Cosmic rejection power comparison

- Combining 2 2GeV cosmic runs, (76k events in total, including discharged event)
- All numbers obtained with the 1800 < E < 2500 MeV, theta > 5.0 deg
- There are 151 clusters satisfy the above condition

Cut	# of cluster after	Ratio (%)
No additional cut	151	100
NNID > 0	19	12.6 +/- 2.7
NNID2 > 0	19	12.6 +/- 2.7
NNID > 0 OR NNID2 > 0	25	16.5 +/- 3.0
NNID > 0 AND NNID2 > 0	13	8.6 +/- 2.3
Single cluster event + 2σ cluster size cut	26	17.2 +/- 3.0
Single cluster event + 2σ cluster size cut + NNID > 0 AND NNID2 > 0	3	2.0 +/- 1.1

Error estimated using binomial statistics

Cosmic rejection power comparison

- Combining 2 2GeV cosmic runs, (76k events in total, including discharged event)
- All numbers obtained with the 1800 < E < 2500 MeV, theta > 5.0 deg
- There are 105 clusters satisfy the above condition

Cut	# of cluster after	Ratio (%)
No additional cut	151	100
NNID > 0 + 1 sigma E	2	1.3 +/- 0.9
NNID2 > 0 + 1 sigma E	2	1.3 +/- 0.9
NNID > 0 OR NNID2 > 0 + 1sigma E	3	2.0 +/- 1.1
NNID > 0 AND NNID2 > 0 + 1 sigma E	1	0.7 +/- 0.7
Single cluster event + 2σ cluster size cut + 1 sigma E	8	5.3 +/-1.8
Single cluster event + 2σ cluster size cut + NNID > 0 AND NNID2 > 0 + 1sigma E	0	0

Error estimated using binomial statistics

Cosmic rejection power comparison

- Combining 2 2GeV cosmic runs, (76k events in total, including discharged event)
- All numbers obtained with the 1800 < E < 2500 MeV, 2.0 < theta < 5.0 deg
- There are 1580 clusters satisfy the above condition

Cut	# of cluster after	Ratio (%)
No additional cut	1580	100
NNID > 0	117	7.4 +/- 0.7
NNID2 > 0	119	7.5 +/- 0.7
NNID > 0 OR NNID2 > 0	126	8.0 +/- 0.7
NNID > 0 AND NNID2 > 0	110	7.0 +/- 0.6
Single cluster event + 2σ cluster size cut	9	0.6 +/- 0.2
Single cluster event + 2σ cluster size cut + NNID > 0 AND NNID2 > 0	9	0.6 +/- 0.2

Error estimated using binomial statistics

Cosmic rejection power comparison

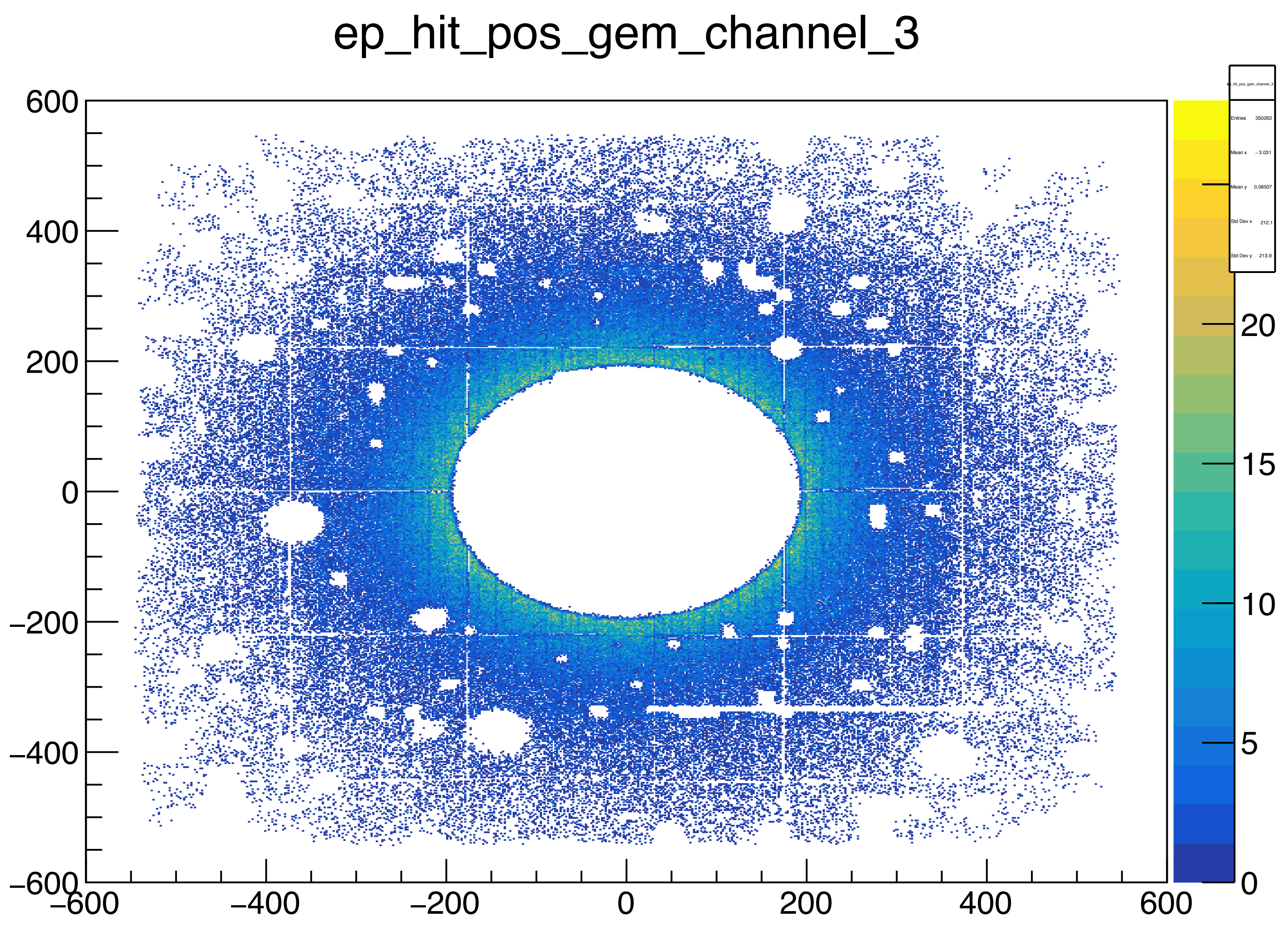
- Combining 2 2GeV cosmic runs, (76k events in total, including discharged event)
- All numbers obtained with the 1800 < E < 2500 MeV, 2.0 < theta < 5.0 deg
- There are 1580 clusters satisfy the above condition

Cut	# of cluster after	Ratio (%)
No additional cut	1580	100
NNID > 0 + 1 sigma E	18	1.1 +/- 0.3
NNID2 > 0 + 1 sigma E	16	1.0 +/- 0.3
NNID > 0 OR NNID2 > 0 + 1 sigma E	18	1.1 +/- 0.3
NNID > 0 AND NNID2 > 0 + 1sigma E	16	1.0 +/- 0.3
Single cluster event + 2σ cluster size cut + 1 sigma E	2	0.1 +/- 0.1
Single cluster event + 2σ cluster size cut + NNID > 0 AND NNID2 > 0 + 1 sigma E	2	0.1 +/- 0.1

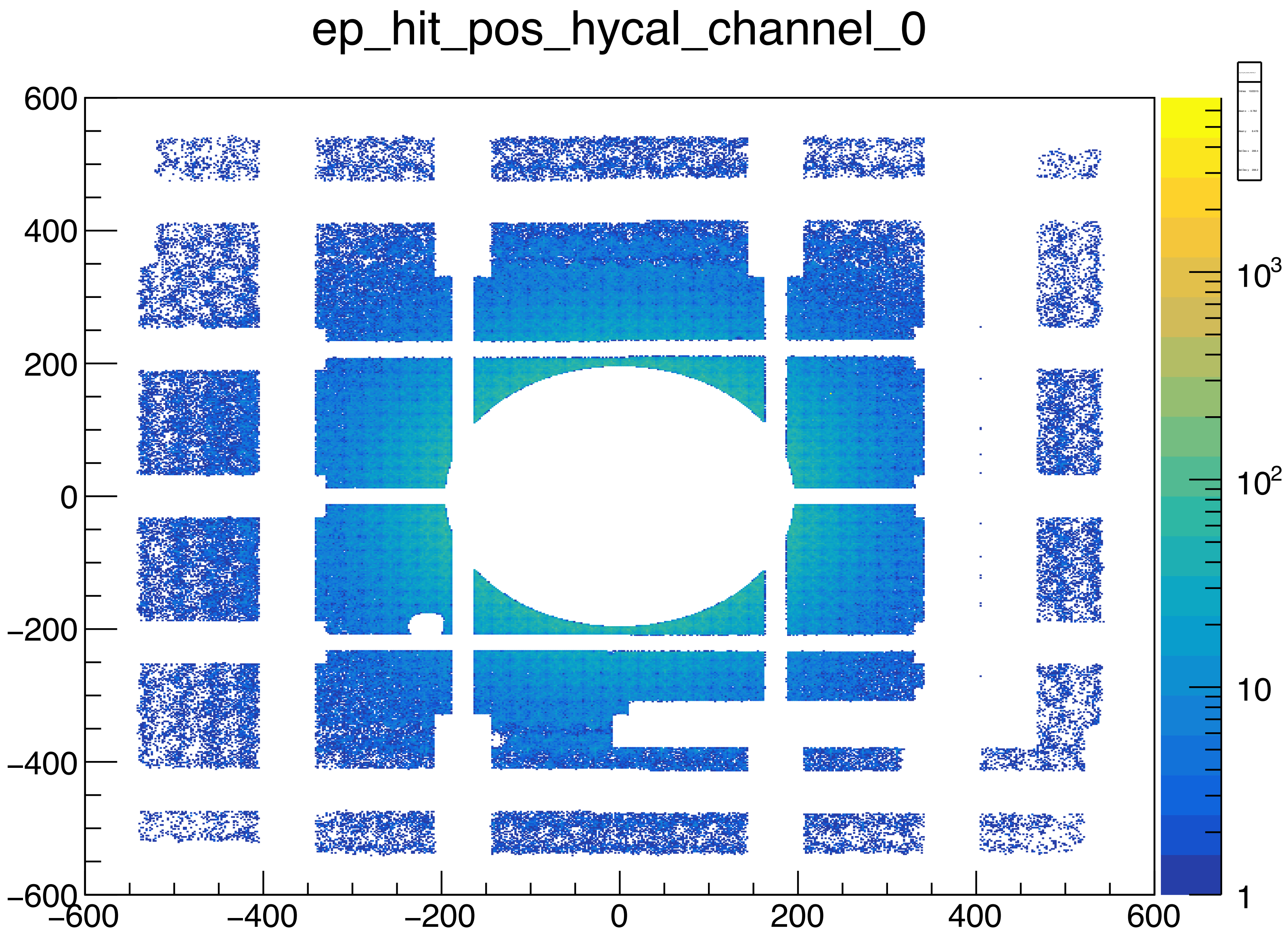
Error estimated using binomial statistics

Remained ep hit position after NNAE cuts

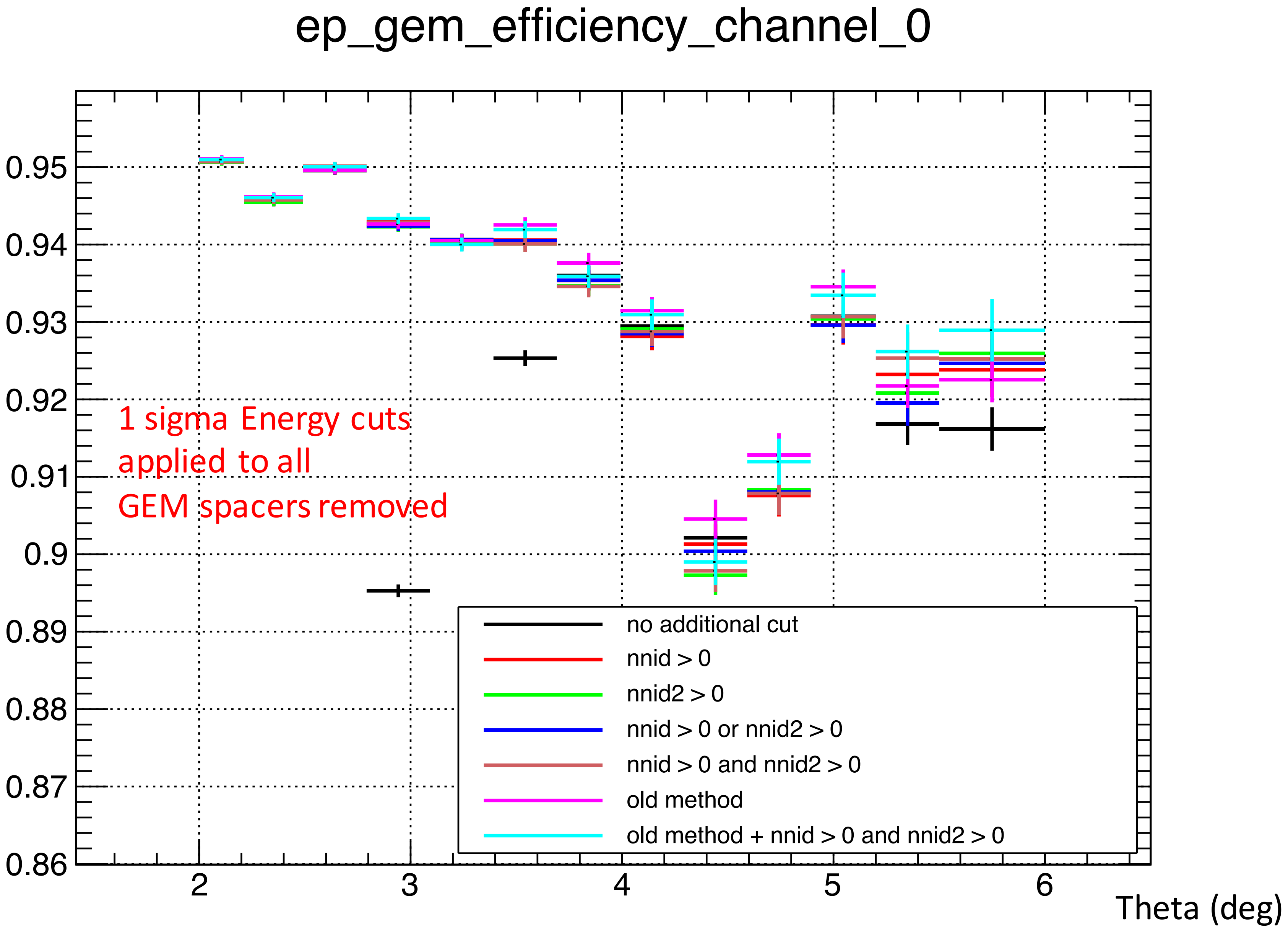
- We are aware that the NNAE cuts tend to remove all hits on certain modules
- Probably because some discharge events are trained together with cosmic
- We can apply the NNAE cuts if we remove the GEM dead areas
- Otherwise NNAE tend to produce higher efficiency than the old method



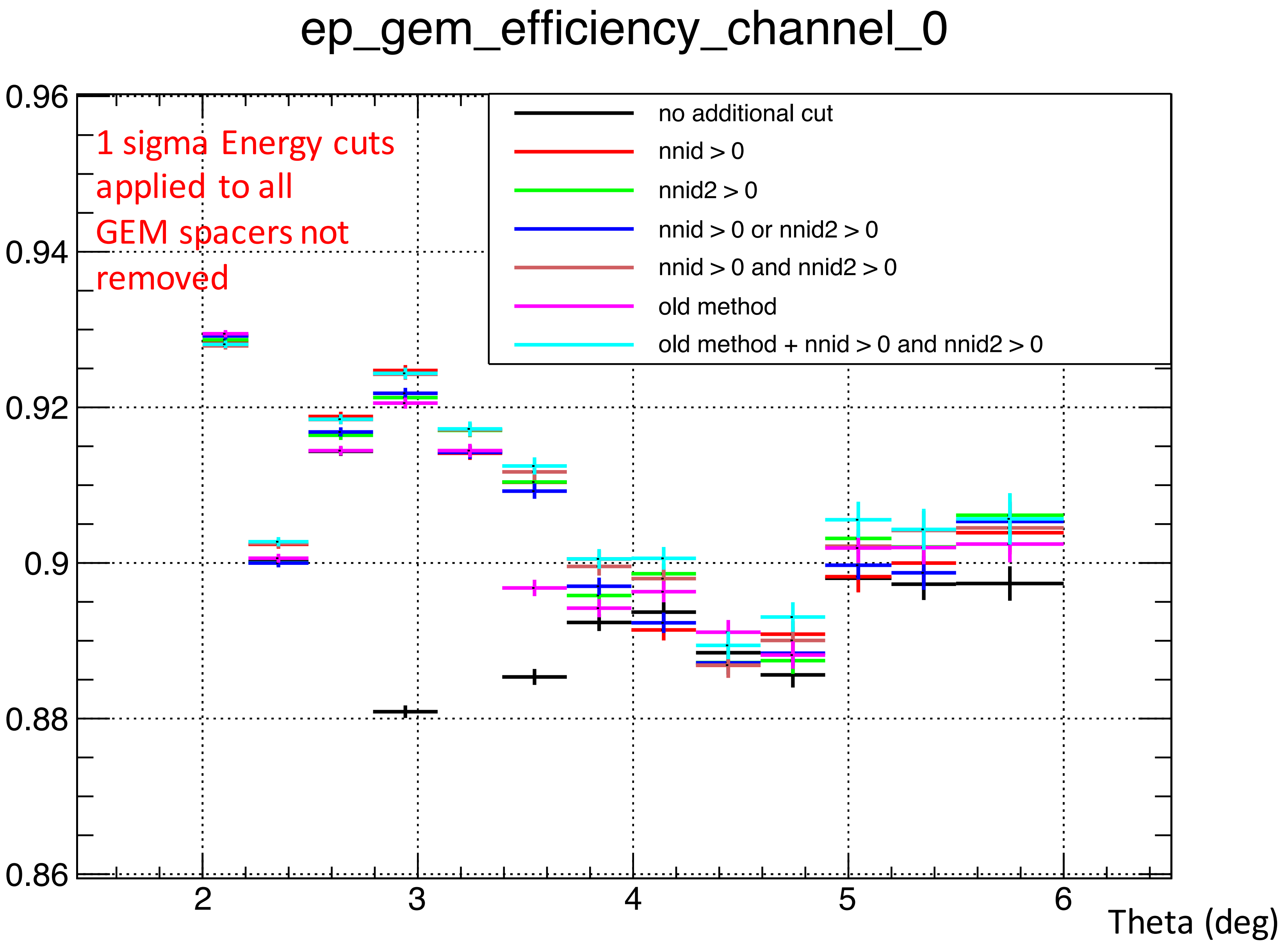
My ep hit position after spacer removal



GEM efficiency of ep for theta > 2.0



GEM efficiency of ep for theta > 2.0



Cosmic rejection power comparison for Moller

- Combining 2 2GeV cosmic runs, (76k events in total, including discharged event)
- With the normal double arm Moller selection cuts:
  - Elasticity cut: 4 sigma of HyCal E resolution
  - Positon dependent cut using HyCal coordinates: 6 sigma of HyCal E resolution
  - Coplanarity using HyCal coordinates: 10 deg
  - Vertex z using HyCal coordinates: 500mm
  - Minimum theta angle cut: 0.7 deg

- There is 0 events pass through these cuts
- Double arm Moller should be much cleaner from cosmic and discharge than ep
- Efficiency obtained using Moller is quite stable unless one cuts too tight with the position dependent cut, in which case the efficiency slightly increases

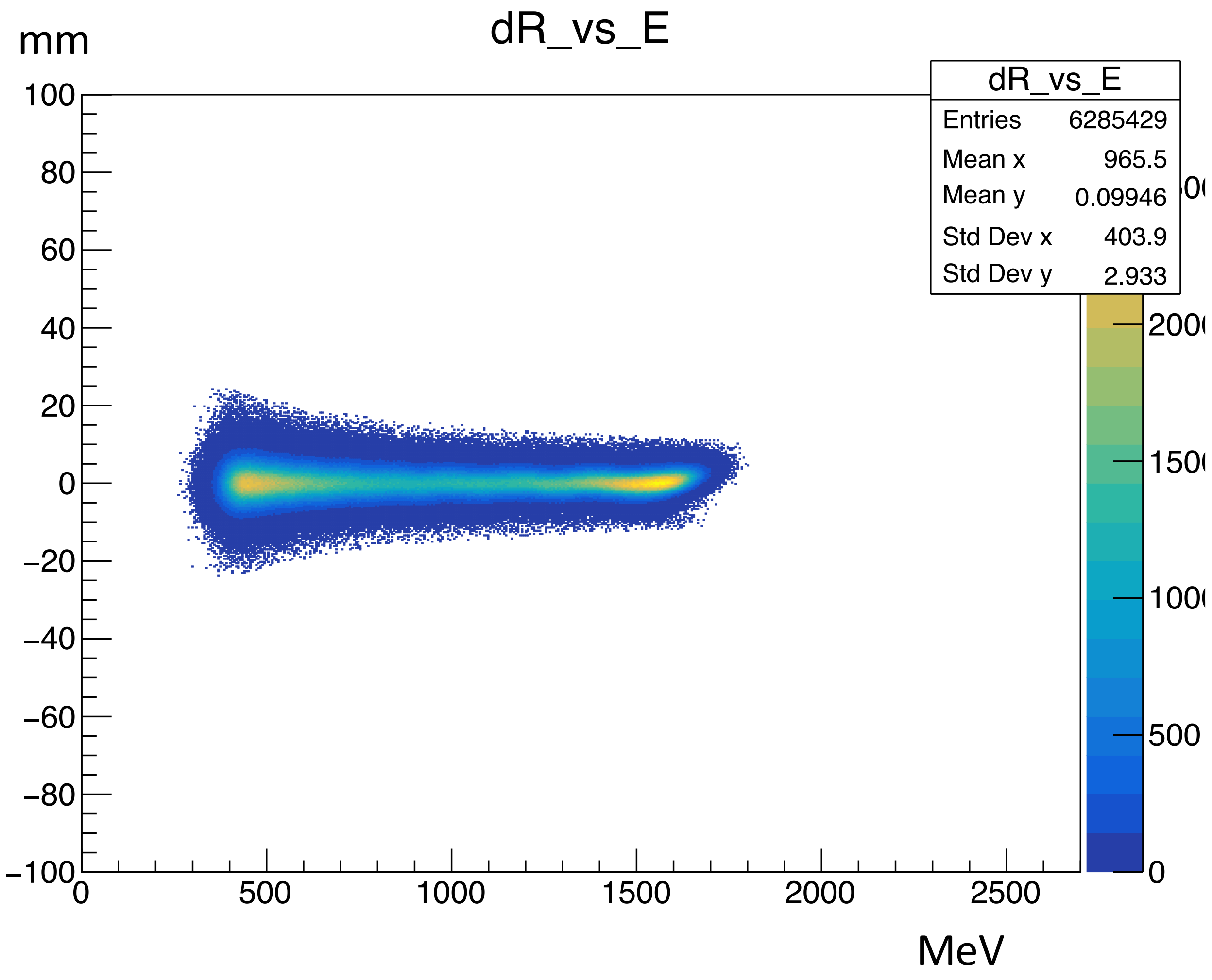
GEM Efficiency for ee

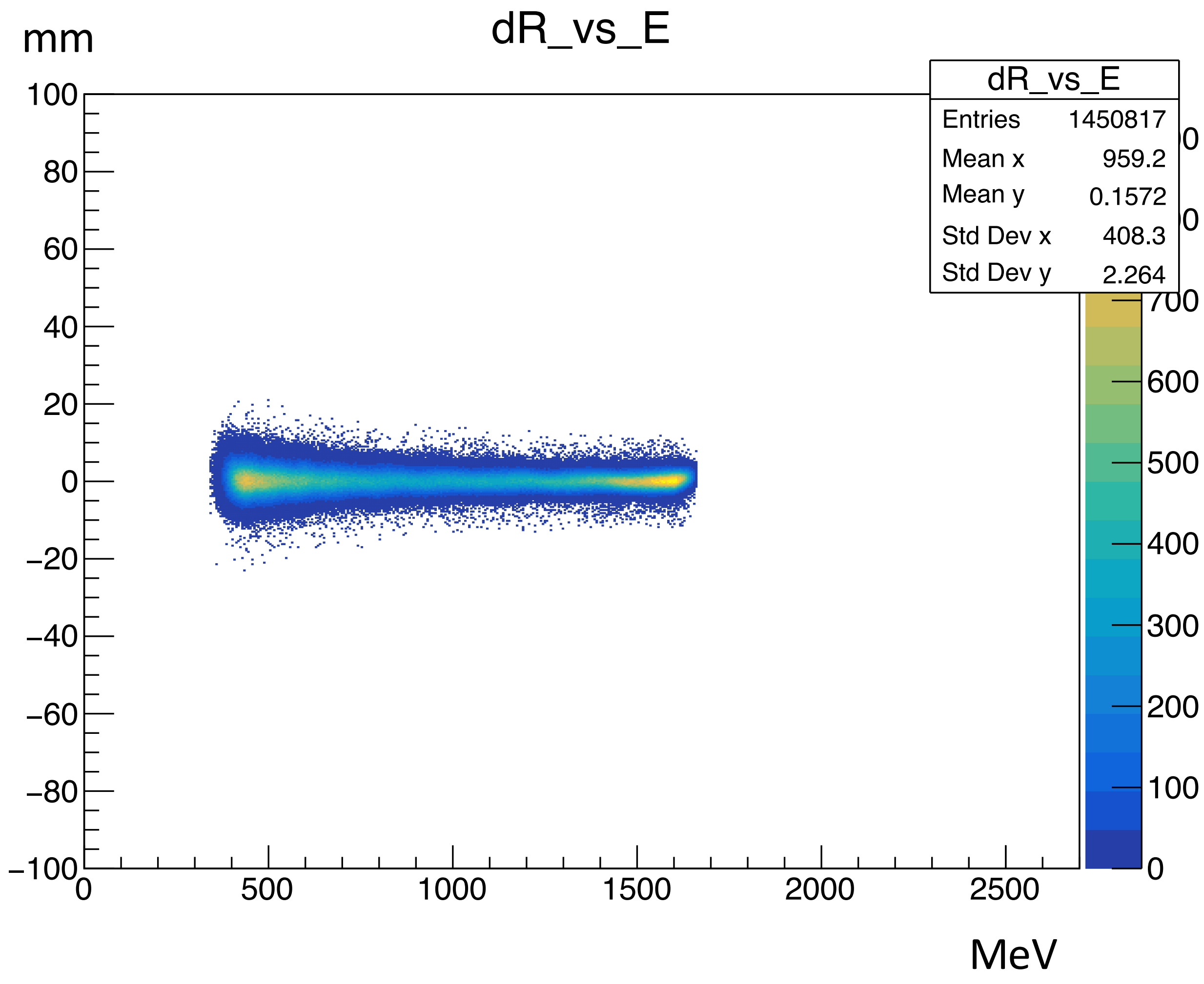
- The GEM efficiency we obtain in this way is not the intrinsic GEM efficiency
- It is a convolution of intrinsic GEM efficiency and the matching condition
- We determined the matching condition by looking at dR distribution (or dX and dY) between HyCal reconstructed hit coordinate and GEM coordinates

- When calculate the efficiency, we may use different cuts from the normal event selection cuts
- We need to be careful if the cut has some obvious effects on the dR distribution

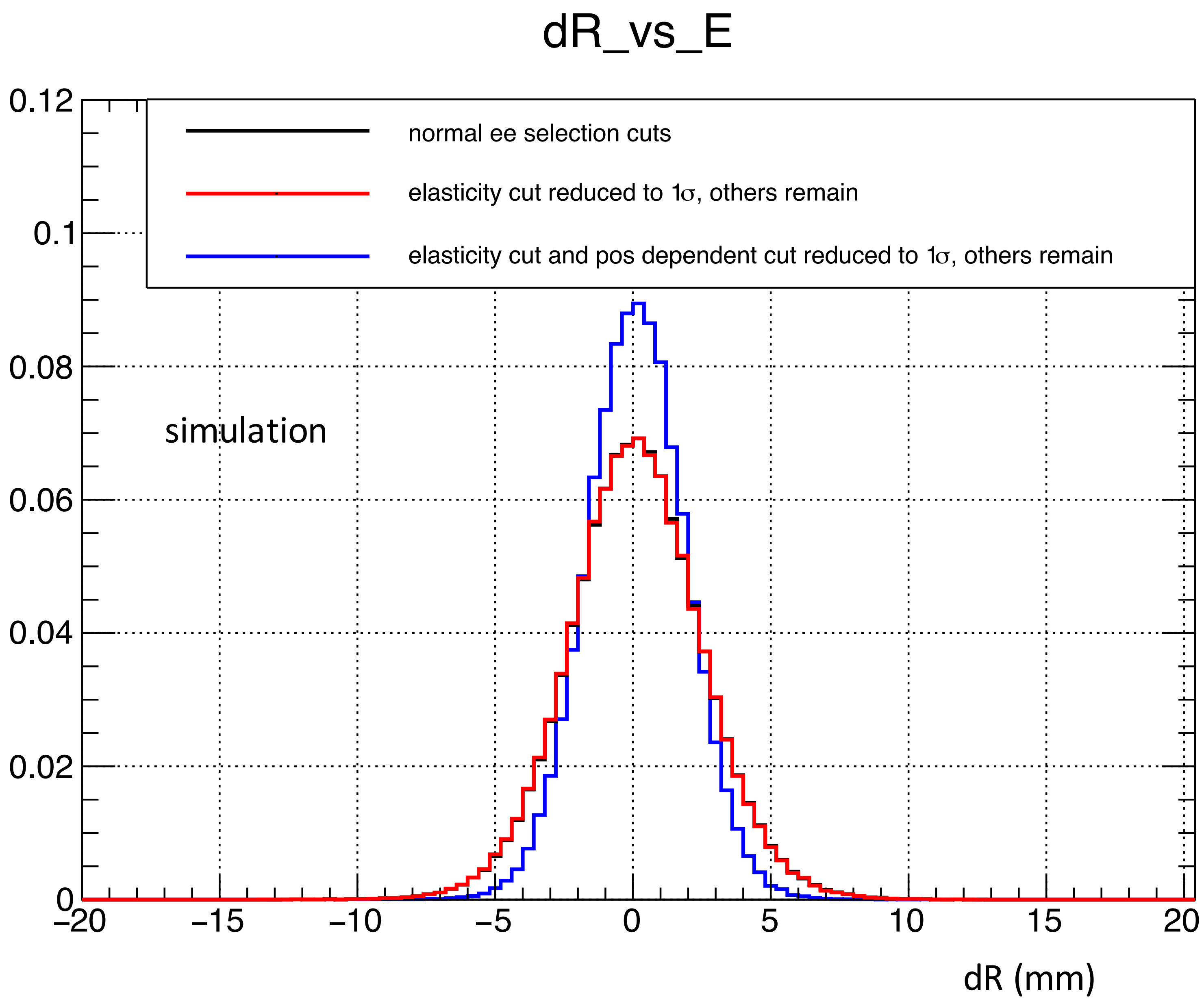
Effect of pos dependent cut for ee

dR = HyCal R – GEM R
Using simulation events

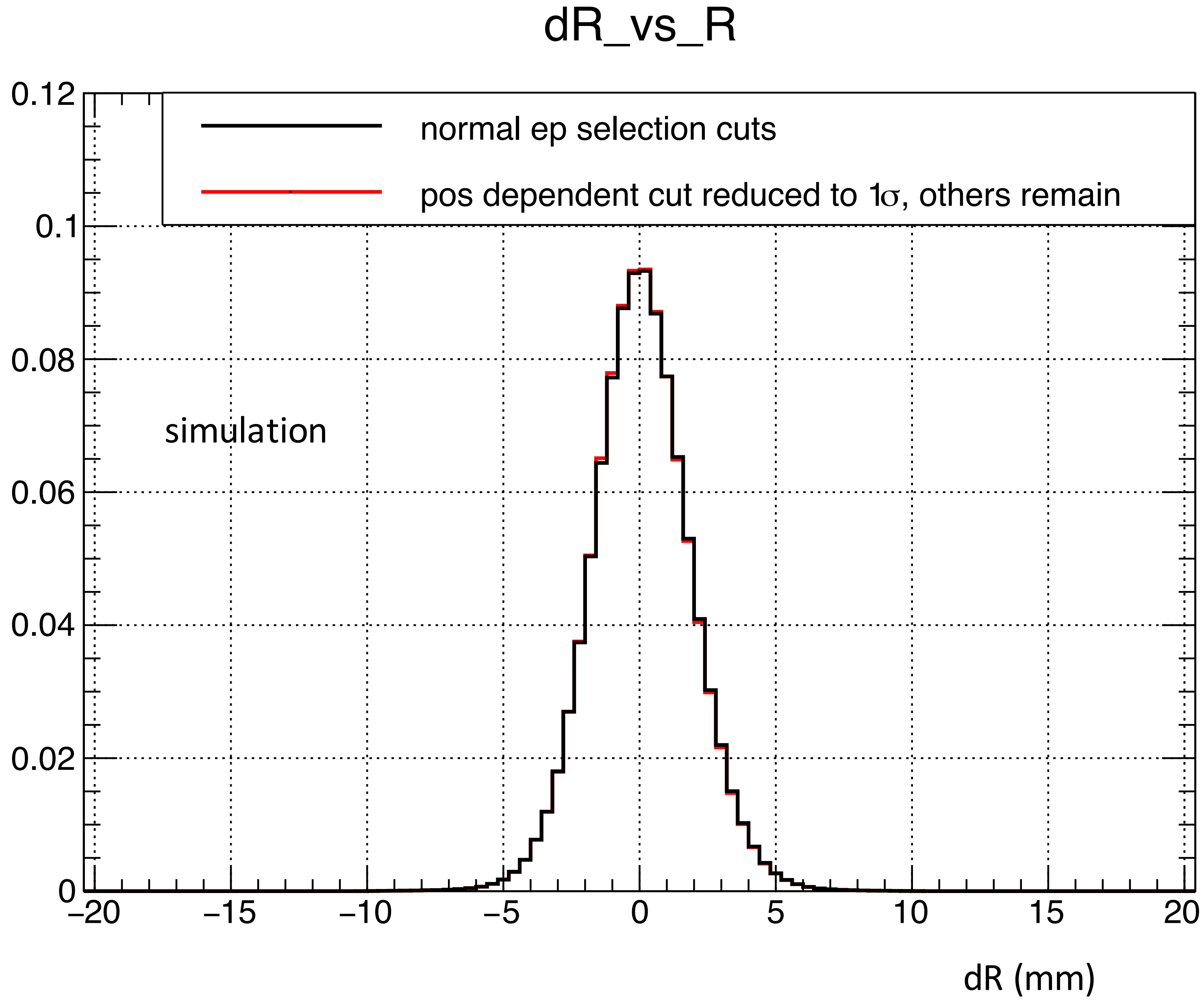




Effect of pos dependent cut for ee

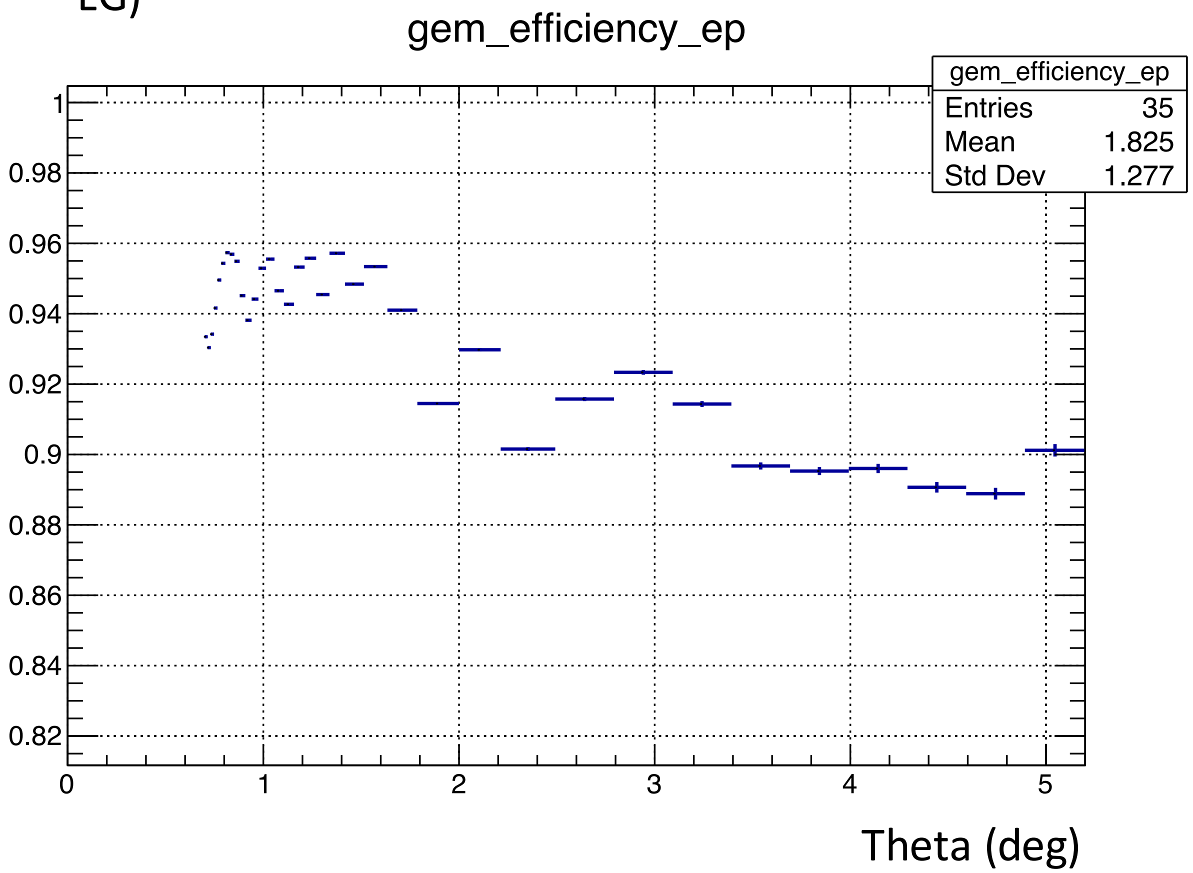


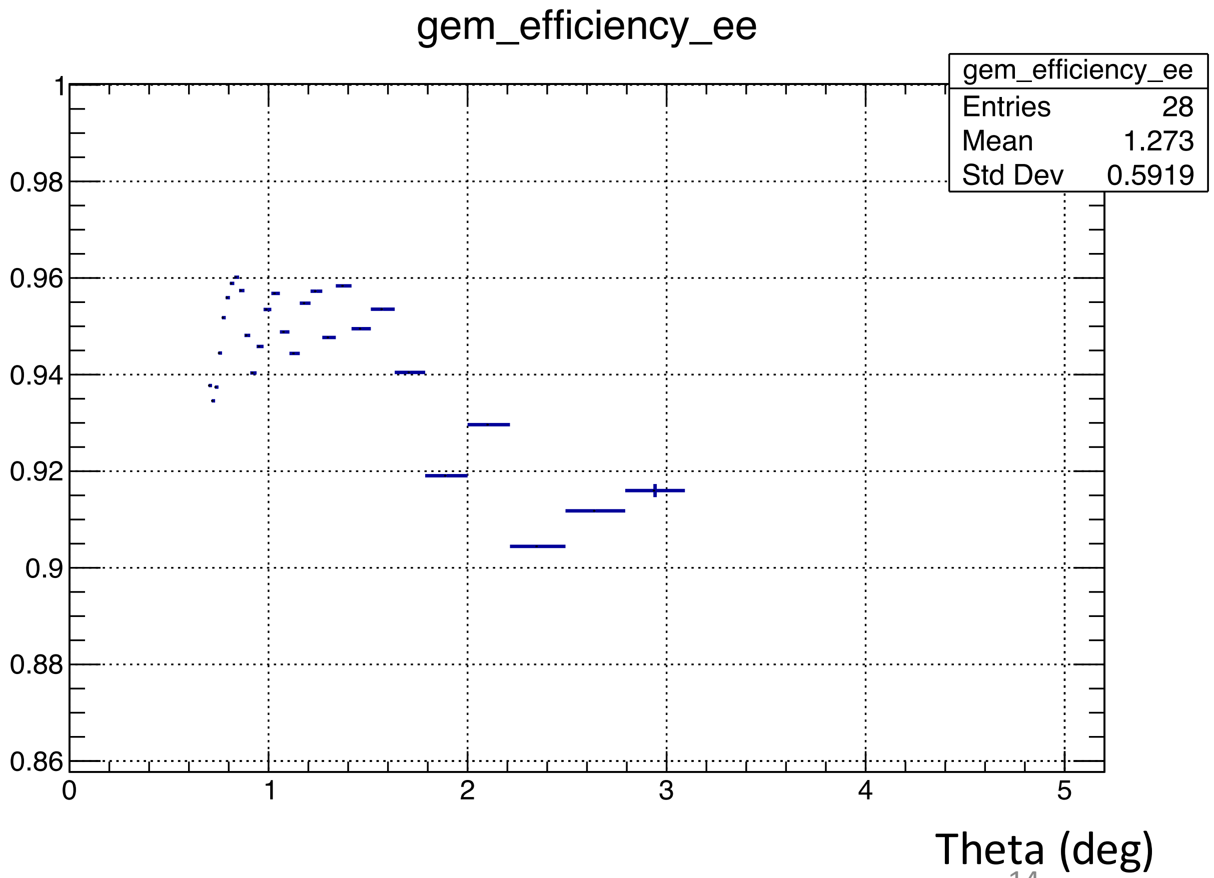
Effect of pos dependent cut for ep

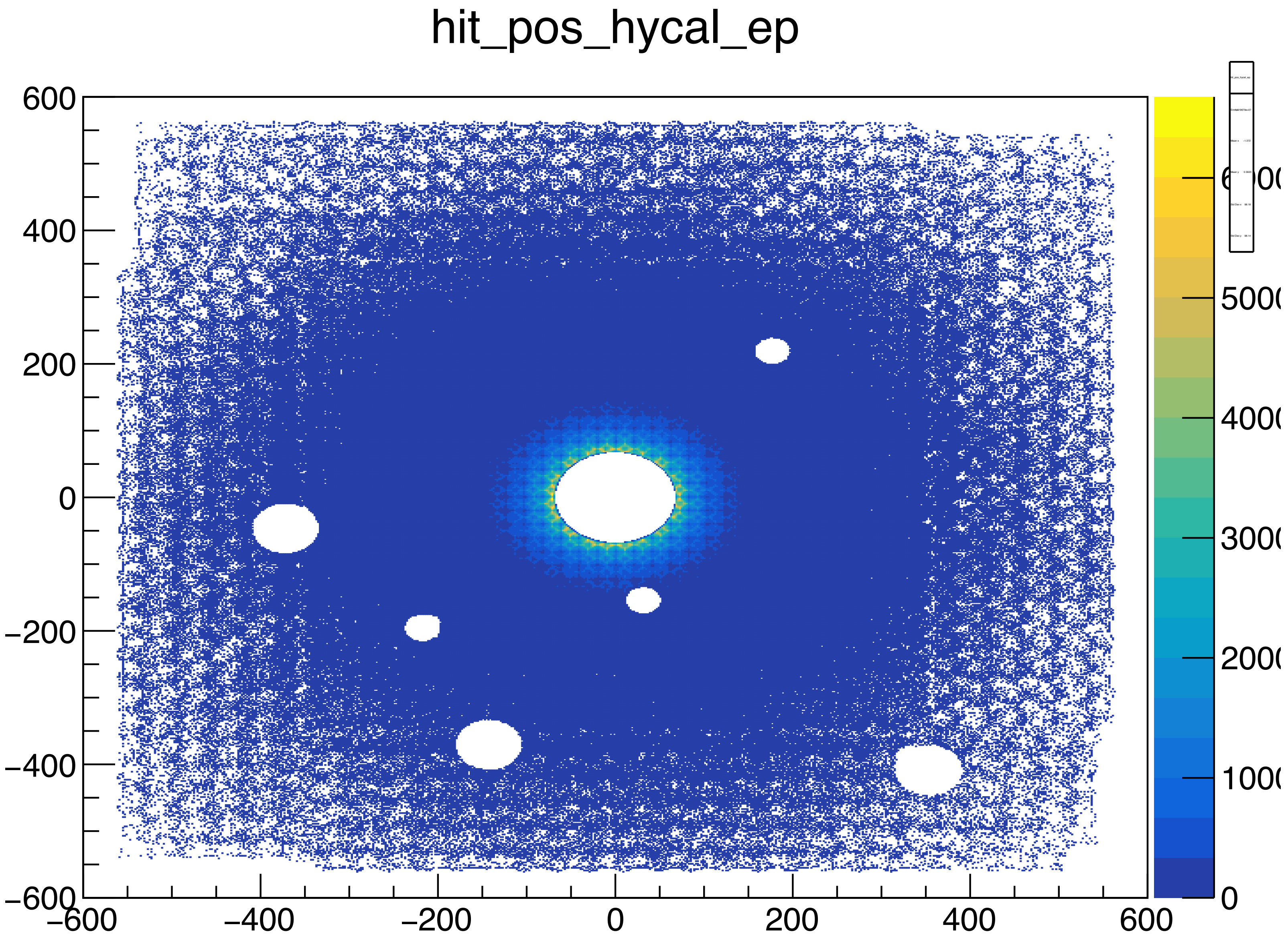


GEM efficiency without spacer removal

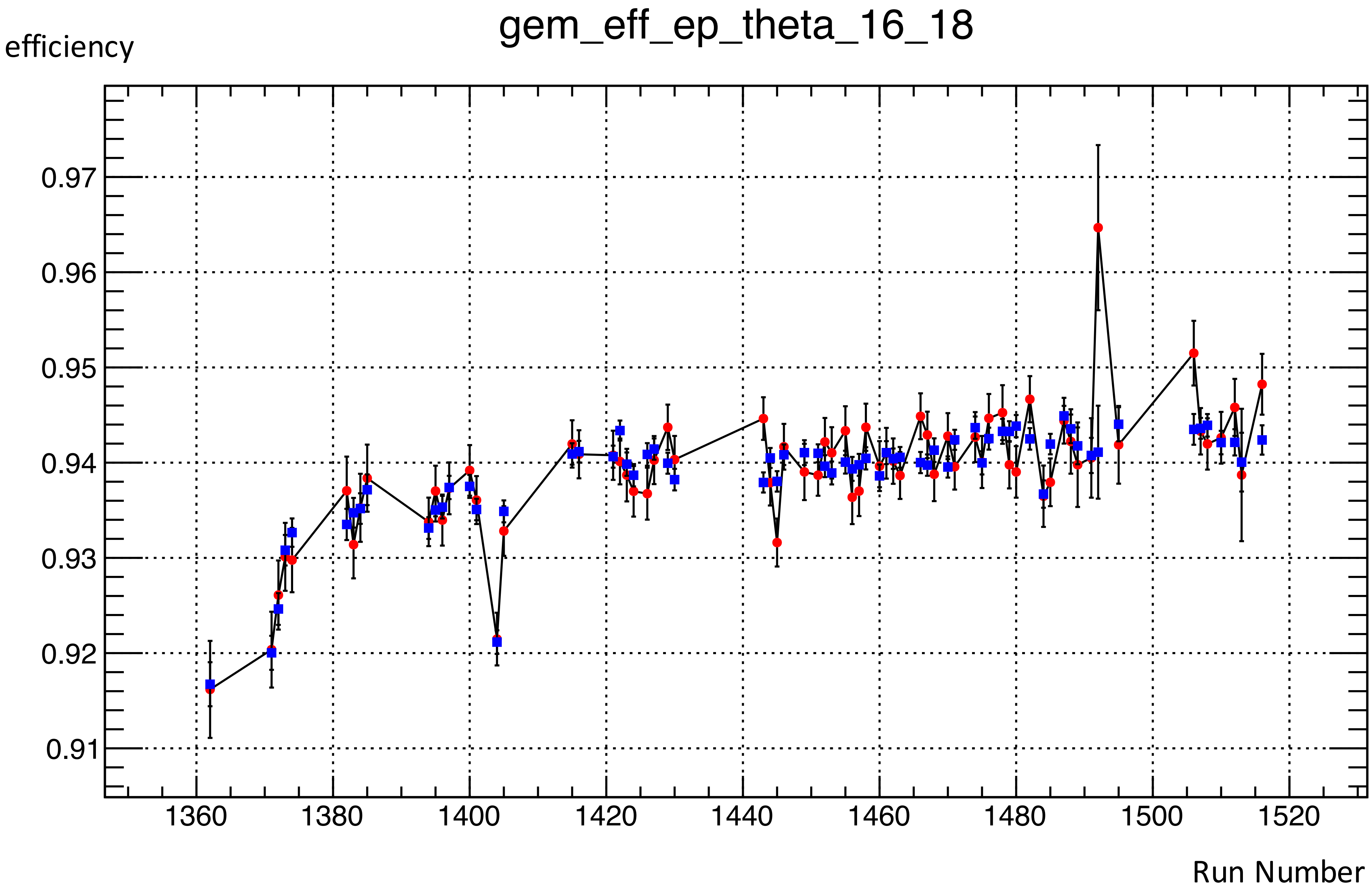
- Run: all production run from 1415 to 1516
- Dead module cut: one module size around dead modules W835, W891, W230, G775, G486, G732, G900
- Cuts for ee: normal cuts as listed before, except for reducing the elasticity cut from 4 sigma to 1sigma, and require 2 clusters events
- Cuts for ep: 1 sigma Energy cuts, single cluster events, cluster size (18 ~ 30 for PWO, 13 ~ 25 for transition, 8 ~ 23 for LG)



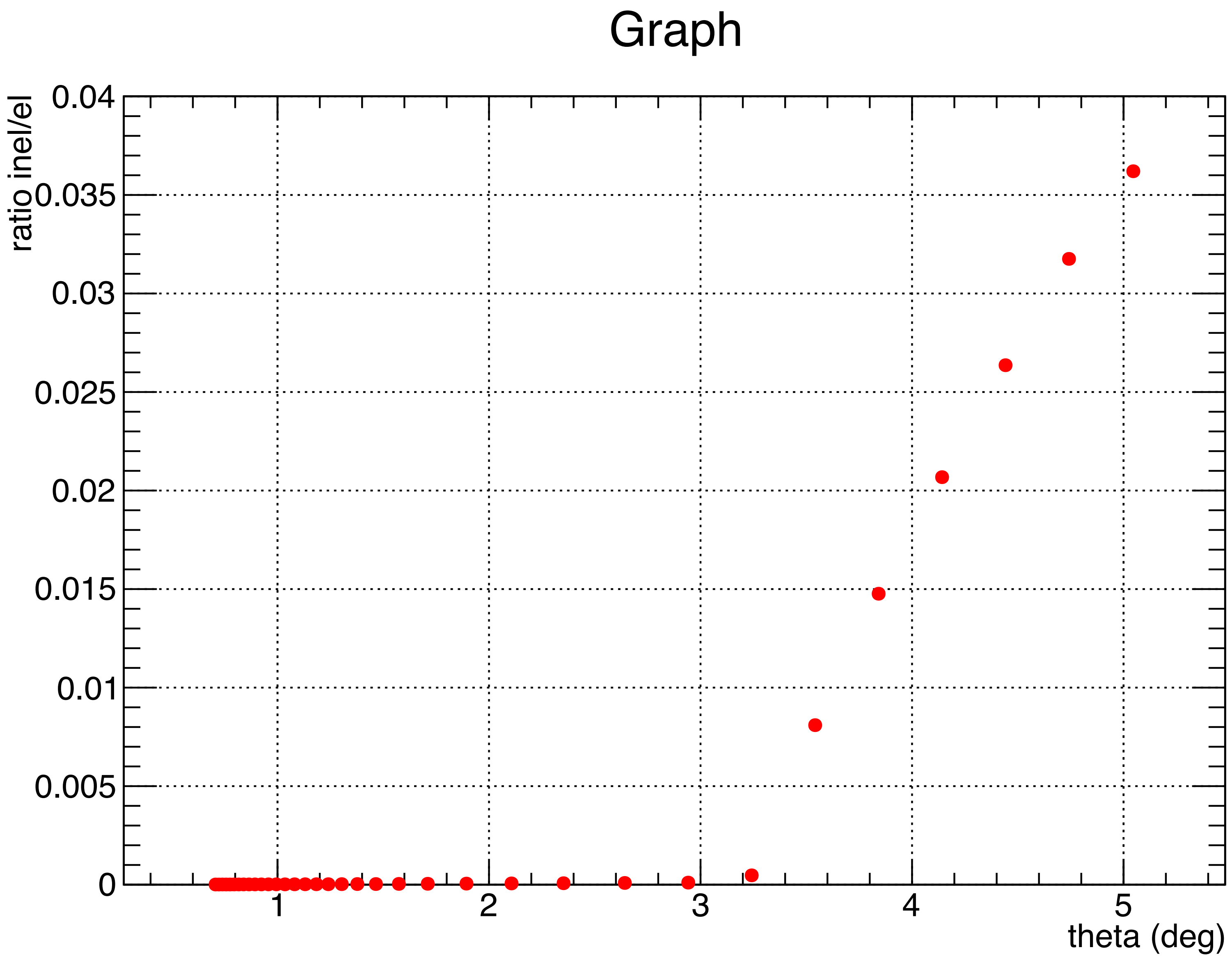




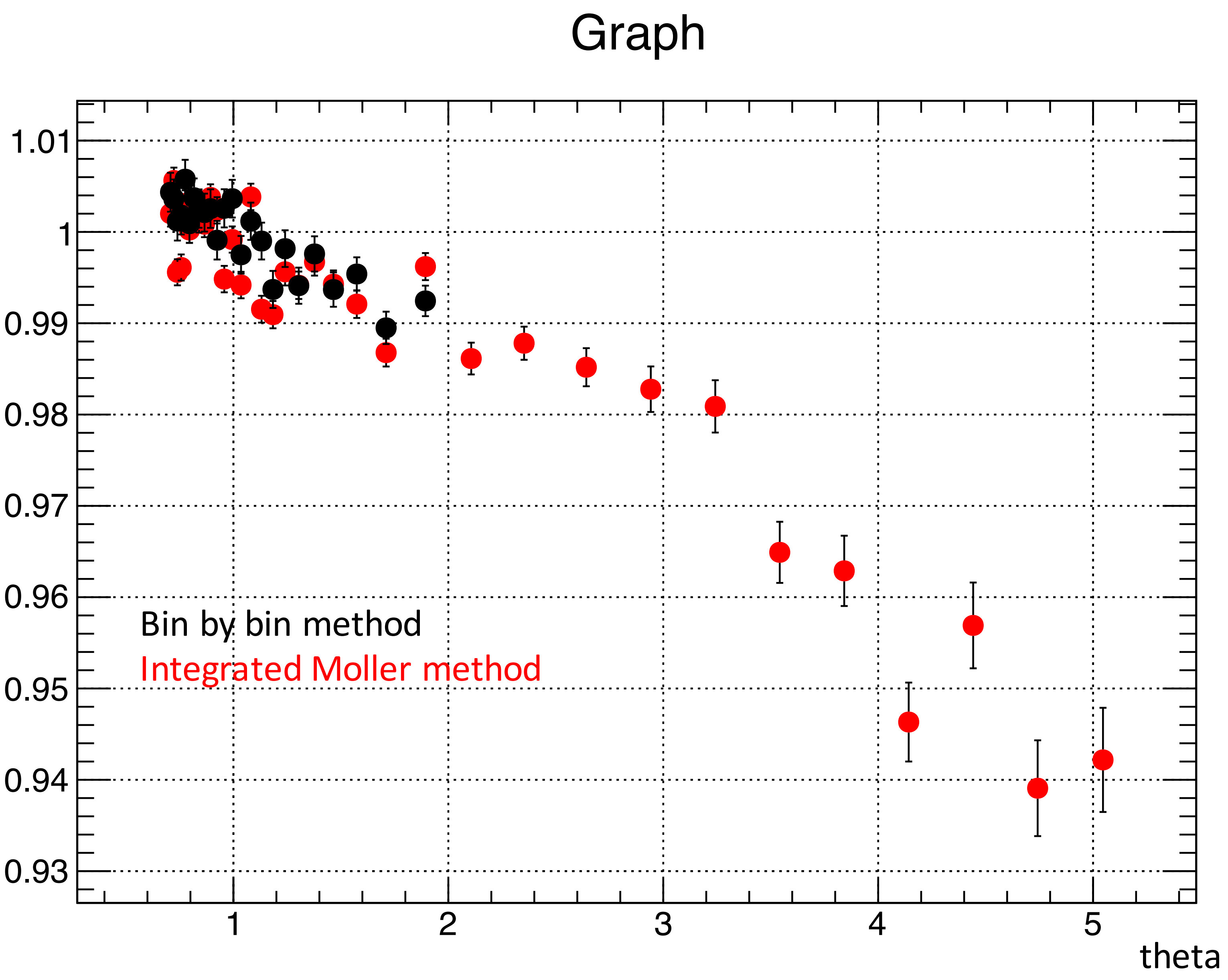
hit_pos_hycal_ep
600
400
200
0
−200
−400
−600
−600
−400
−200
0
200
400
600
0
1000
2000
3000
4000
5000


gem_eff_ep_theta_16_18
efficiency
0.97
0.96
0.95
0.94
0.93
0.92
0.91
1360
1380
1400
1420
1440
1460
1480
1500
1520
Run Number

Inelastic ep contamination



ep/ee from simulation over ep/ee ratio from data



GEM efficiency of ep for theta > 2.0