Sub-periods for 1GeV runs

Sub-period lists (production runs are before the "|" mark)
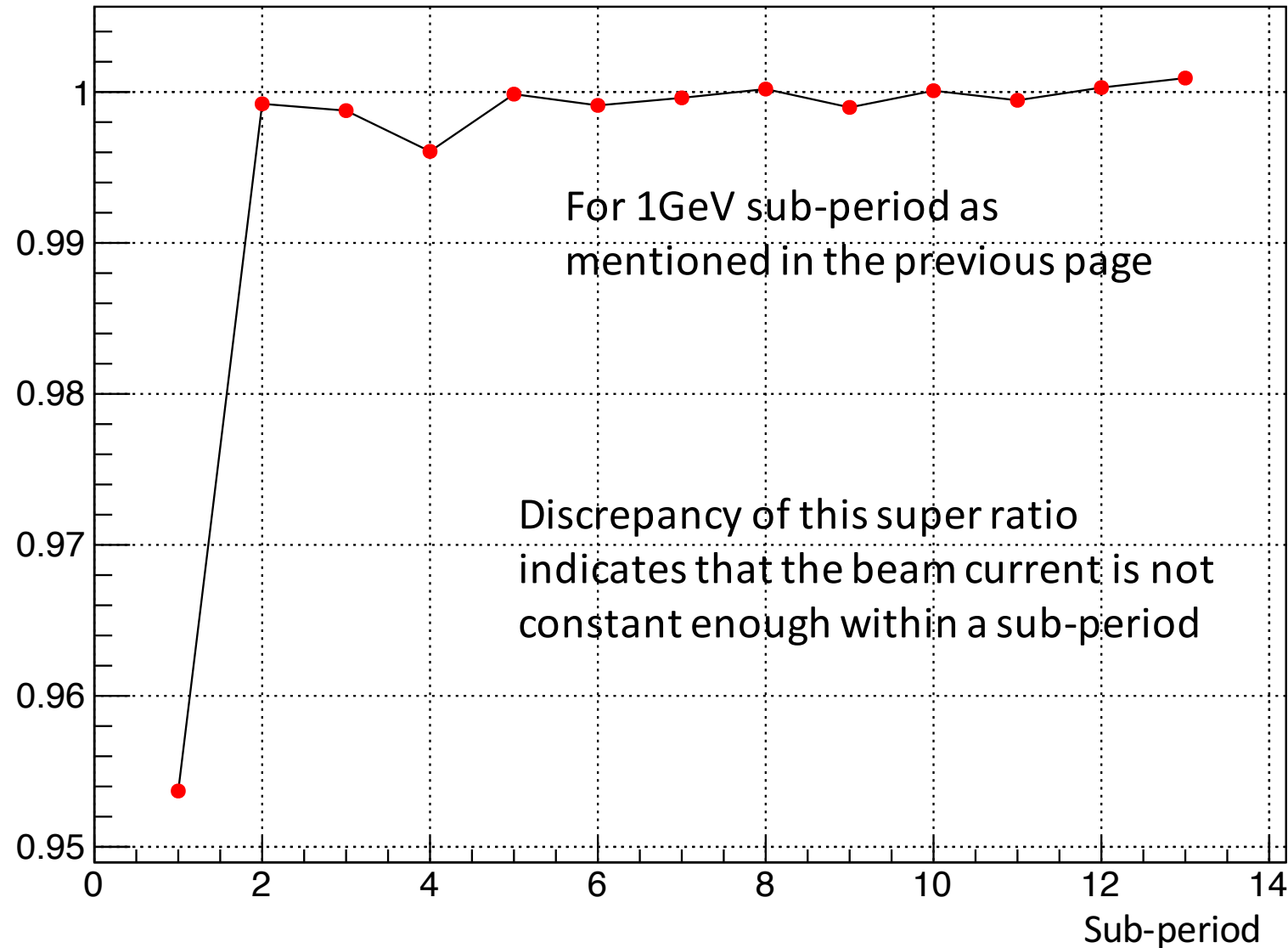
1. 1136, 1137 | 1135
2. 1155, 1158, 1159, 1160 | 1153, 1154, 1161
3. 1201, 1202, 1203, 1205, 1206, 1207 | 1197, 1198

with ~63% live time for the production runs

4. 1238, 1240, 1241, 1242, 1243 | 1237
5. 1287, 1288, 1290, 1291, 1292, 1293, 1295 | 1289, 1294
6. 1302, 1303, 1304 | 1306
7. 1308, 1309, 1310, 1311 | 1306, 1312
8. 1313, 1314, 1315, 1316 | 1312, 1317
9. 1320, 1322, 1323 | 1324

with ~86% live time for the production runs

10. 1325 | 1324, 1326
11. 1328 | 1327, 1329
12. 1331 | 1330
13. 1336, 1337, 1338, 1340, 1341 | 1339

Notice: (1) 1129 should be a target in gas out run (no gas flow rate), marked as empty target run in run list
    (2) there are production runs before 1136, but have not done event selection cuts yet, and they are before the increase of HV for the compensation of rad damage (which was done at 1125)

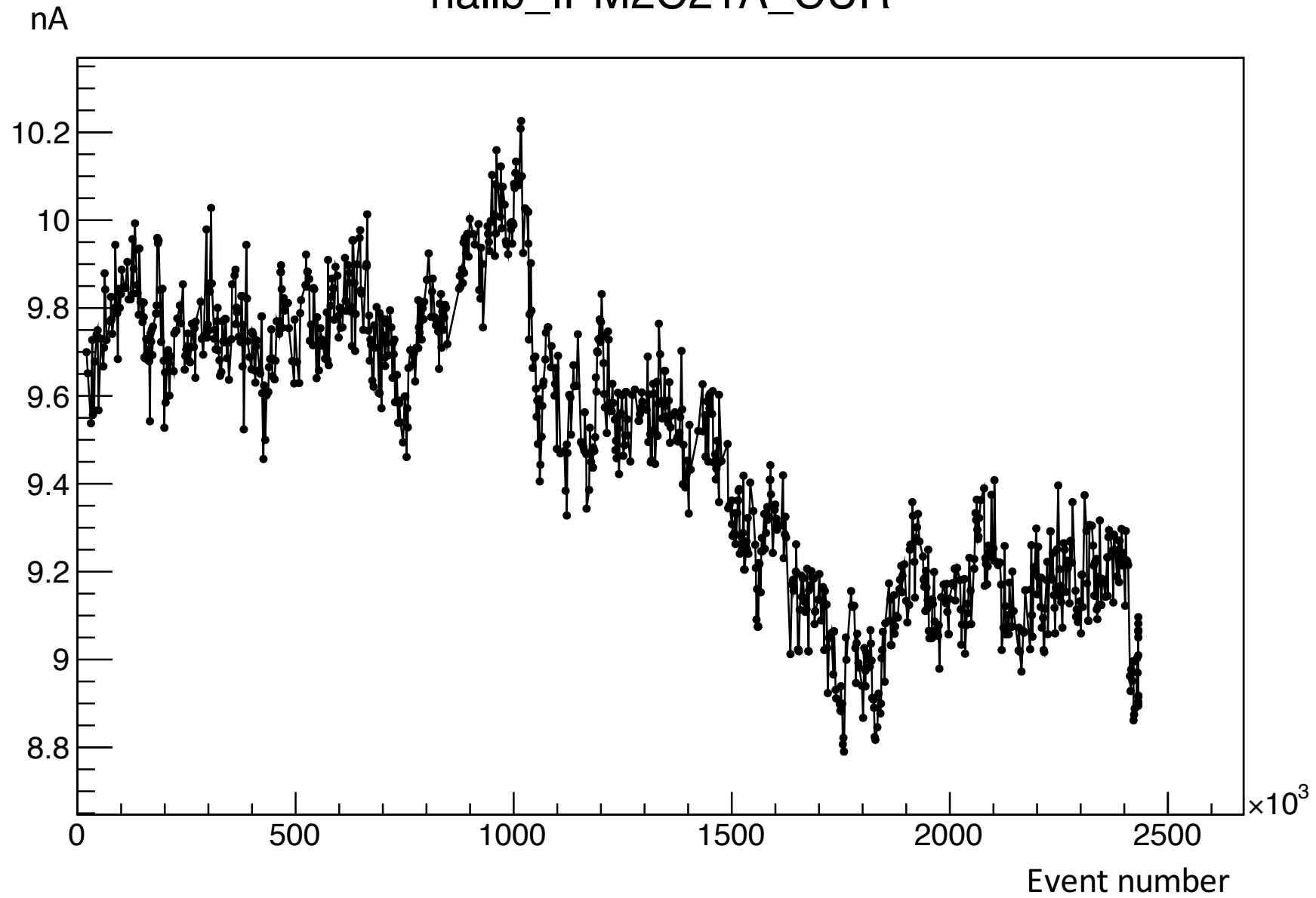# Live charge ratio over live time ratio

Graph

(live charge pro/live charge empty) / (live time pro / live time empty)

For 1GeV sub-period as mentioned in the previous page

Discrepancy of this super ratio indicates that the beam current is not constant enough within a sub-period
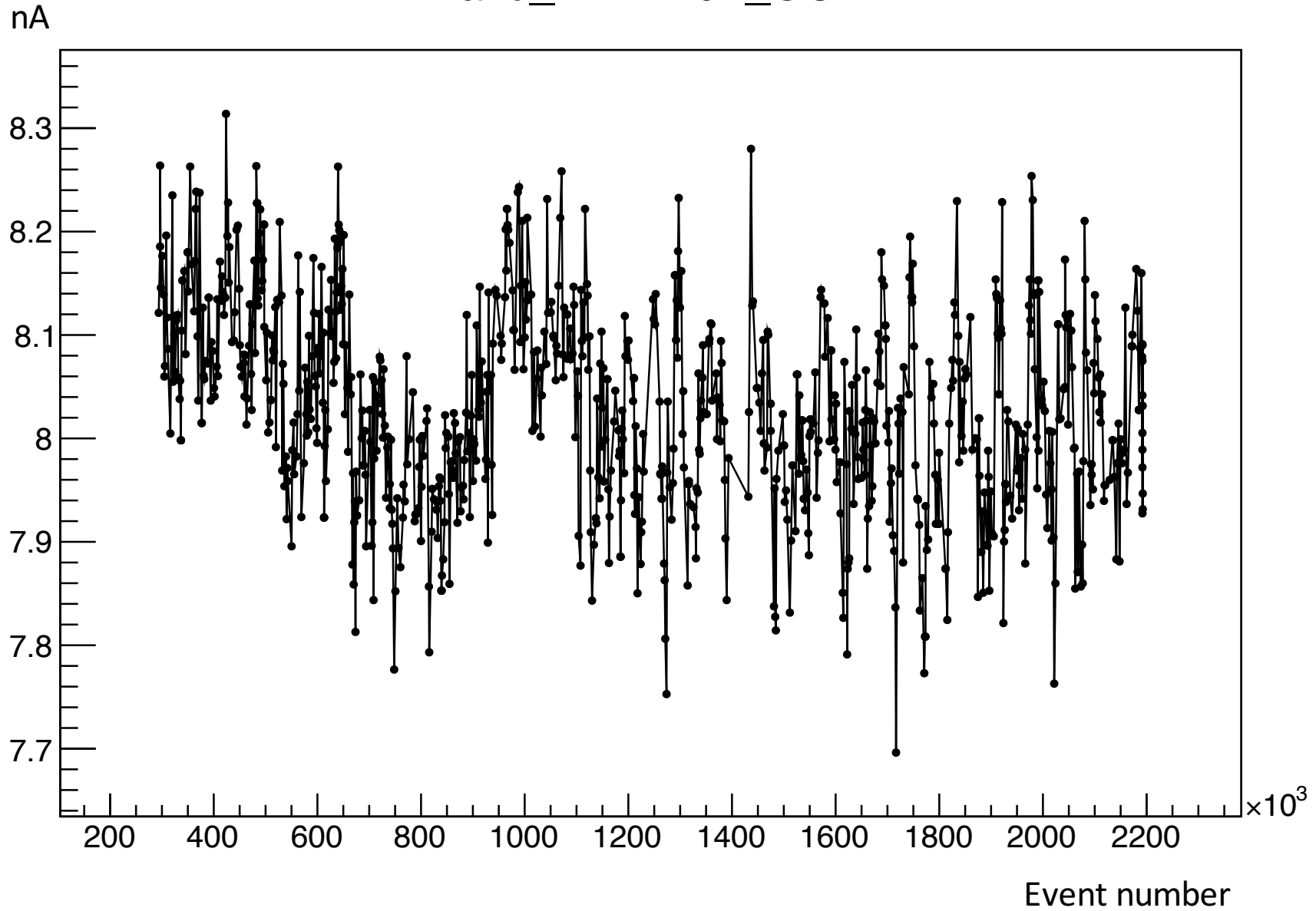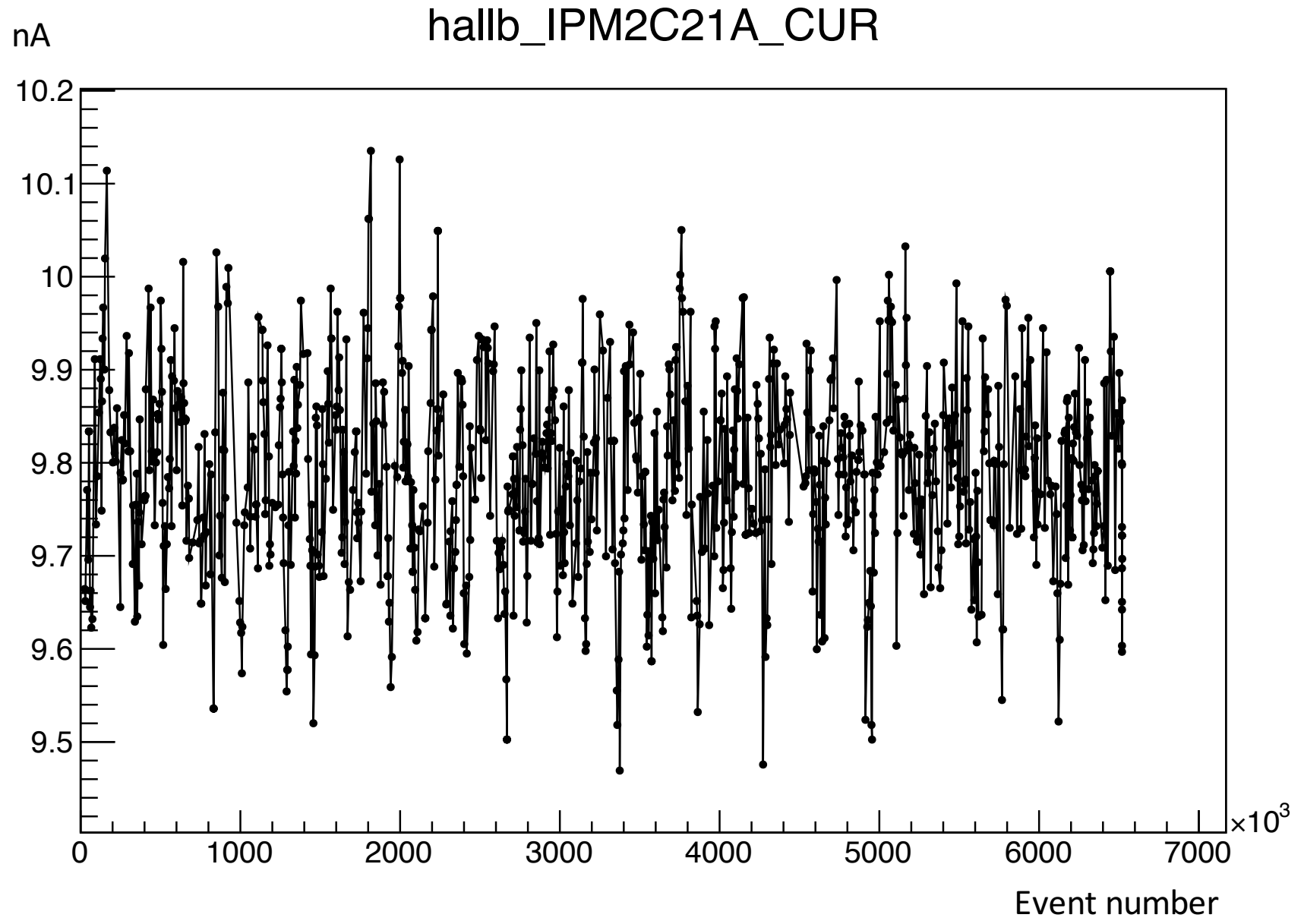
Sub-period

2

Beam current run 1135

hallb_IPM2C21A_CUR
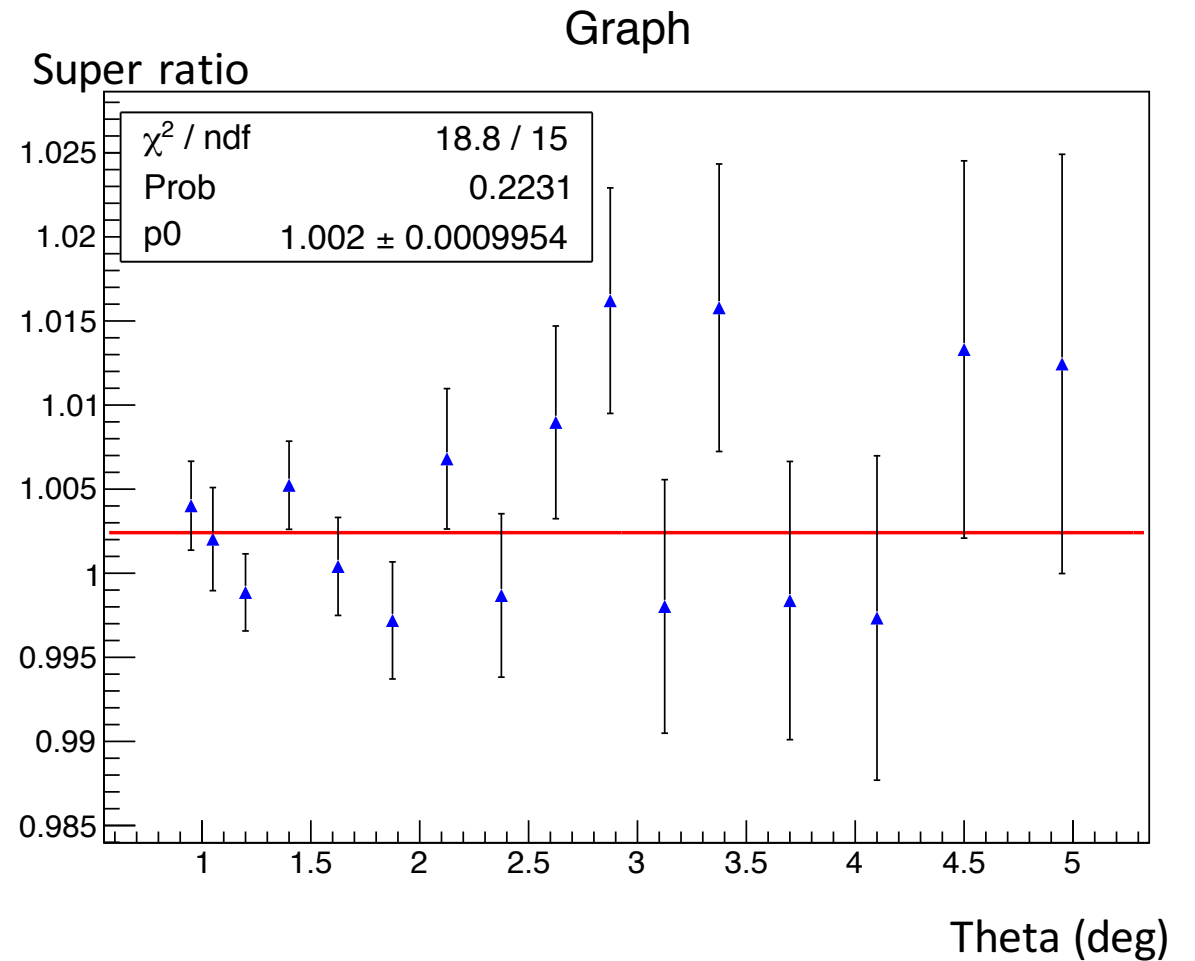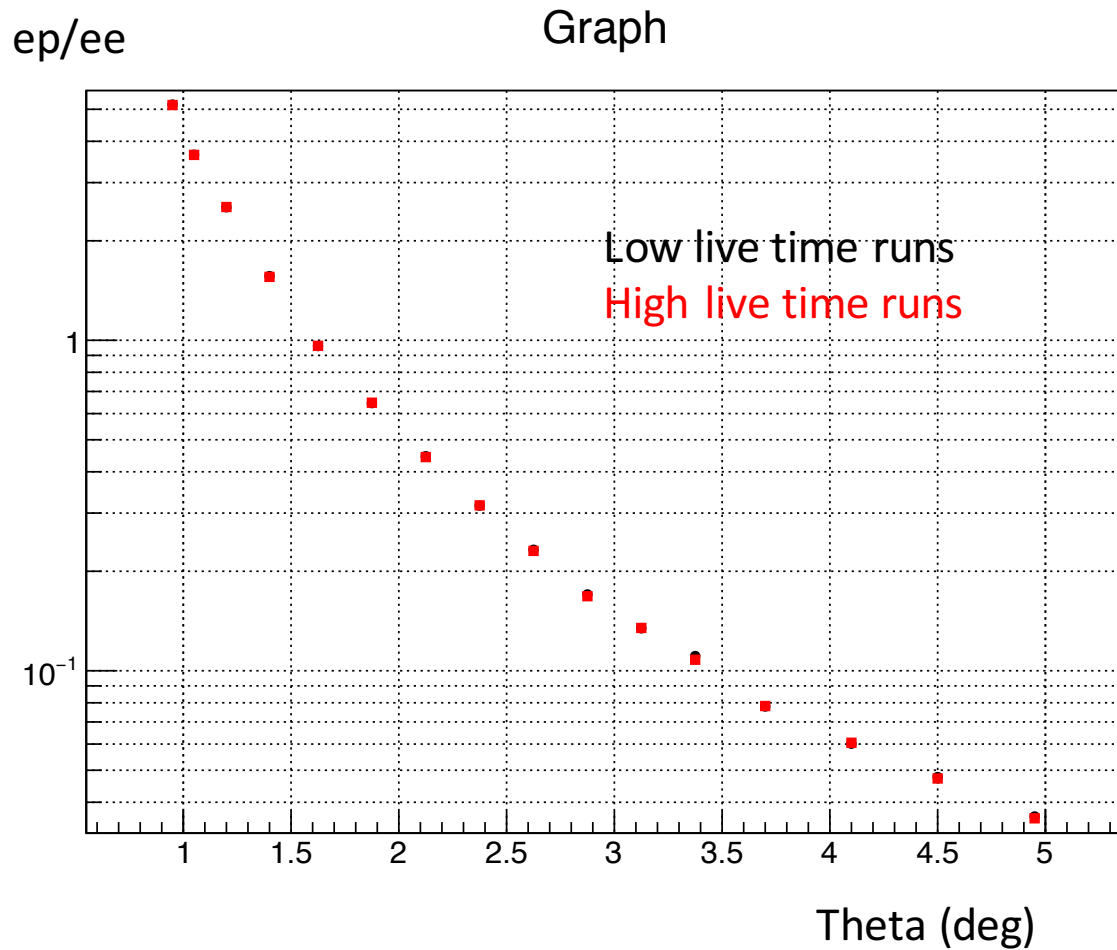
Beam current run 1237

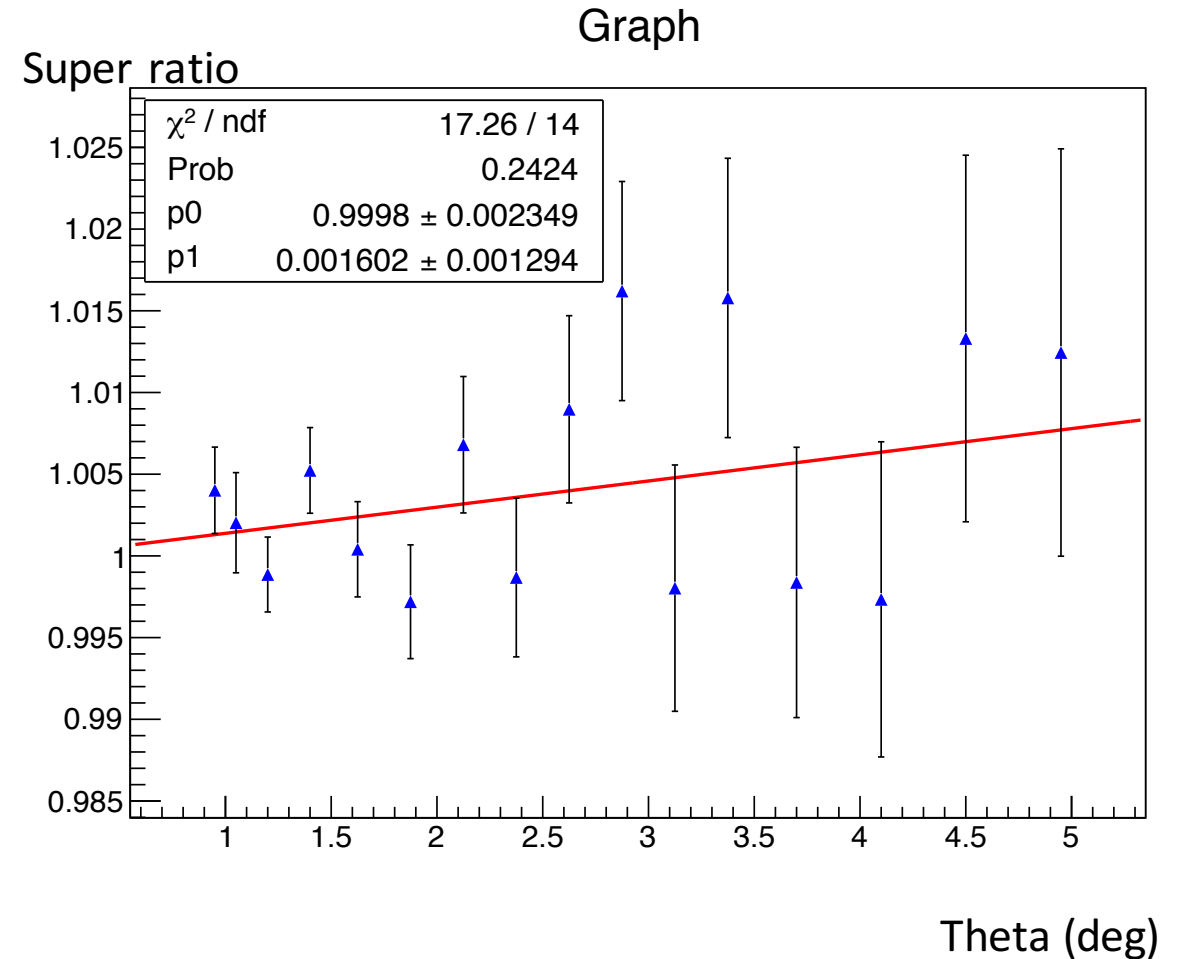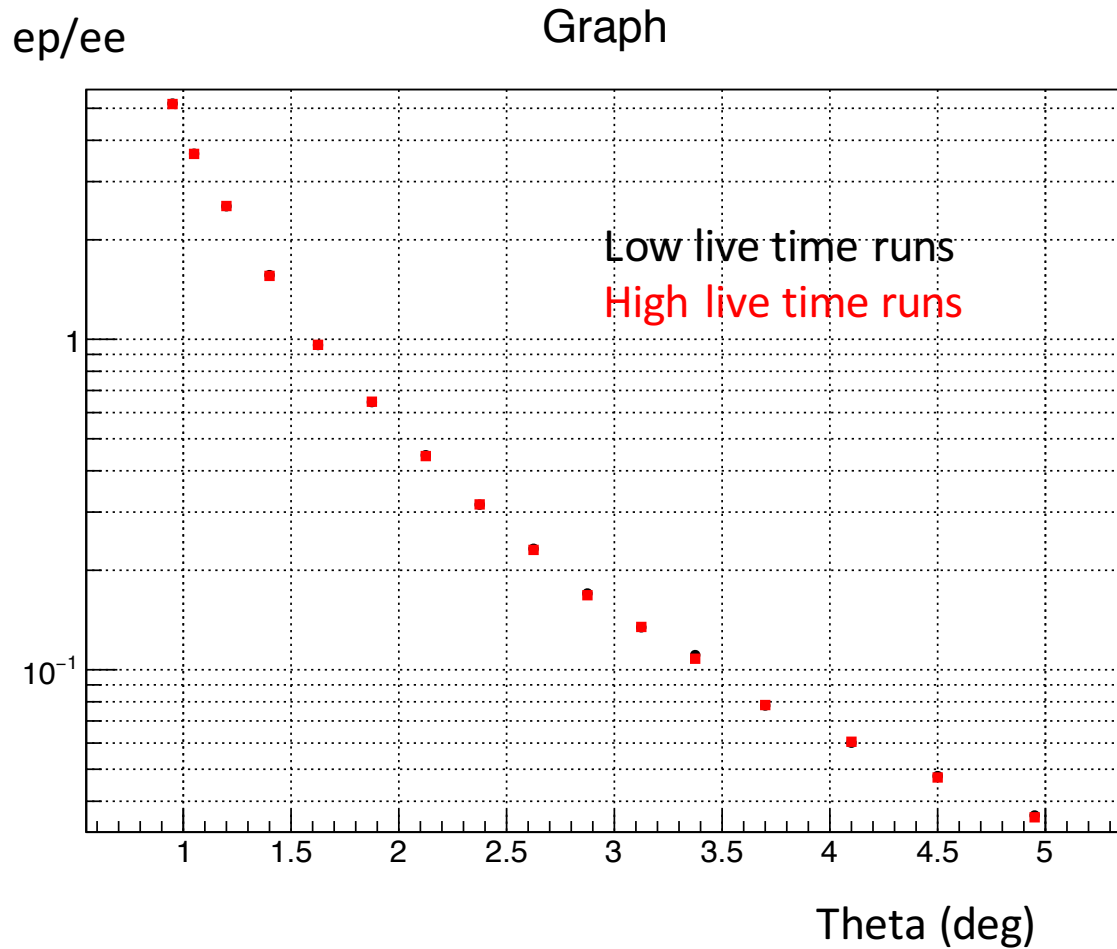## hallb_IPM2H01_CUR

hallb_IPM2C21A_CUR

Yield comparison for sub-periods with different live time

Using HyCal only

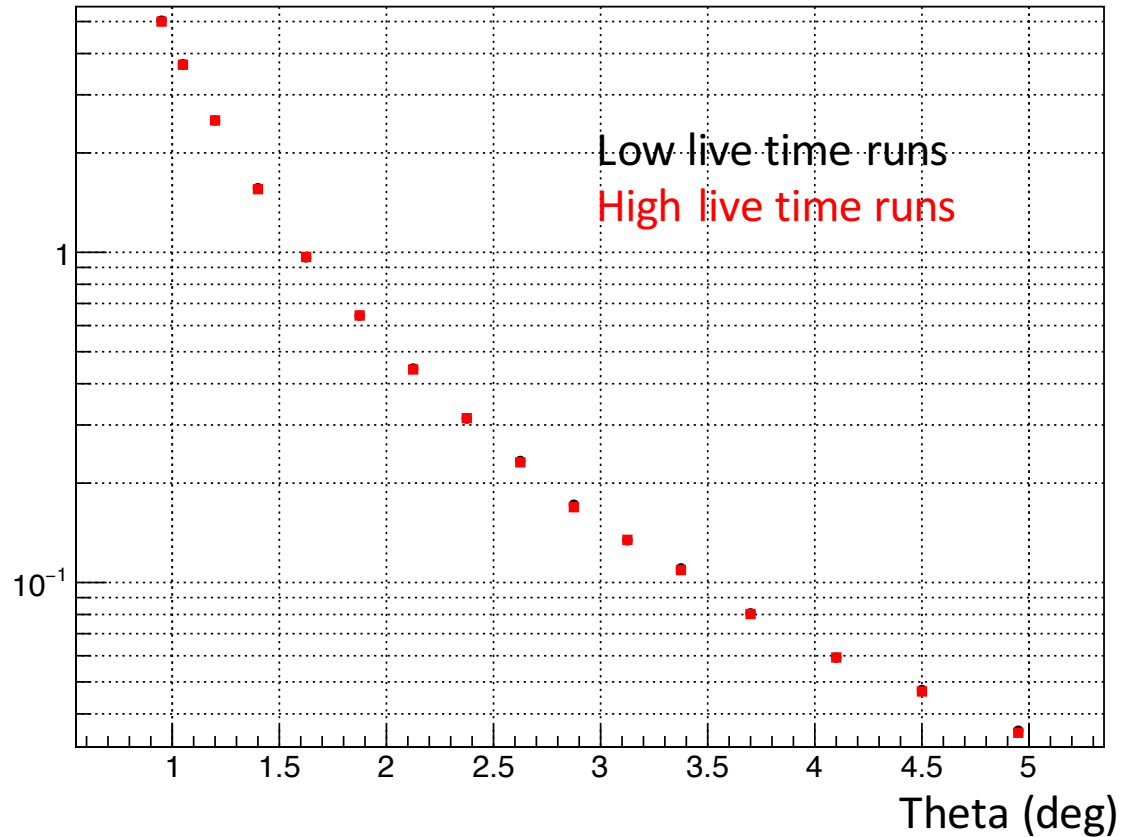# Yield comparison for sub-periods with different live time

Using HyCal only

Yield comparison for sub-periods with different live time

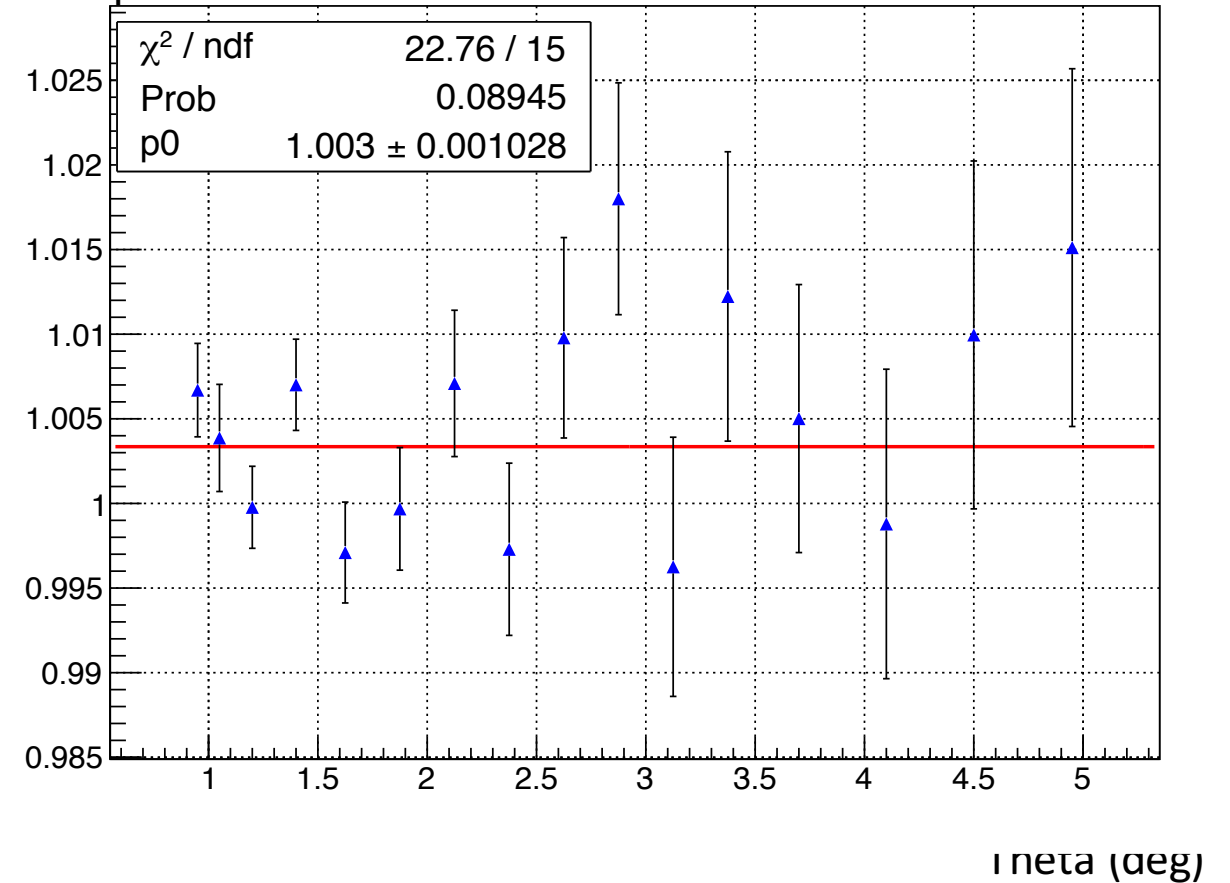## Using GEM, efficiency calculated and corrected for high and low live time runs separately

ep/ee

Graph

Graph

Super ratio

Low live time runs
High live time runs

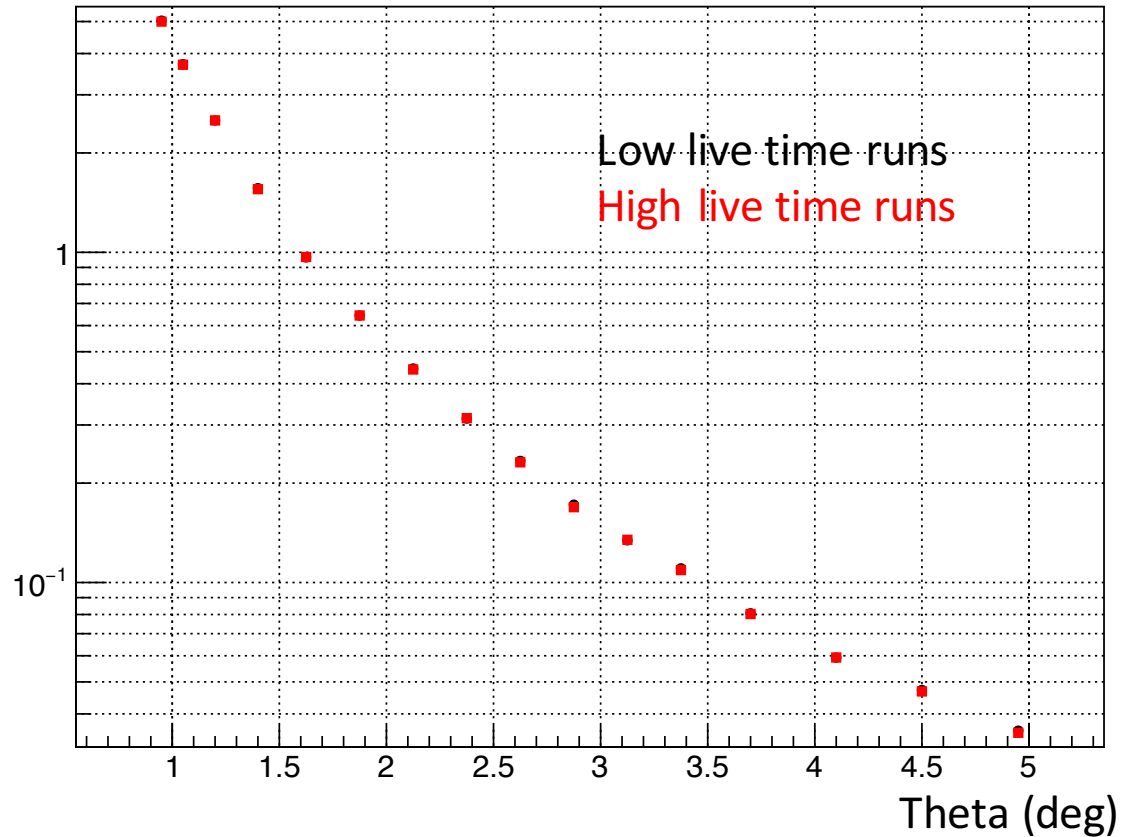| χ^2 / ndf	22.76 / 15
Prob	0.08945
p0	1.003 ± 0.001028

Theta (deg)

Theta (deg)

Yield comparison for sub-periods with different live time

Using GEM, efficiency calculated and corrected for high and low live time runs separately
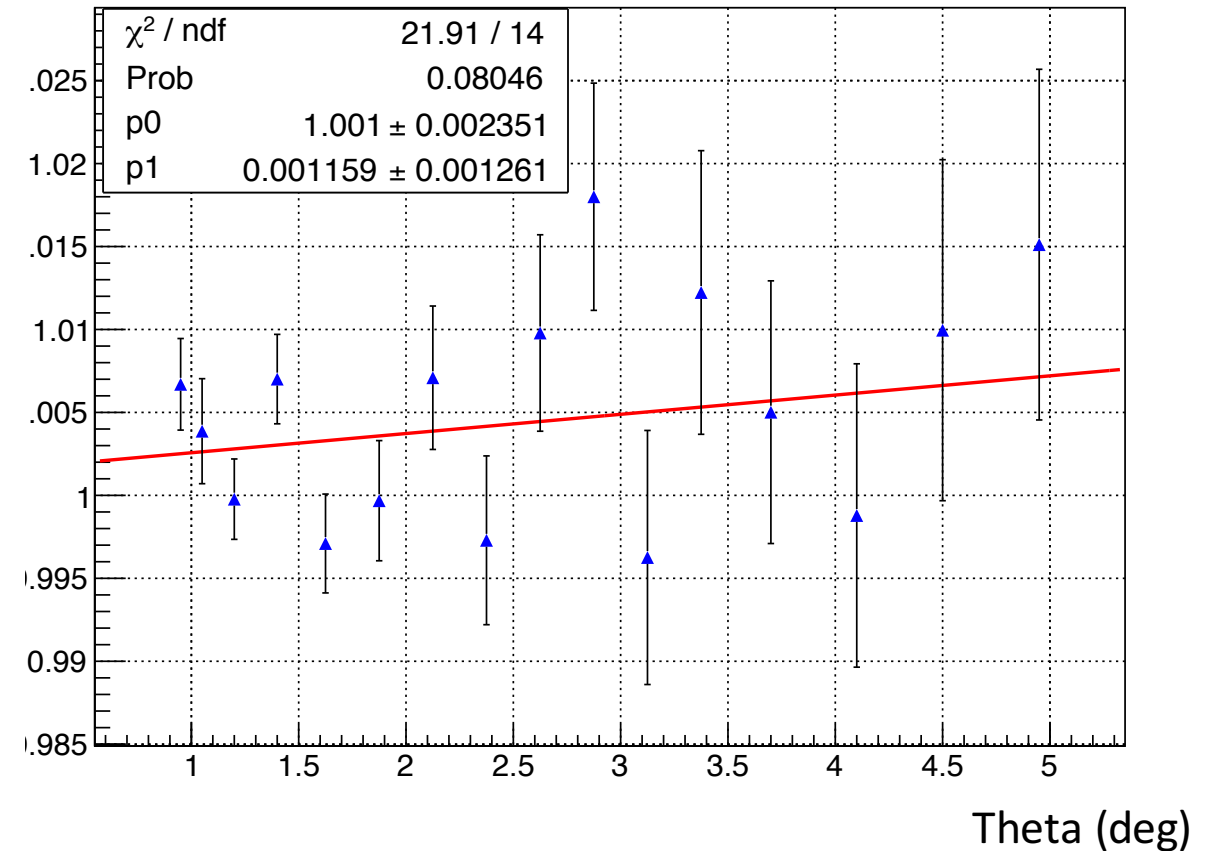

ep/ee   Graph

Low live time runs
High live time runs

Super ratio   Graph

| χ² / ndf | 21.91 / 14 |
Prob	0.08046
p0	1.001 ± 0.002351
p1	0.001159 ± 0.001261

GEM efficiency correction

- It is possible that we can correct the GEM efficiency by doing background subtraction using the live charge ratio
  - Efficiency = $(n_{pro} - cn_{bg})/(N_{pro} - cN_{bg})$ where c is the live charge ratio, n for GEM counts, N for HyCal counts

- We can check the efficiency dependency on the energy cut since if background is cleanly removed, the efficiency should be less sensitive on the cut

GEM efficiency correction
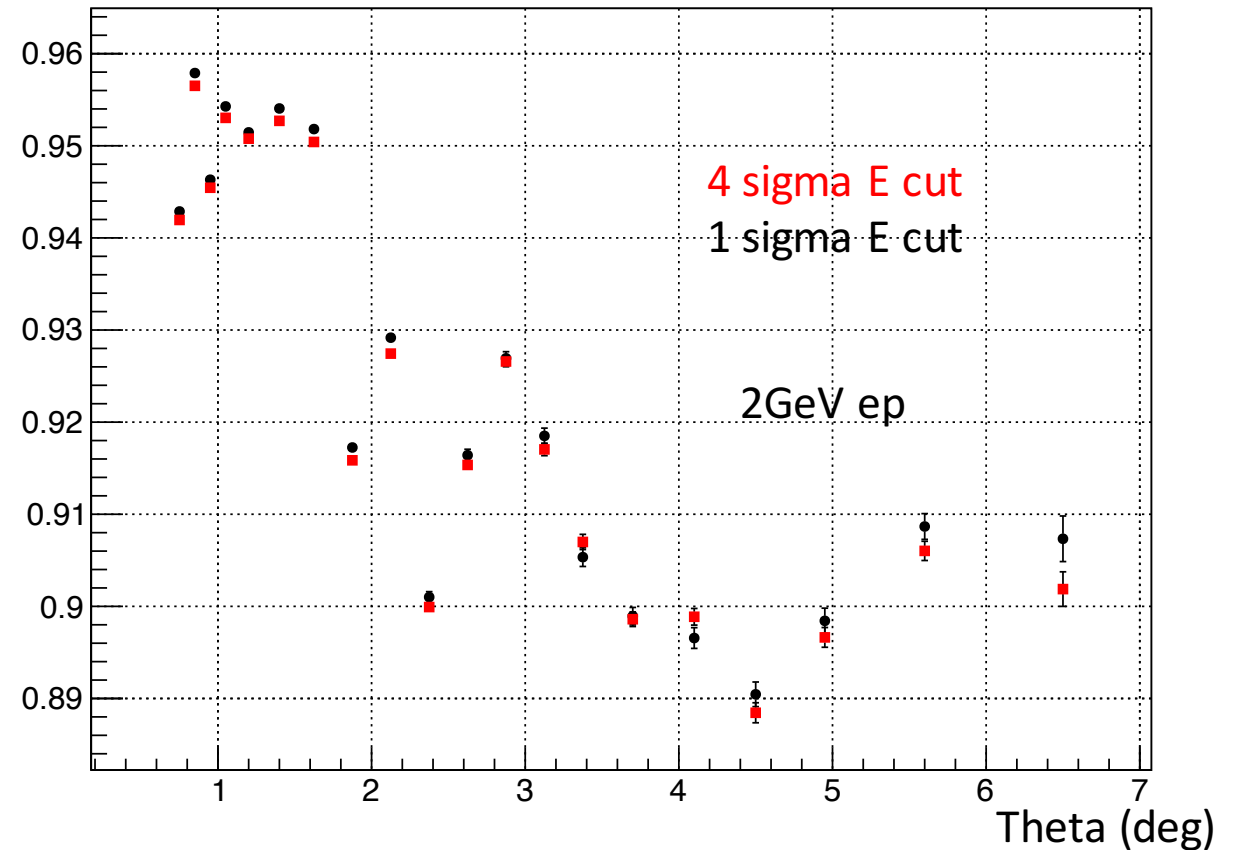

No correction Graph

efficiency

4 sigma E cut
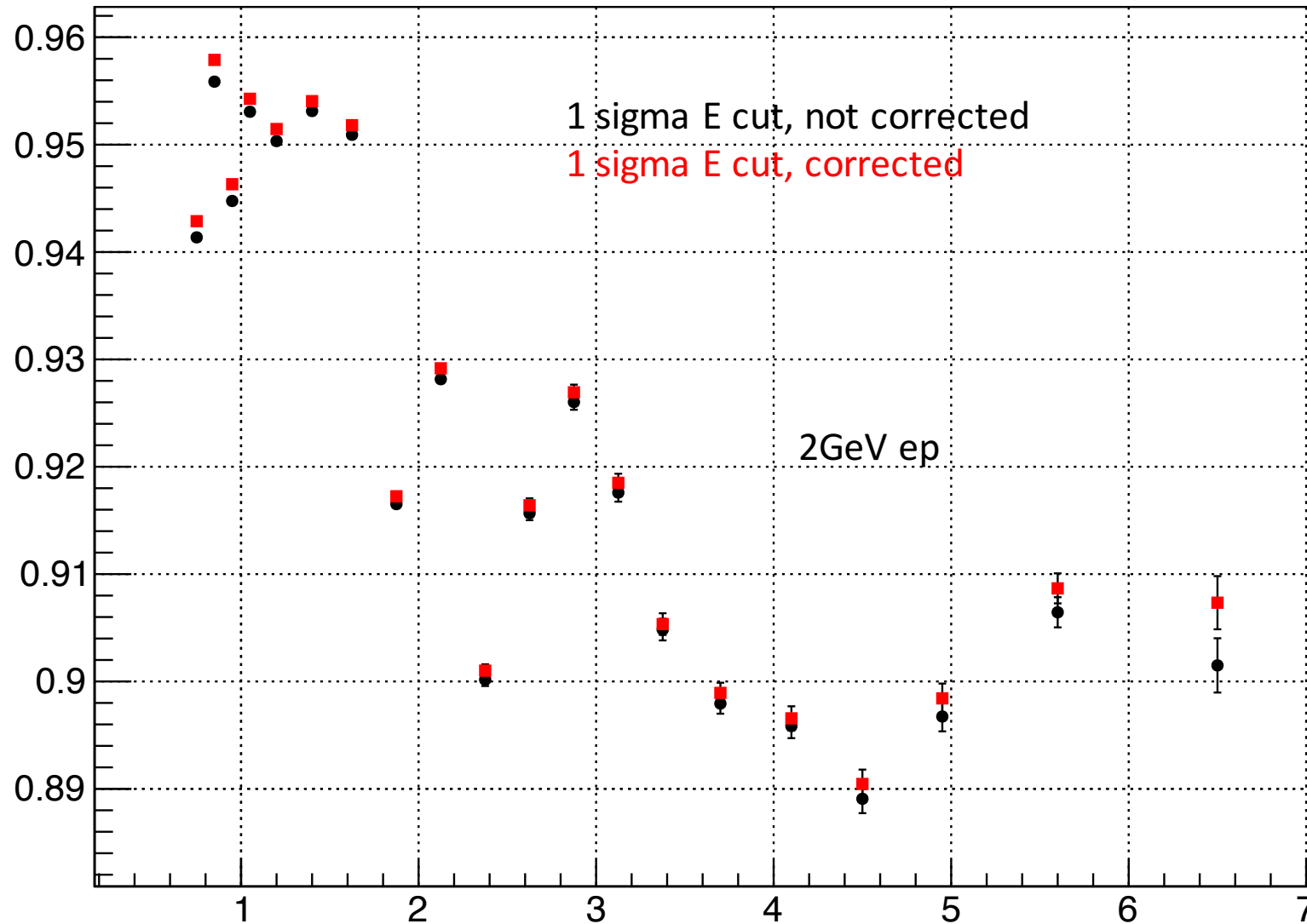
1 sigma E cut

2GeV ep
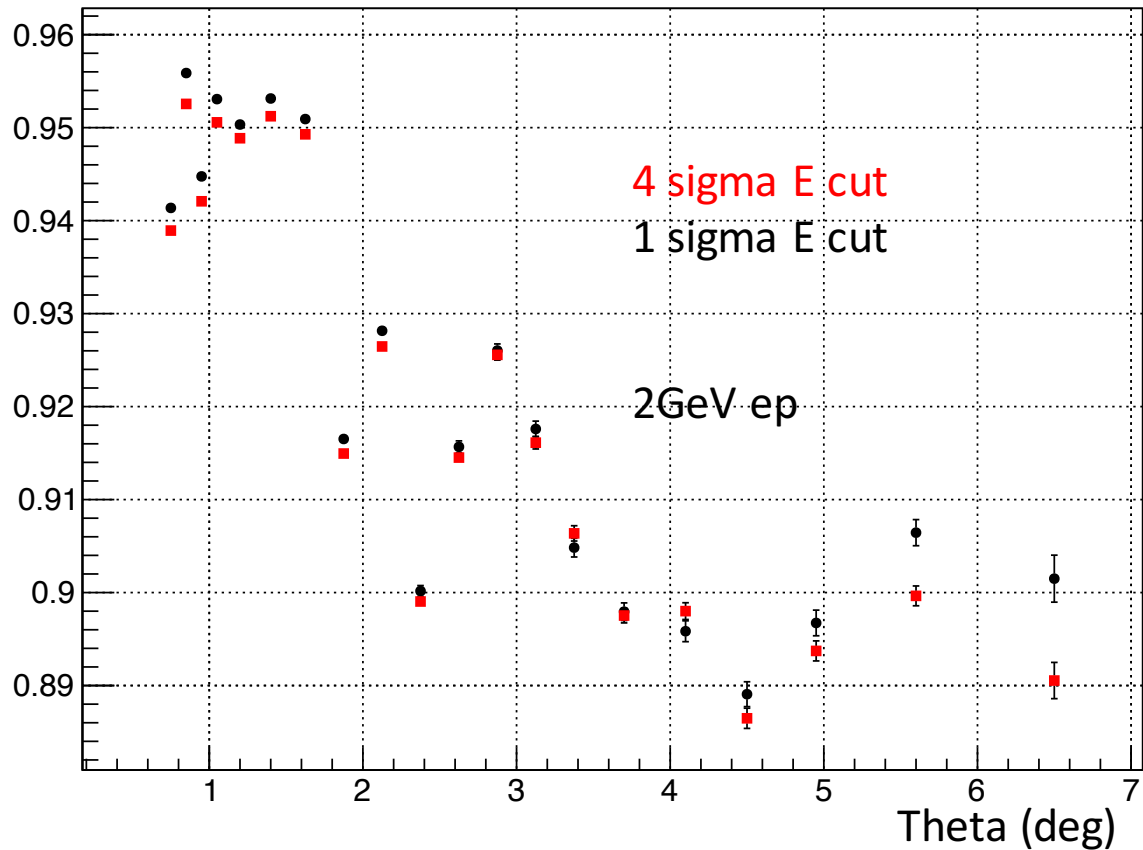
Theta (deg)

Corrected Graph

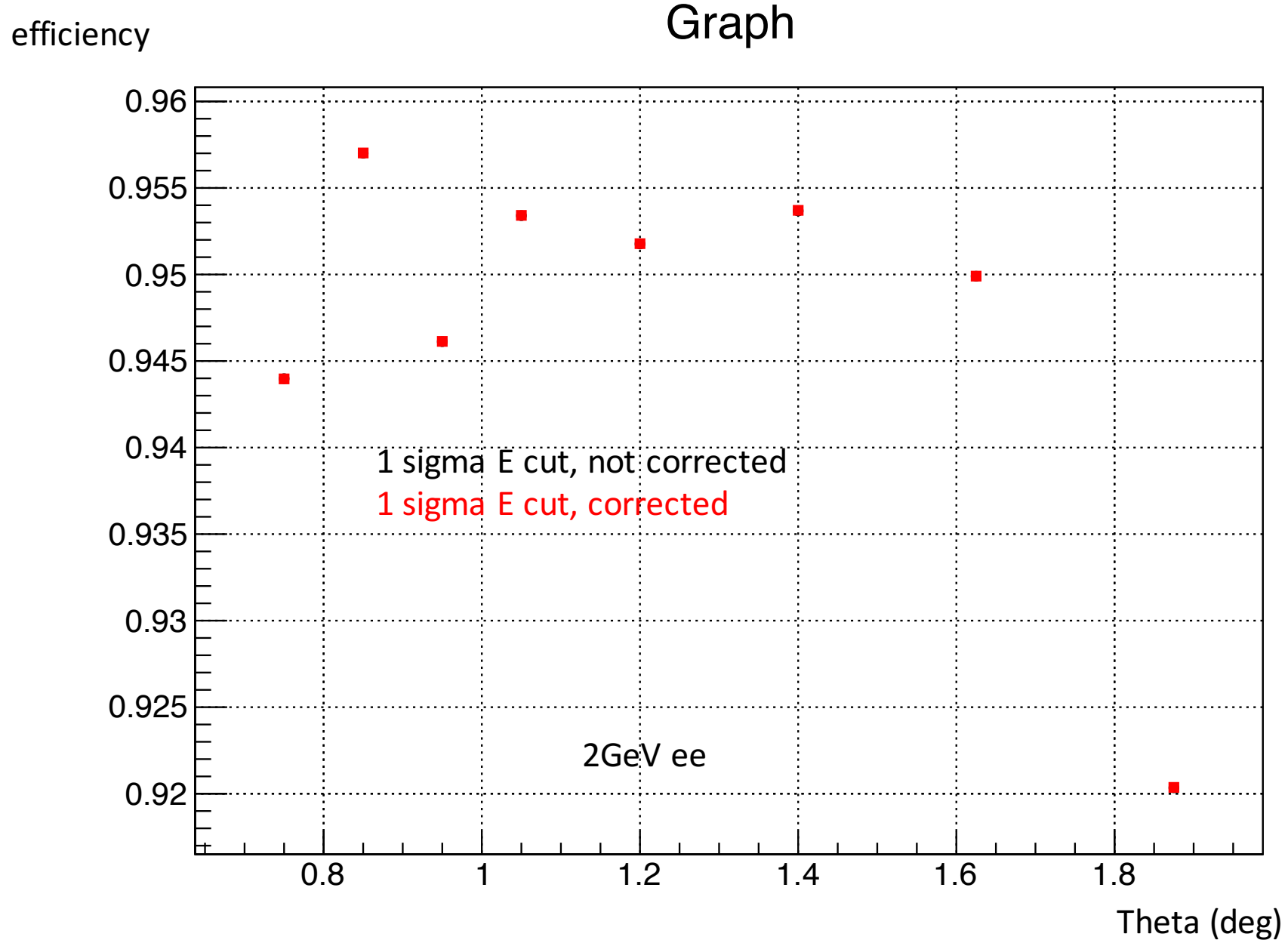efficiency

4 sigma E cut

1 sigma E cut

2GeV ep

Theta (deg)

GEM efficiency correction
Graph

GEM efficiency correction
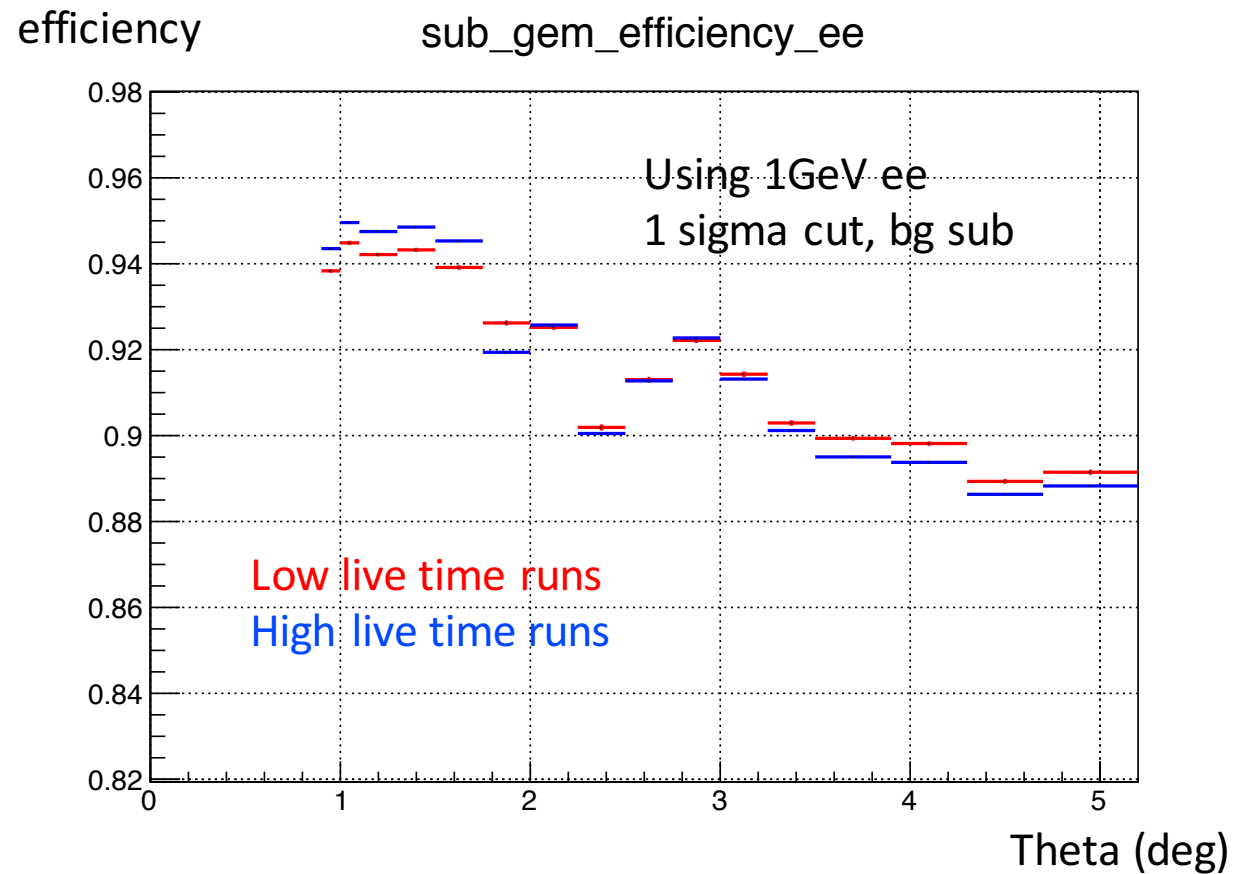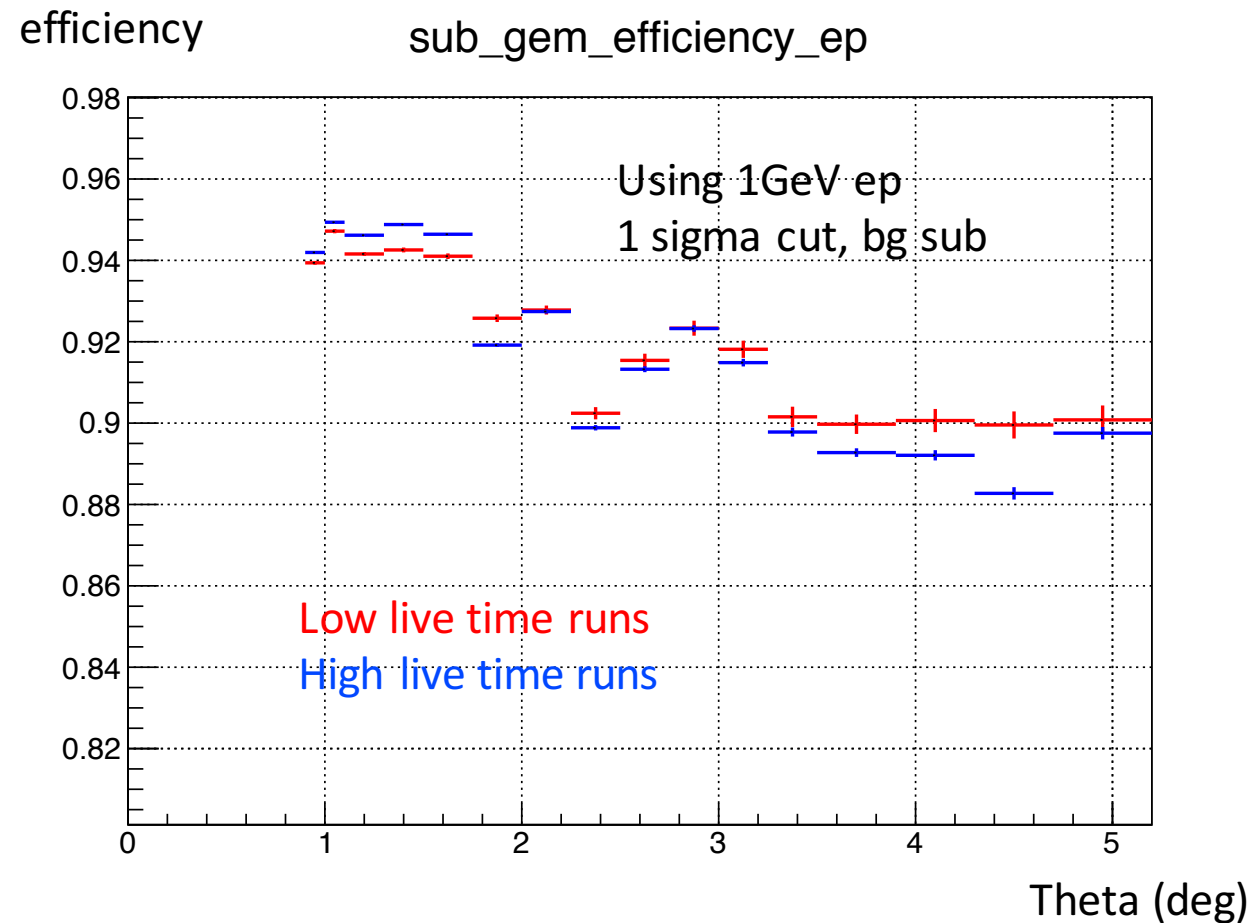

ep_gem_efficiency_channel_0
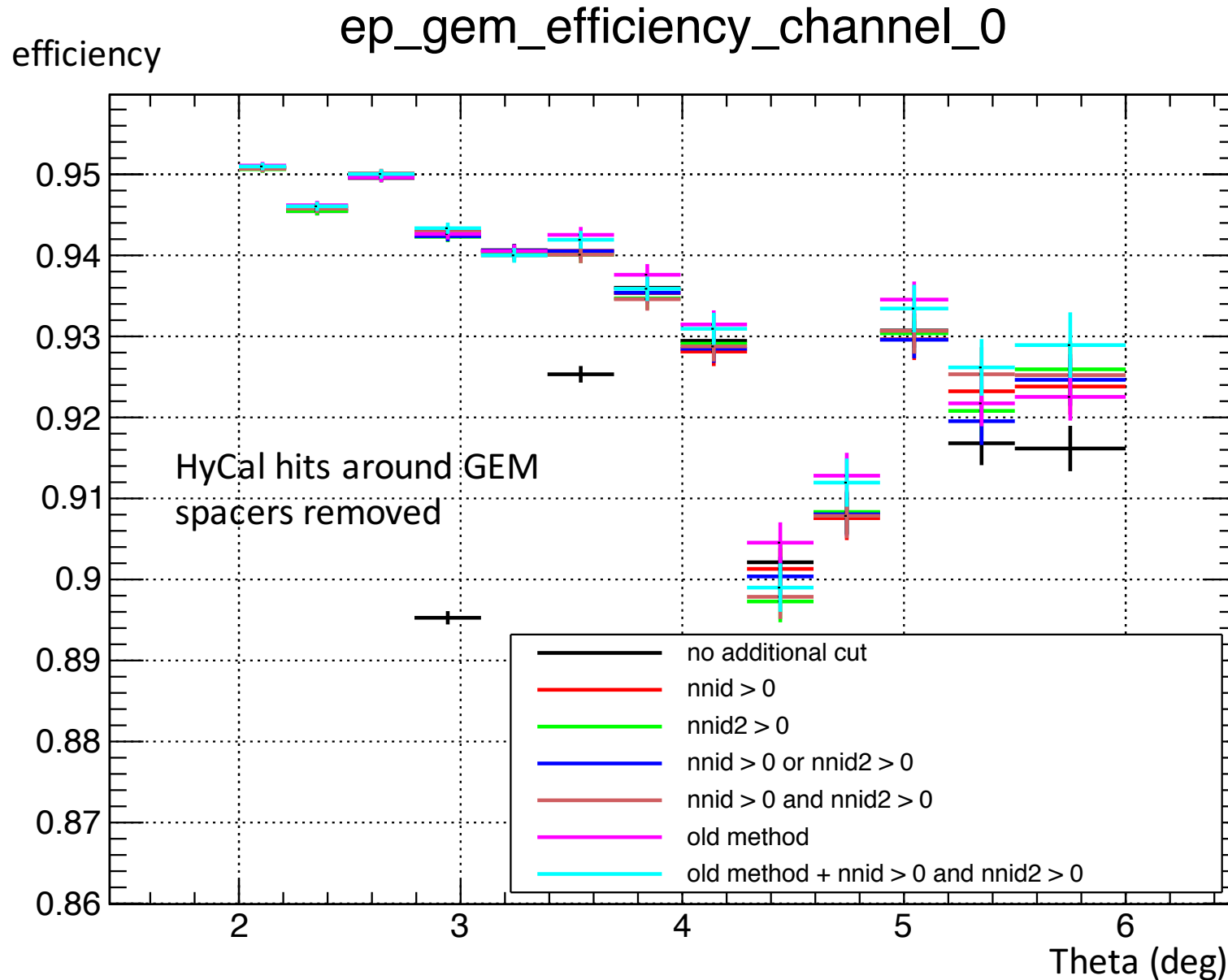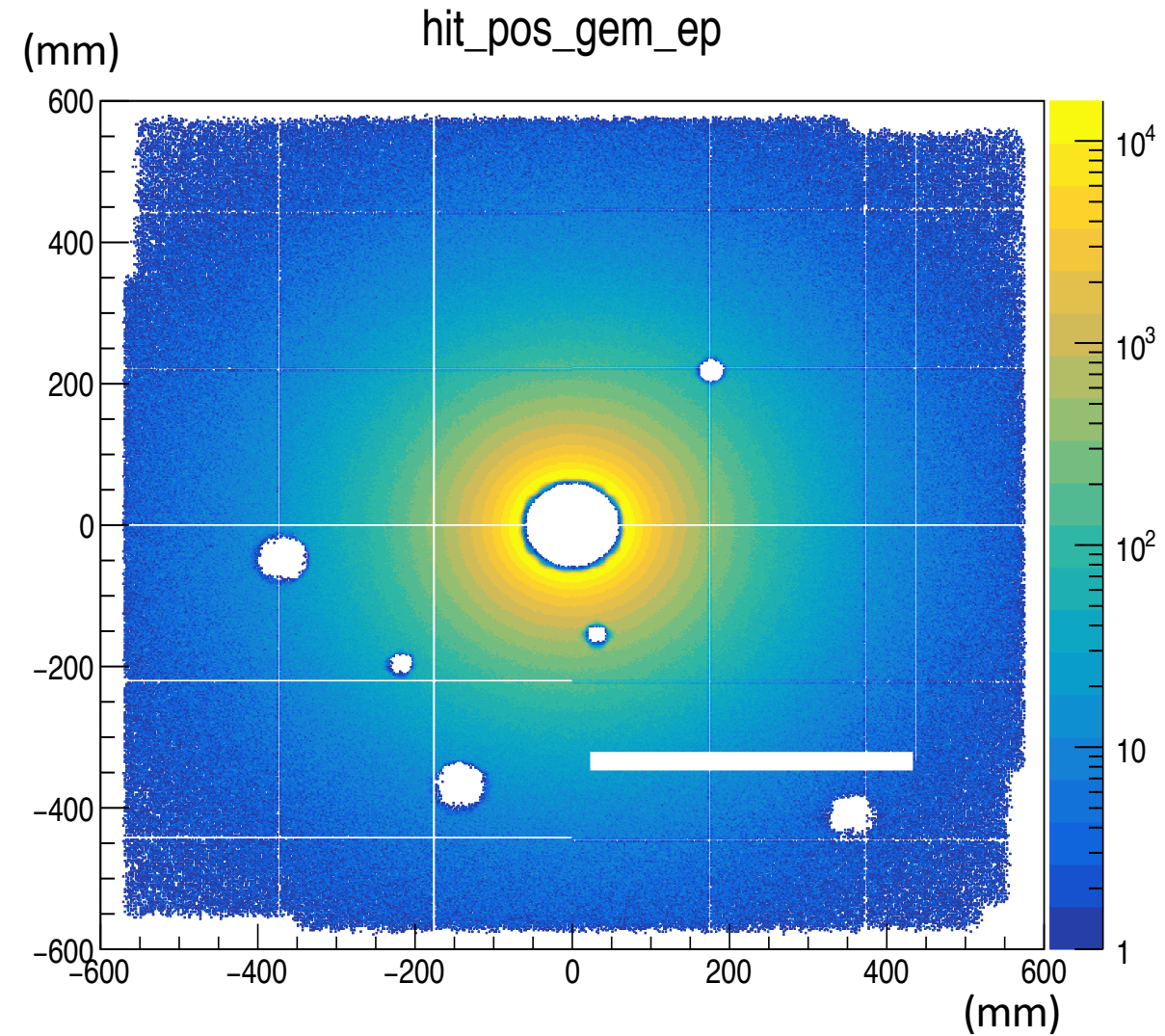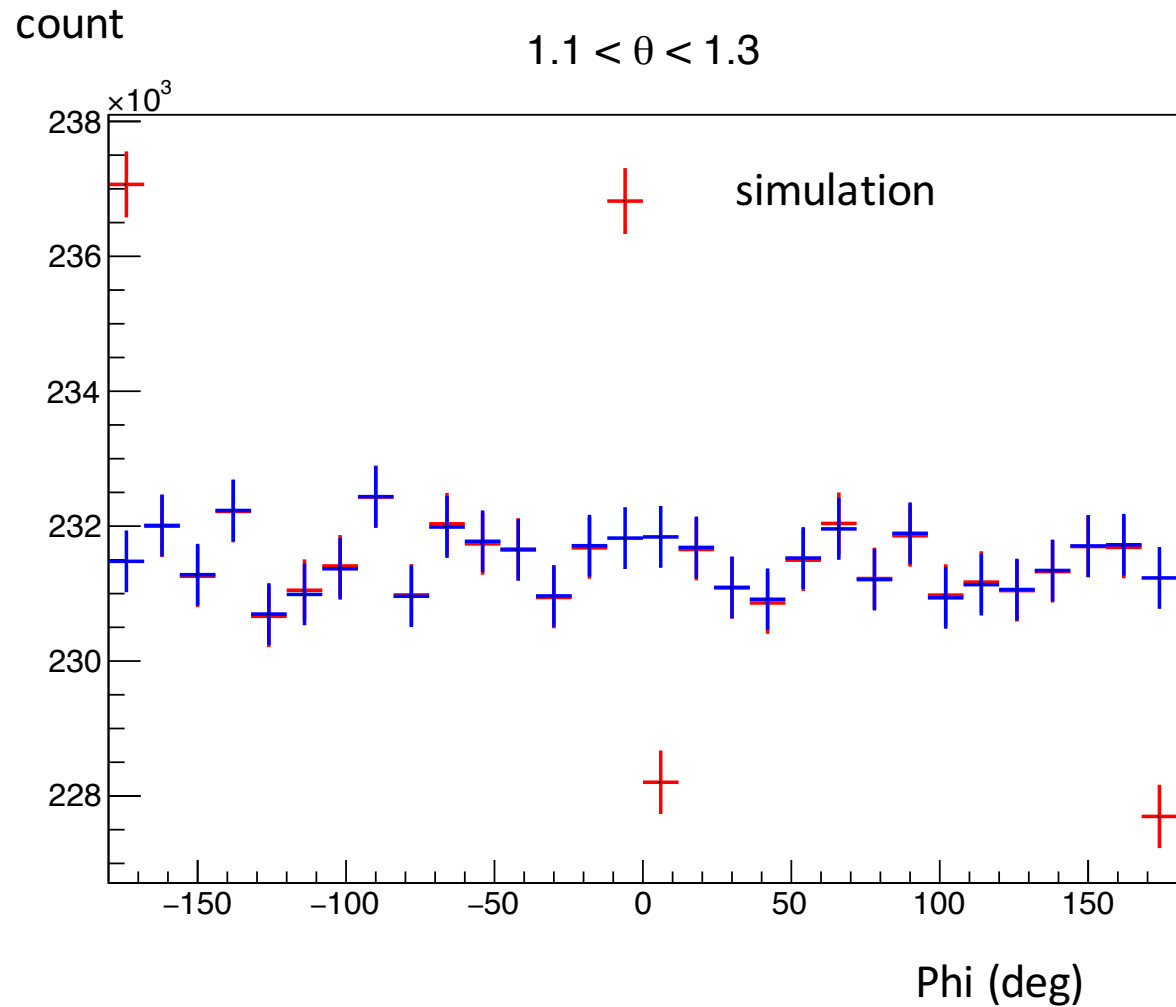
GEM efficiency correction

Remaining issue with GEM efficiency

Time dependency of GEM efficiency, particularly for 1GeV

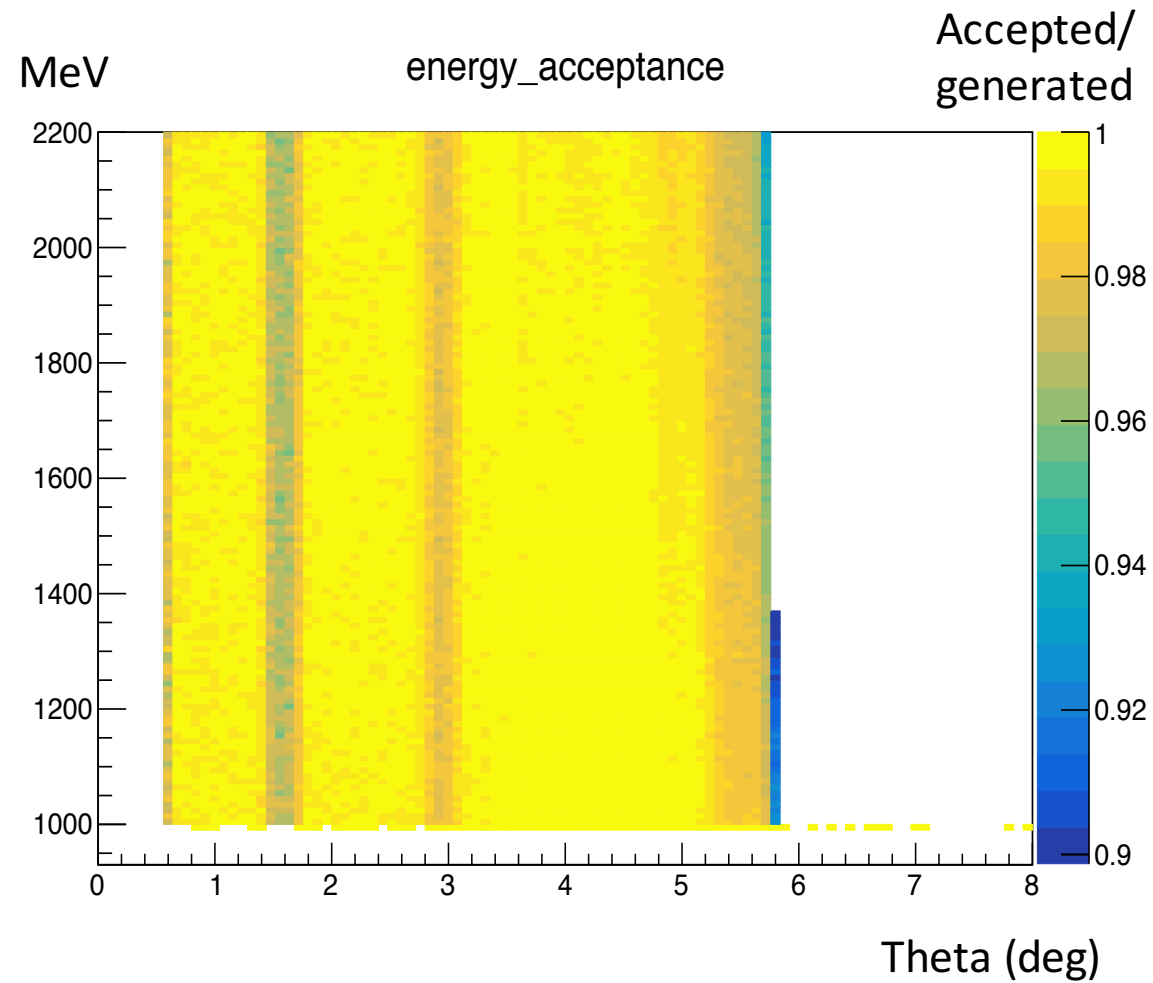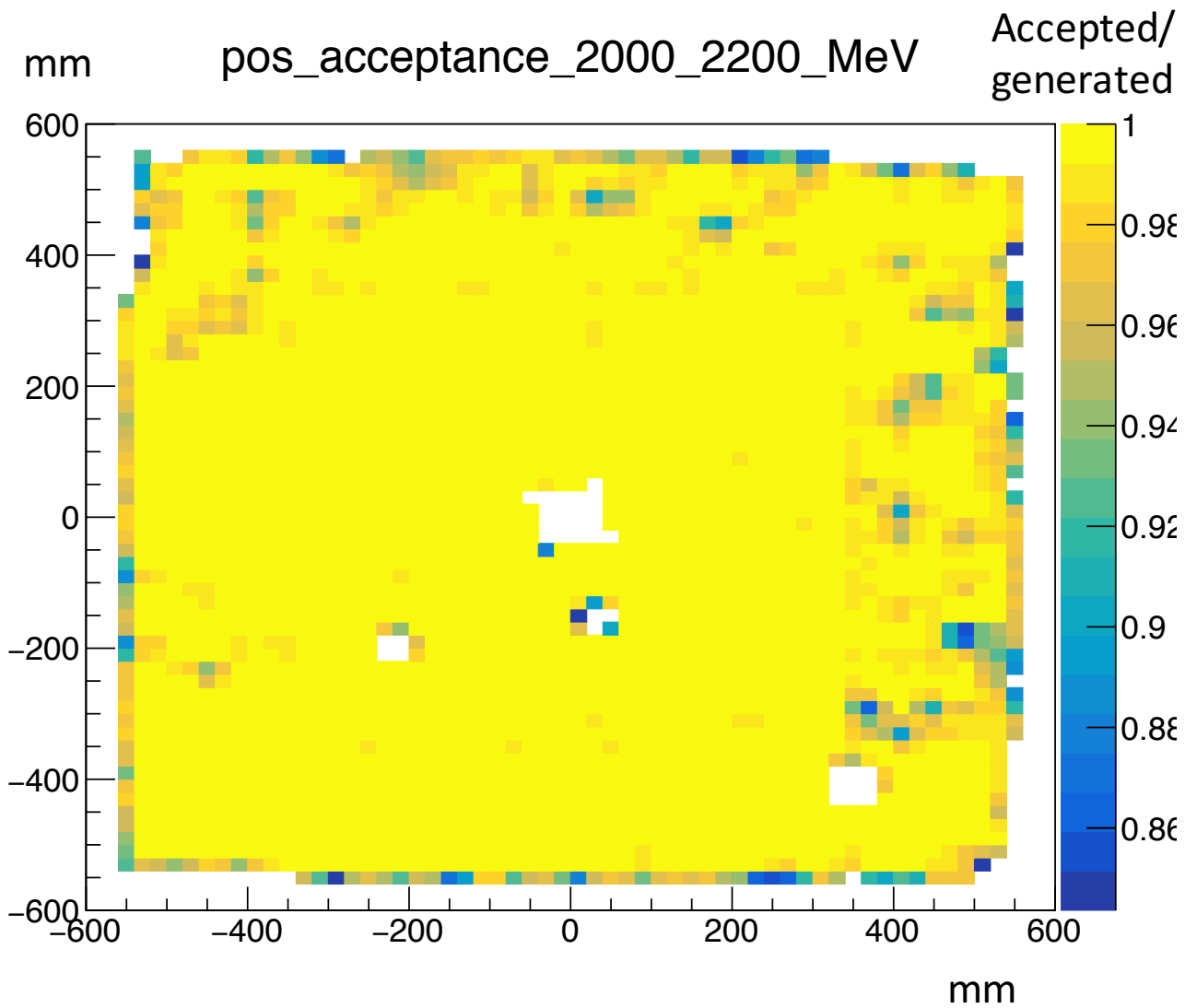# Remaining issue with GEM efficiency
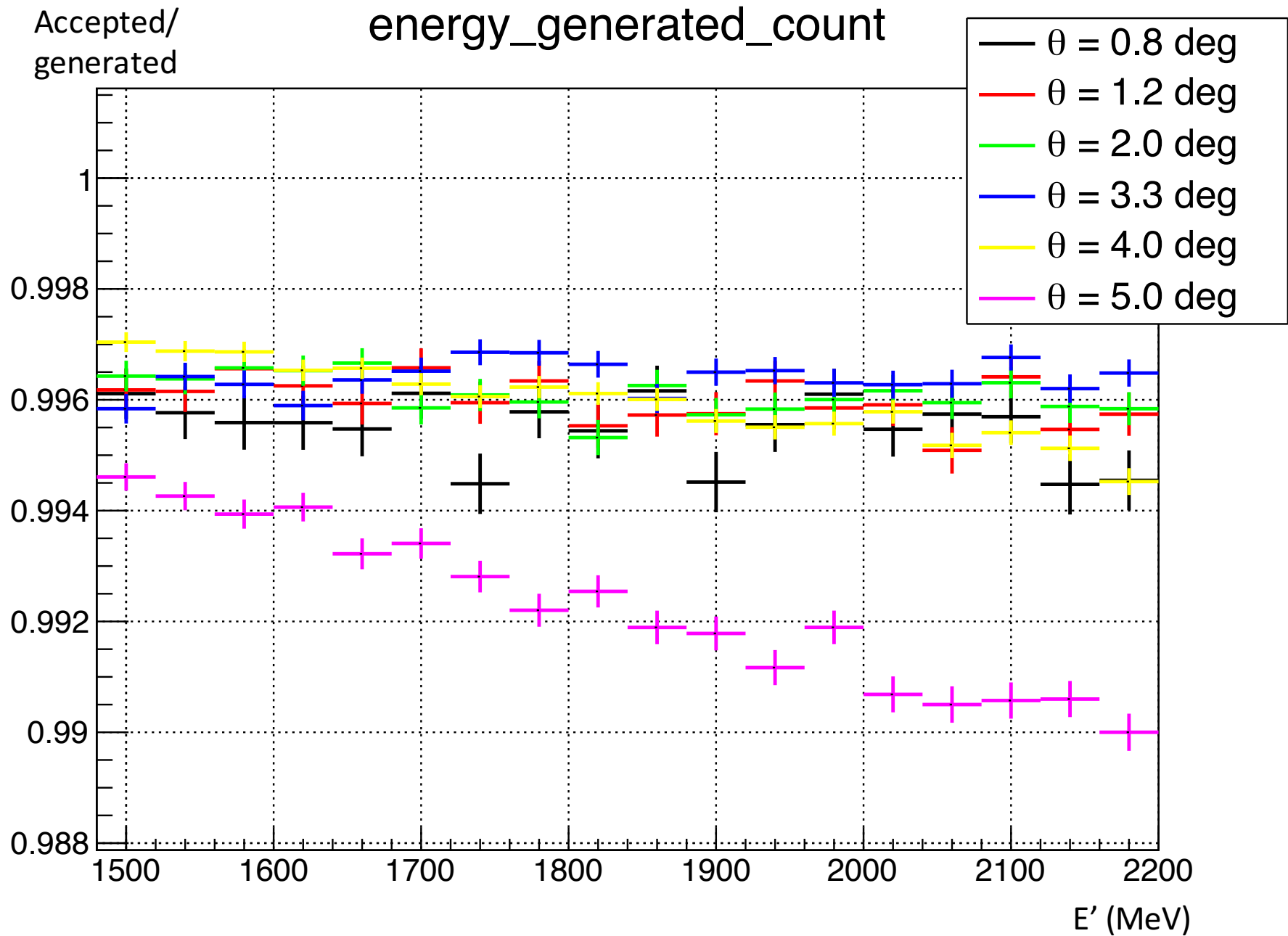
Uncertainty due to dead area

Checking the simulation

- Right now the discrepancy at large angle is that there is either more ep yield from the data or there is less ep yield from the simulation

- For the simulation, less ep may either come from:
  - the generator
  - there is some yield loss when during transportation in Geant 4, digitization and reconstruction

- To test the second point, use uniform distributed electrons in x and y and energy from 1000 to 2200 MeV and check the acceptance

- Condition of acceptance:
  - Reconstructed energy within 4 sigma (HyCal energy resolution) agreement with the vertex momentum
  - Reconstructed position within 6 sigma (HyCal position resolution) agreement with the projected hit position

pos_acceptance_2000_2200_MeV

energy_acceptance

energy_generated_count

Legend:
- θ = 0.8 deg (black)
- θ = 1.2 deg (red)
- θ = 2.0 deg (green)
- θ = 3.3 deg (blue)
- θ = 4.0 deg (yellow)
- θ = 5.0 deg (magenta)

Y-axis: Accepted/generated

X-axis: E' (MeV)

Compare single cluster events

- It may be important to find a way to compare the radiation between the data and the simulation. But single cluster cut for ep, may not be a good cut for this comparison
    - There is pile-up in the data, but "so far" never in the simulation
    - The behavior of this cut depends on the reconstruction of low energy particle (because there is a threshold threshold for the reconstructed cluster) but we are not certain about their reconstruction in both data and simulation
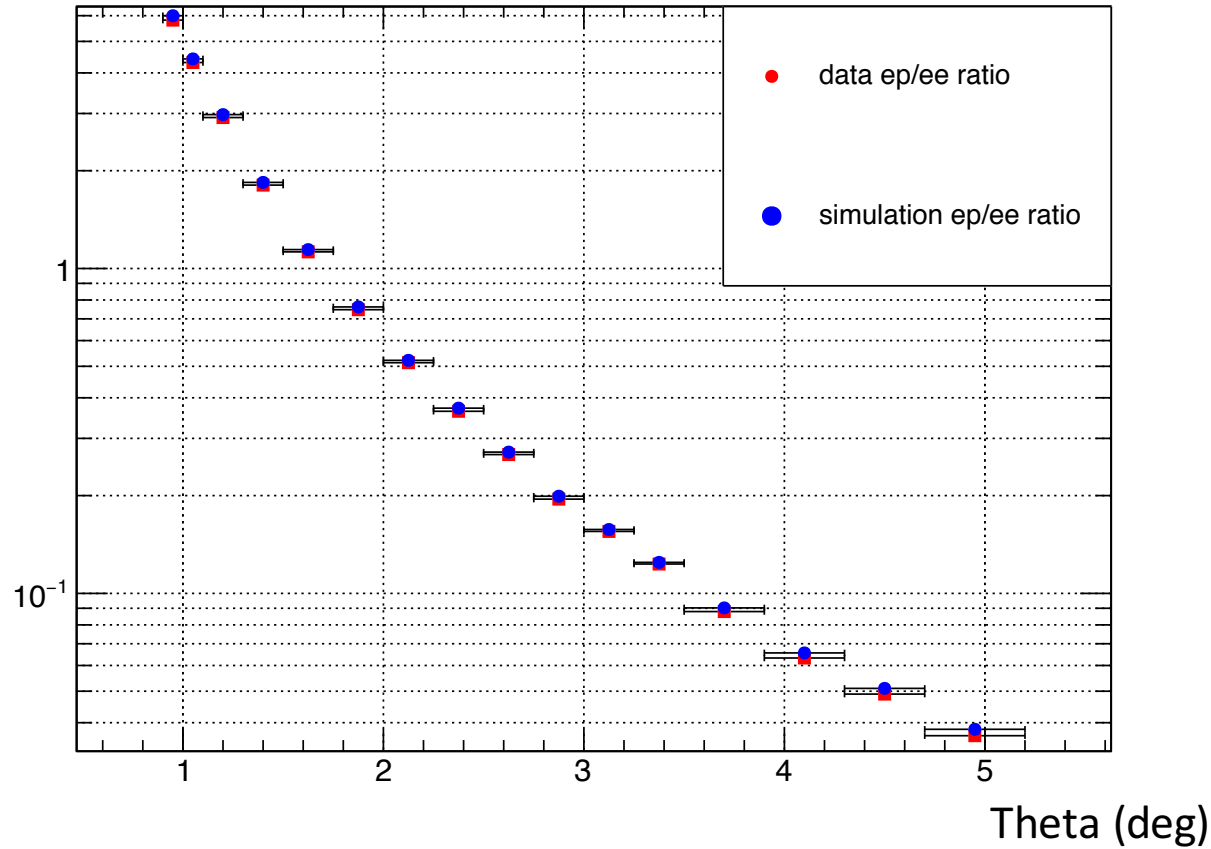
Pile-up events in data
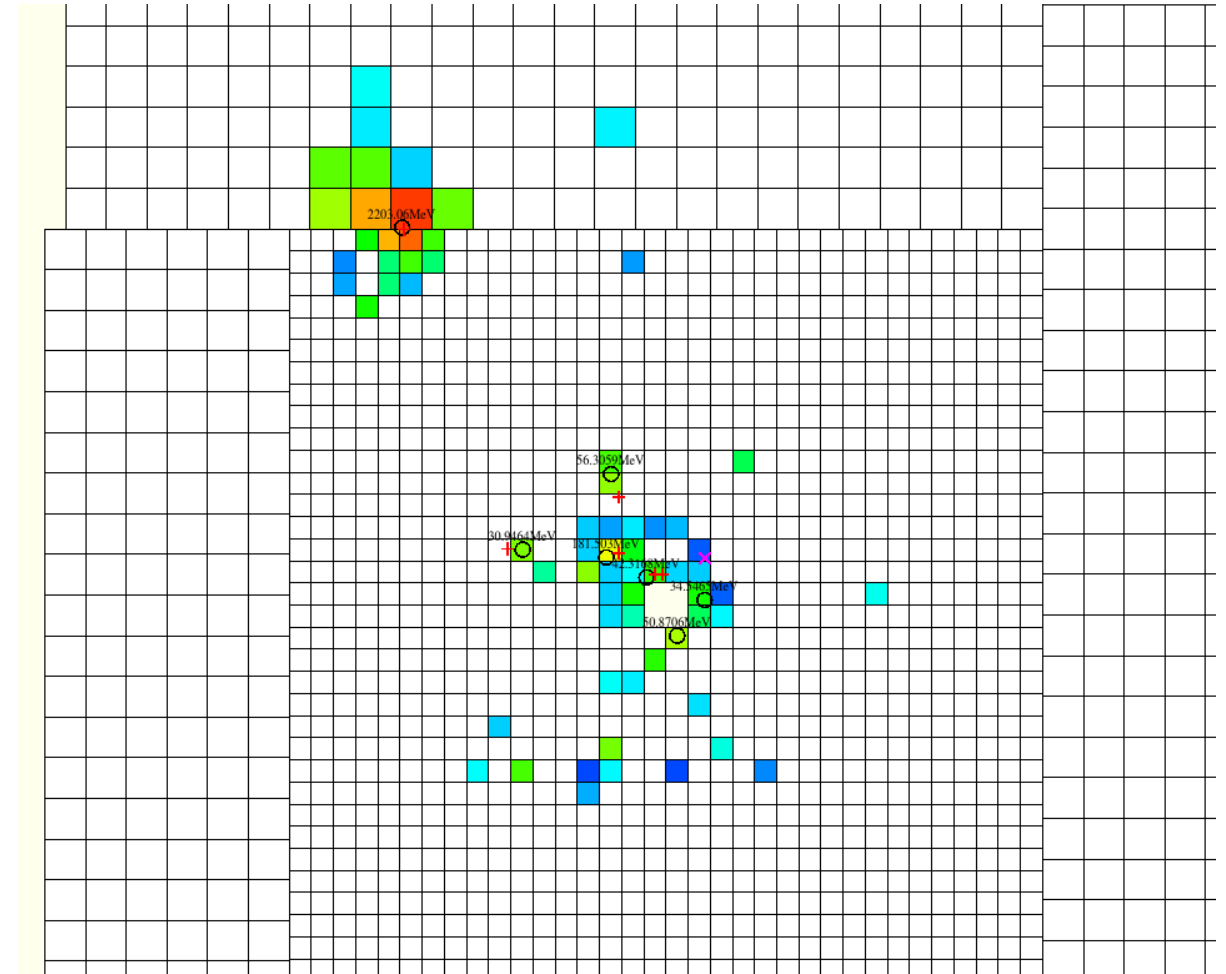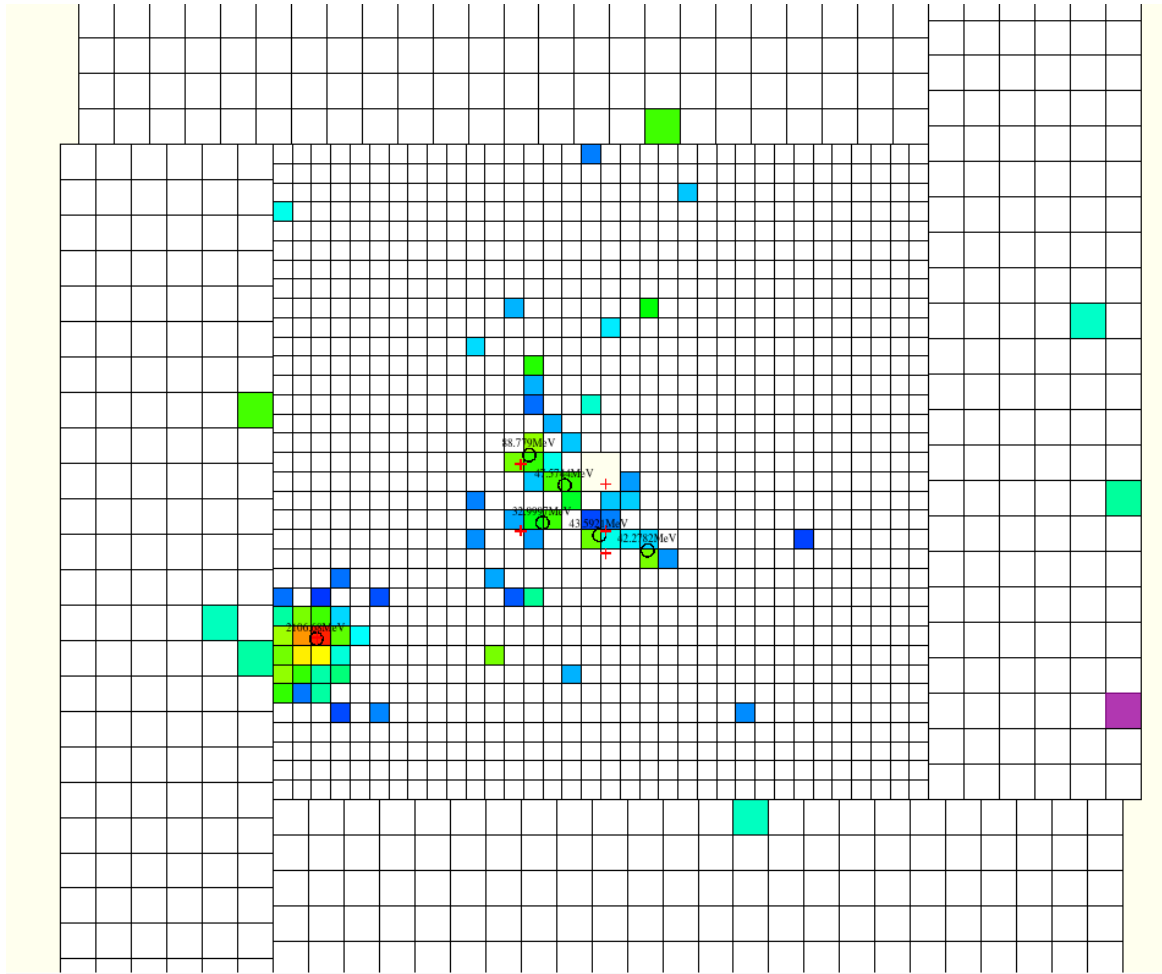
ep/ee ratio (1GeV)
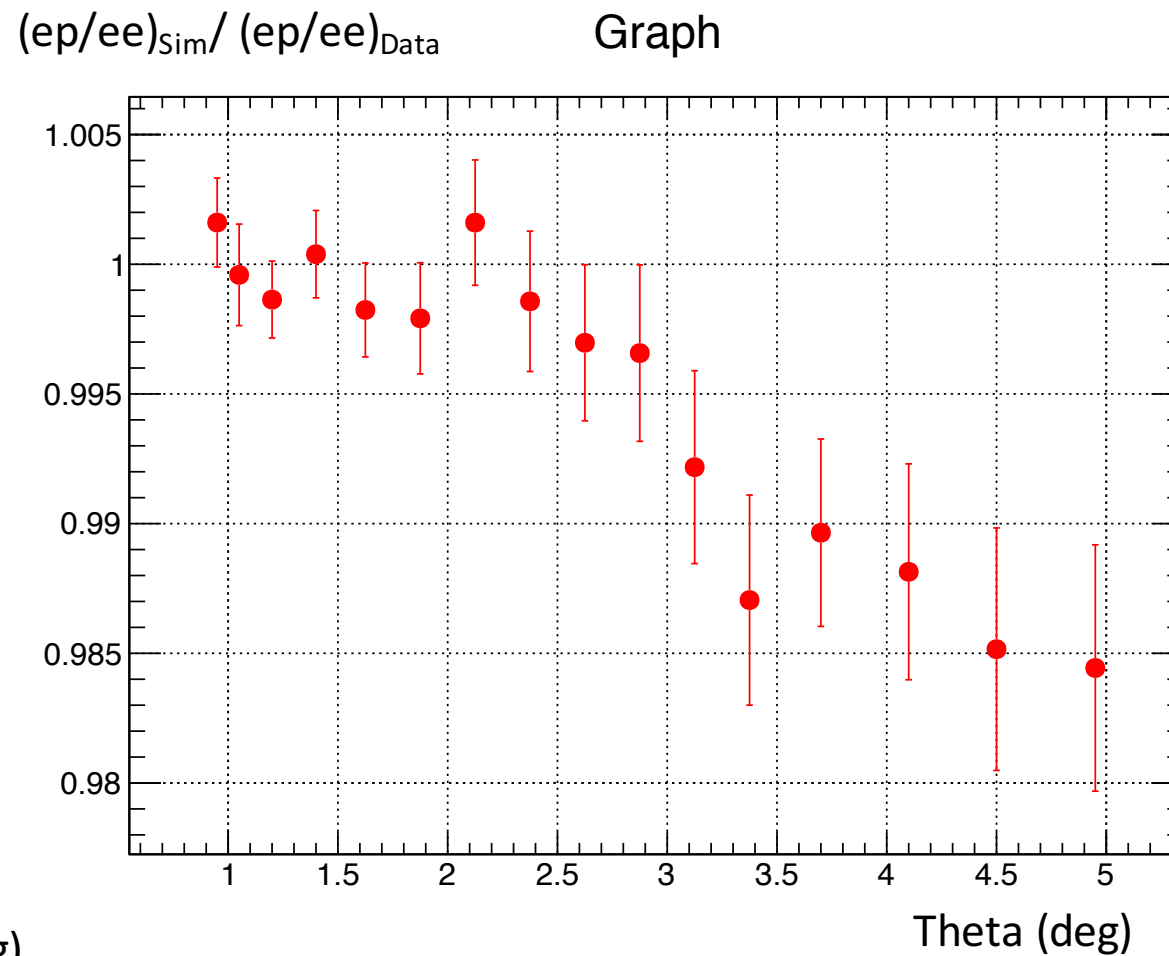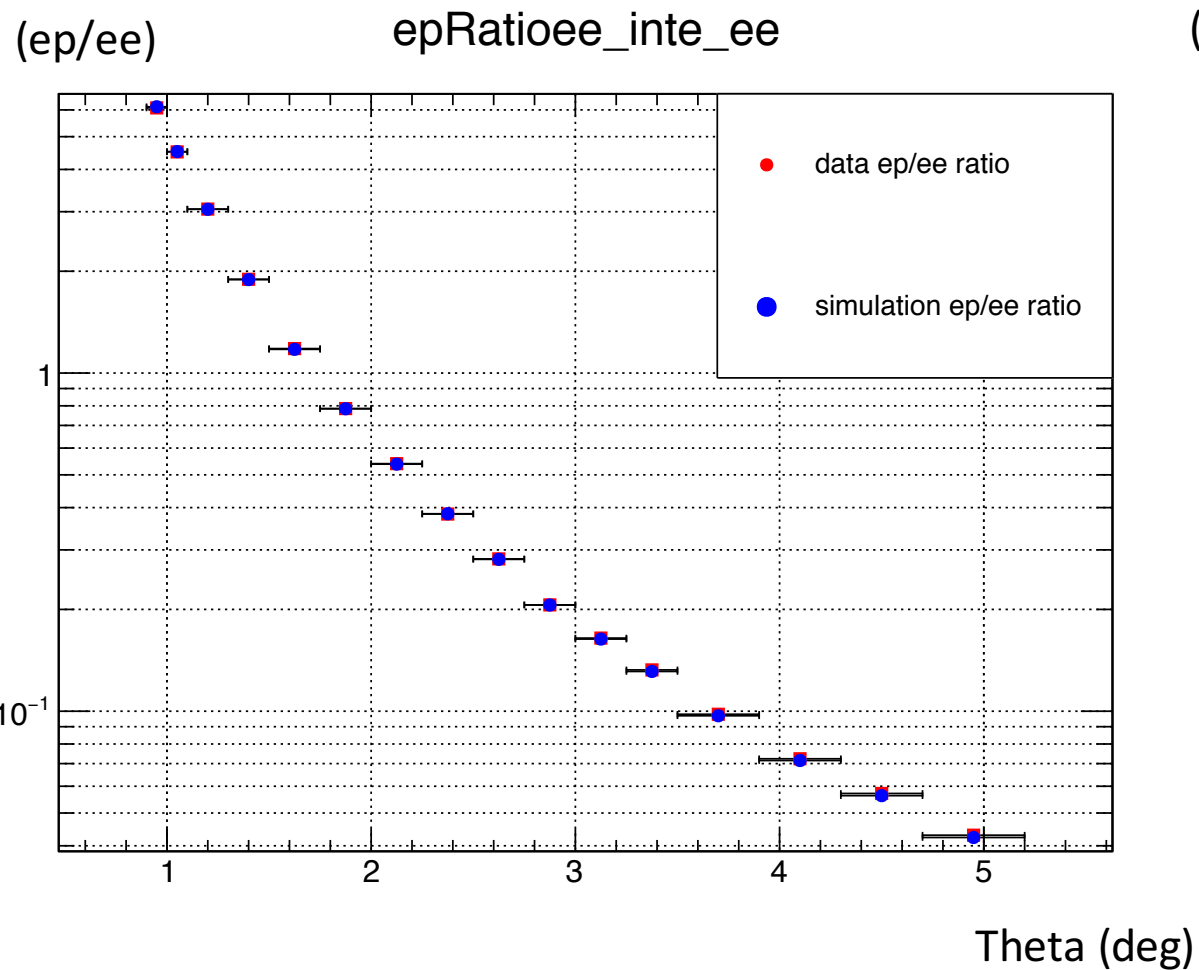
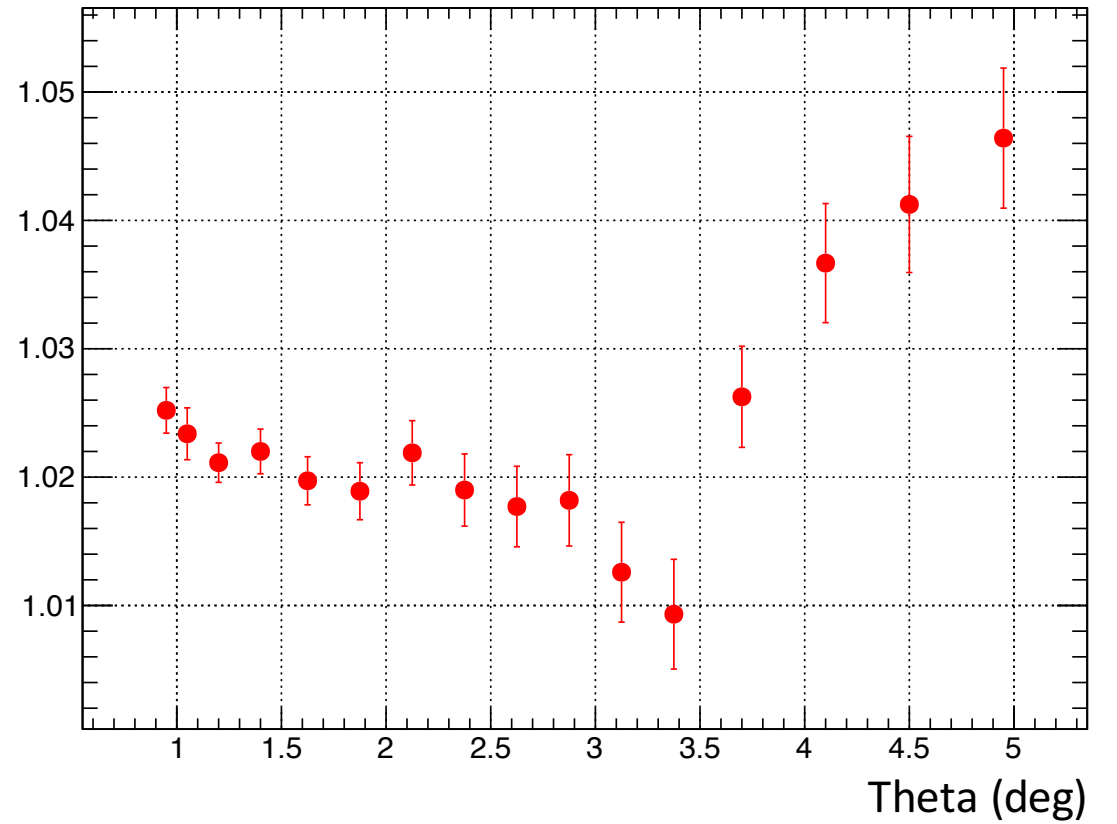# ep/ee ratio (1GeV)

Single cluster cut applied for ep

ep/ee ratio (2GeV)

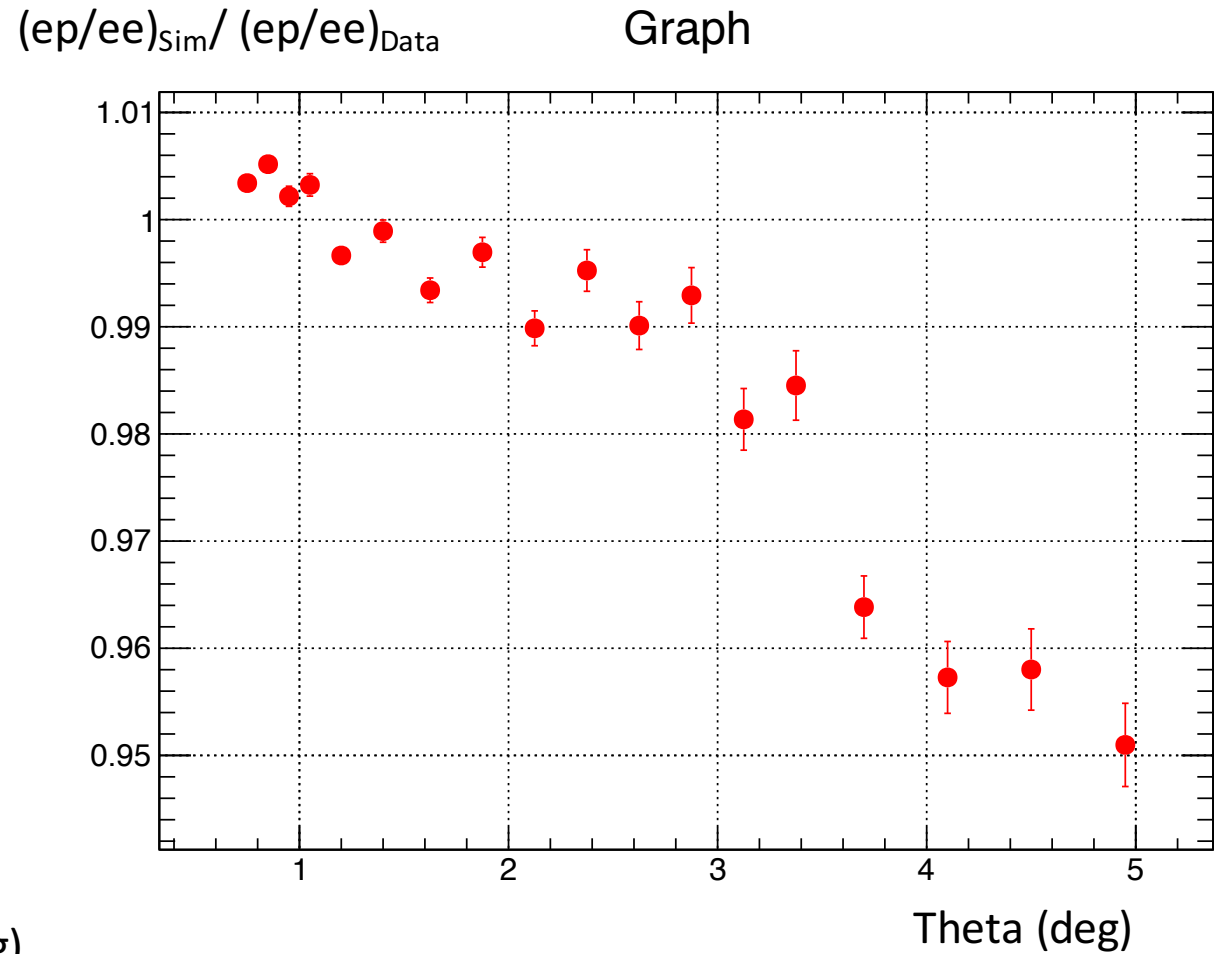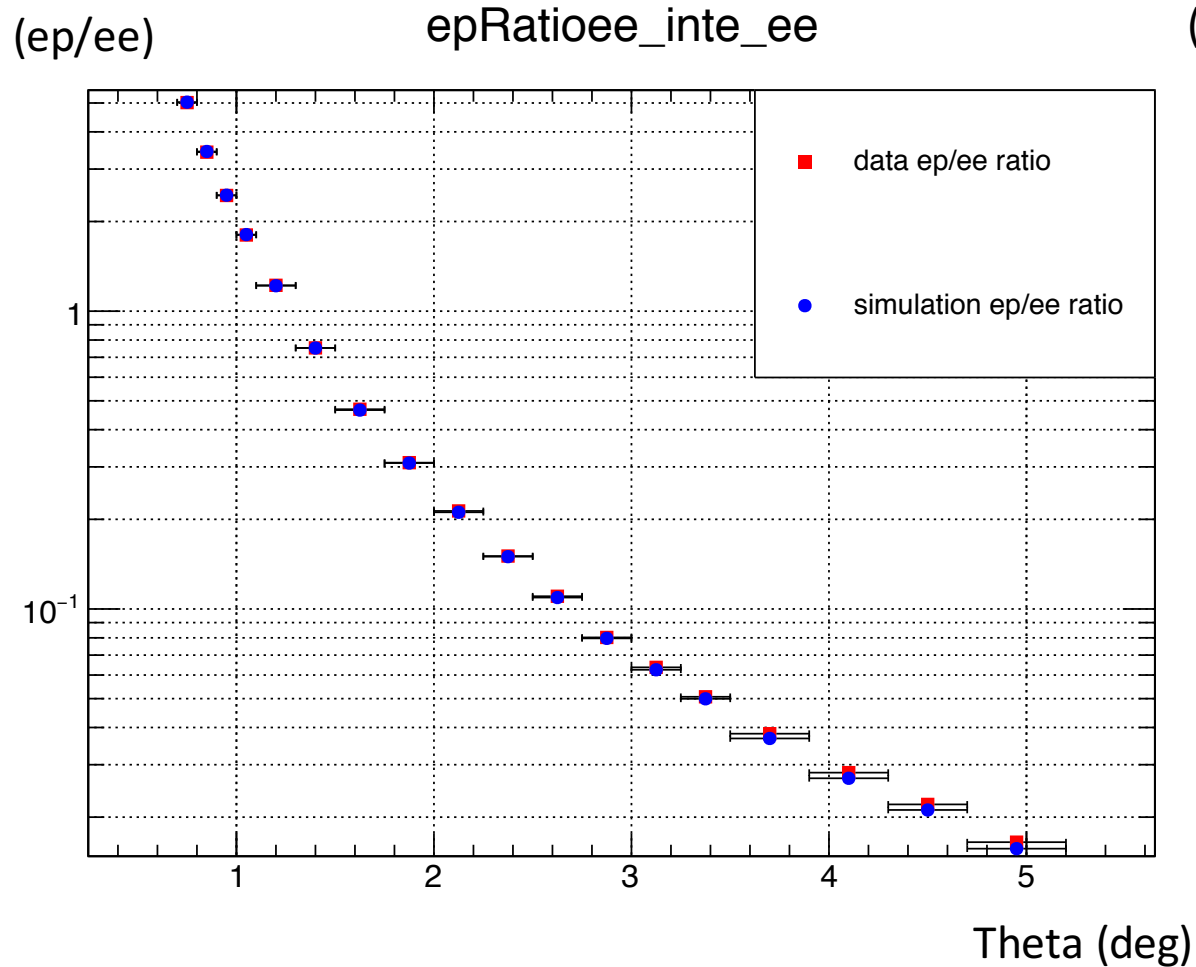# ep/ee ratio (2GeV)

(ep/ee)

epRatioee_inte_ee

$(ep/ee)_{Sim} / (ep/ee)_{Data}$

Graph

- data ep/ee ratio
- simulation ep/ee ratio

Theta (deg)

Theta (deg)