Measurements of charged spectator-fragments with the scintillation wall at the BM@N Xe run 8

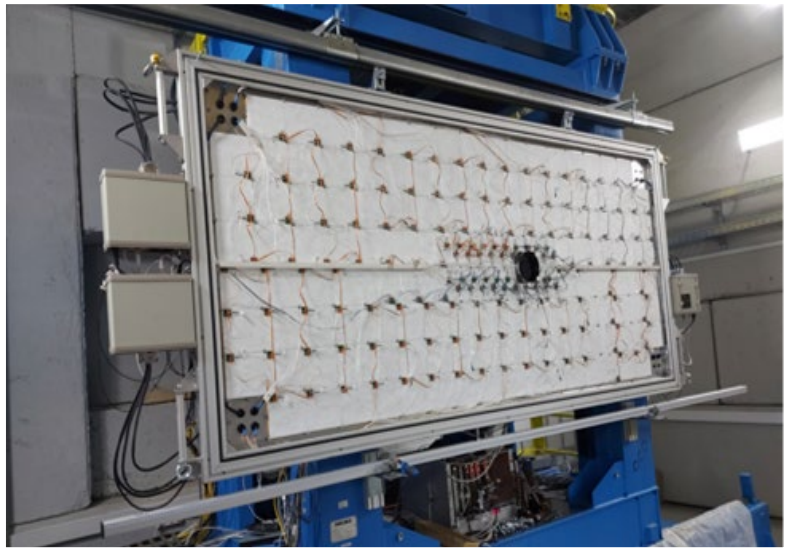
Volkov Vadim
INR RAS, MIPT

10th Collaboration Meeting of the BM@N Experiment at the NICA Facility
18/05/23

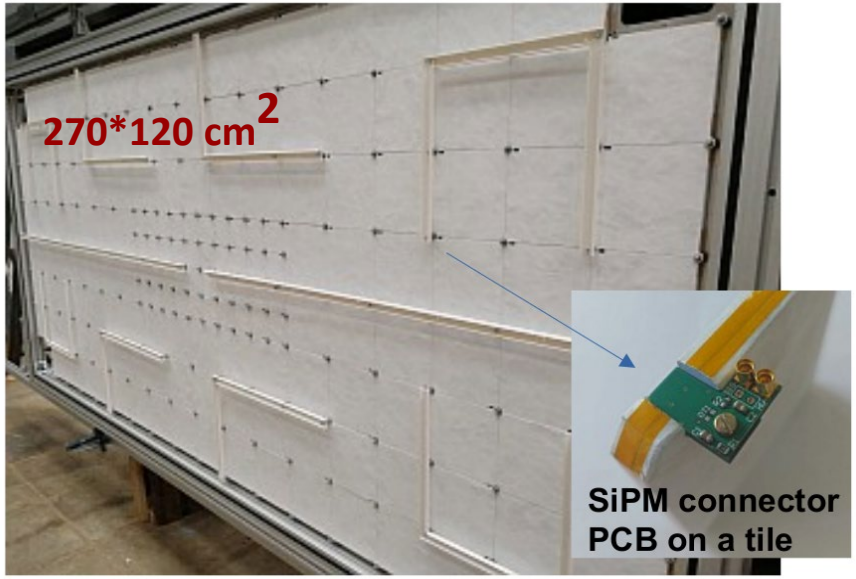
Outline

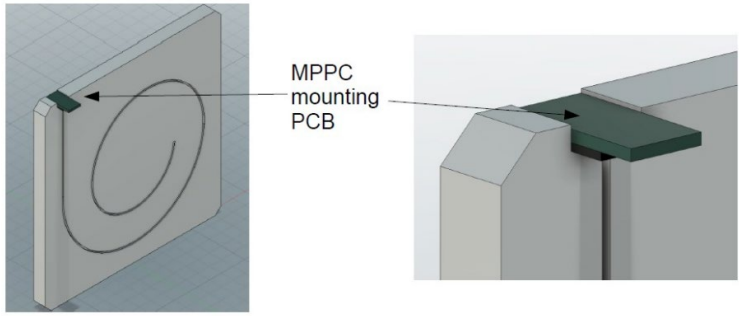
- The general structure and tasks of the scintillation wall
- The ScWall performance examples at different energies
- ScWall calibration
- The charges range detected in the last BMN runs
- The sensitivity of the ScWall to centrality according to multiplicity
- Multiplicity distributions as a function of the charge deposited on the ScWall
- Correlations of ScWall multiplicity with the calorimeter deposited energy and barrel detector multiplicity

Scintillation Wall (ScWall) for fragments charge measurements and reaction plane estimation

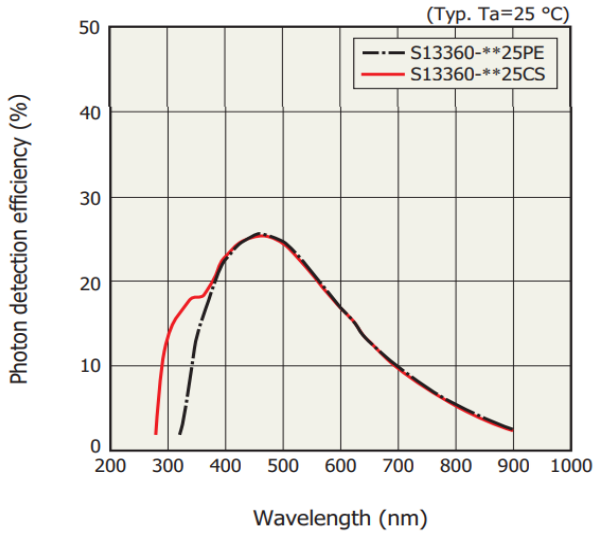


- 36 small inner cells 7.5×7.5×1 cm^3 + 138 big outer cells 15×15×1 cm^3
- light yield for MIP signal – small cells 55 p.e.±2.4%; big cells 32 p.e.± 6%.
- optional beam hole (covered with 4 small cells for the SRC run)
- covered with a light-shielding aluminum plate
- light collection by WLS fibers
- light readout with SiPM mounted on the PCB at each scint. cell



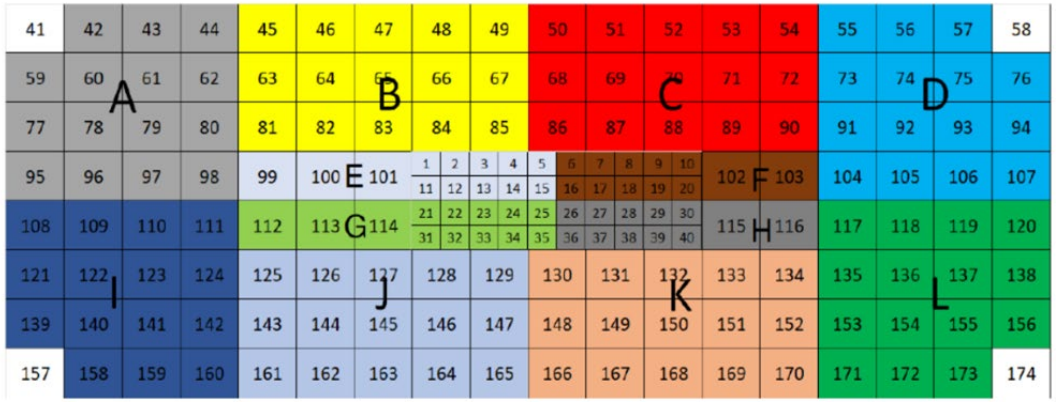


light collection from tiles



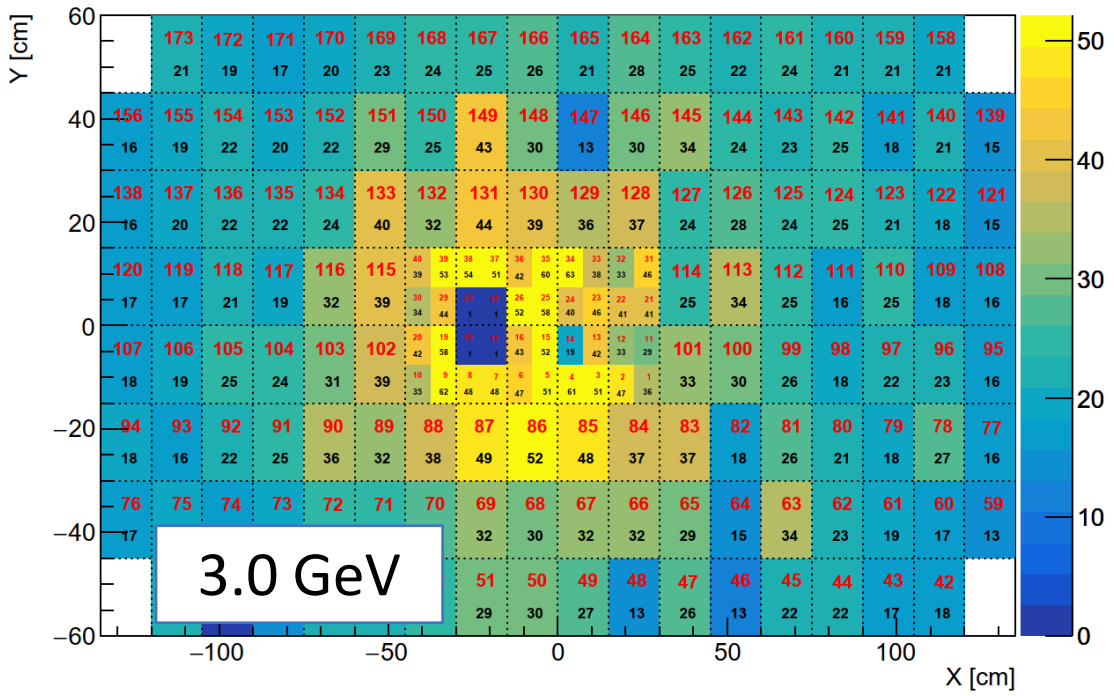
- Hamamatsu MPPC S13360-1325CS 1.3*1.3mm^2
- Number of pixels: 2668
- Gain: 7*10^5
- PDE: 25%

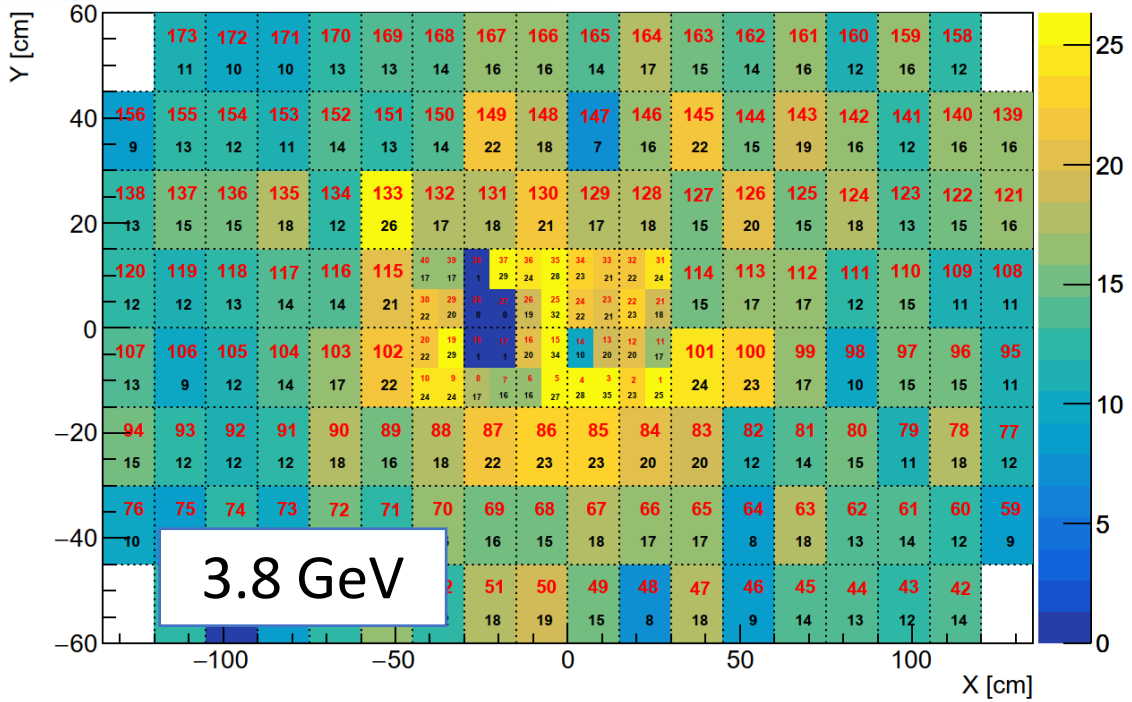
ScWall: design



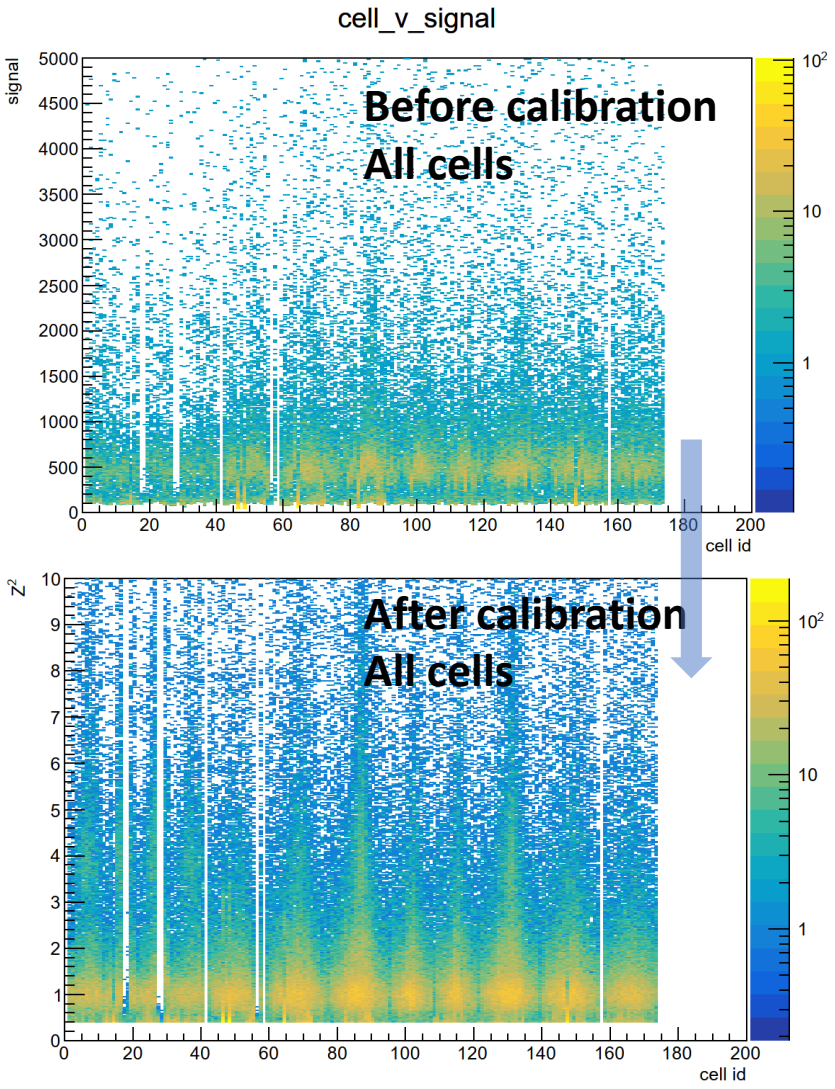
- readout divided into 12 sectors each one equipped with single temperature sensor
- each 4 sectors are read by combined electronics unit:
  - One ADC64s2 board
  - Four 16-channels FEE boards
  - Voltage control unit

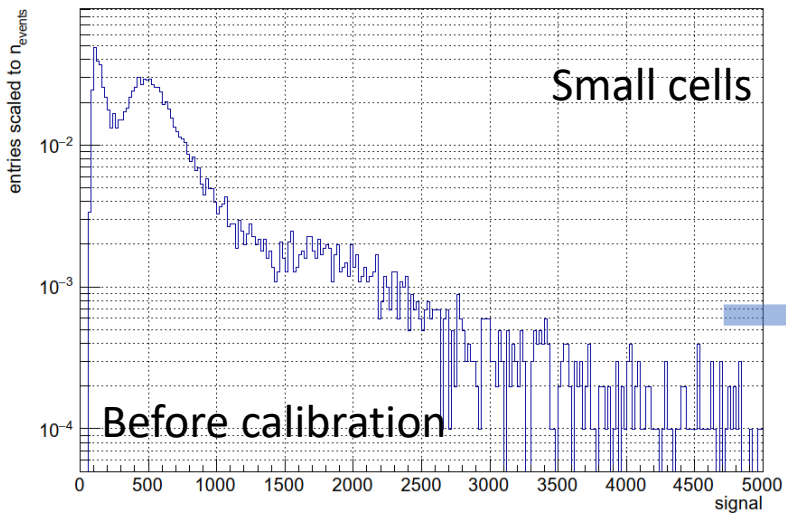
ScWall average Z^2 distribution with CsI (2%) target, Xe, CCT2

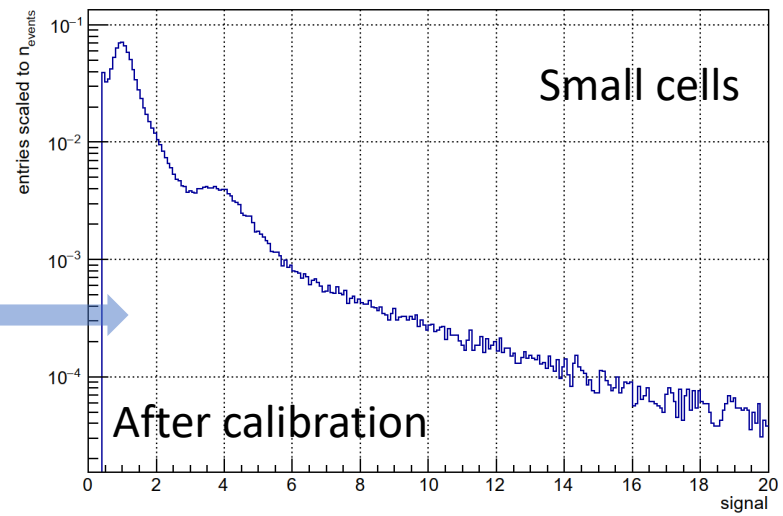


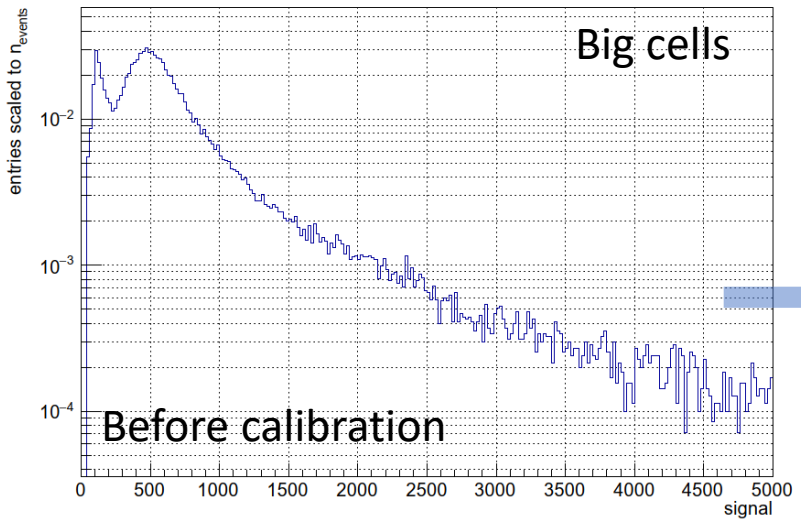


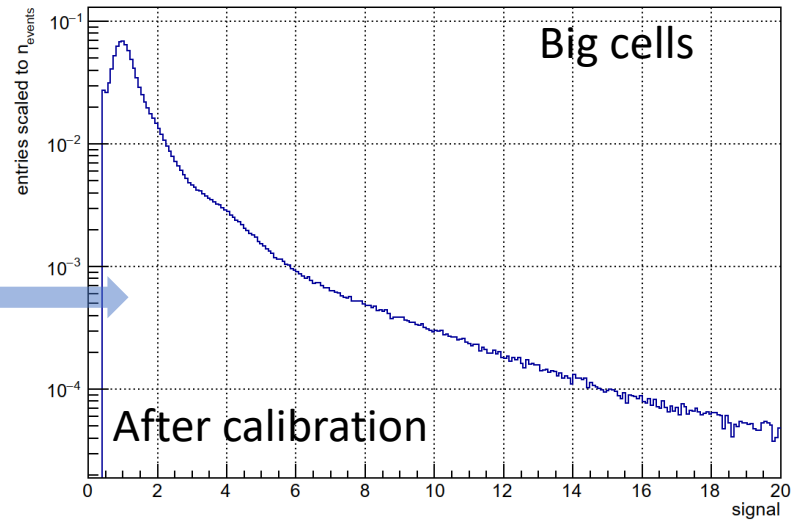
Charge distribution in ScWall cells (CCT2) 3.0 AGeV









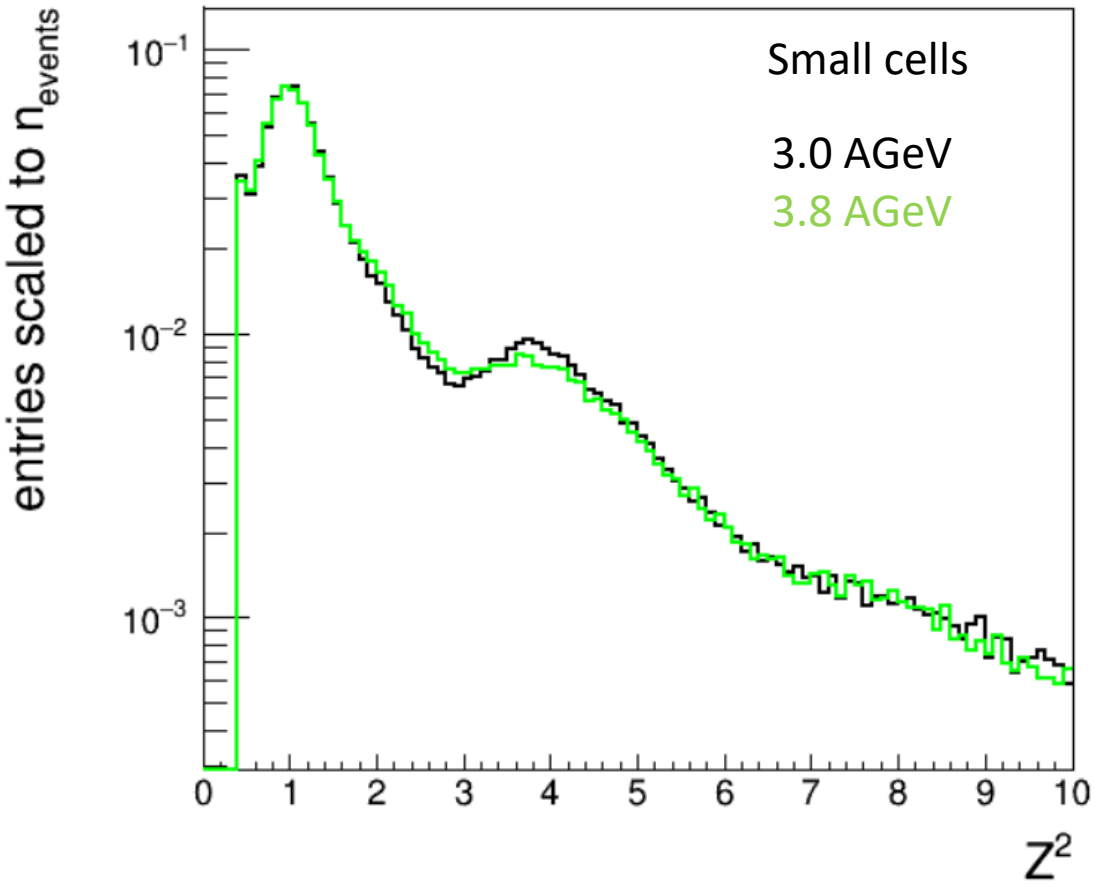


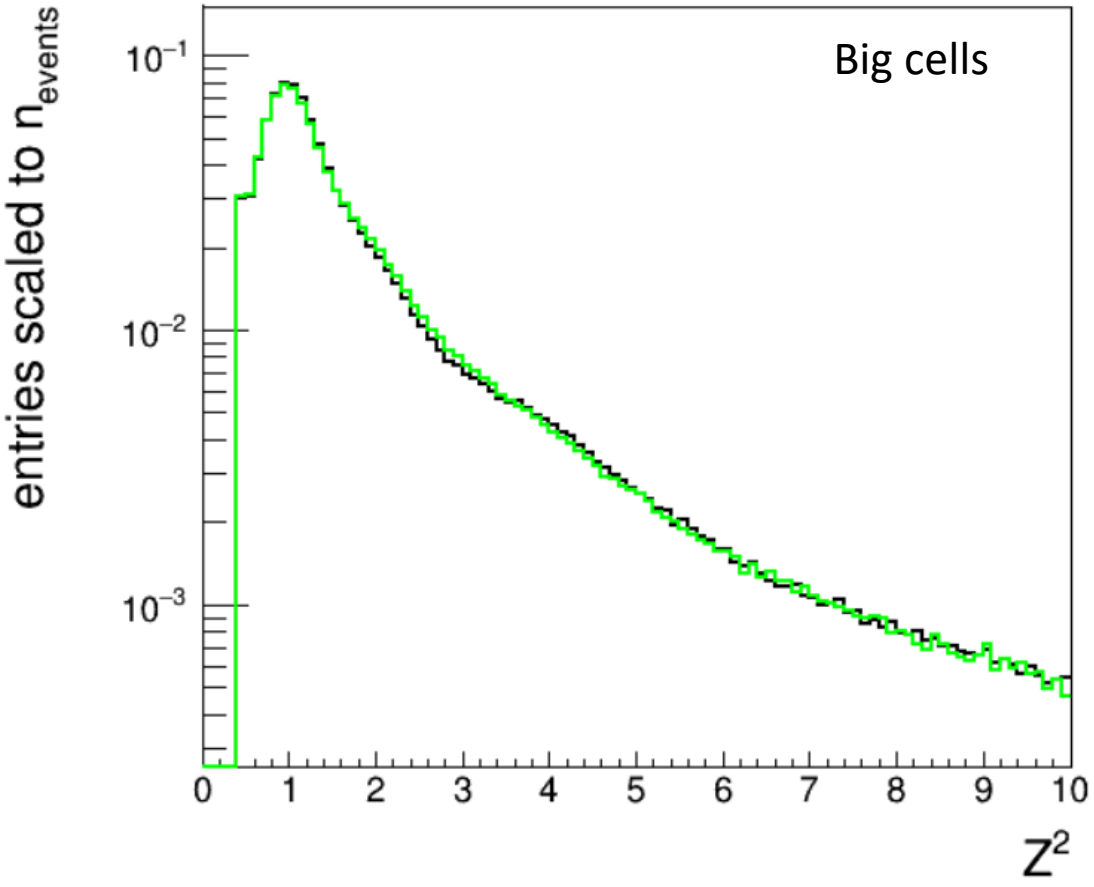
Charge distribution over the scintillation wall before/after calibration. A peaks corresponding to charges Z = 1, 2 can be clearly seen.

Cuts: BC1S (1Xe)

Runs: 8380, 81, 82, 84, 86, 87

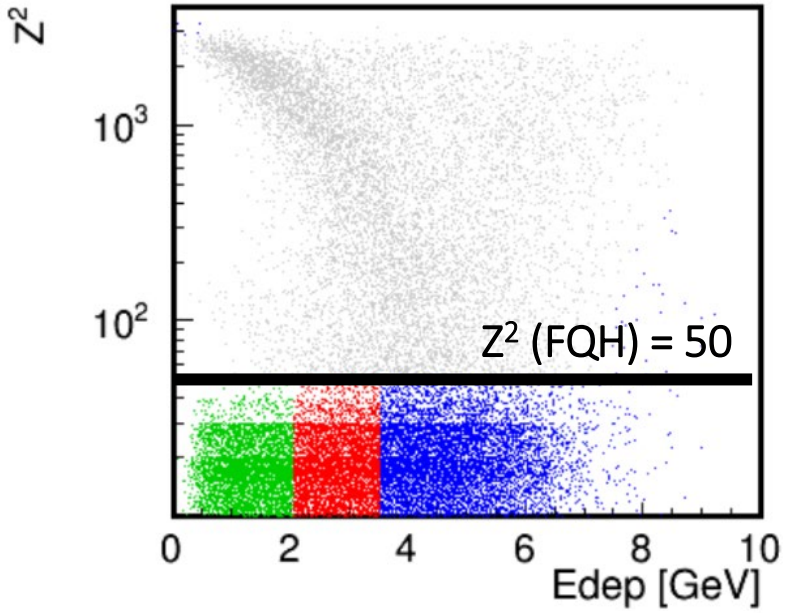
Charge distribution in ScWall cells

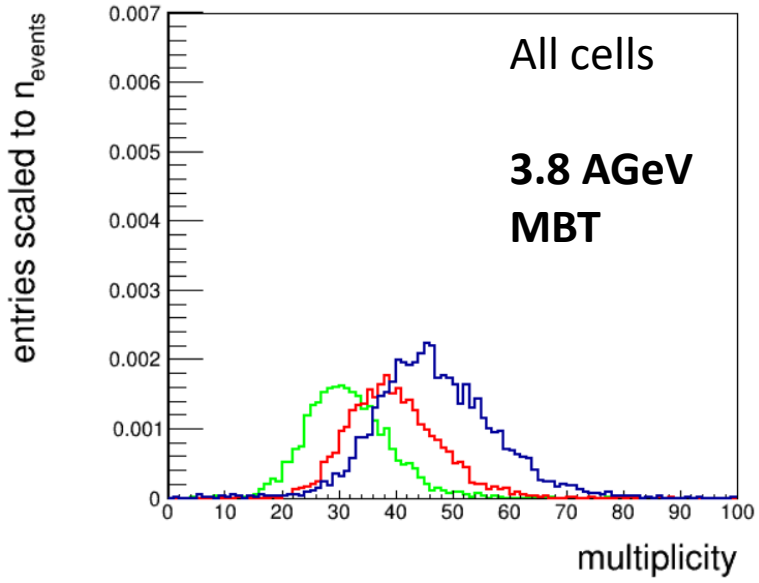


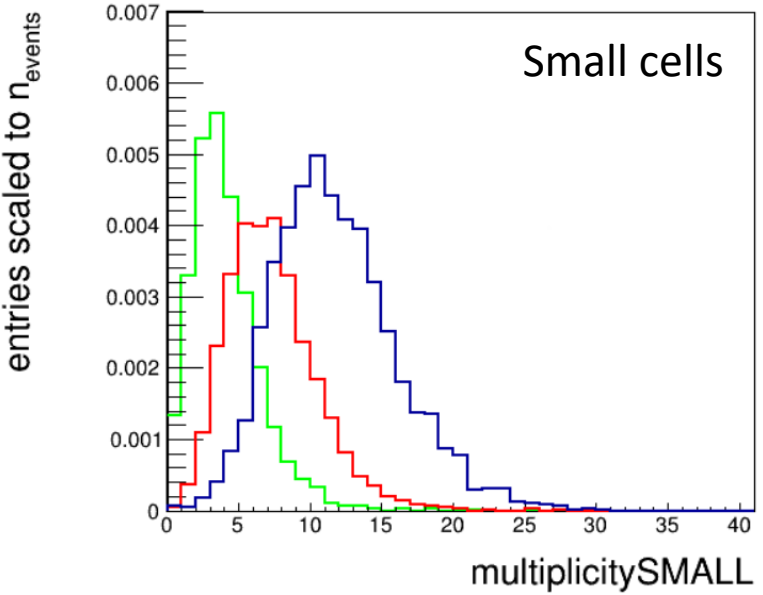


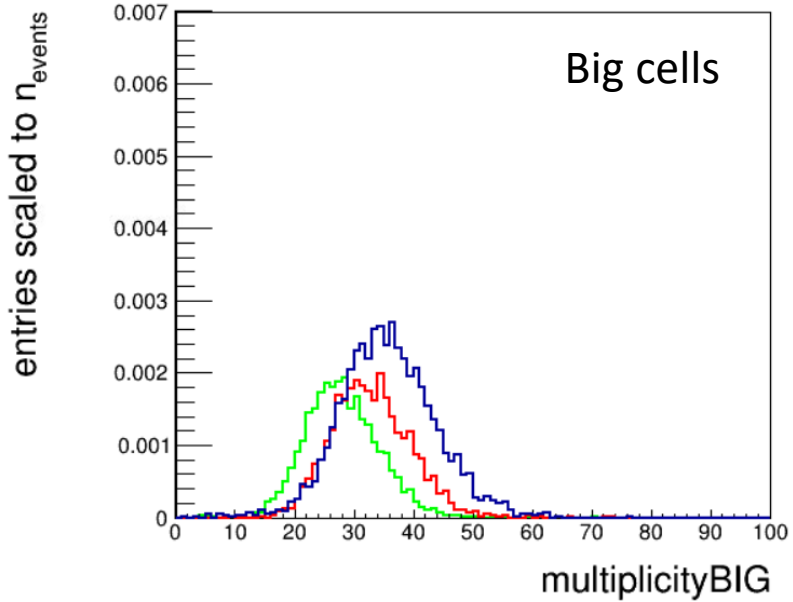
- Comparison of the charge distributions over the scintillation wall for the two energies at 3.0 and 3.8 GeV for the CCT2 trigger.
- The two cell types (small and big) are presented separately.
- It can be seen that the distributions are very similar, with a slight difference in the second peak.

ScWall multiplicity distributions of charged particles for different centrality classes









ScWall multiplicity refers to the number of fired cells in the wall.

Multiplicity is sensitive to centrality. Green, red and blue reflect the most central, semi-central and semi-peripheral arbitrary classes of events.

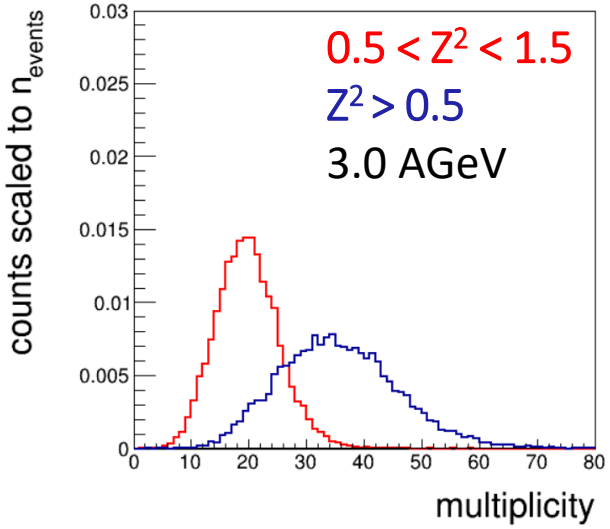
~50% of minbias events, need to be checked with sim (b<10 fm).

Cuts:
BC1S (1 Xe)
Z^2 (ScWall) > 0.4
vertex Z (-1.5 < Z <1.5)
Z^2 (FQH) < 50

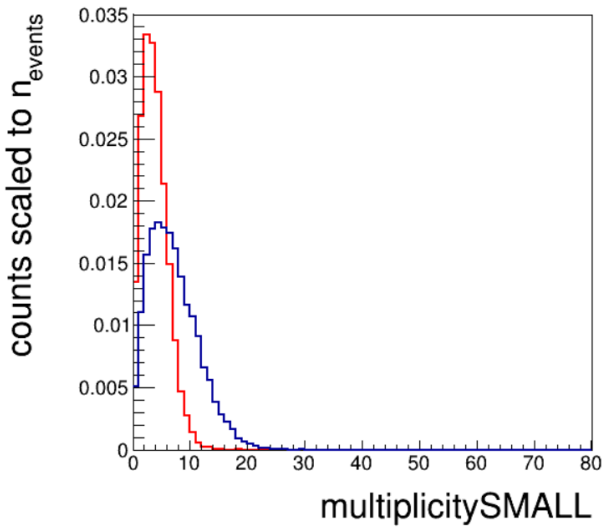
MBT

Multiplicity distribution of charged particles in ScWall

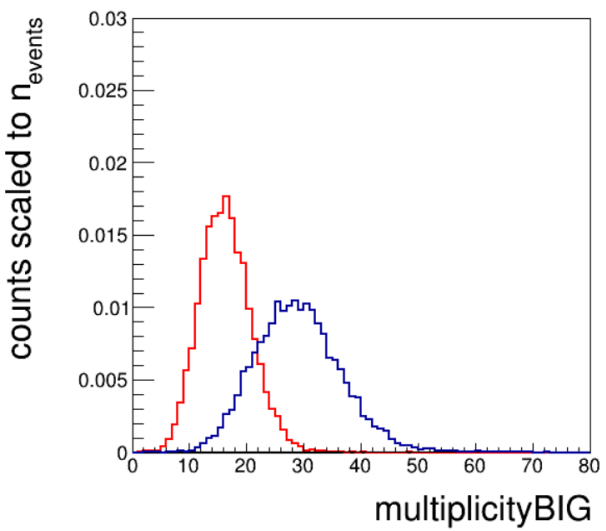
All cells



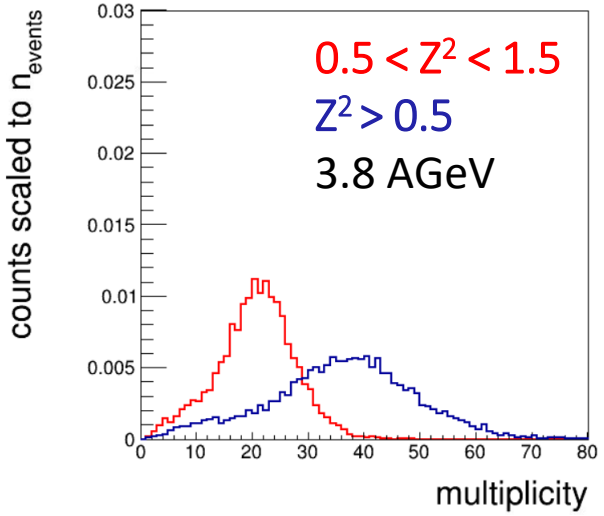
Small cells



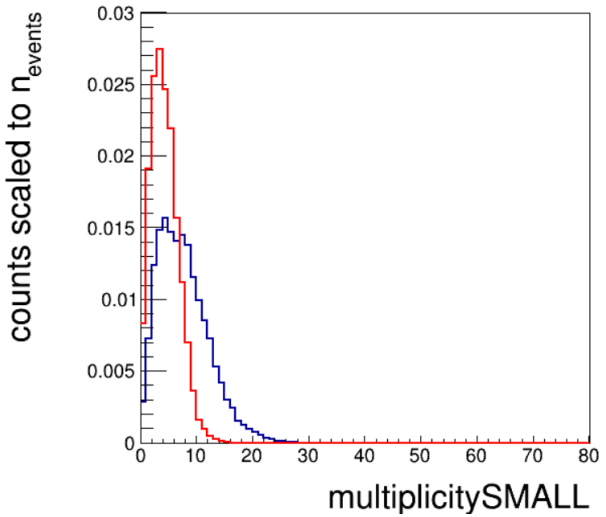
Big cells



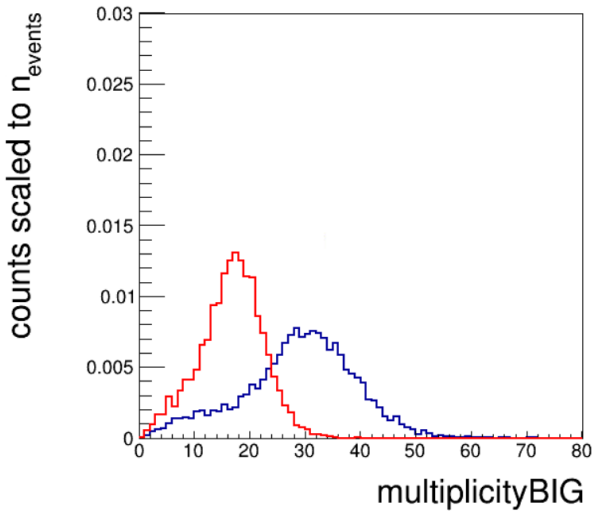
All cells



Small cells



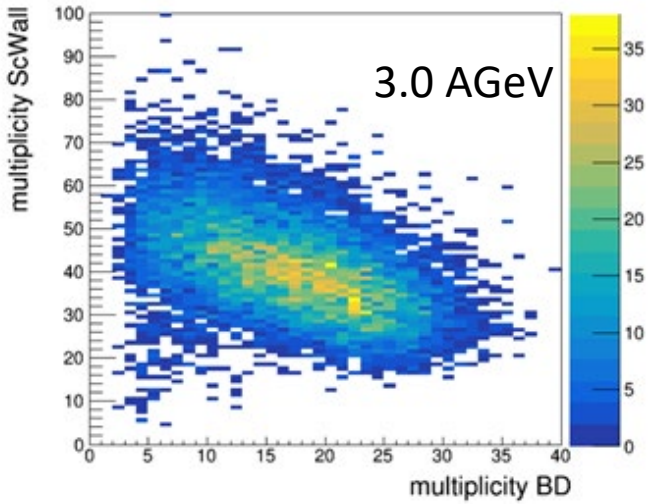
Big cells

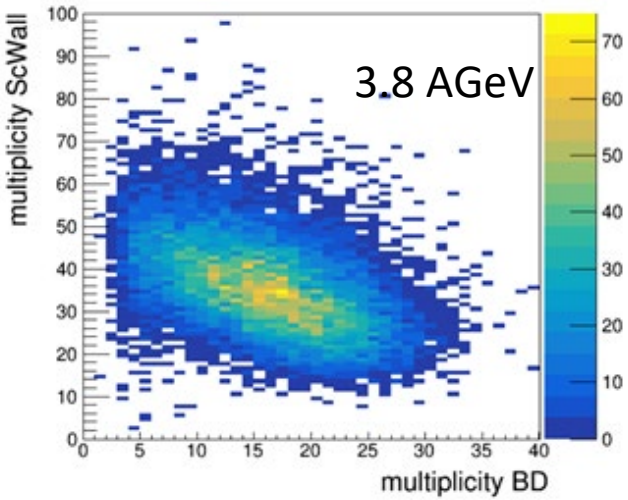


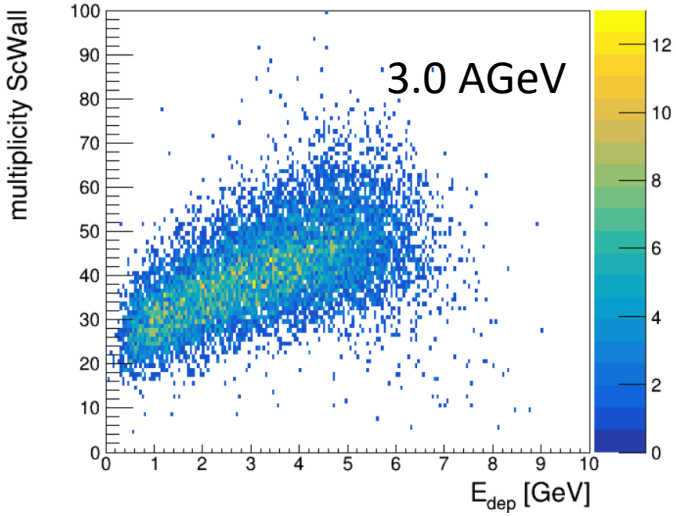
Multiplicity is sensitive to charges on the wall for both energies. The peak corresponding to the single charge is clearly prominent.

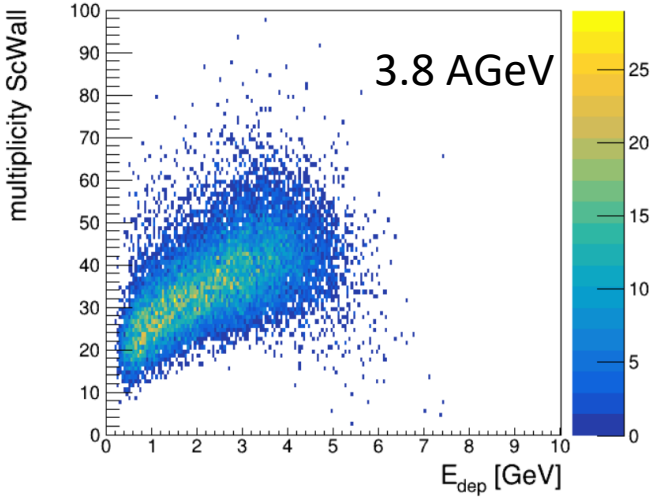
This dependency can be used for comparison with Monte Carlo models (DCM-QGSM-SMM etc.)

Multiplicity in ScWall / multiplicity in BD









Multiplicity correlates with energy deposition in the calorimeter, and anticorrelates with multiplicity in BD.

Cuts:
BC1S
Z^2 (ScWall) > 0.4
vertex Z (-1.5 < Z <1.5)
Z^2 (FQH) < 100

CCT2

Conclusion

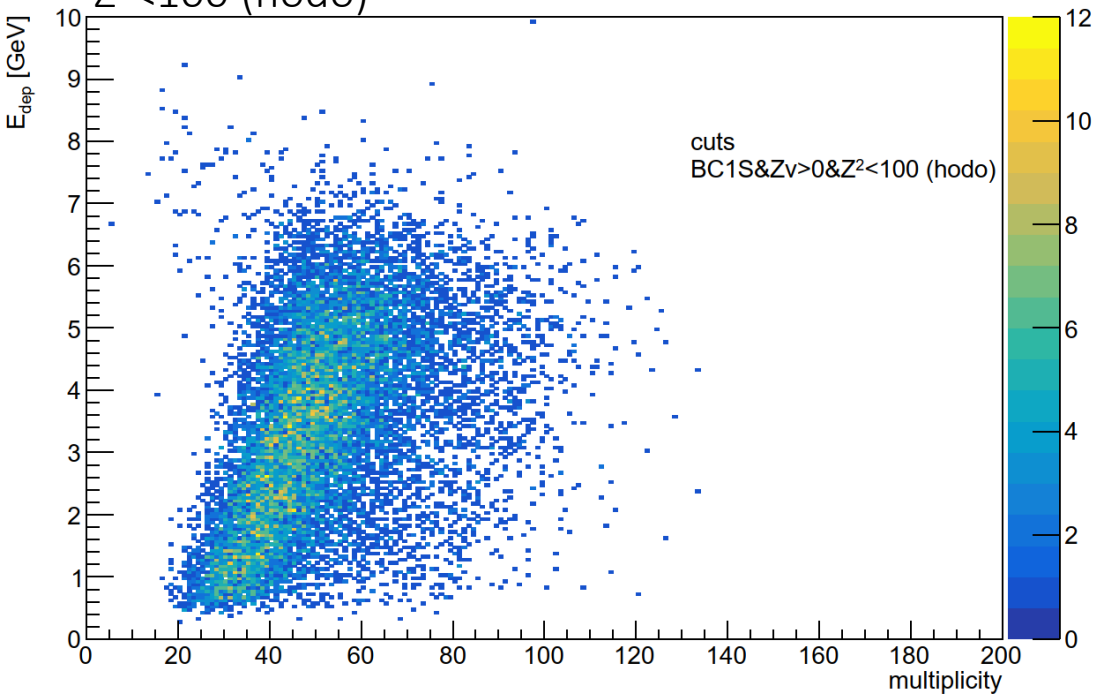
- The general structure and tasks of the scintillation wall have been presented.
- The ScWall performance examples at different energies were demonstrated.
- ScWall calibration results were shown.
- The charges range detected in the BMN run 8 are shown.
- The sensitivity of the ScWall to centrality according to hit multiplicity is shown.
- ScWall hit multiplicity distributions for different spectator charges are shown.
- Correlations of ScWall multiplicity with the calorimeter deposited energy and barrel detector multiplicity are presented.
- *To do: MC simulations and comparison with the run data.*

Thank you for your attention!

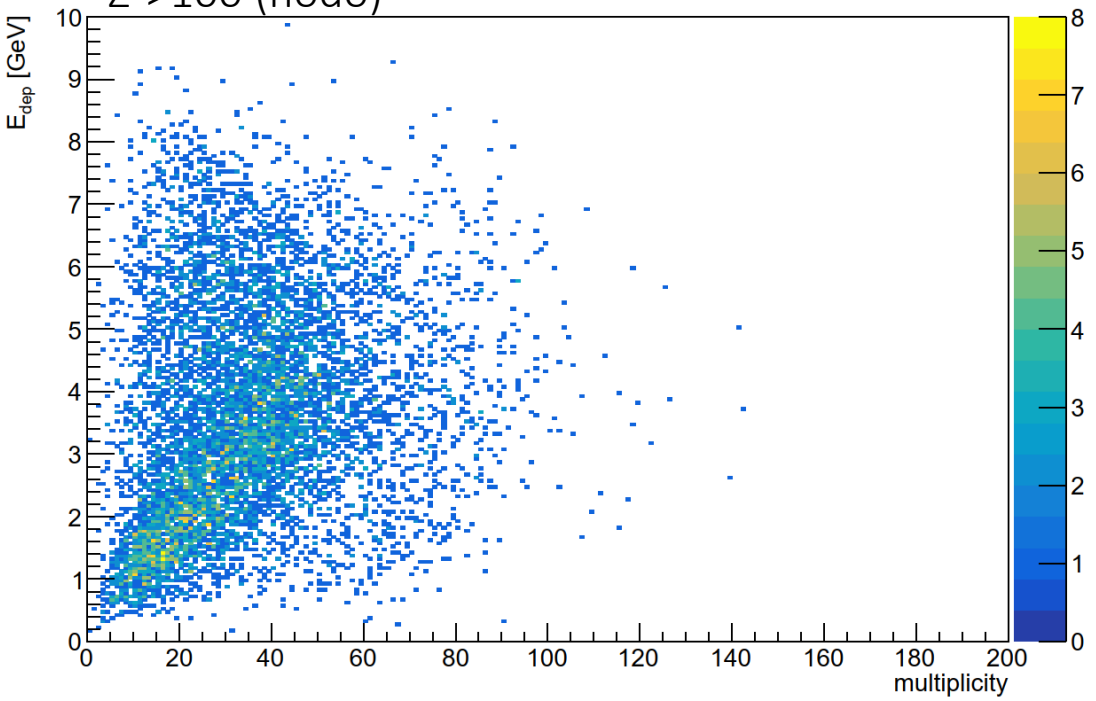
Backup

Edep vs multiplicity (scwall) CCT2 (MBT is equal)

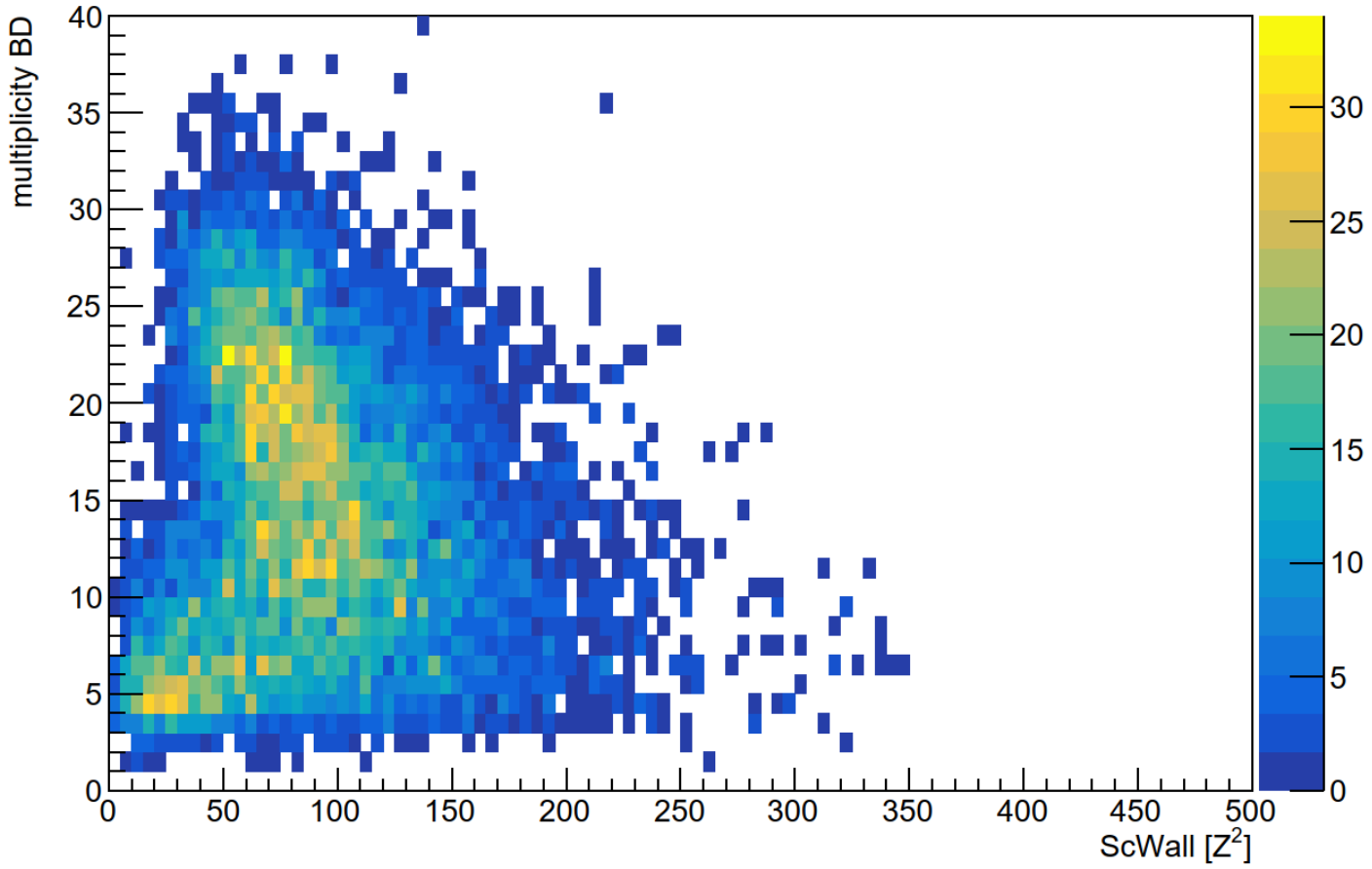
Cut (BC1S)
Cut (vertex & BC1S)
Cut (vertex (|z| > 0) & BC1S)
Z^2<100 (hodo)



Cut (BC1S)
Cut (vertex & BC1S)
Cut (vertex (|z| > 0) & BC1S)
Z^2>100 (hodo)



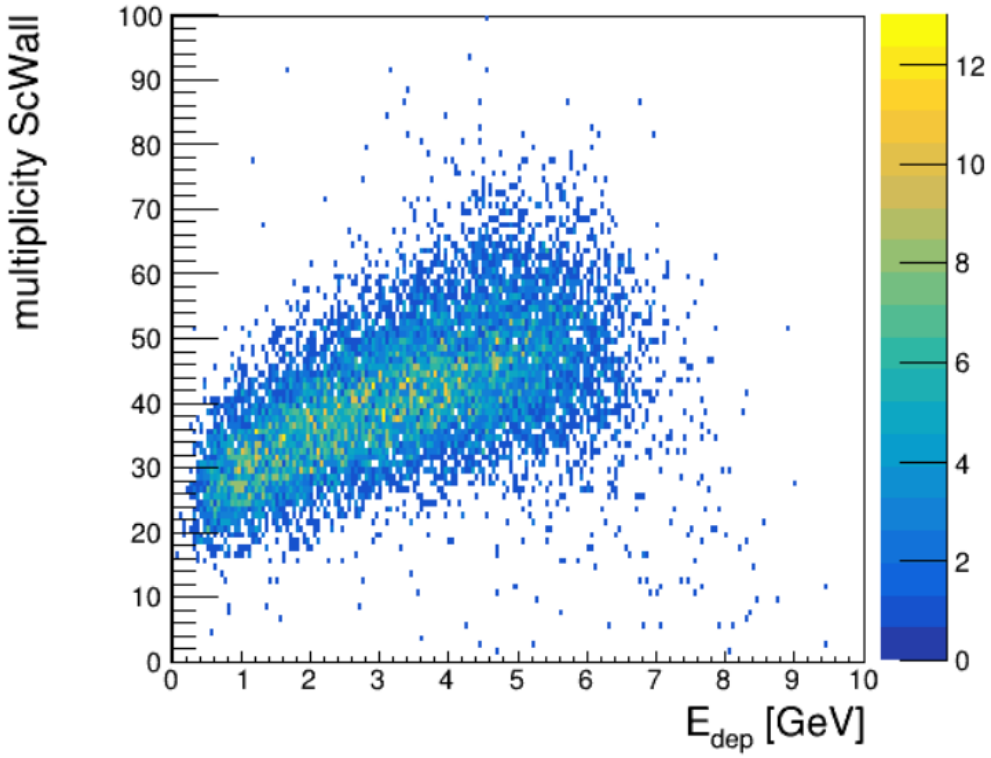
BD mult vs ScWall charge

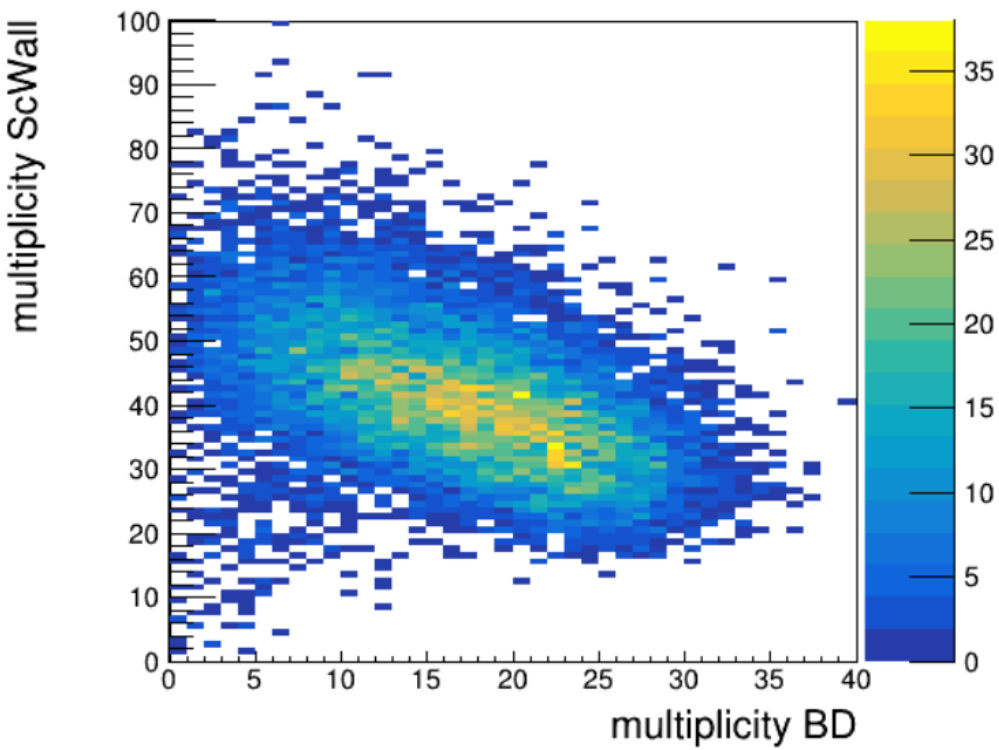


MBT 3.8

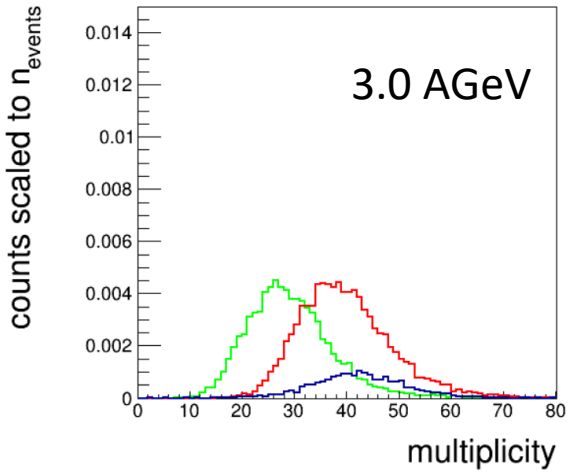
Cuts:
BC1S
Z^2 (ScWall) > 0.4
vertex Z (-1.5 < Z <1.5)
Z^2 (FQH) < 50

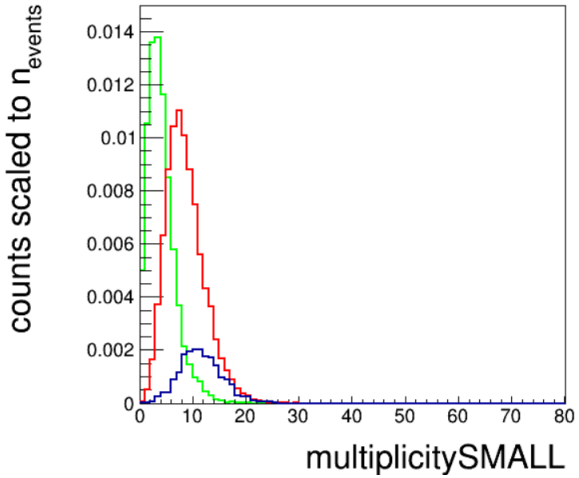
MBT

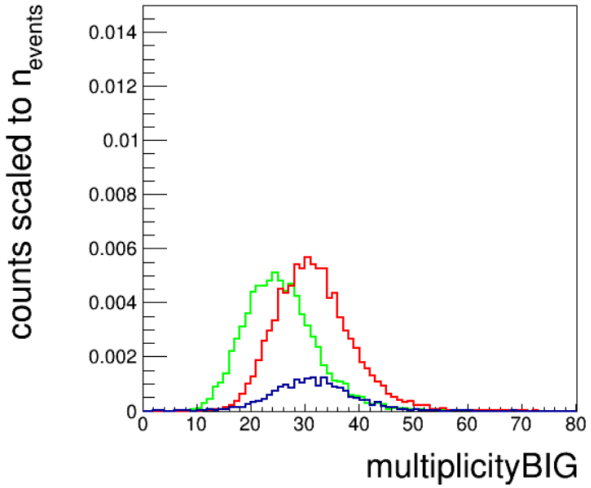


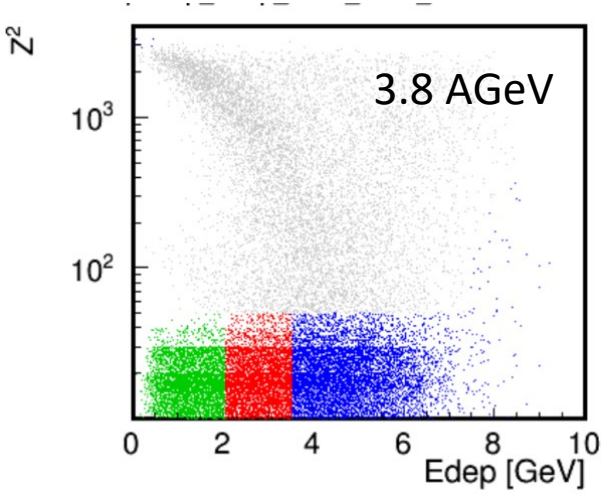


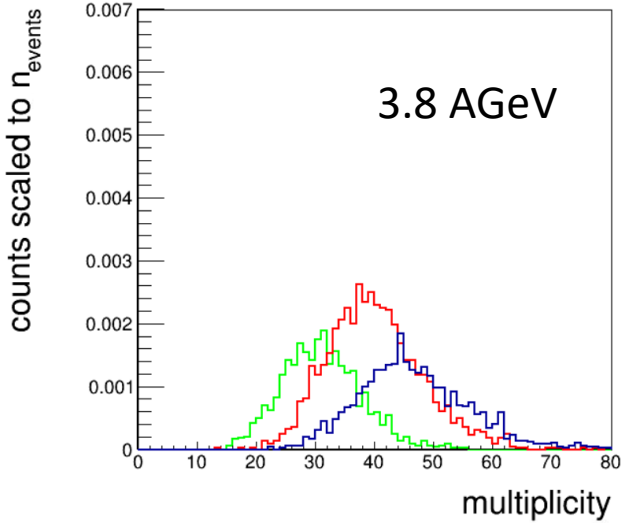
ScWall multiplicity distributions of charged particles for different centrality classes

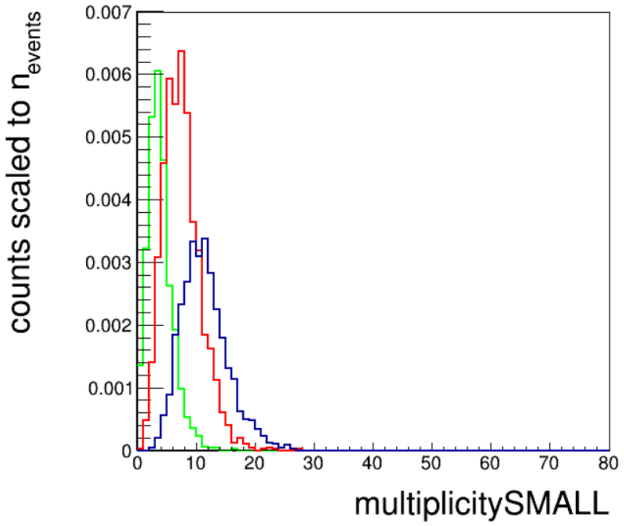


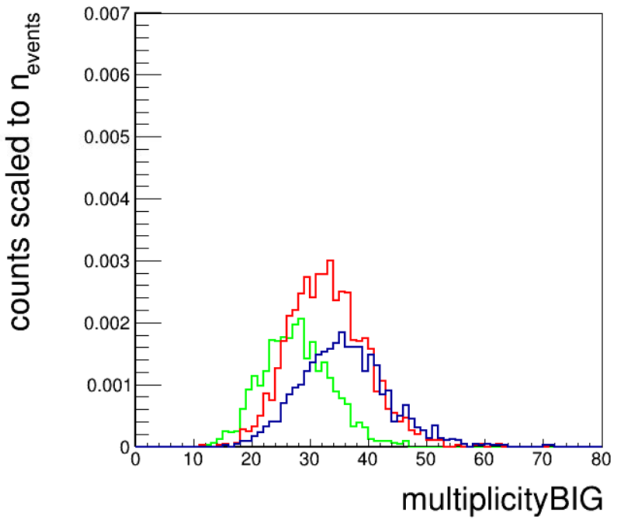






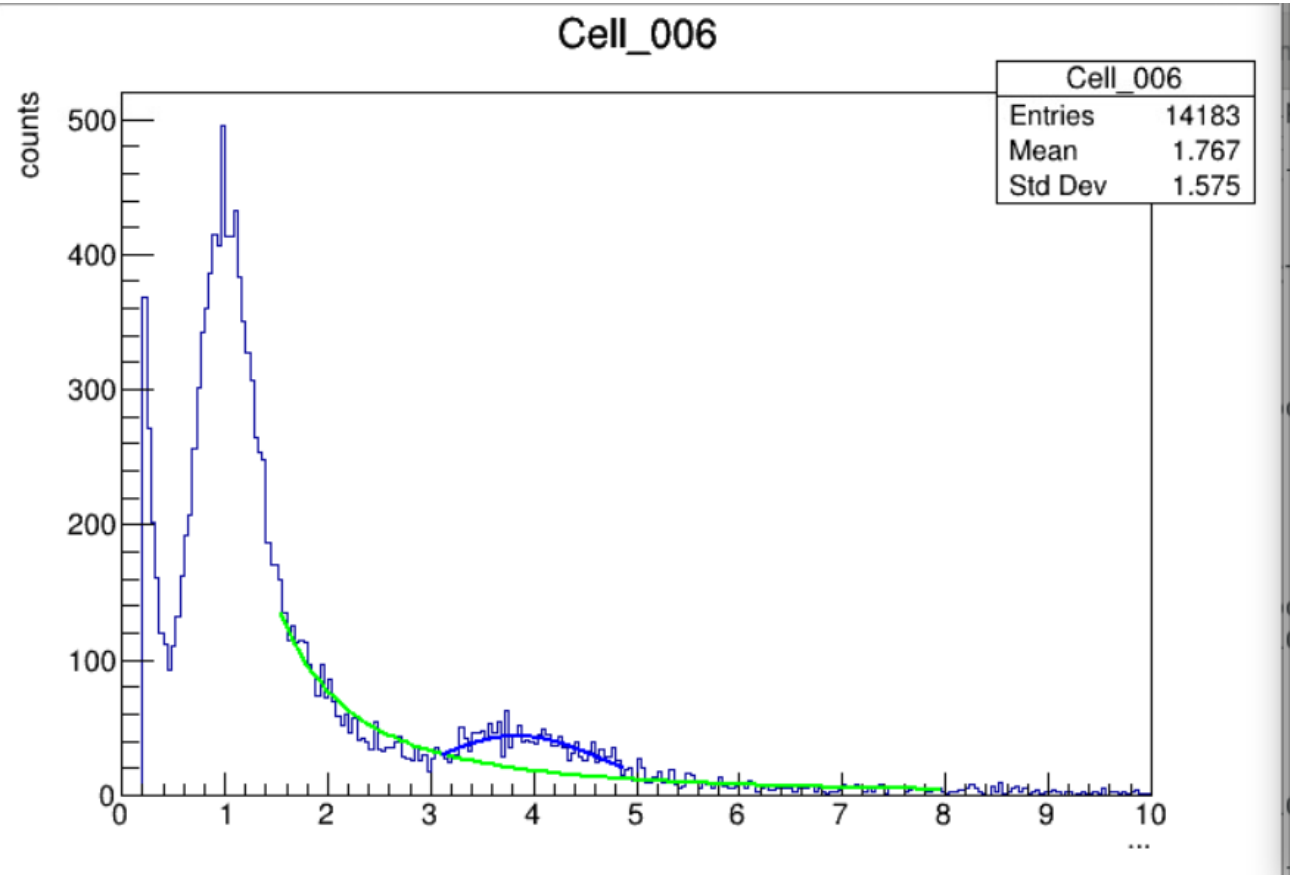


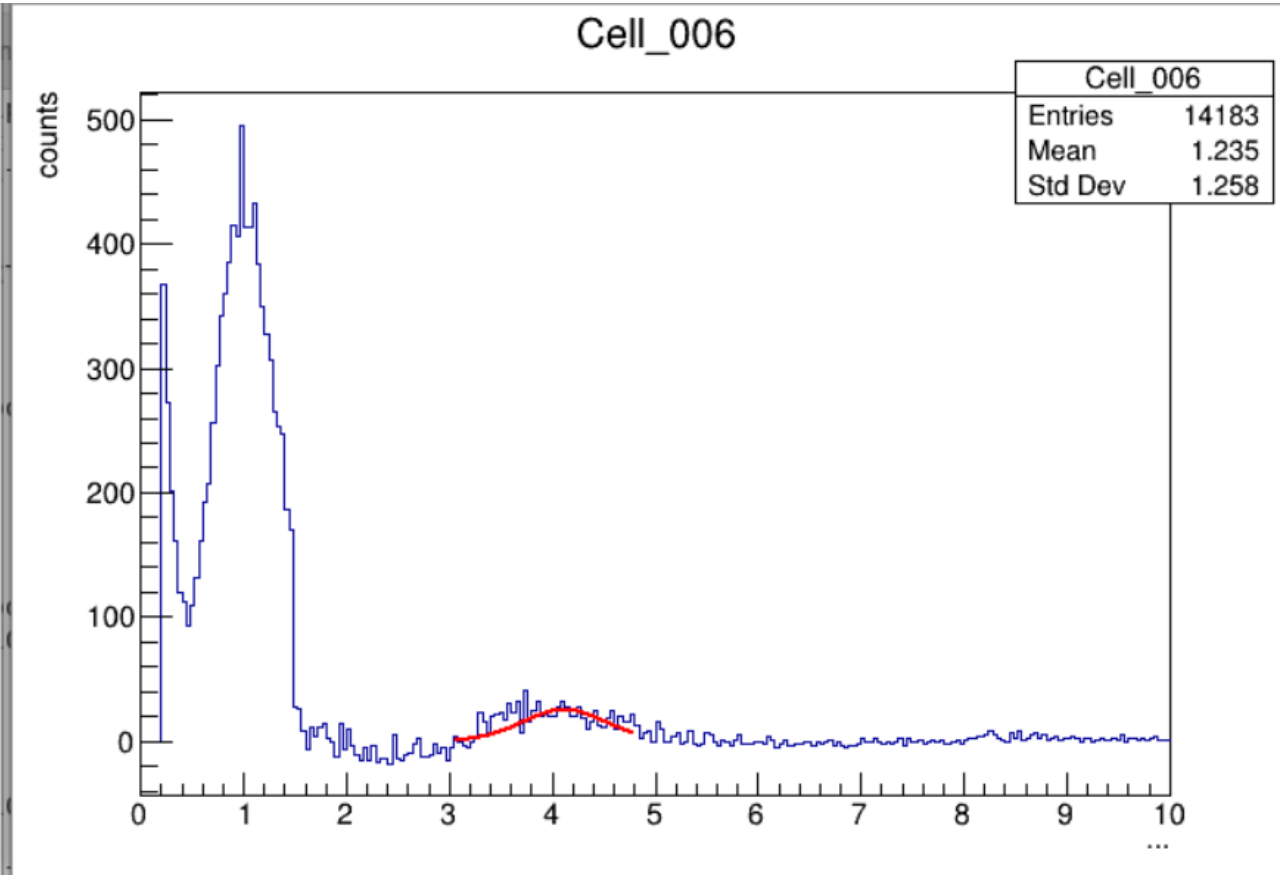


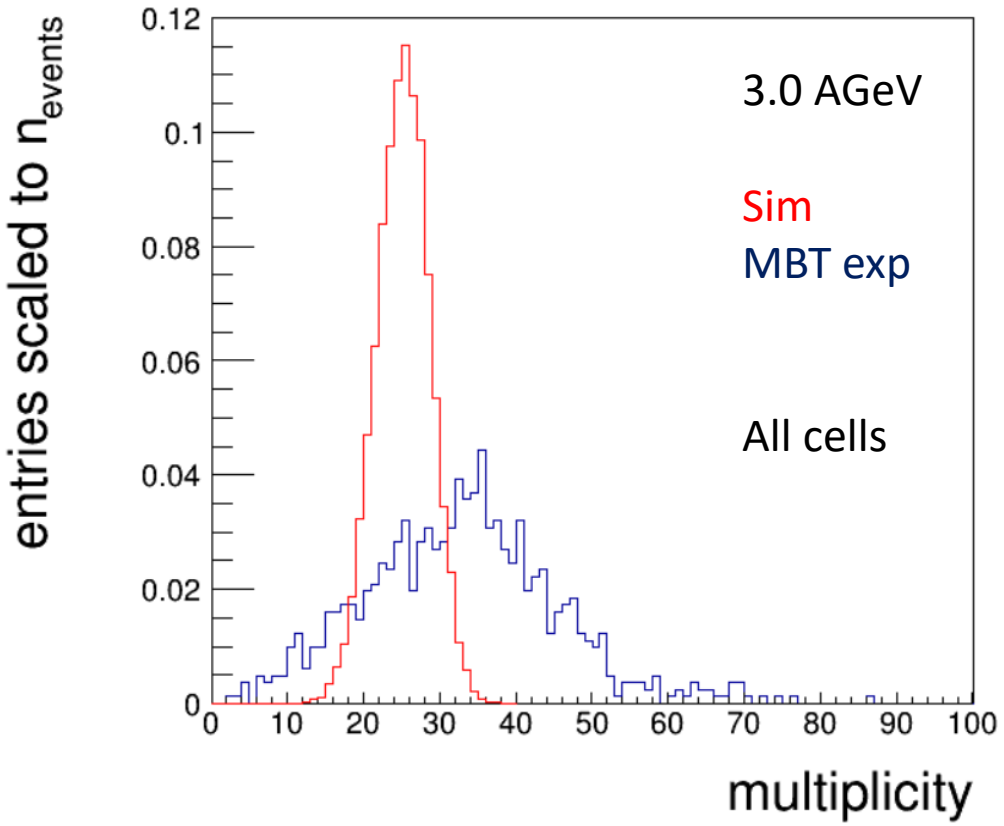


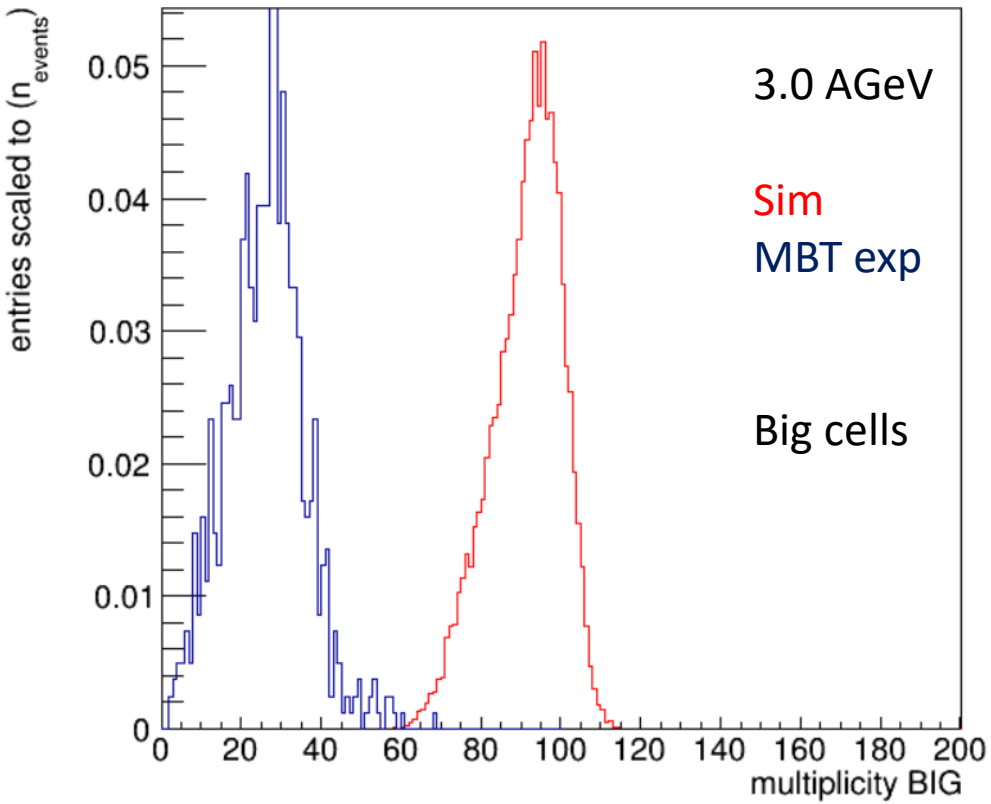
Multiplicity is sensitive to centrality. Green, red and blue reflect the most central, semi-peripheral and peripheral classes of events.

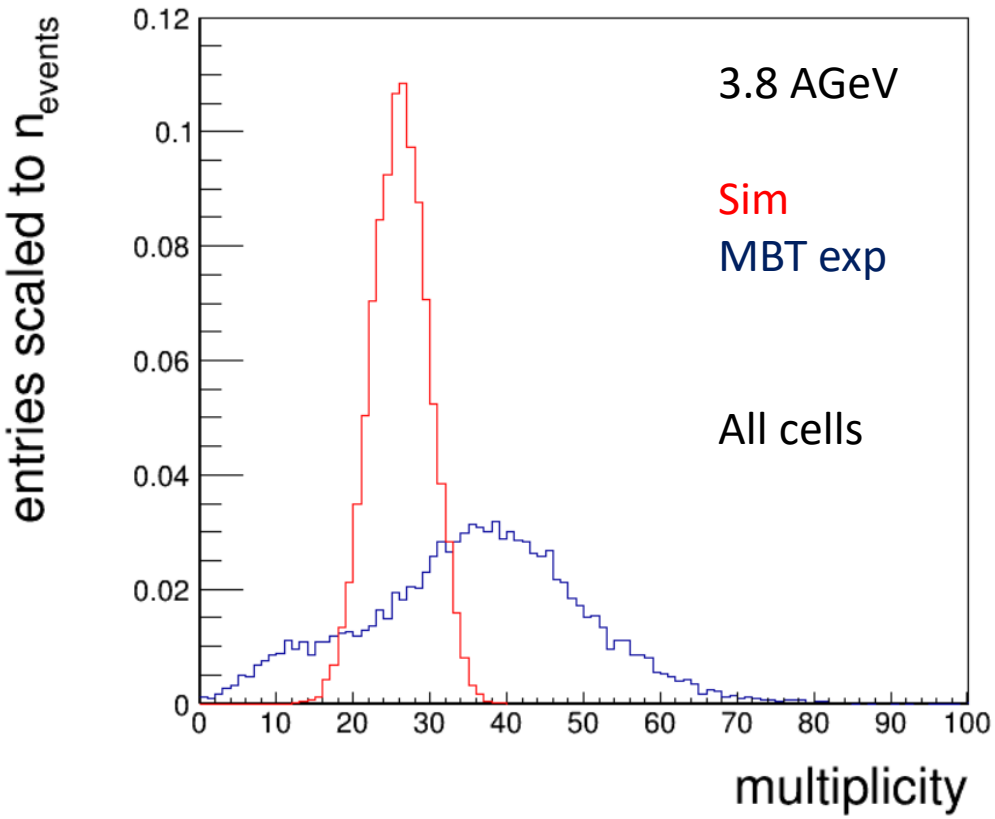
Background subtr.
Before / after

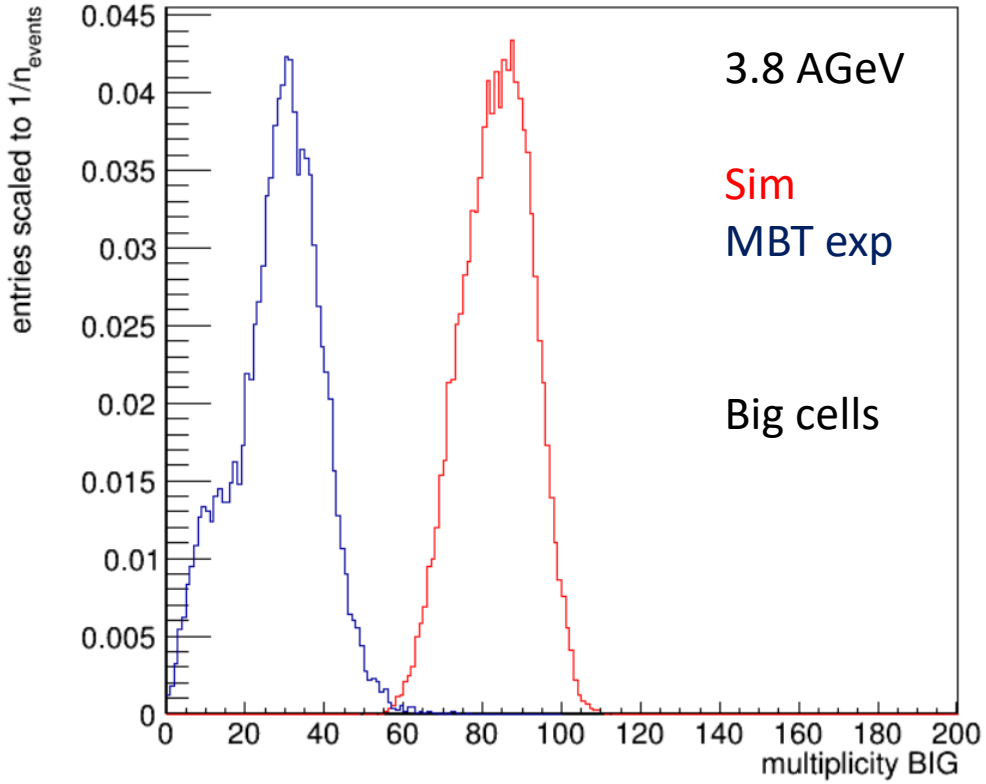





entries scaled to n_{events}
0.12
0.1
0.08
0.06
0.04
0.02
0
0 10 20 30 40 50 60 70 80 90 100
multiplicity
3.0 AGeV
Sim
MBT exp
All cells


entries scaled to (n_{events})
0.05
0.04
0.03
0.02
0.01
0
0 20 40 60 80 100 120 140 160 180 200
multiplicity BIG
3.0 AGeV
Sim
MBT exp
Big cells


entries scaled to n_{events}
0.12
0.1
0.08
0.06
0.04
0.02
0
0 10 20 30 40 50 60 70 80 90 100
multiplicity
3.8 AGeV
Sim
MBT exp
All cells


entries scaled to $1/n_{events}$
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0 20 40 60 80 100 120 140 160 180 200
multiplicity BIG
3.8 AGeV
Sim
MBT exp
Big cells