
Beam gas background update

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Beam parameters and collision rate

Species	Au ion	electron	Au ion	electron	Au ion	electron	Au ion	electron
Energy [GeV]	110	18	110	10	110	5	41	5
CM energy [GeV]	89.0		66.3		46.9		28.6	
Bunch intensity [10^{10}]	0.08	6.2	0.05	17.2	0.05	17.2	0.036	17.2
No. of bunches	290		1160		1160		1160	
Beam current [A]	0.23	0.227	0.57	2.50	0.57	2.50	0.41	2.50

Cross section of Au+proton fixed target collision from Pythia8 model:
110GeV: 1600mb;

DPMJET3.0: 1720mb;

PM = dRT;

R = 0.0821 atm/mol;

P = 2.560254e-09 mbar = 2.560254e-09*0.000986923atm = 2.5267736e-12atm

T = 293k;

M = 1.00794g/mol (molar mass)

Density = 1.0587422e-13g/L = 6.326e7 molecules/cm³

Background collision rate = $L_{bg} * \sigma_{AuH^2}$;

Luminosity of background = (beam current) * (average gas density) * (length);

Current = (0.57C/s)*(Au/79.0*1.6e-19C) = 4.5094937e+16 Au/s;

Length = 10.5m;

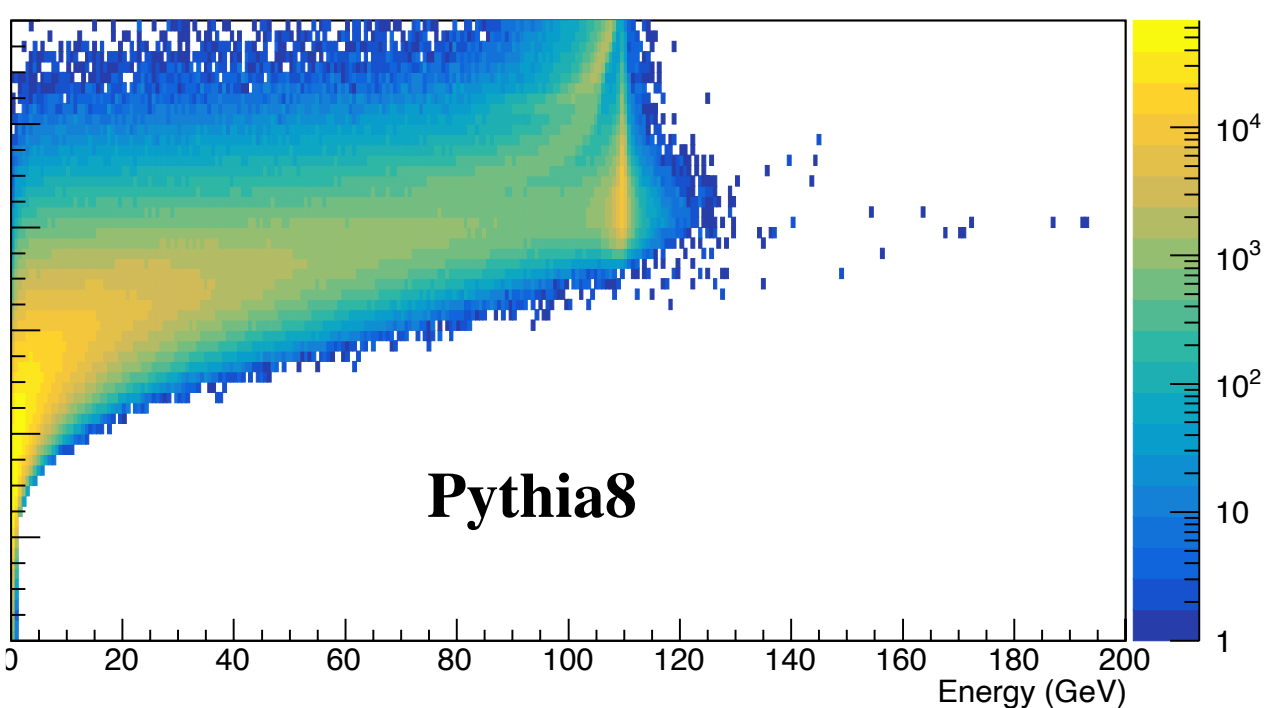
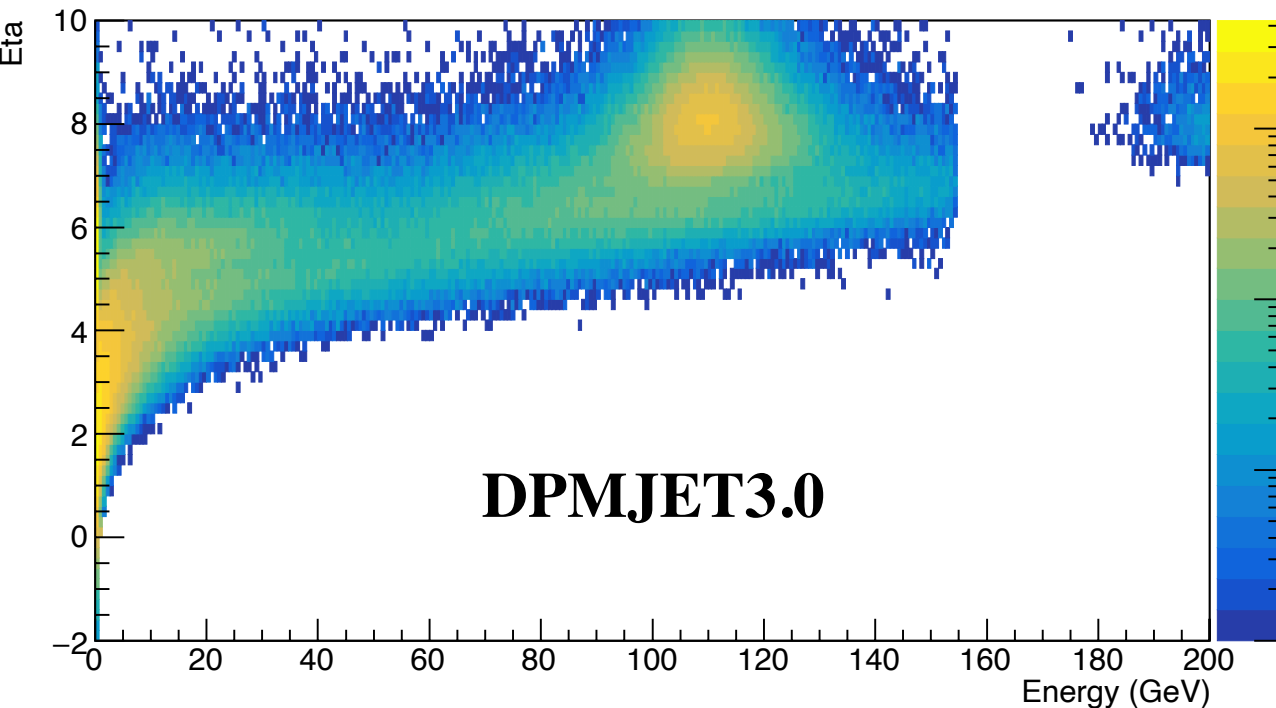
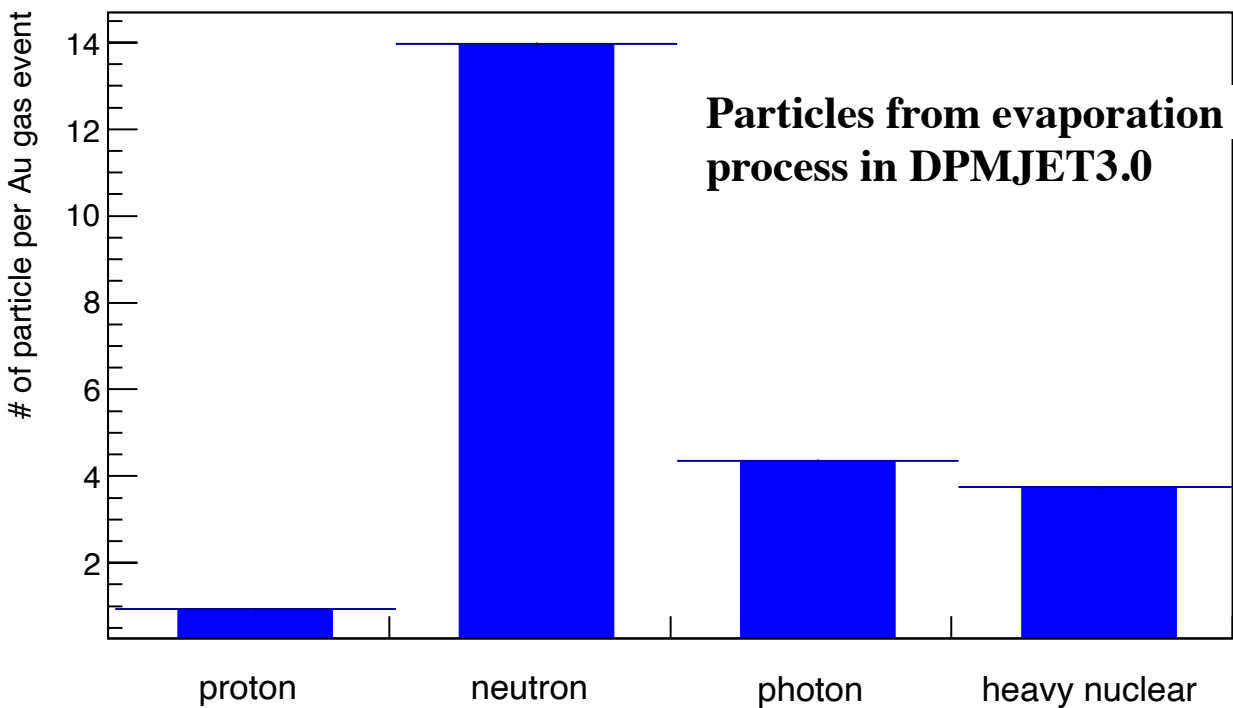
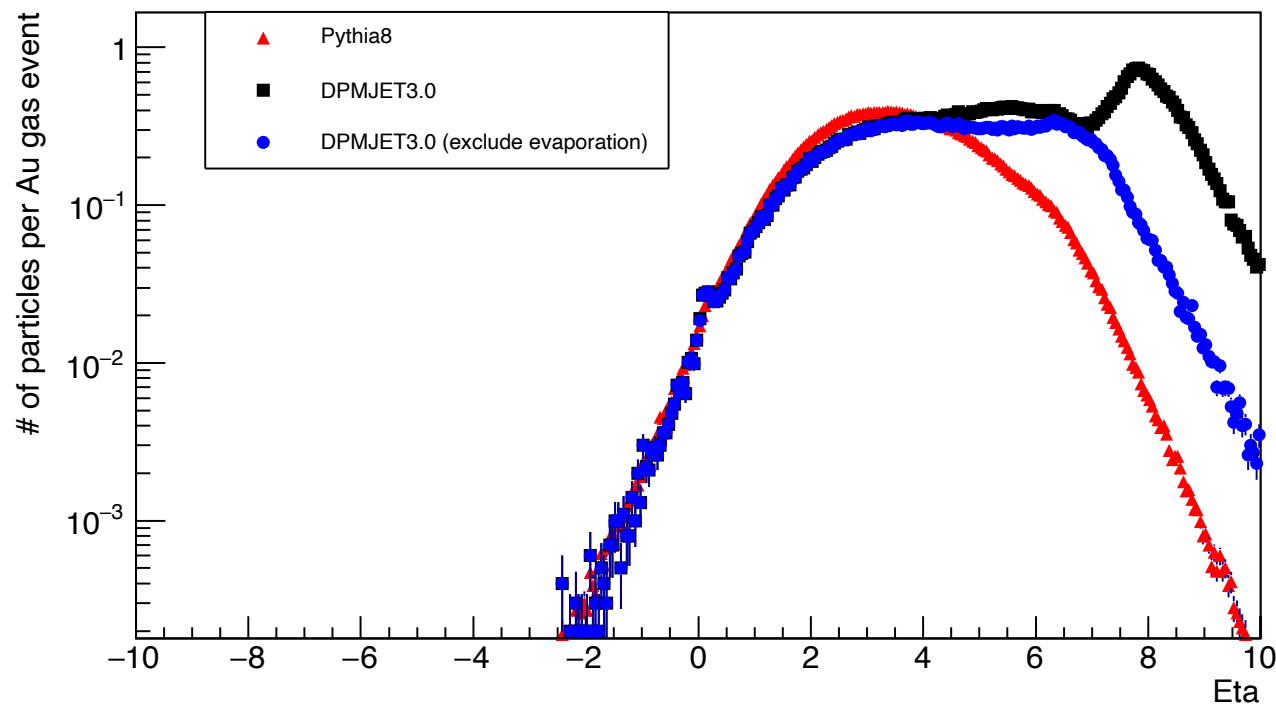
σ_{AuH^2} = 1600mb *2 (Pythia8);

Background collision rate =

4.5094937e+16(s-1)*6.326e7(cm-3)*1050(cm)*1600*(1.0e-27cm²) *2 = 9.58**kHz**; //110X10GeV, 110X5GeV

DPMJET3.0 vs Pythia8

No cross angle (25mrad) here, the rotation would added to the events before we do the ddsim simulation;



DPMJET3.0

```

DPMJET EVENT FILE
=====
ievent, process1, process2, IP, N_coll, N_par1, N_par2, nTracks, B_impact
=====
I ISTHKK(I) IDHKK(I) IDRES(I) IDXRES(I)      JMOHKK(1,I) JDAHKK(1,I) JDAHKK(2,I) PHKK(1,I) PHKK(2,I)      PHKK(3,I) PHKK(4,I) PHKK(5,I) VHKK(1,I) VHKK(2,I) VHKK(3,I)      IDRES(I) IDXR
ES(I)
=====
          1          1          0          1          1          1          1      251          7.76515
=====
1  13    2212      0      0      0      230      0      -0.04319      -0.04731      0.11372      0.94730      0.93827      -0.674102E-11      0.433537E-11      0.728067E-12
2  13    2112      0      0      0      0      0      -0.07496      -0.03734      -0.16497      0.95761      0.93957      0.858042E-12      0.840834E-12      0.937566E-12
3  13    2112      0      0      0      0      0      -0.11749      -0.02243      -0.07092      0.94980      0.93957      -0.108425E-11      0.376357E-11      -0.332663E-11
4  13    2212      0      0      0      0      0      -0.09630      -0.10483      -0.05881      0.95083      0.93827      0.352395E-11      -0.118126E-11      0.254385E-11
5  13    2112      0      0      0      0      0      -0.05562      -0.11611      -0.05927      0.95020      0.93957      0.728472E-12      0.614724E-11      -0.101982E-11
6  13    2212      0      0      0      0      0      -0.04481      -0.02794      -0.10641      0.94576      0.93827      -0.554687E-11      0.527650E-11      -0.443716E-11
7  13    2212      0      0      0      0      0      -0.04594      -0.07764      -0.01778      0.94277      0.93827      0.347843E-11      0.361611E-12      0.637150E-12
8  13    2112      0      0      0      0      0      -0.06762      -0.07428      -0.06721      0.94731      0.93957      -0.607299E-11      -0.990046E-12      -0.281320E-11
9  13    2112      0      0      0      0      0      -0.03426      -0.17493      -0.01716      0.95648      0.93957      -0.448941E-11      -0.935520E-12      -0.540642E-11
10 13    2112      0      0      0      0      0      -0.07926      -0.04483      -0.14502      0.95505      0.93957      0.202027E-11      0.380348E-11      -0.155058E-11
11 13    2112      0      0      0      0      0      -0.04936      -0.12201      -0.10202      0.95421      0.93957      0.350173E-11      -0.329623E-12      0.267363E-11
12 13    2112      0      0      0      0      0      -0.02666      -0.04975      -0.06025      0.94319      0.93957      0.457128E-11      -0.397503E-12      -0.698466E-12
13 13    2112      0      0      0      0      0      -0.05544      -0.12595      -0.07918      0.95289      0.93957      -0.829404E-12      0.569102E-11      0.764358E-12
14 13    2112      0      0      0      0      0      -0.05360      -0.01388      -0.14113      0.95172      0.93957      -0.121275E-11      0.243921E-11      -0.141974E-11
15 13    2112      0      0      0      0      0      -0.09288      -0.00228      -0.05834      0.94595      0.93957      -0.322423E-11      0.142720E-11      0.358664E-11
16 13    2212      0      0      0      0      0      -0.06656      -0.09276      -0.08798      0.94928      0.93827      -0.163639E-11      -0.132495E-11      0.396382E-11
17 13    2112      0      0      0      0      0      -0.15708      -0.06843      -0.00435      0.95507      0.93957      -0.407502E-11      -0.110372E-11      -0.222697E-11
18 13    2112      0      0      0      0      0      -0.11034      -0.02273      -0.03690      0.94702      0.93957      0.799989E-12      0.191793E-11      0.440700E-11
19 13    2212      0      0      0      0      0      -0.01428      -0.02653      -0.10506      0.94461      0.93827      0.104060E-12      0.352155E-11      -0.147062E-11

```

Convert to HepMC3 format

```

HepMC::Version 3.02.03
HepMC::Ascii3-START_EVENT_LISTING
E 0 17 251
U GEV MM
W 1.000000000000000000000000e+00
A 0 GenCrossSection 3.07028722e+10 2.47887451e+10 -1 -1
A 0 GenPdfInfo 2212 2212 1.00000000e+00 1.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00 0 0
A 0 alphaQCD 0.129844
A 0 alphaQED 0.007818181
A 0 cycles 1
A 0 event_scale 7.60606
A 0 signal_process_id 102
P 1 0 2212 -0.0460192 -0.04731 0.112605 0.9473 0.93827 23
V -1 0 [0] @ -0.205643 -0.0262736 1813.9 0.000000000000000000e+00
P 2 -1 1000791960 -535.051 0.04399 21396 21403.5 182.521 2
P 3 0 2112 0.0790604 0.03734 -0.163045 0.95761 0.93957 23
P 4 0 2112 -0.11568 -0.02243 -0.0738348 0.9498 0.93957 23
P 5 0 2212 -0.0947998 0.10483 -0.0611989 0.95083 0.93827 23
P 6 0 2112 0.0570842 0.11611 -0.0578611 0.9502 0.93957 23
P 7 0 2212 -0.047456 -0.02794 0.105257 0.94576 0.93827 23
P 8 0 2212 0.0463701 -0.07764 -0.0166261 0.94277 0.93827 23
P 9 0 2112 -0.0659188 0.07428 -0.0688793 0.94731 0.93957 23

```

/gpfs/mnt/gpfs02/eic/zhangzq/beamGas_Au/convert/ver2/convert_dpmjet_hepmc3_ver2.C

ddsim --compactFile /opt/detector/epic-nightly/share/epic/epic_brycecanyon.xml --numberOfEvents 2000 --inputFile /gpfs/mnt/gpfs02/eic/zhangzq/beamGas_Au/convert/ver2/110GeV_Au_beam.hepmc --outputFile 110GeV_Au_beamGas.edm4hep.root

```

ParticleHandler INFO +++ Event 5 Begin event action. Access event related information.
Geant4Output2EDM4hep INFO +++ Saving EDM4hep event 5 run -1.
corrupted double-linked list
*** Break *** abort

```

Crashed after a few events!

Pythia8

```
A 52 flow2 204
A 53 flow2 0
A 54 flow2 0
A 55 flow2 0
A 62 flow2 203
A 0 signal_process_id 101
P 1 0 1000791970 -541.674 0 21662.5 21670 183.473 4
V -1 0 [1] @ -3.6344865683545372e+01 -2.9235337080025375e-03 1.4471642223597728e+03 0.0000000000000000e+00
P 2 -1 2212 -2.74943 9.86305e-05 109.962 110 0.93827 13
P 3 -1 2212 -2.7499 0.000214398 109.962 110 0.93827 13
P 4 -1 1000771950 -536.175 -0.000298919 21442.5 21450 181.41 1
P 5 0 2212 0.000187559 0 -0.00750079 0.9383 0.93827 4
V -2 0 [5] @ -3.6344865683545919e+01 -2.9235337081450889e-03 1.4471642223597728e+03 0.0000000000000000e+00
P 6 -2 2212 0.000407597 -1.41094e-05 -0.00906369 0.938314 0.93827 13
V -3 0 [2] @ -3.6344865683545322e+01 -2.9235337079897166e-03 1.4471642223597728e+03 0.0000000000000000e+00
P 7 -3 2 -0.920395 0.0366831 46.3765 46.3856 0 61
P 8 -3 21 -0.440996 0.0868497 28.6427 28.6462 0 61
P 9 -3 2101 -1.26291 -0.123439 29.9384 29.9709 0.57933 63
V -4 0 [3] @ -3.6344865683546352e+01 -2.9235337084187992e-03 1.4471642223597728e+03 -1.7299768083837652e-16
P 10 -4 9902210 -2.82201 0.0610796 109.958 110.01 1.84721 15
V -5 0 [6] @ -3.6344865683545819e+01 -2.9235337081186508e-03 1.4471642223597728e+03 0.0000000000000000e+00
P 11 -5 21 0.459405 -0.143265 0.597075 0.766862 0 61
```

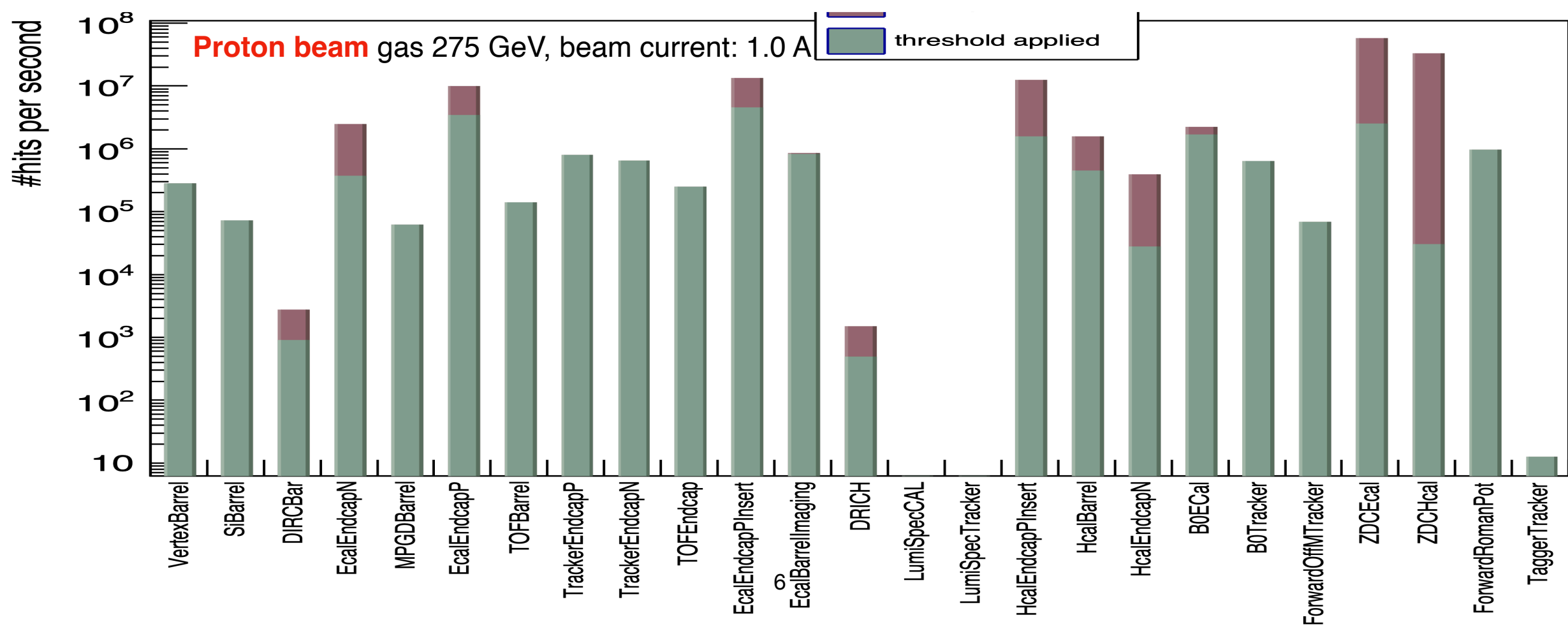
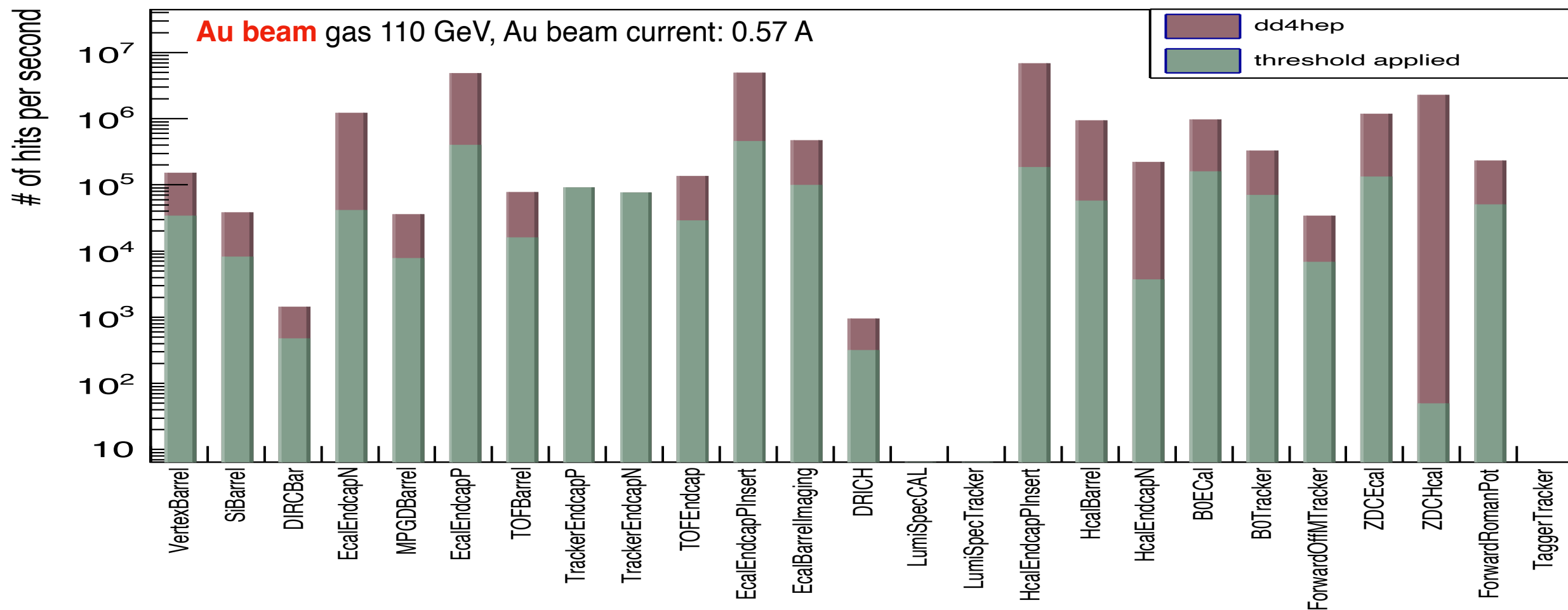
participant {

noninteracting projectile spectator

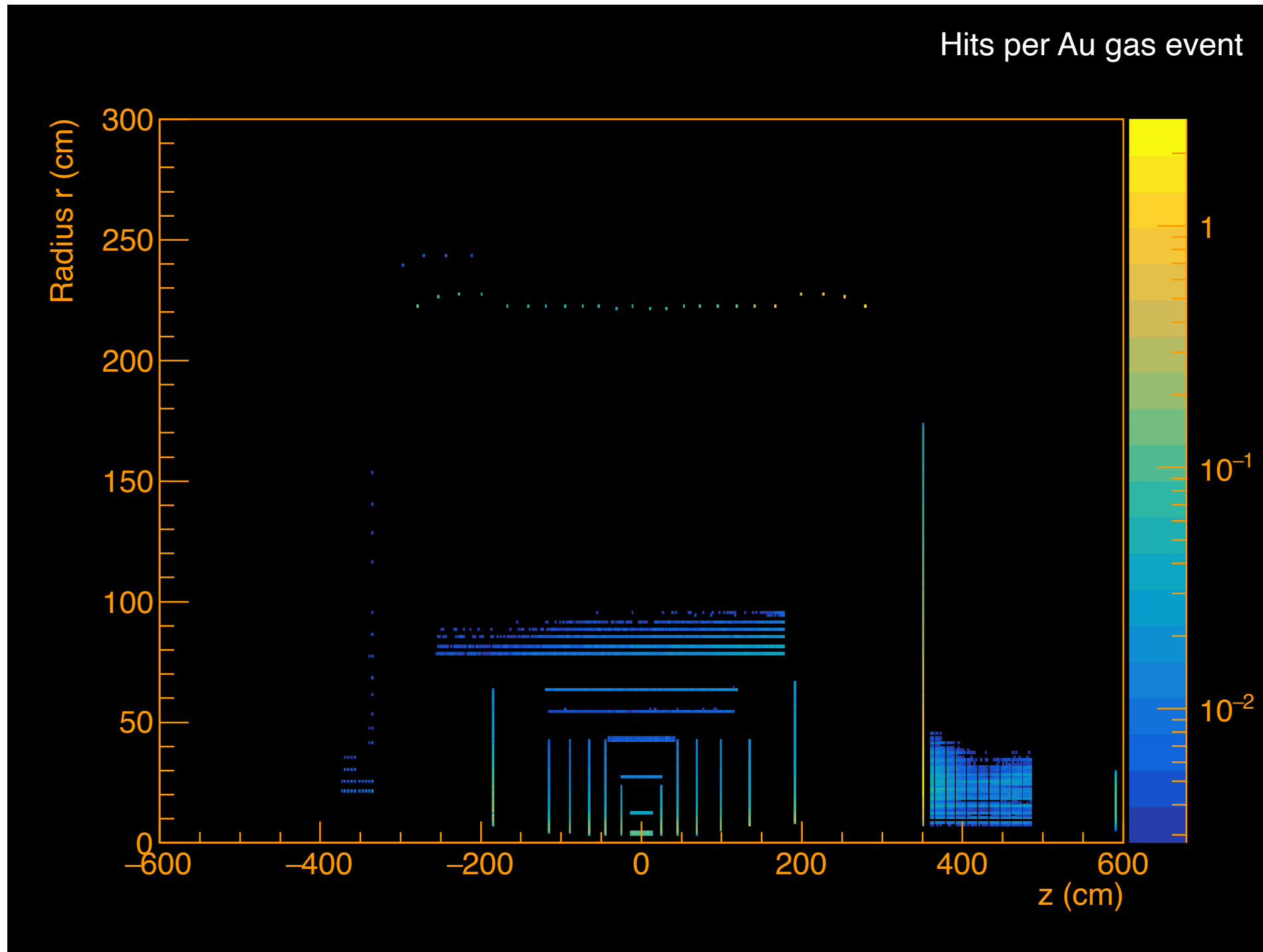
- In Pythia8, the noninteracting projectile spectator which is a very heavy ion, it is marked as a stable particle (status = 1), this would make ddsim run very slow (maybe over 30mins for one event). In order to get it running, I had to modify the status to '2'.

```
ddsim --compactFile /opt/detector/epic-nightly/share/epic/epic_brycecanyon.xml --numberOfEvents 2000 --
inputFile /gpfs/mnt/gpfs02/eic/zhangzq/pythia8/beameffect/BeamGas_Au/Au_beamGas.hepmc --outputFile
110GeV_Au_beamGas.edm4hep.root
```

The output from Pythia8 works well!

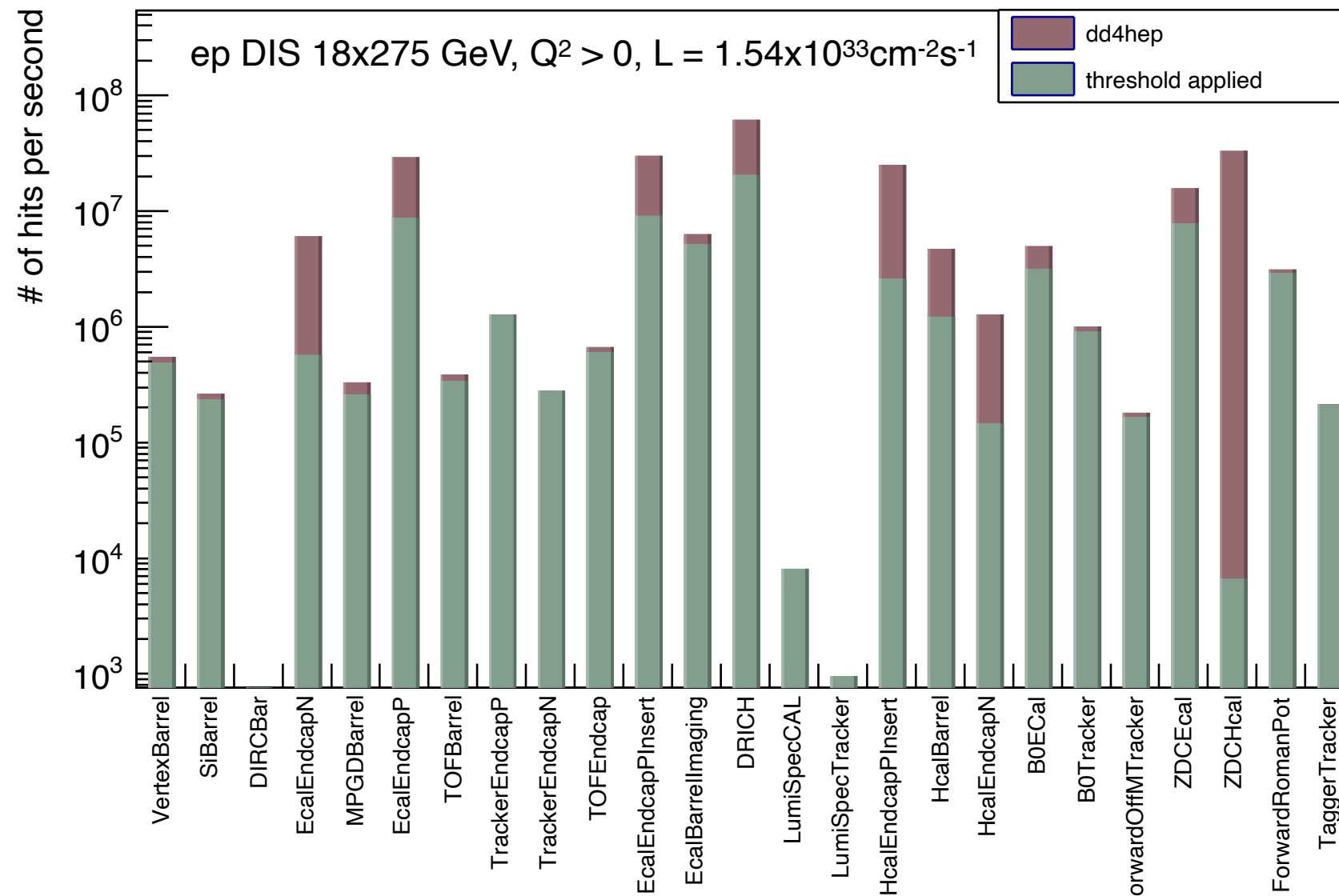


Hits distribution



Hit rates for DIS events

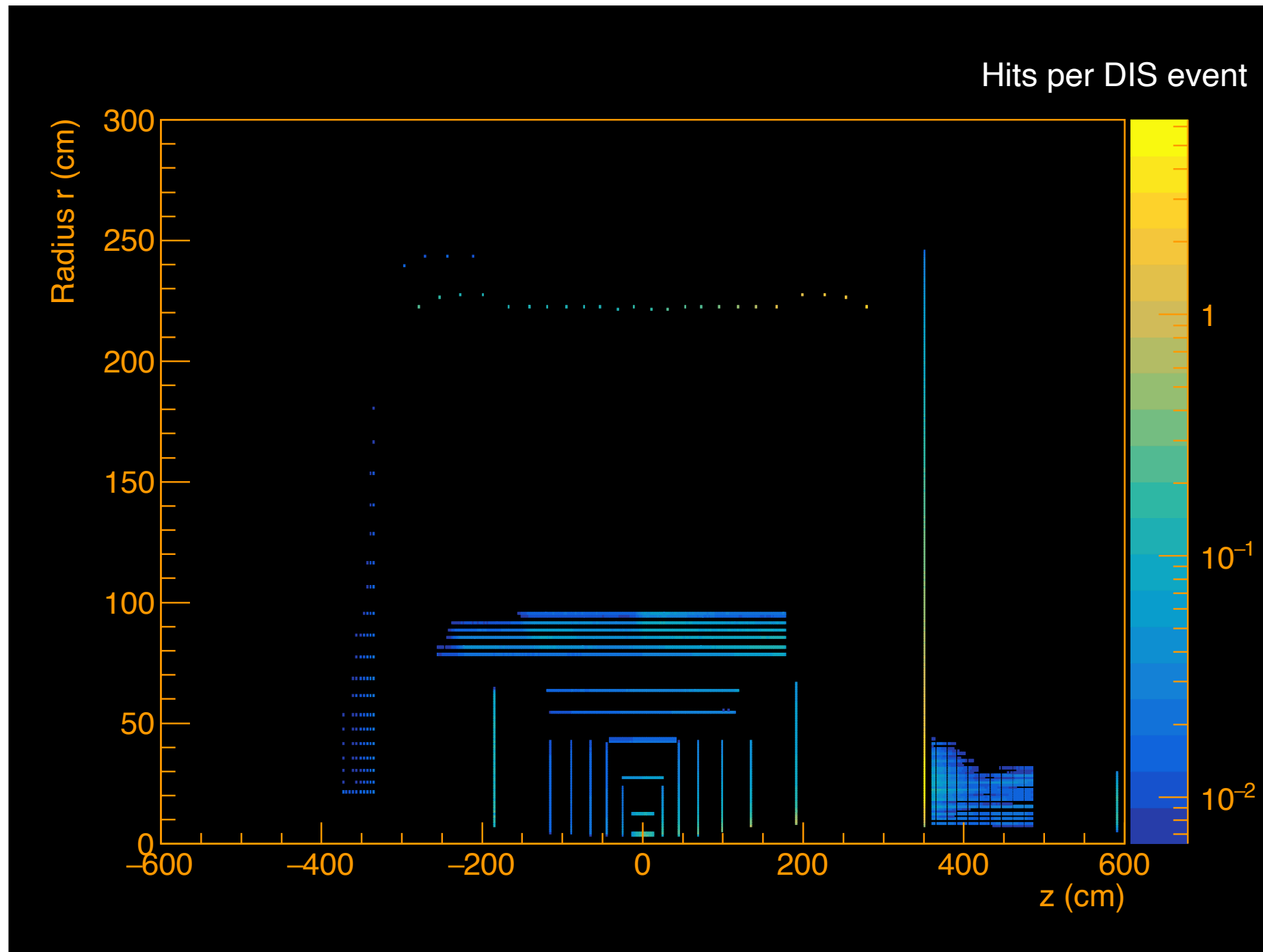
```
jug_xl> zhangzq@eic0101:/gpfs/mnt/gpfs02/eic/zhangzq/EPIC/eic_newVer/analysis_DIS/data$ mc ls S3/eictest/EPIC/FULL/23.06.1/epic_brycecanyon/SIDIS/pythia6
[2023-06-27 12:25:10 EDT] 0B ep_10x100/
[2023-06-27 12:25:10 EDT] 0B ep_18x275/
[2023-06-27 12:25:10 EDT] 0B ep_5x41/
```



rates in kHz	5x41 GeV	5x100 GeV	10x100 GeV	10x275 GeV	18x275 GeV
DIS ep	12.5 kHz	129 kHz	184 kHz	500 kHz	83 kHz

- Do we need to check 10x275GeV since this configuration has the highest collision rate? No data for 10x275GeV case in S3.

Hits distribution for DIS events



Thank you.