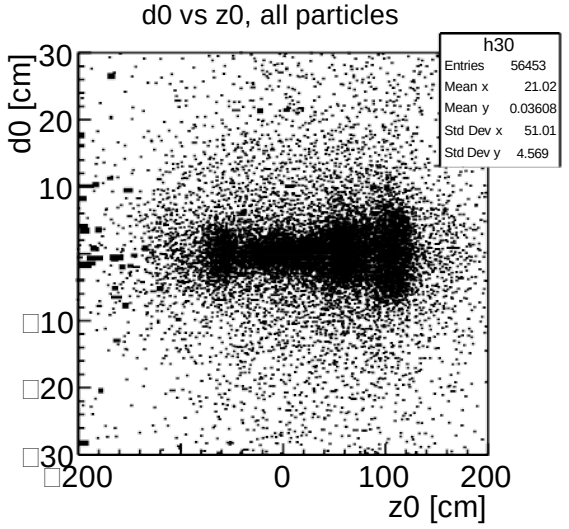

cosTheta vs d0, all particles
h60
Entries 24479
Mean x 0.06292
Mean y −0.1666
Std Dev x 5.126
Std Dev y 0.5682
cos(theta)
d0 [cm]

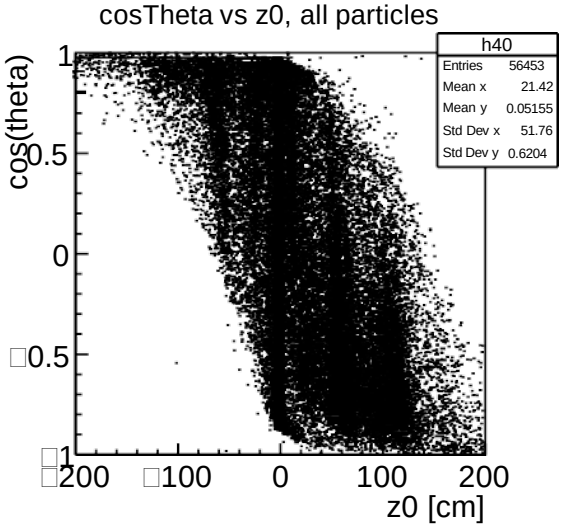
# Run 5187

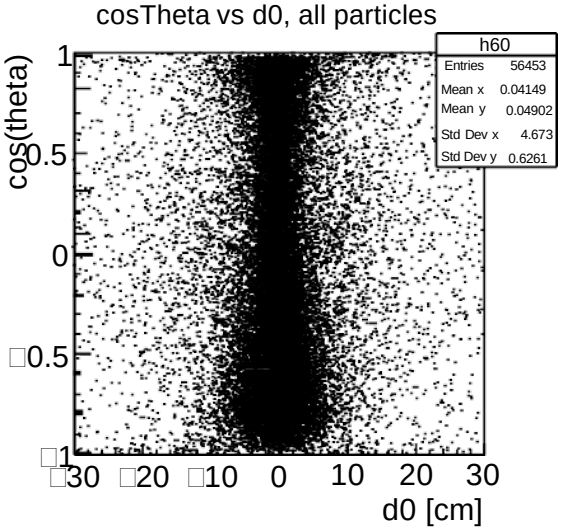

d0, all particles
h10
Entries 56453
Mean 0.04169
Std Dev 4.673
15000
10000
5000
0
−30 −20 −10 0 10 20 30
d0 [cm]


z0, all particles
h20
Entries 56453
Mean 21.42
Std Dev 51.76
12000
10000
8000
6000
4000
2000
0
−200 −100 0 100 200
z0 [cm]

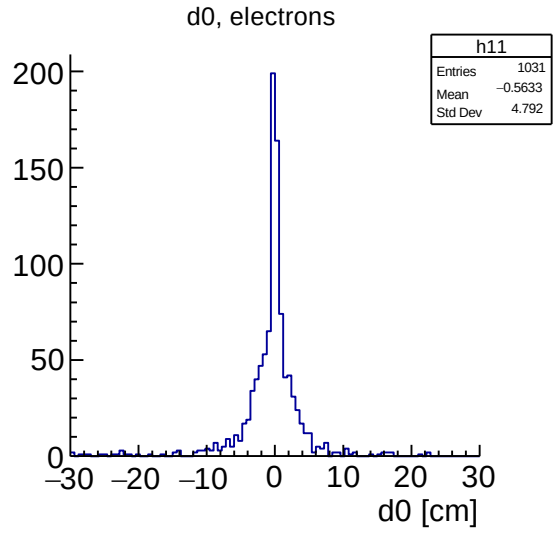

cosTheta, all particles
h50
Entries 56453
Mean 0.04727
Std Dev 0.6241
1500
1000
500
−1 −0.5 0 0.5 1
cos(theta)

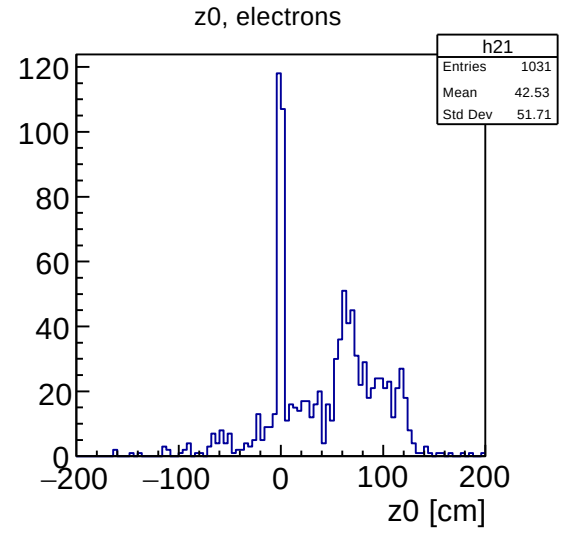

d0 vs z0, all particles
h30
Entries 56453
Mean x 21.02
Mean y 0.03608
Std Dev x 51.01
Std Dev y 4.569
d0 [cm]
30
20
10
−10
−20
−30
−200 0 100 200
z0 [cm]

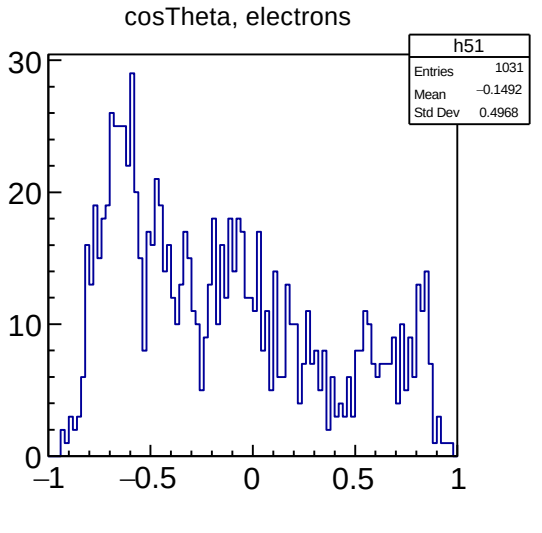

cosTheta vs z0, all particles
h40
Entries 56453
Mean x 21.42
Mean y 0.05155
Std Dev x 51.76
Std Dev y 0.6204
cos(theta)
1
0.5
0
−0.5
−1
−200 −100 0 100 200
z0 [cm]

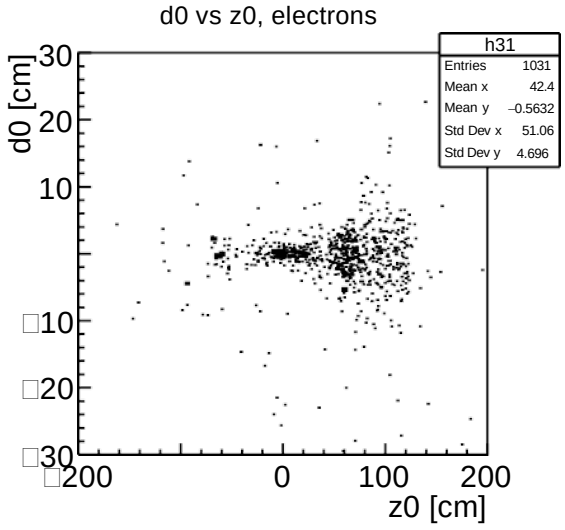

cosTheta vs d0, all particles
h60
Entries 56453
Mean x 0.04149
Mean y 0.04902
Std Dev x 4.673
Std Dev y 0.6261
cos(theta)
1
0.5
0
−0.5
−1
−30 −20 −10 0 10 20 30
d0 [cm]

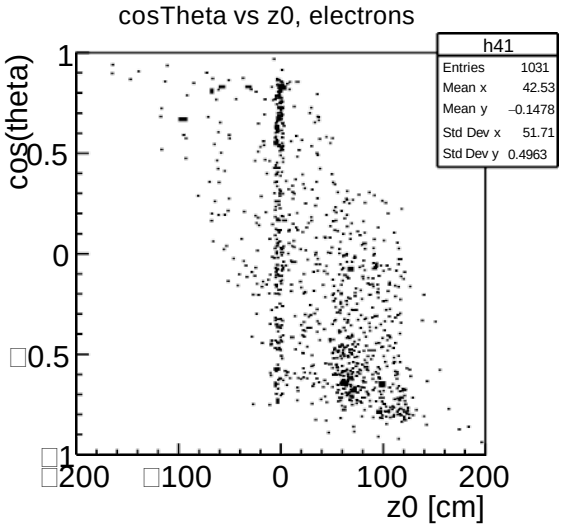
# Run 4814

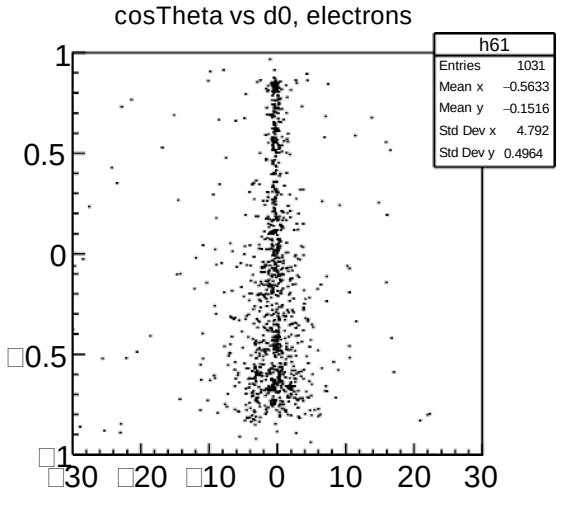

d0, electrons
h11
Entries 1031
Mean −0.5633
Std Dev 4.792
d0 [cm]


z0, electrons
h21
Entries 1031
Mean 42.53
Std Dev 51.71
z0 [cm]

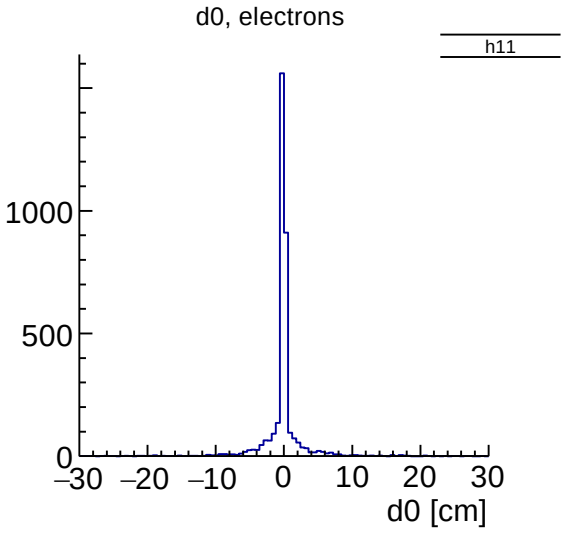

cosTheta, electrons
h51
Entries 1031
Mean −0.1492
Std Dev 0.4968

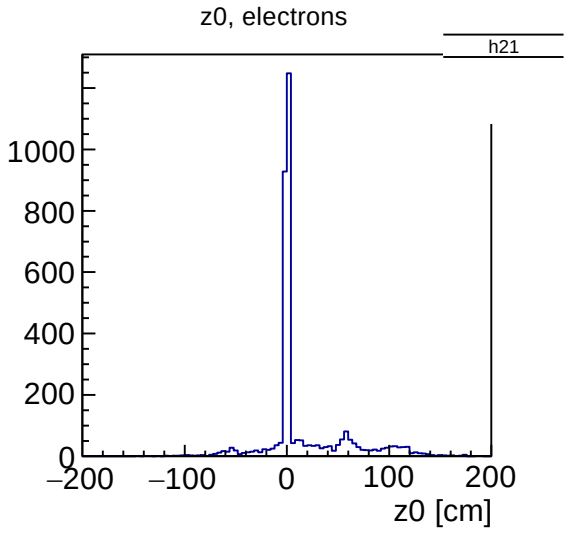

d0 vs z0, electrons
h31
Entries 1031
Mean x 42.4
Mean y −0.5632
Std Dev x 51.06
Std Dev y 4.696
d0 [cm]
z0 [cm]

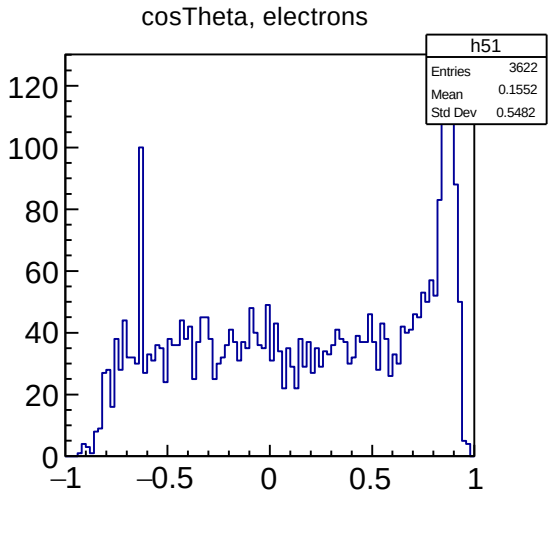

cosTheta vs z0, electrons
h41
Entries 1031
Mean x 42.53
Mean y −0.1478
Std Dev x 51.71
Std Dev y 0.4963
cos(theta)
z0 [cm]

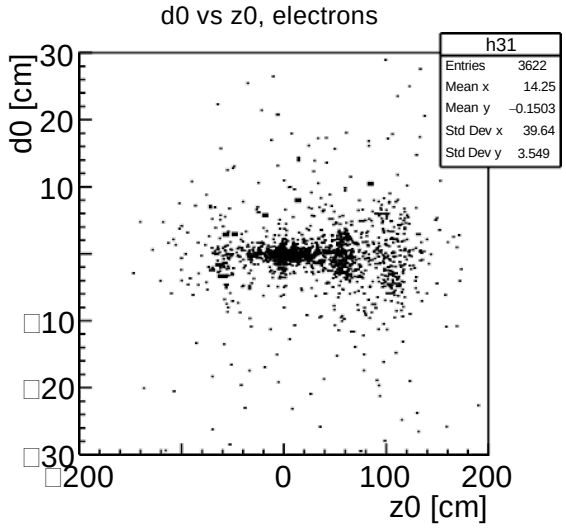

cosTheta vs d0, electrons
h61
Entries 1031
Mean x −0.5633
Mean y −0.1516
Std Dev x 4.792
Std Dev y 0.4964

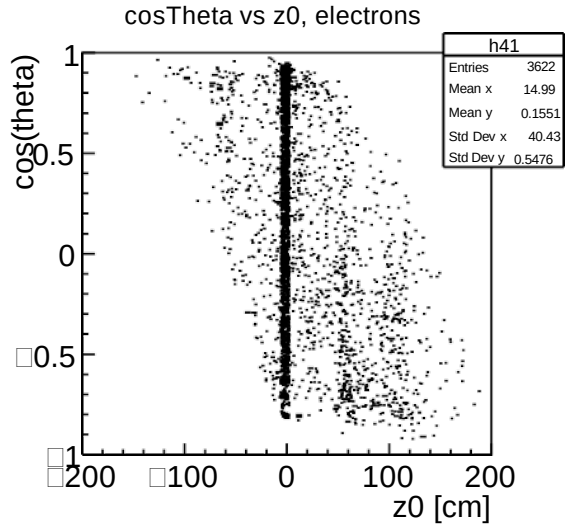
# Run 5187

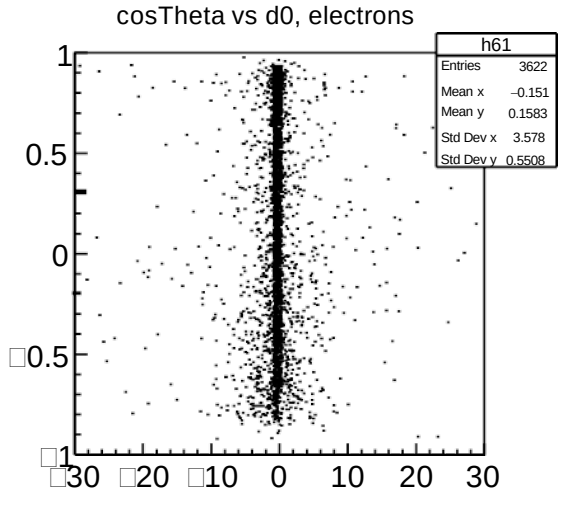

d0, electrons
h11
1000
500
0
−30 −20 −10 0 10 20 30
d0 [cm]


z0, electrons
h21
1000
800
600
400
200
0
−200 −100 0 100 200
z0 [cm]

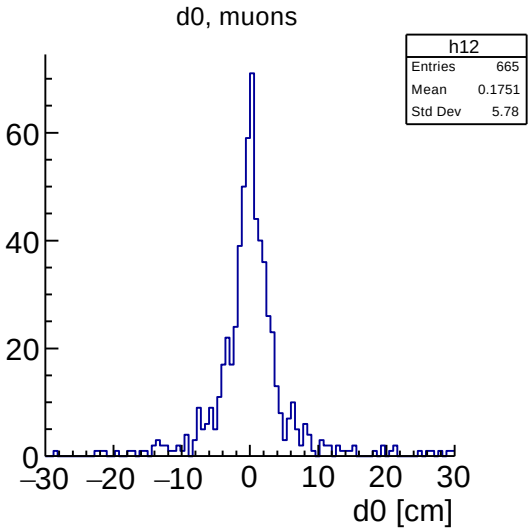

cosTheta, electrons
h51
Entries 3622
Mean 0.1552
Std Dev 0.5482
120
100
80
60
40
20
0
−1 −0.5 0 0.5 1

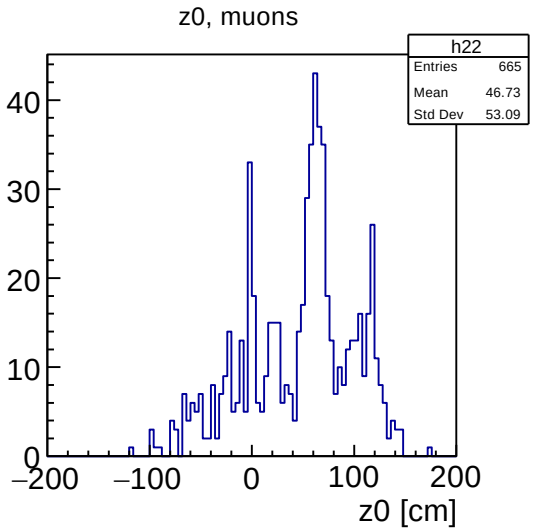

d0 vs z0, electrons
h31
Entries 3622
Mean x 14.25
Mean y −0.1503
Std Dev x 39.64
Std Dev y 3.549
d0 [cm]
30
20
10
−10
−20
−30
−200 0 100 200
z0 [cm]

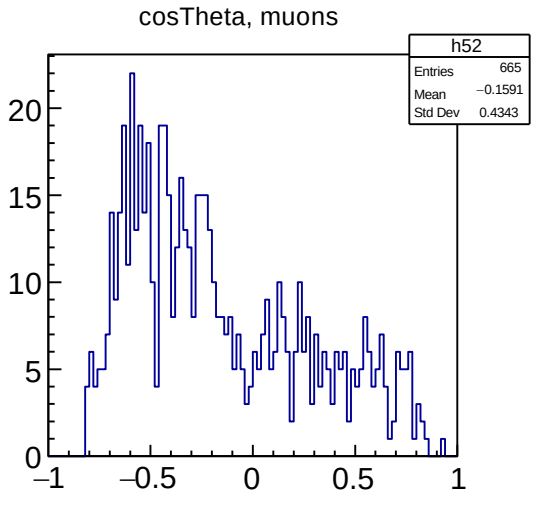

cosTheta vs z0, electrons
h41
Entries 3622
Mean x 14.99
Mean y 0.1551
Std Dev x 40.43
Std Dev y 0.5476
cos(theta)
1
0.5
0
−0.5
−1
−200 −100 0 100 200
z0 [cm]

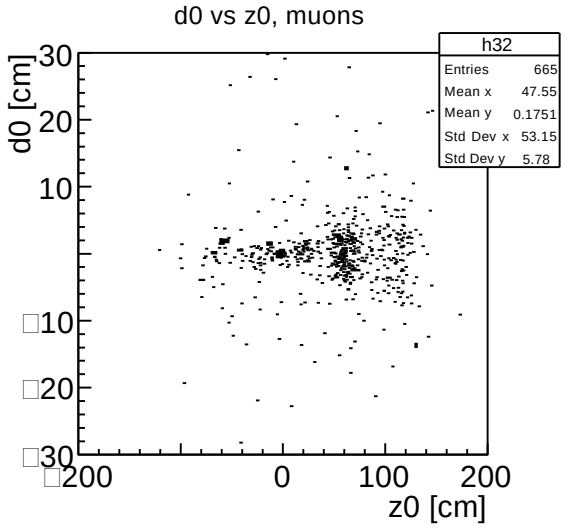

cosTheta vs d0, electrons
h61
Entries 3622
Mean x −0.151
Mean y 0.1583
Std Dev x 3.578
Std Dev y 0.5508
1
0.5
0
−0.5
−1
−30 −20 −10 0 10 20 30

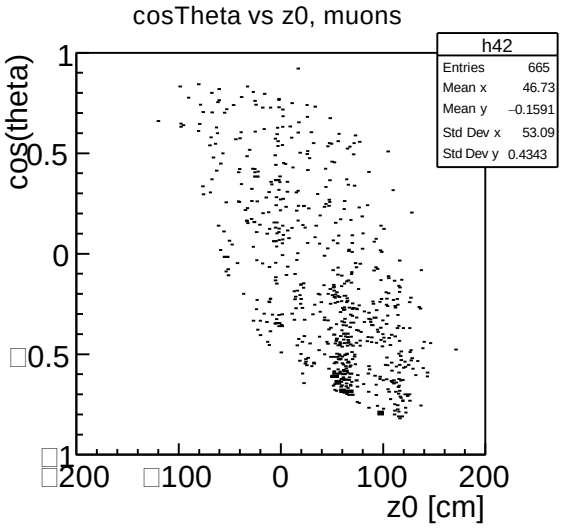
# Run 4814

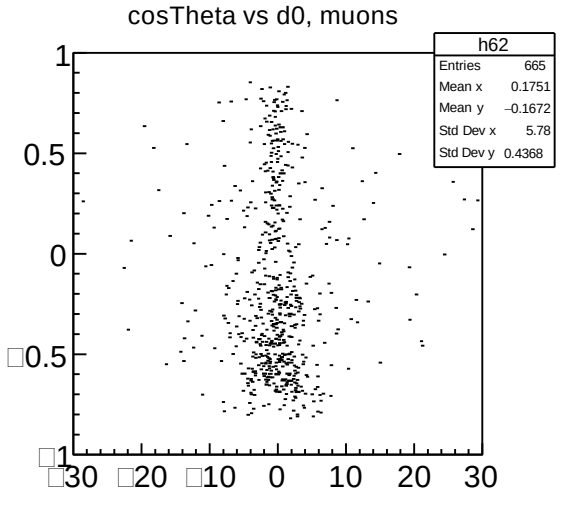

d0, muons
h12
Entries 665
Mean 0.1751
Std Dev 5.78
d0 [cm]


z0, muons
h22
Entries 665
Mean 46.73
Std Dev 53.09
z0 [cm]

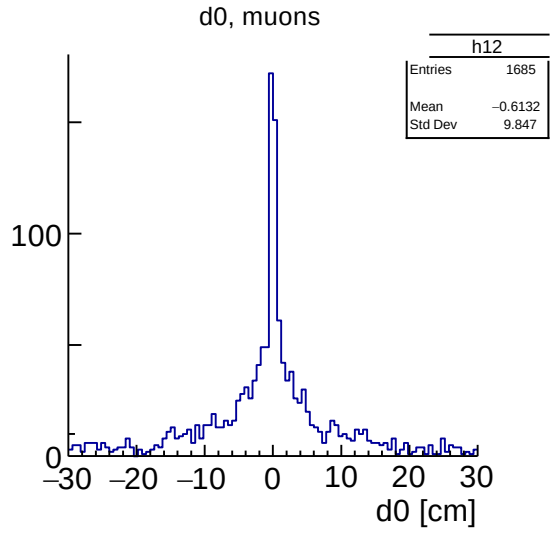

cosTheta, muons
h52
Entries 665
Mean −0.1591
Std Dev 0.4343

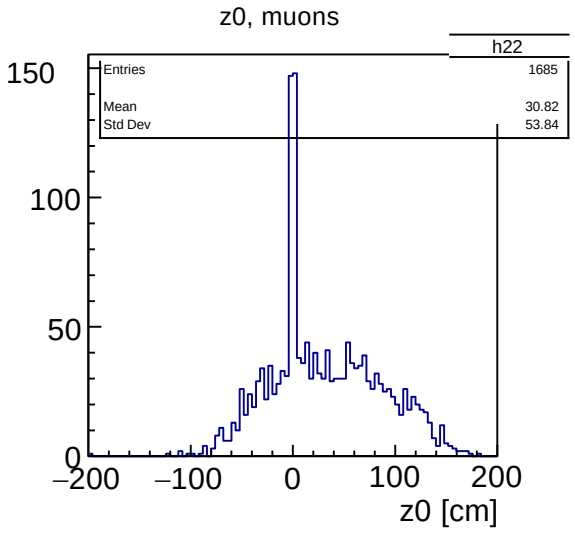

d0 vs z0, muons
h32
Entries 665
Mean x 47.55
Mean y 0.1751
Std Dev x 53.15
Std Dev y 5.78
d0 [cm]
z0 [cm]

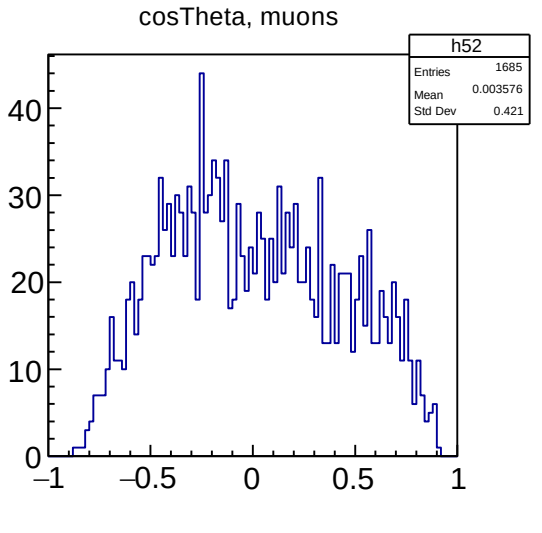

cosTheta vs z0, muons
h42
Entries 665
Mean x 46.73
Mean y −0.1591
Std Dev x 53.09
Std Dev y 0.4343
cos(theta)
z0 [cm]

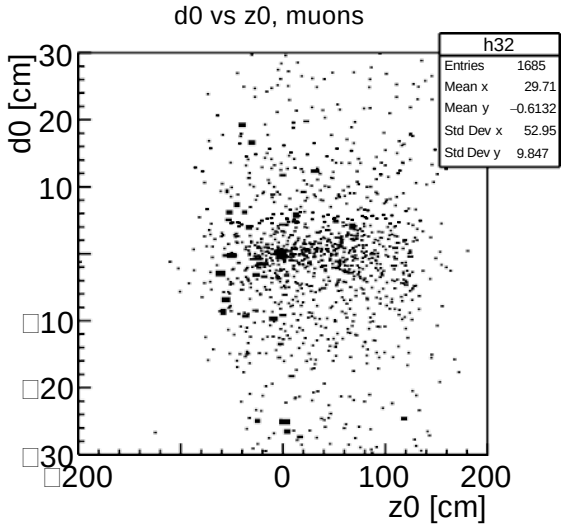

cosTheta vs d0, muons
h62
Entries 665
Mean x 0.1751
Mean y −0.1672
Std Dev x 5.78
Std Dev y 0.4368

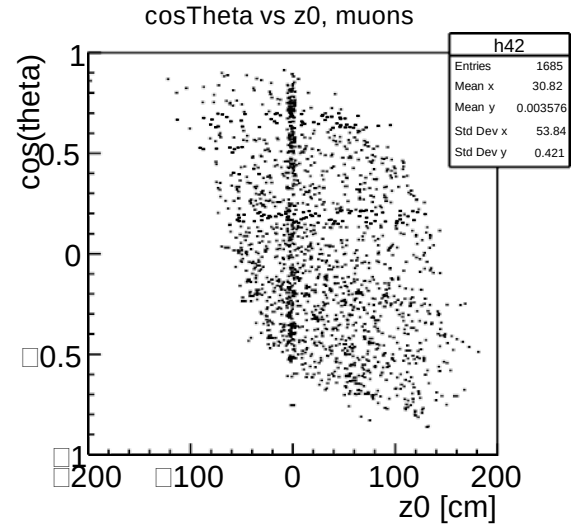
# Run 5187

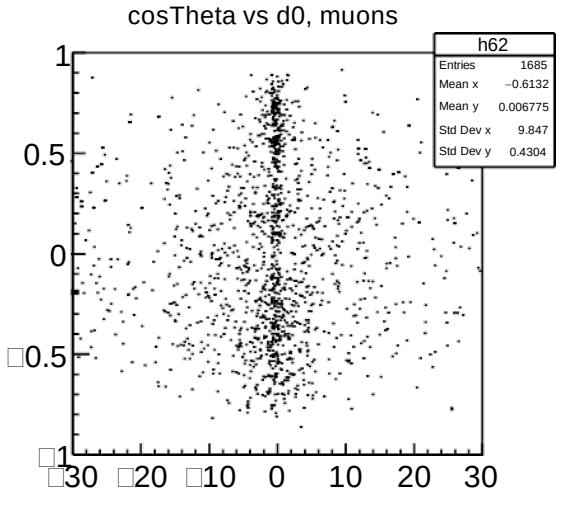

d0, muons
h12
Entries 1685
Mean −0.6132
Std Dev 9.847
d0 [cm]


z0, muons
h22
Entries 1685
Mean 30.82
Std Dev 53.84
z0 [cm]

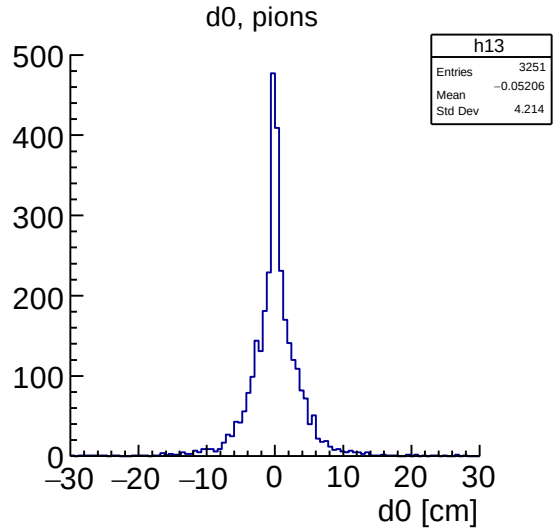

cosTheta, muons
h52
Entries 1685
Mean 0.003576
Std Dev 0.421

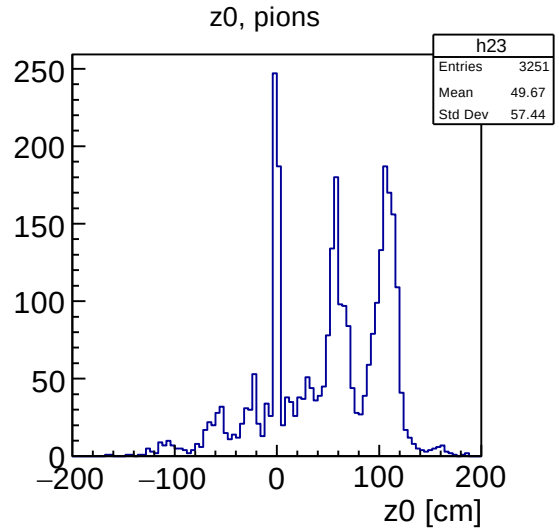

d0 vs z0, muons
h32
Entries 1685
Mean x 29.71
Mean y −0.6132
Std Dev x 52.95
Std Dev y 9.847
d0 [cm]
z0 [cm]

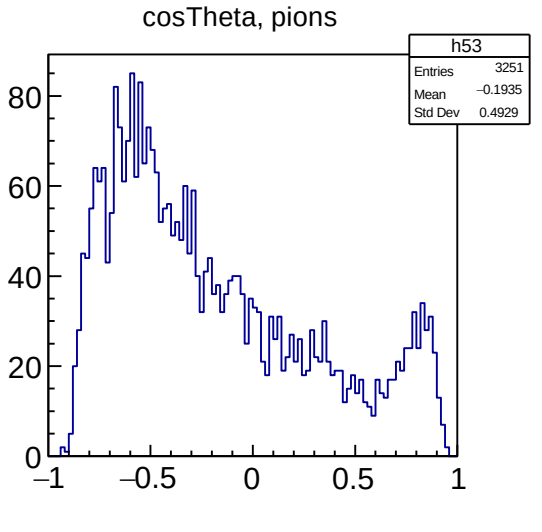

cosTheta vs z0, muons
h42
Entries 1685
Mean x 30.82
Mean y 0.003576
Std Dev x 53.84
Std Dev y 0.421
cos(theta)
z0 [cm]

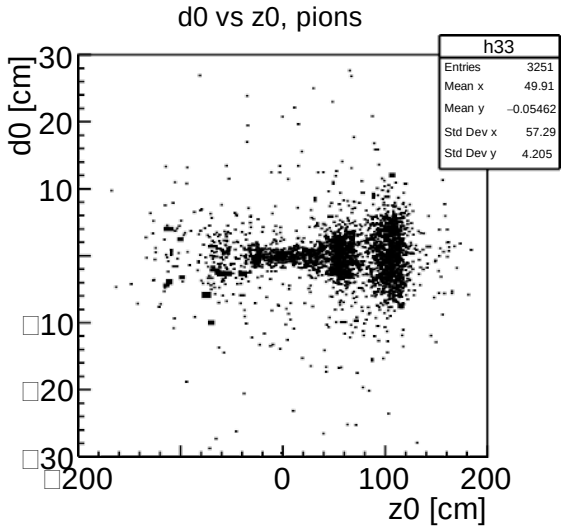

cosTheta vs d0, muons
h62
Entries 1685
Mean x −0.6132
Mean y 0.006775
Std Dev x 9.847
Std Dev y 0.4304

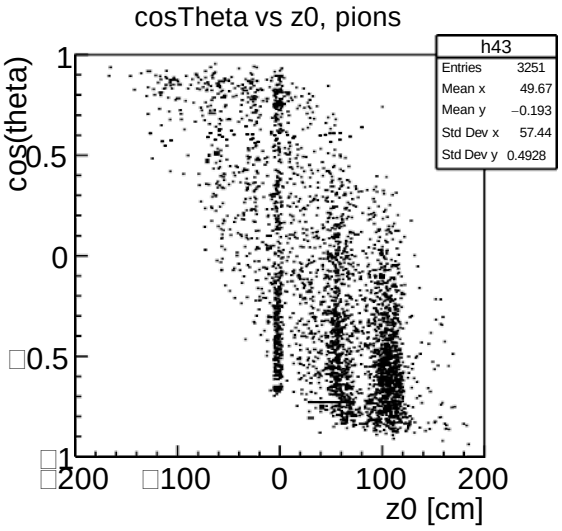
# Run 4814

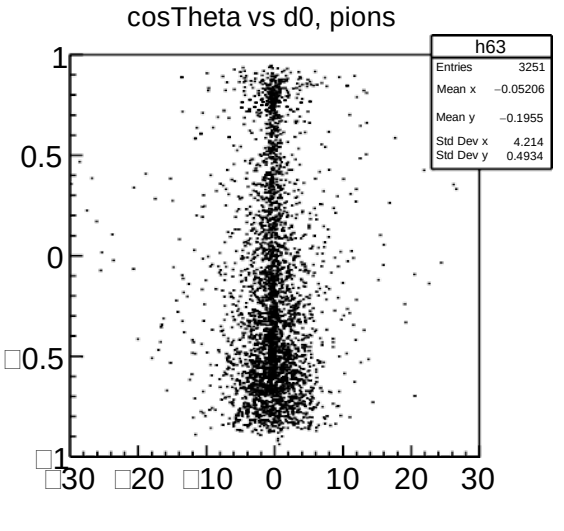

d0, pions
h13
Entries 3251
Mean −0.05206
Std Dev 4.214
d0 [cm]


z0, pions
h23
Entries 3251
Mean 49.67
Std Dev 57.44
z0 [cm]

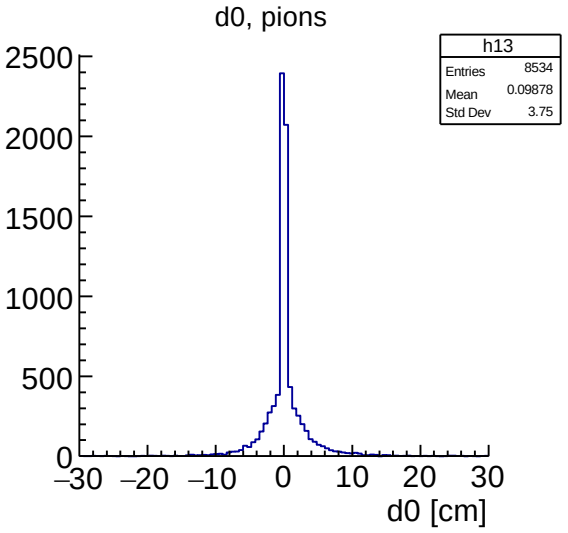

cosTheta, pions
h53
Entries 3251
Mean −0.1935
Std Dev 0.4929

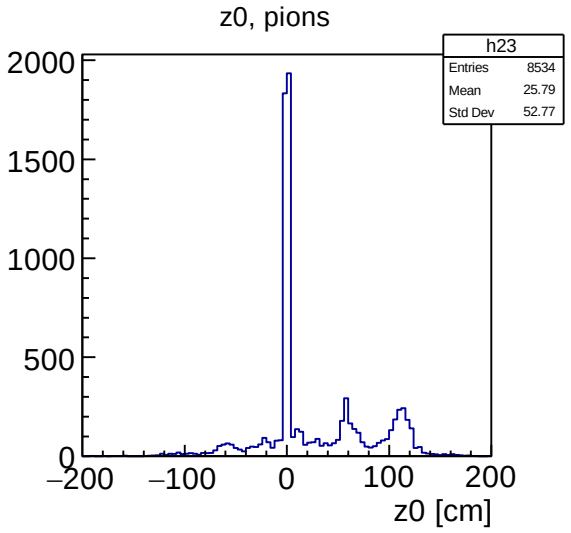

d0 vs z0, pions
h33
Entries 3251
Mean x 49.91
Mean y −0.05462
Std Dev x 57.29
Std Dev y 4.205
d0 [cm]
z0 [cm]

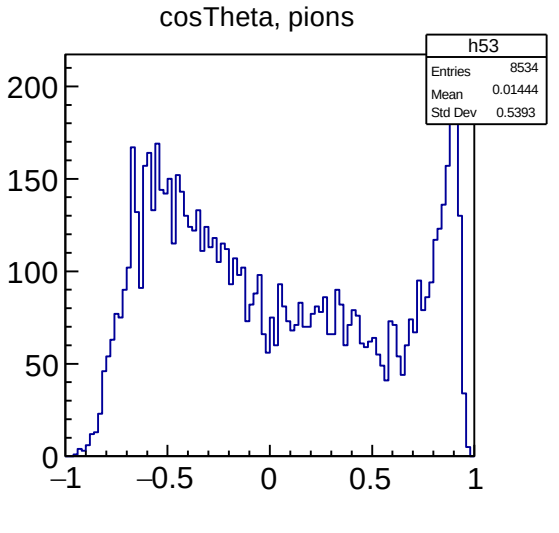

cosTheta vs z0, pions
h43
Entries 3251
Mean x 49.67
Mean y −0.193
Std Dev x 57.44
Std Dev y 0.4928
cos(theta)
z0 [cm]

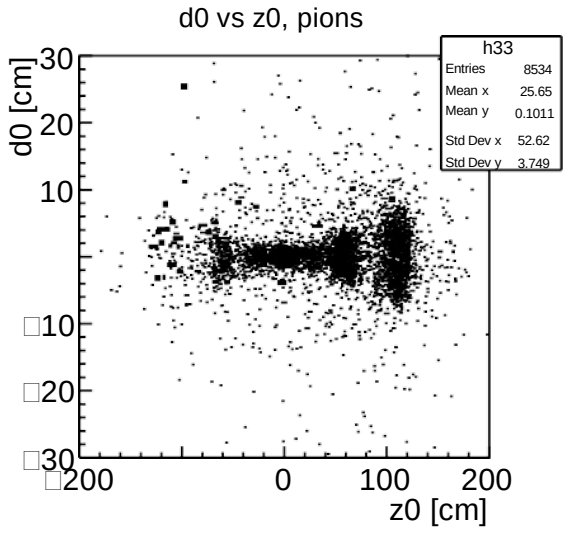

cosTheta vs d0, pions
h63
Entries 3251
Mean x −0.05206
Mean y −0.1955
Std Dev x 4.214
Std Dev y 0.4934

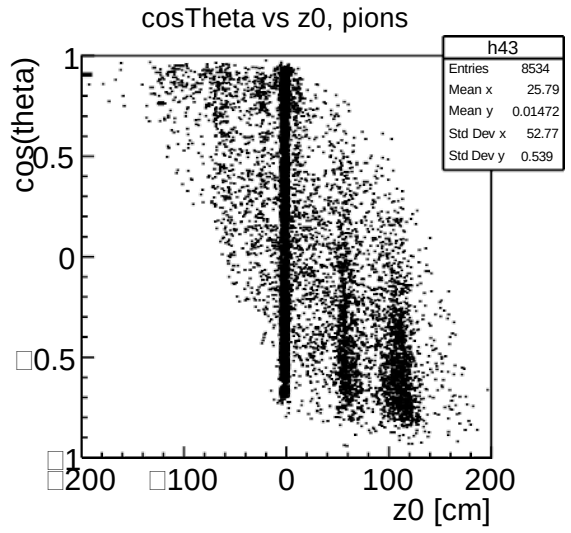
# Run 5187

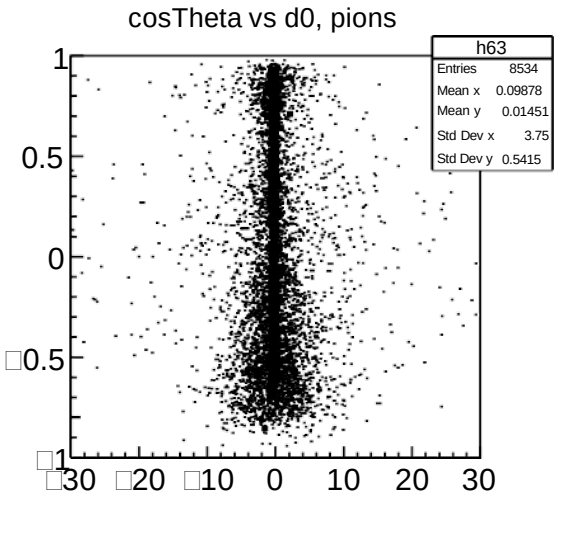

d0, pions
h13
Entries 8534
Mean 0.09878
Std Dev 3.75
d0 [cm]


z0, pions
h23
Entries 8534
Mean 25.79
Std Dev 52.77
z0 [cm]

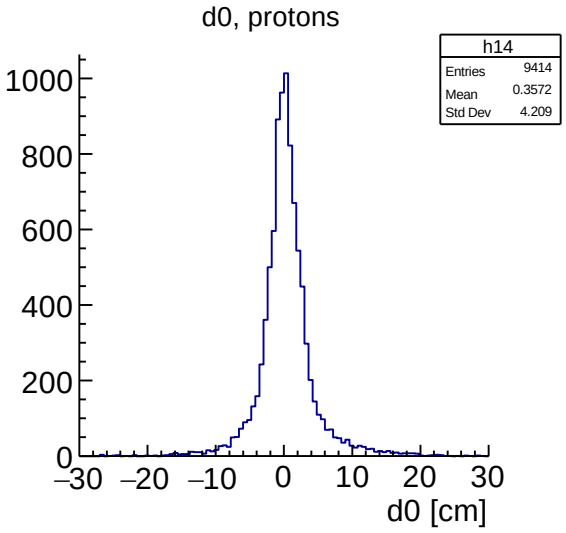

cosTheta, pions
h53
Entries 8534
Mean 0.01444
Std Dev 0.5393

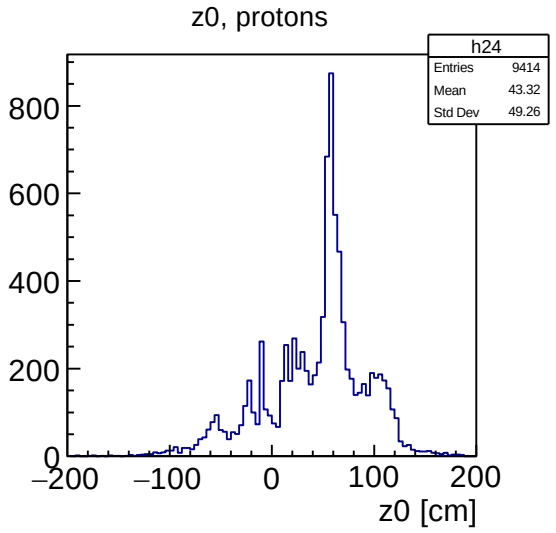

d0 vs z0, pions
h33
Entries 8534
Mean x 25.65
Mean y 0.1011
Std Dev x 52.62
Std Dev y 3.749
d0 [cm]
z0 [cm]

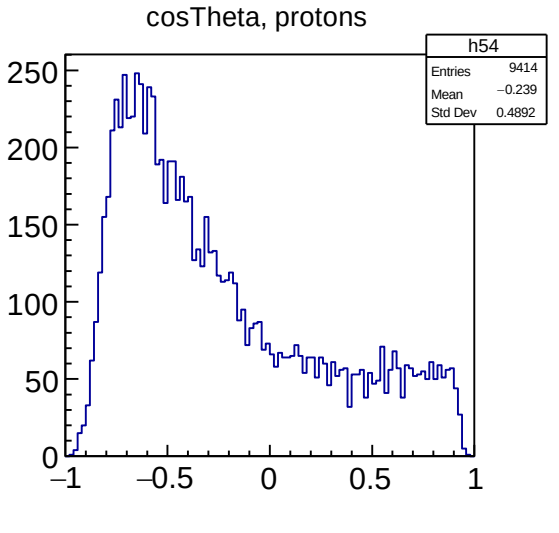

cosTheta vs z0, pions
h43
Entries 8534
Mean x 25.79
Mean y 0.01472
Std Dev x 52.77
Std Dev y 0.539
cos(theta)
z0 [cm]

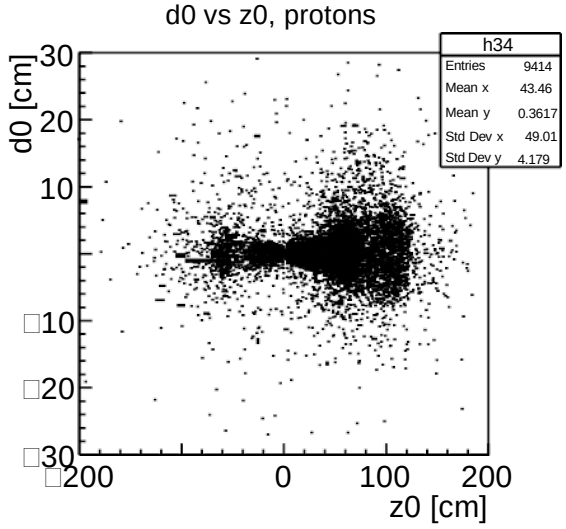

cosTheta vs d0, pions
h63
Entries 8534
Mean x 0.09878
Mean y 0.01451
Std Dev x 3.75
Std Dev y 0.5415

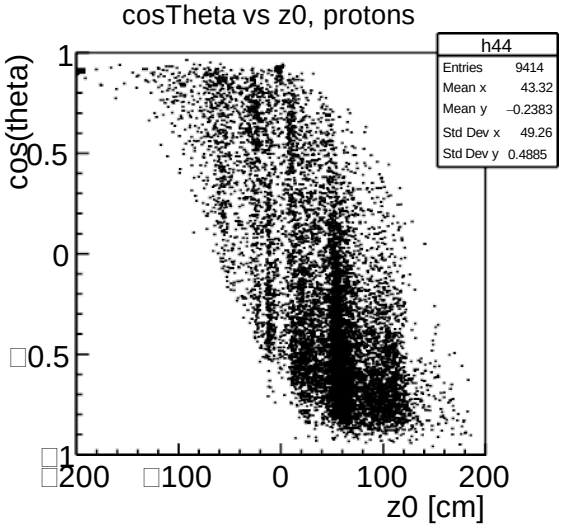
# Run 4814

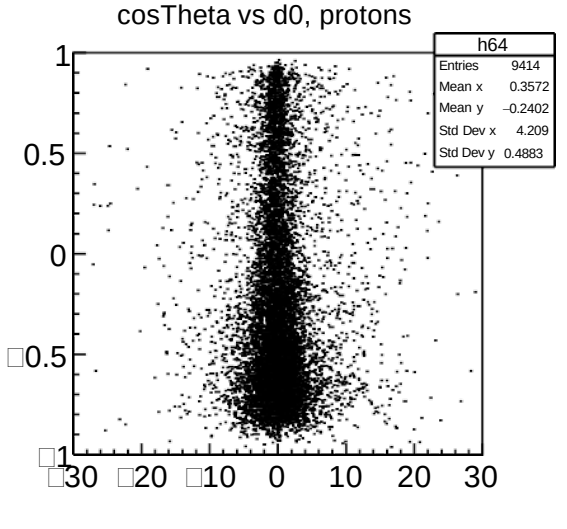

d0, protons
h14
Entries 9414
Mean 0.3572
Std Dev 4.209
d0 [cm]


z0, protons
h24
Entries 9414
Mean 43.32
Std Dev 49.26
z0 [cm]

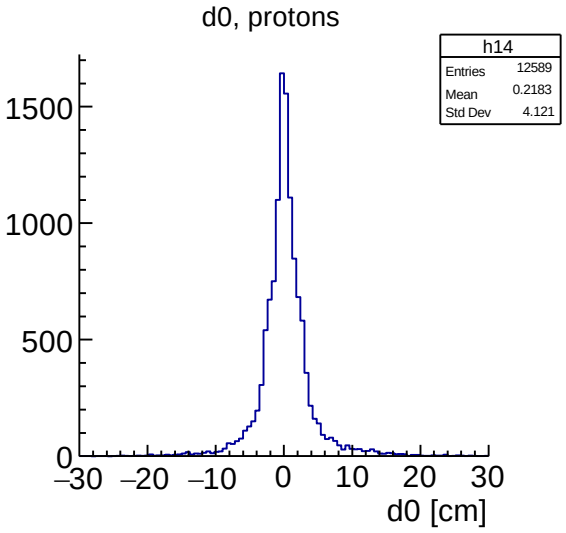

cosTheta, protons
h54
Entries 9414
Mean −0.239
Std Dev 0.4892

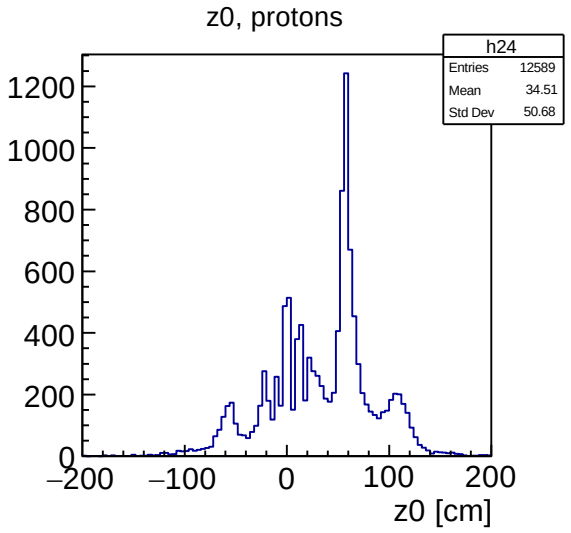

d0 vs z0, protons
h34
Entries 9414
Mean x 43.46
Mean y 0.3617
Std Dev x 49.01
Std Dev y 4.179
d0 [cm]
z0 [cm]

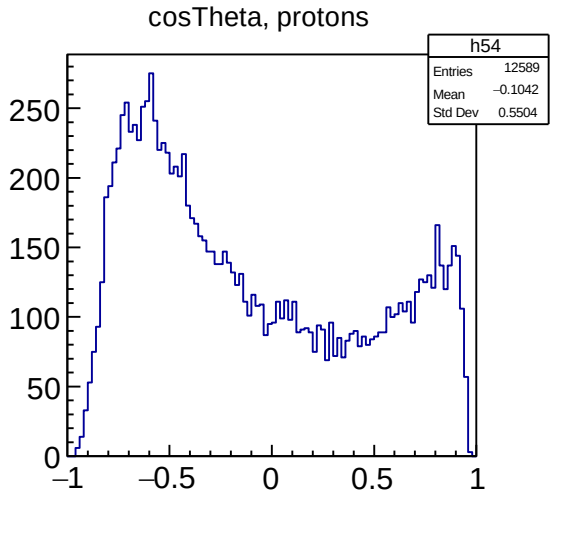

cosTheta vs z0, protons
h44
Entries 9414
Mean x 43.32
Mean y −0.2383
Std Dev x 49.26
Std Dev y 0.4885
cos(theta)
z0 [cm]

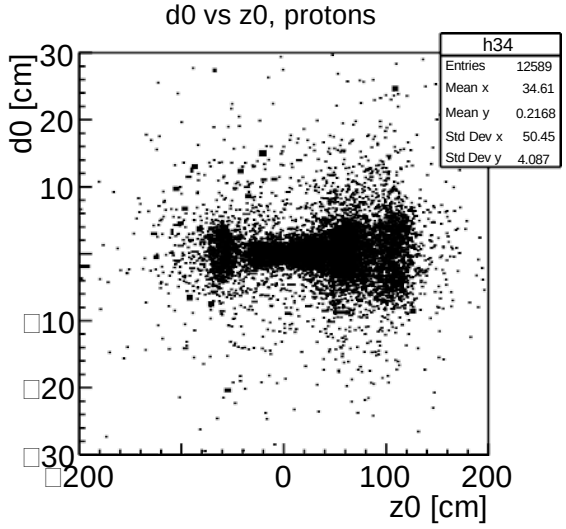

cosTheta vs d0, protons
h64
Entries 9414
Mean x 0.3572
Mean y −0.2402
Std Dev x 4.209
Std Dev y 0.4883

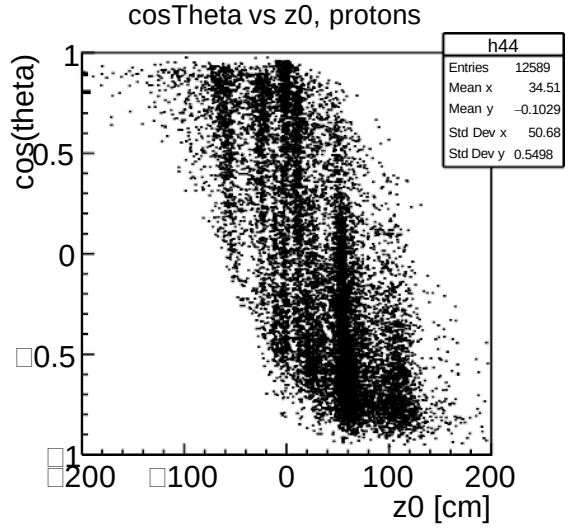
# Run 5187

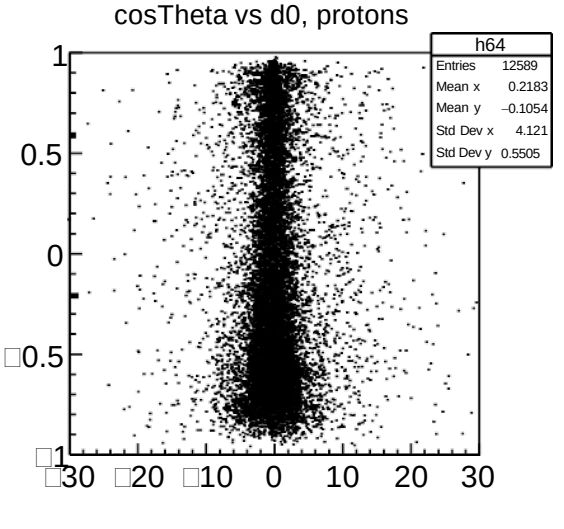

d0, protons
h14
Entries 12589
Mean 0.2183
Std Dev 4.121
d0 [cm]


z0, protons
h24
Entries 12589
Mean 34.51
Std Dev 50.68
z0 [cm]


cosTheta, protons
h54
Entries 12589
Mean −0.1042
Std Dev 0.5504


d0 vs z0, protons
h34
Entries 12589
Mean x 34.61
Mean y 0.2168
Std Dev x 50.45
Std Dev y 4.087
d0 [cm]
z0 [cm]


cosTheta vs z0, protons
h44
Entries 12589
Mean x 34.51
Mean y −0.1029
Std Dev x 50.68
Std Dev y 0.5498
cos(theta)
z0 [cm]


cosTheta vs d0, protons
h64
Entries 12589
Mean x 0.2183
Mean y −0.1054
Std Dev x 4.121
Std Dev y 0.5505

# Conclusions

Track parameters extracted from DST reconstruction

-> need to train networks on reconstructed track data

Background strongly changes with beam conditions

Possible reasons: towards end of Phase 2

- the vaccum improved
- injection better understood

Consequence:

- z <> 0 tracks decreased relative to vertex tracks
- backgrounds look similar in shape
- suggest now training of networks with real data