First Performance Plots of the B0 Calorimeter
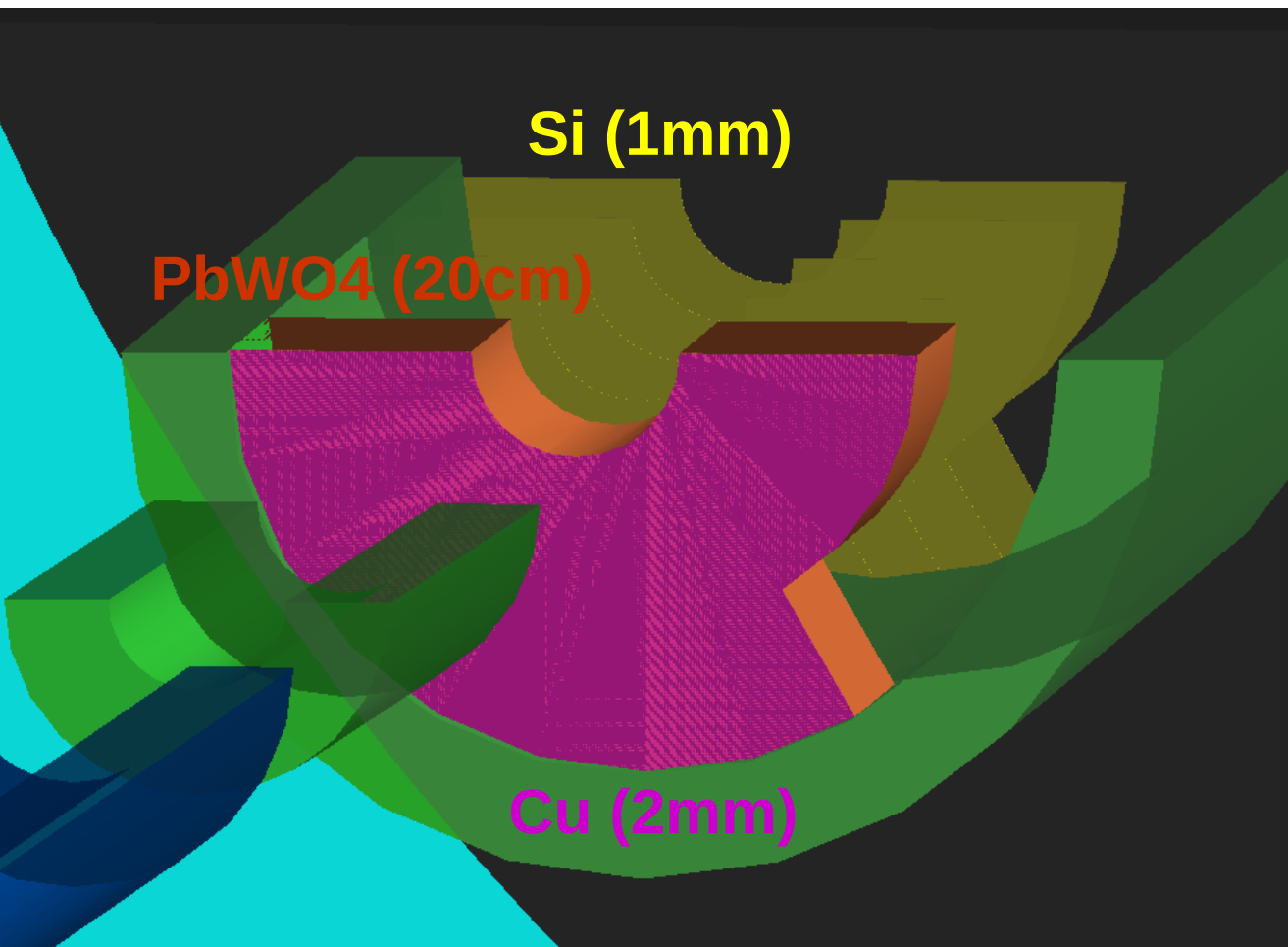
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The University of Kansas

Far-Forward/Far-Backward Meeting, October 28th 2021

Outline

- Realistic B0

- B0 Calorimeter

- Performance plots with photons
  - Position resolution
  - Energy studies

- Summary

Realistic B0

Controlled shape parameters
(with current values at IP6):

Layer Length (0.1, 0.2, 20cm)
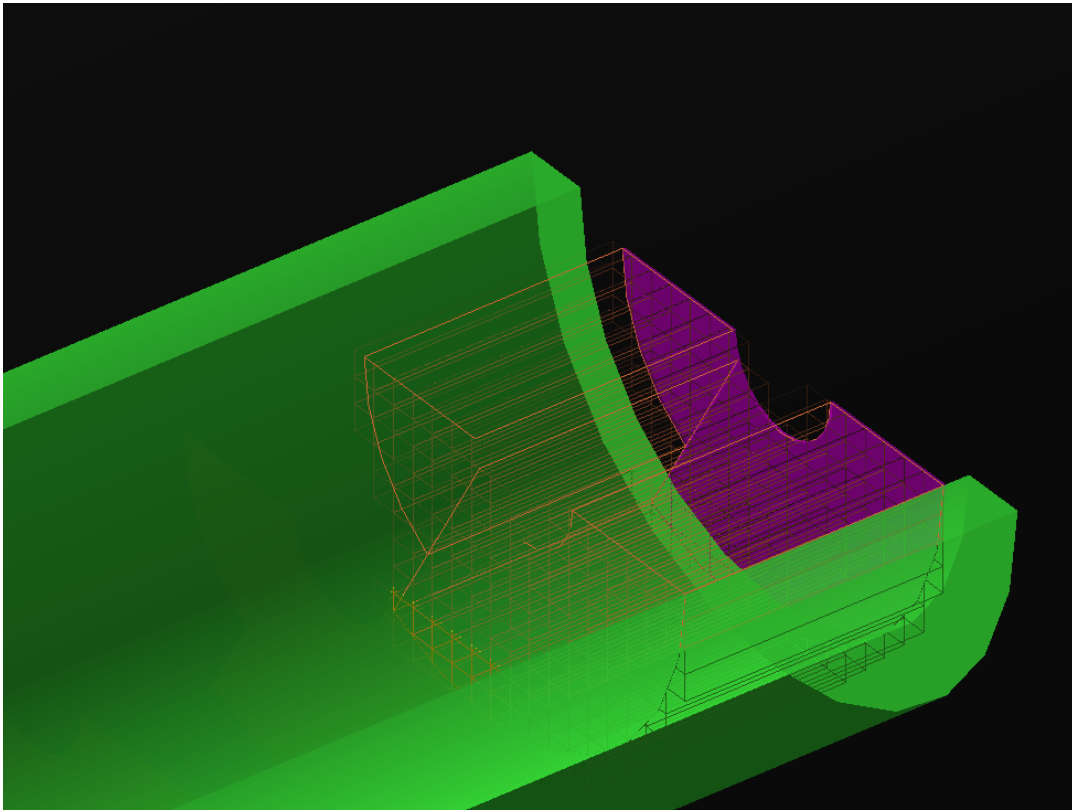Layer Material (Si, Cu, PbWO4)
Radius (20cm)
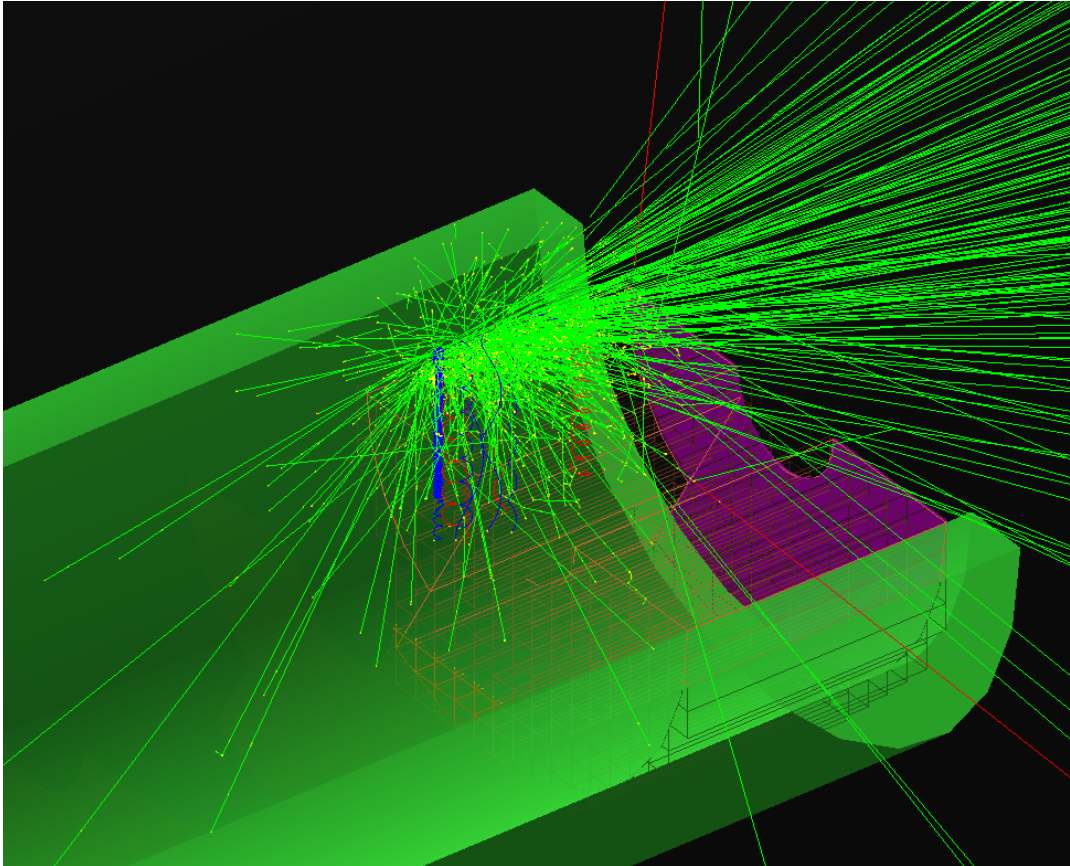ΔRadius (5cm)
Spanning Angle (240°)
Beampipe position (-3.4 cm)

B0 Calorimeter

One 20cm layer of PbW0$_4$

2*2cm granulation implemented in current studies

B0 Calorimeter

One 20cm layer of PbW0$_4$
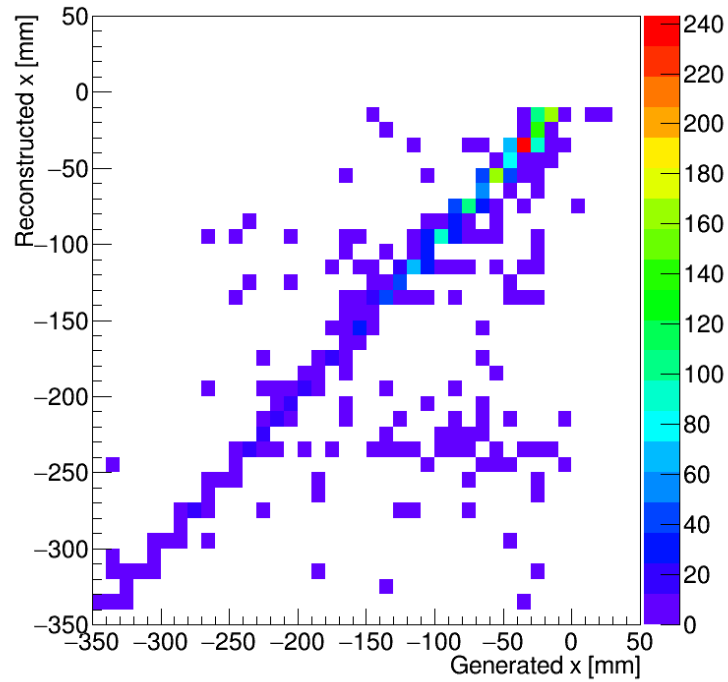
2*2cm granulation implemented in current studies

Example of a 50 GeV photon
in the forward direction

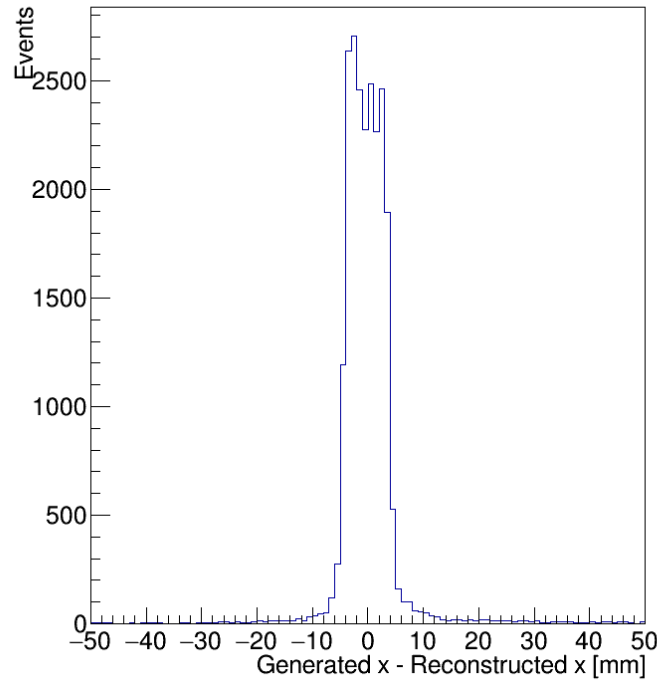1-100 GeV photons produced in 3 < η < 7 range were used in further studies.

The reconstructed variables are from the ntp_cluster TTree produced by CaloEvaluator

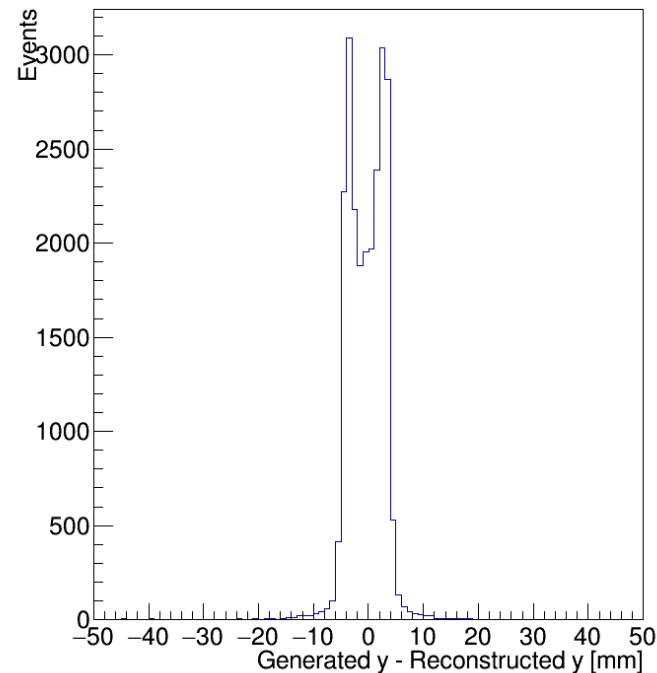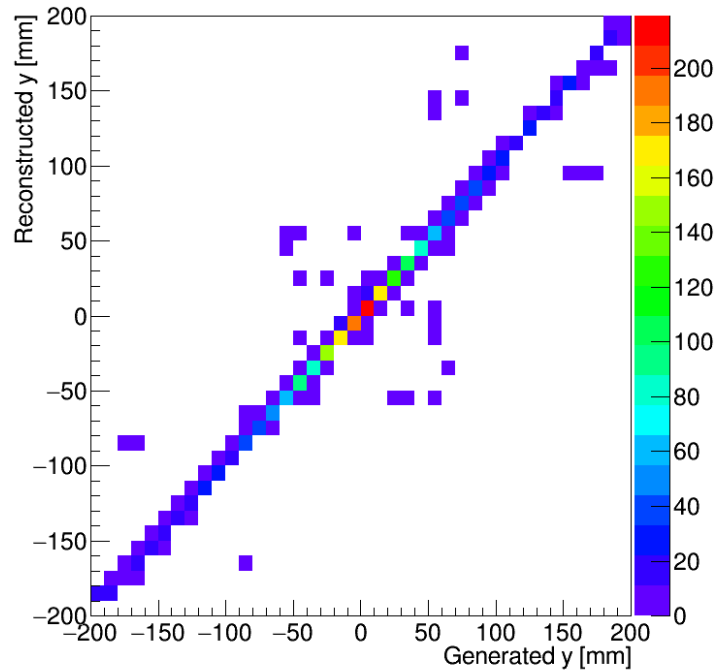# Basic resolution plots for 1-100 GeV photons

Note:

Reconstructed positions correspond to the cluster Position.

For the generated photon we have pseudorapidity η and angle φ – so x-y coordinates are calculated for the center of the B0 Calorimeter: L = 688 cm.
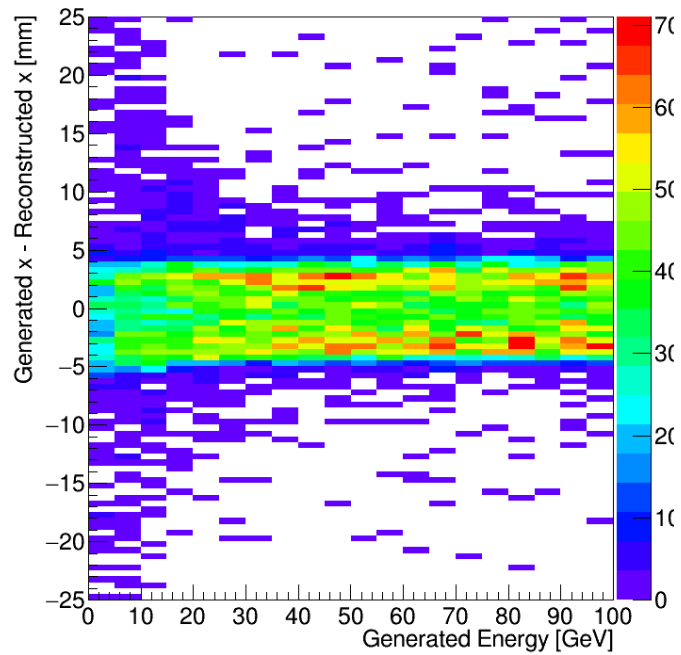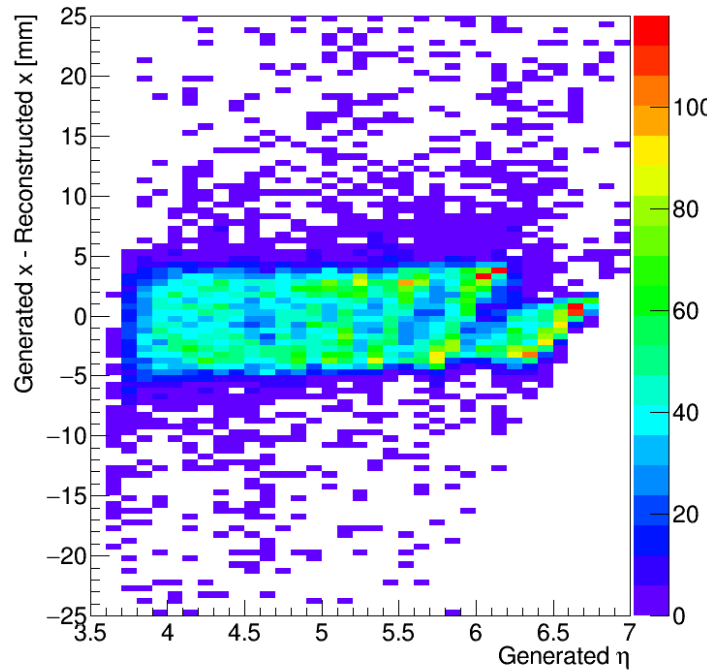
Position resolution is in the 10mm range for the photons

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More detailed look at position resolution
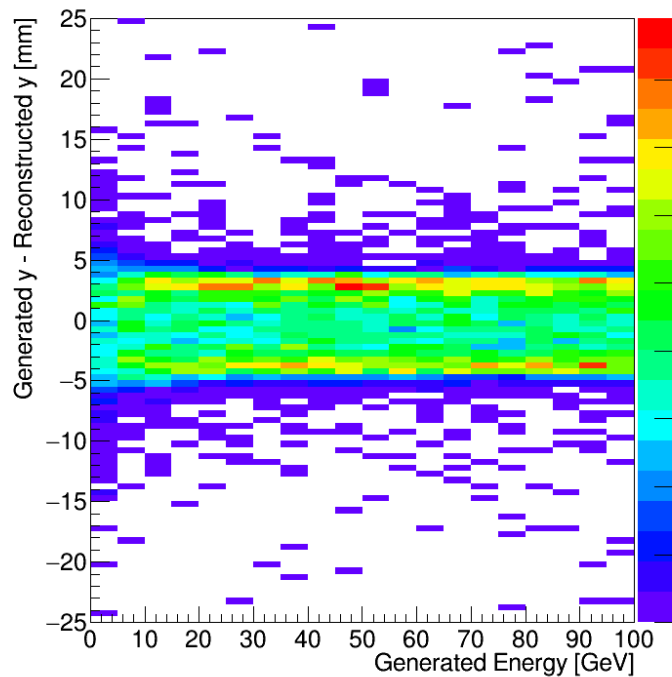
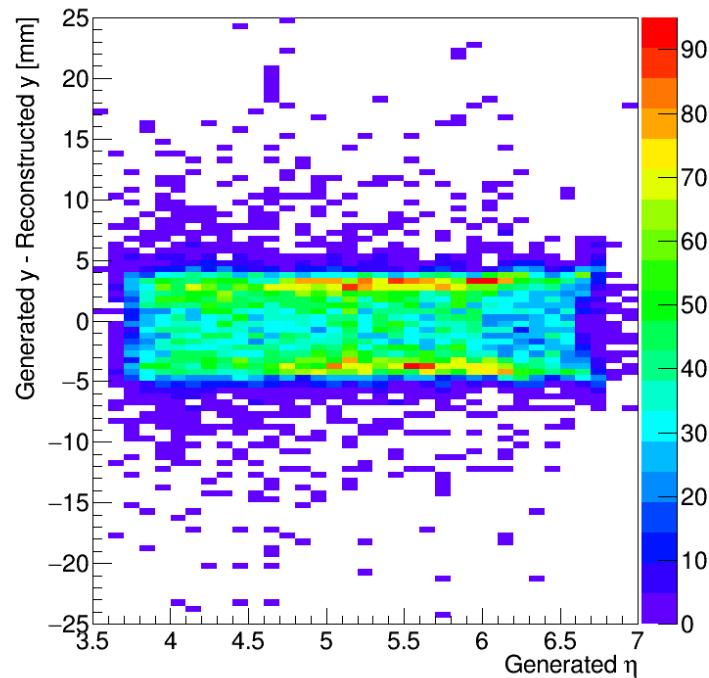X-resolution as a function of energy

X-resolution as a function of η

Y-resolution as a function of energy

Y-resolution as a function of η

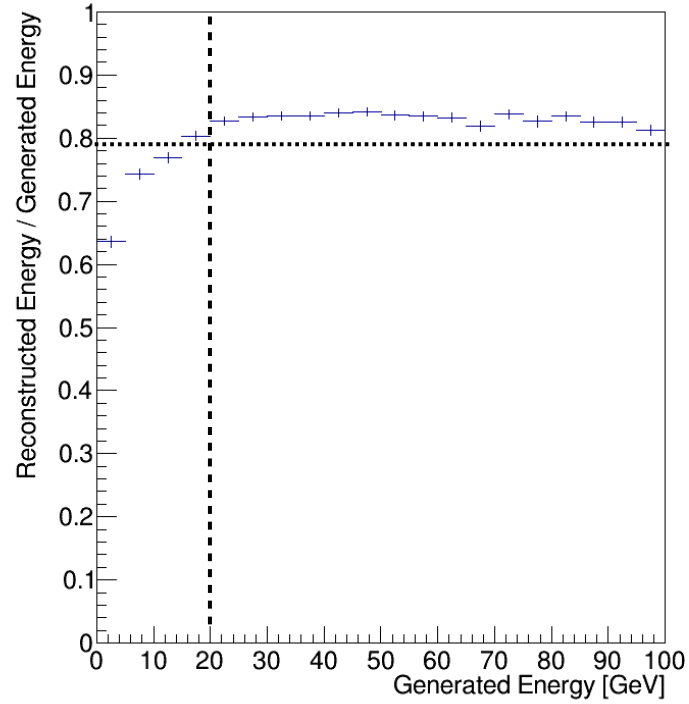Position resolutions are the same for all energies and η
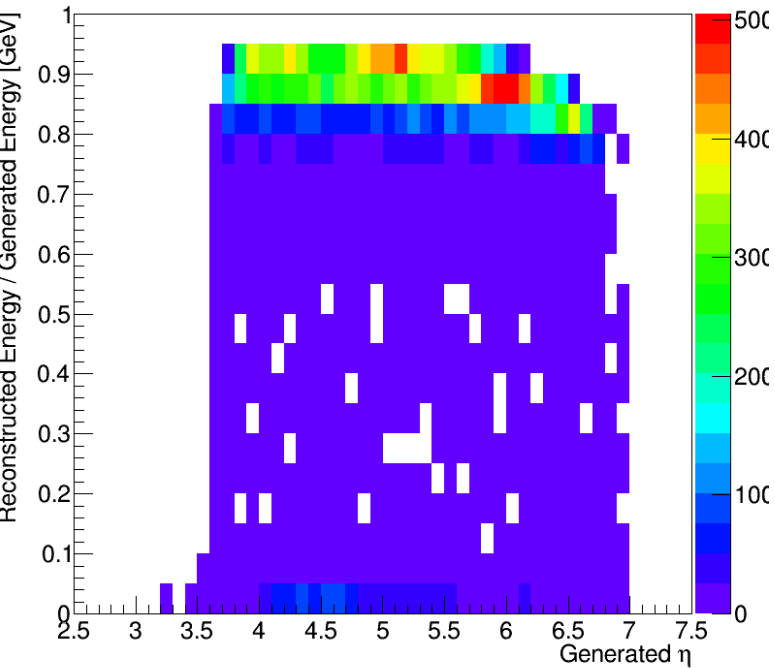
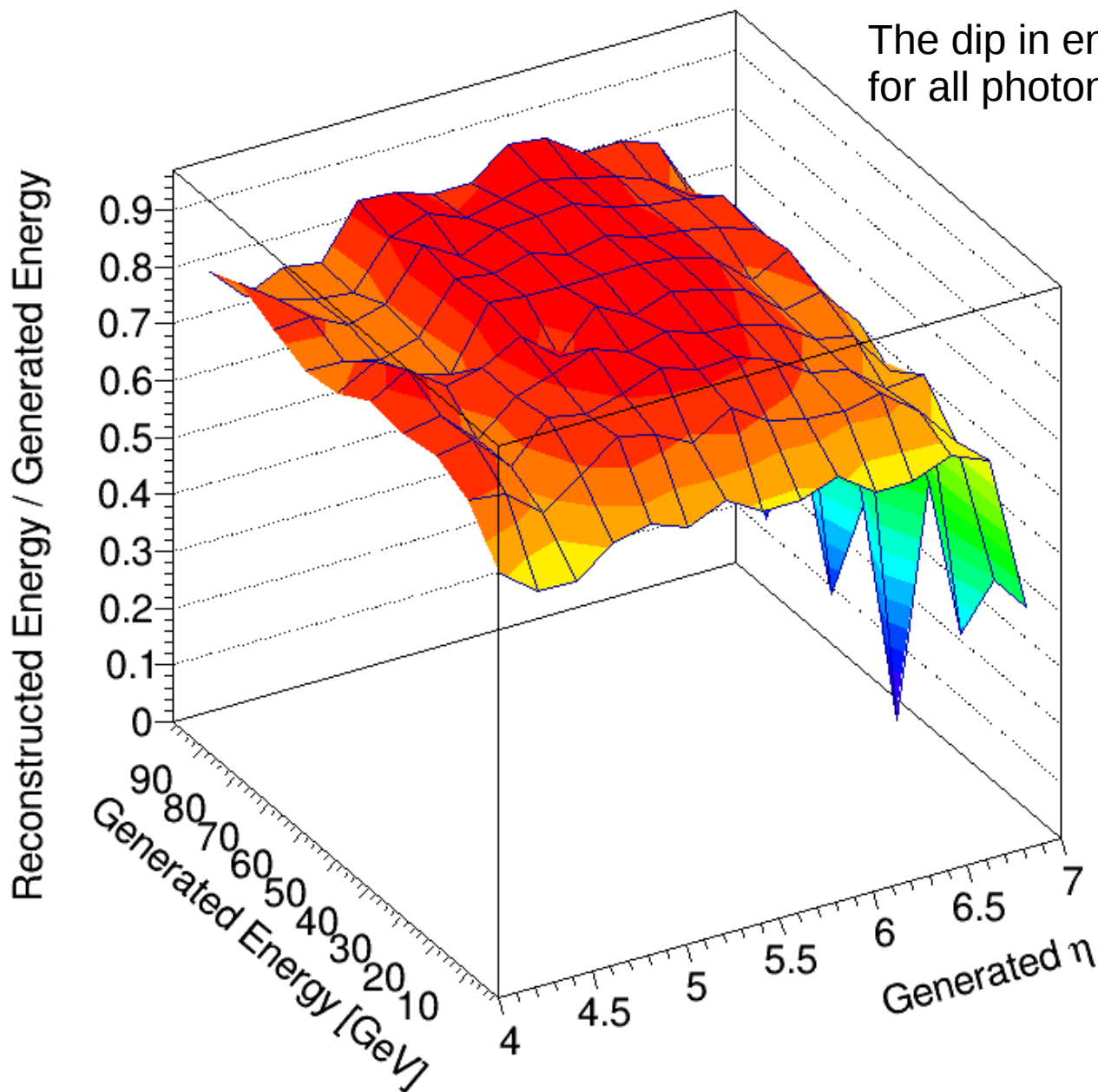# Basic resolution plots for 1-100 GeV photons
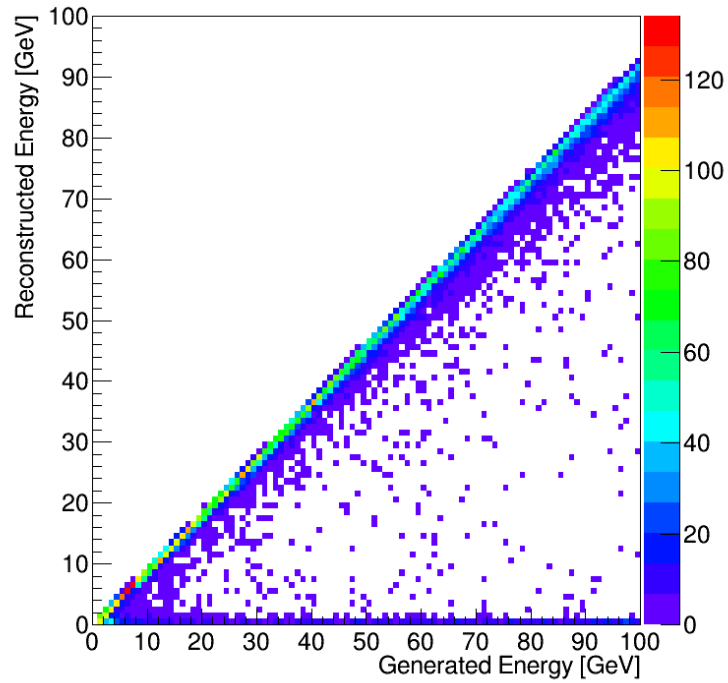
Energy containment is above 80% for photon Energy > 20 GeV

Dip?
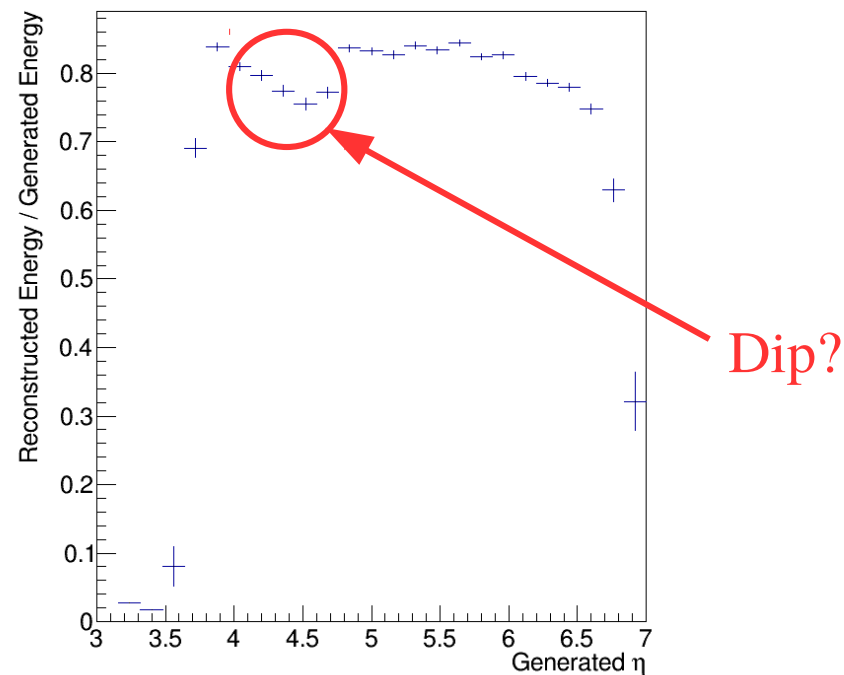
More detailed look at energy resolution
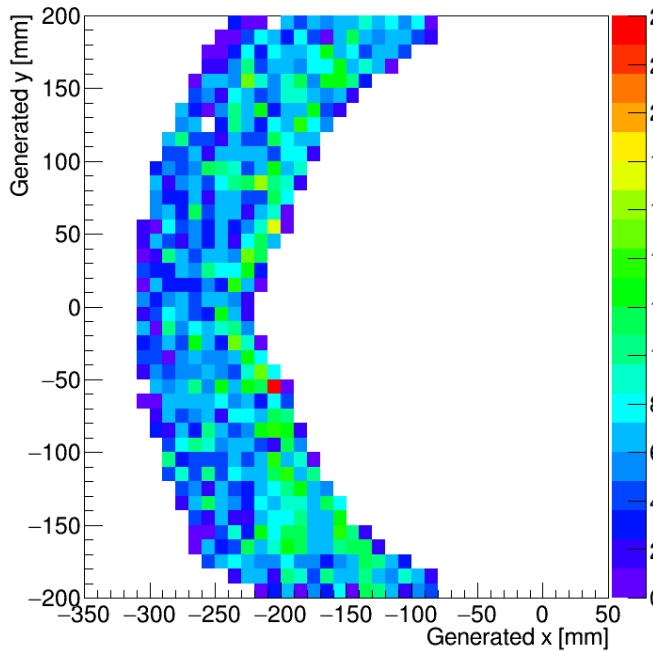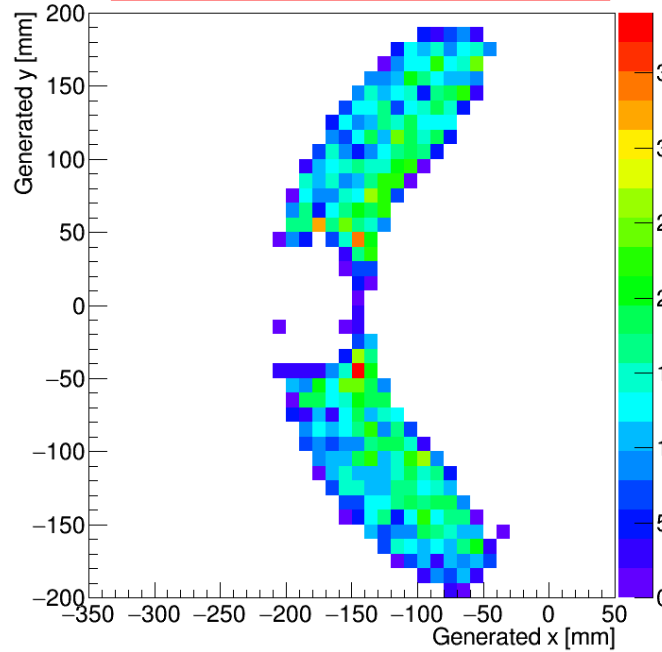

Energy resolution in η-energy plane

The dip in energy containment is present at η ≈ 4.5 for all photon energies 1-100 GeV
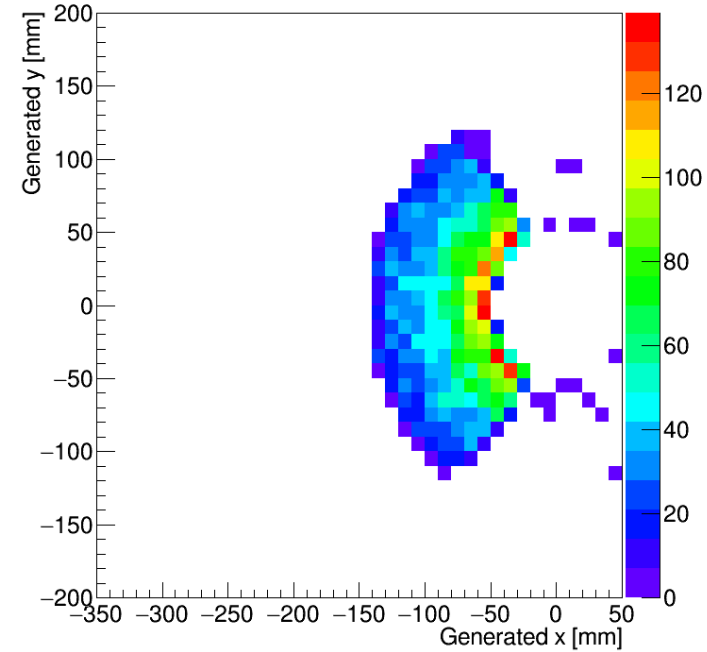
Where do the particles at η ≈ 4.5 go?

XY-position for 3.8 < η < 4.2 photons

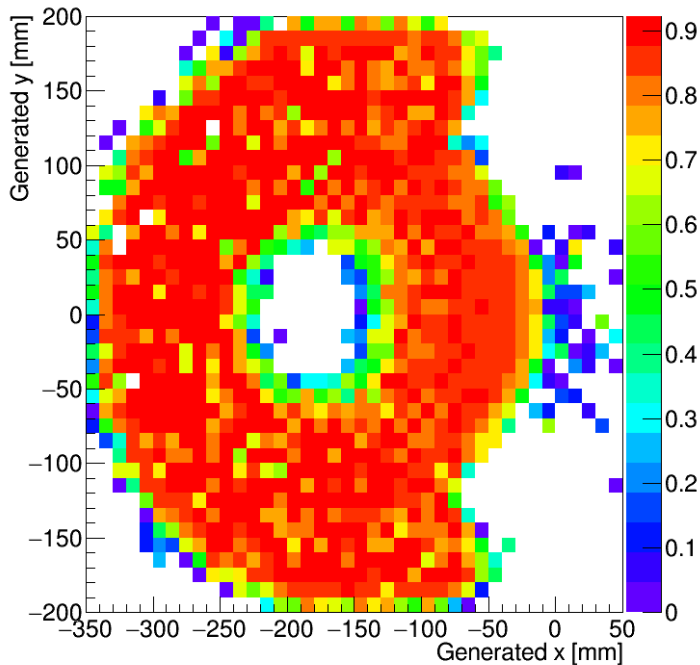XY-position for 4.2 < η < 4.6 photons

XY-position for 4.6 < η < 5.6 photons
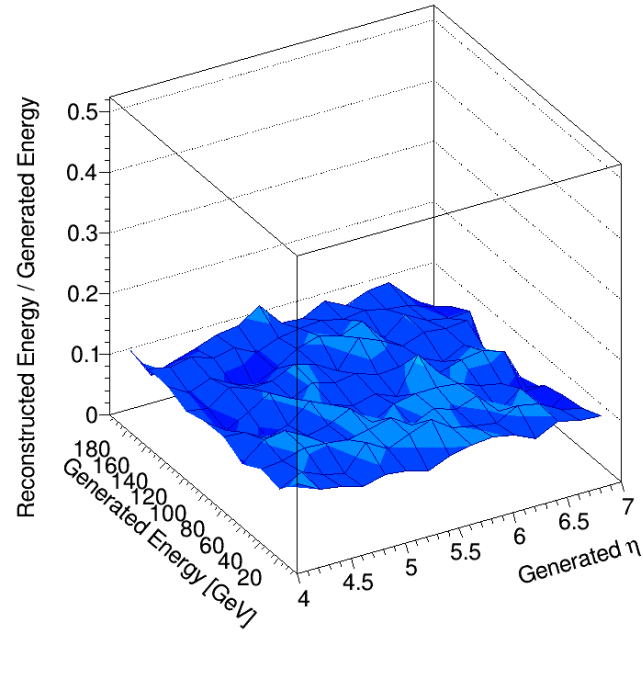
Energy resolution as a function of x-y coordinates

The η ≈ 4.5 region corresponds to the detector cut-off for the hadron beam pipe.

As the energy containment is worse near detector edges, we result in a drop for the rapidity distribution.
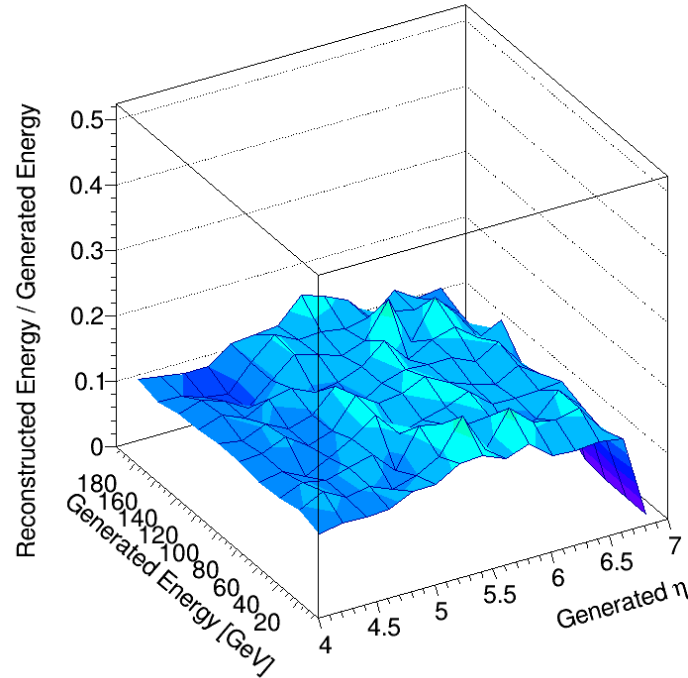
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Brief look at other particles
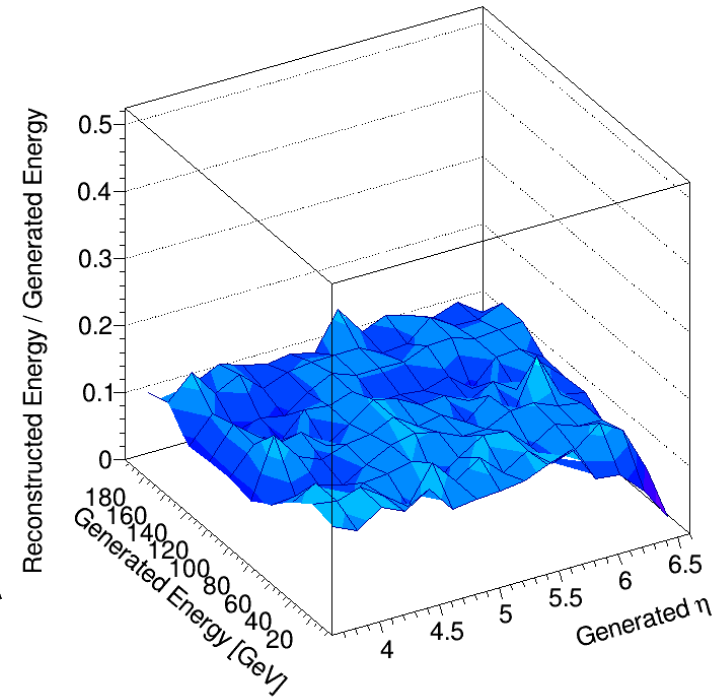
Proton

Neutron

Pion

Energy resolution in η-energy plane

As could be expected hadrons leave only around 10% of their energy in the B0 Calorimeter.

Summary

- The B0 Calorimeter have been implemented in Fun4All with the 2*2cm granularity

  – The pull request to merge the code to the master branch is expected early next week.

- First performance studies performed with the B0 Calorimeter for the generated photons

  – Position resolution is within 10 mm independent on the energy/pseudorapidity

  – Energy containment is above 80% for [4 < η < 6.5], [20 < E < 100 GeV] photons with a slight drop around η ≈ 4.5 because of the detector cut-off for the hadron-beam pipe.

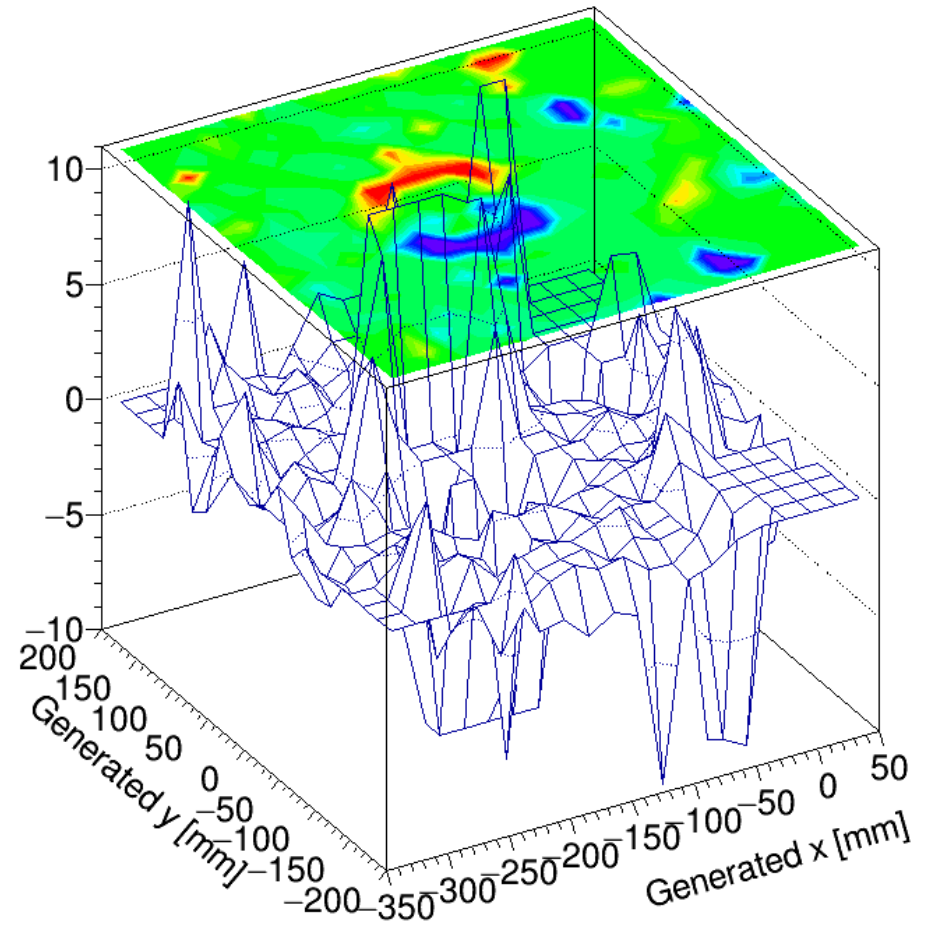- Hadrons leave around 10% of their energy in the B0 Calorimeter.

Backup slides

Position resolution

X-resolution as a function of x-y coordinate
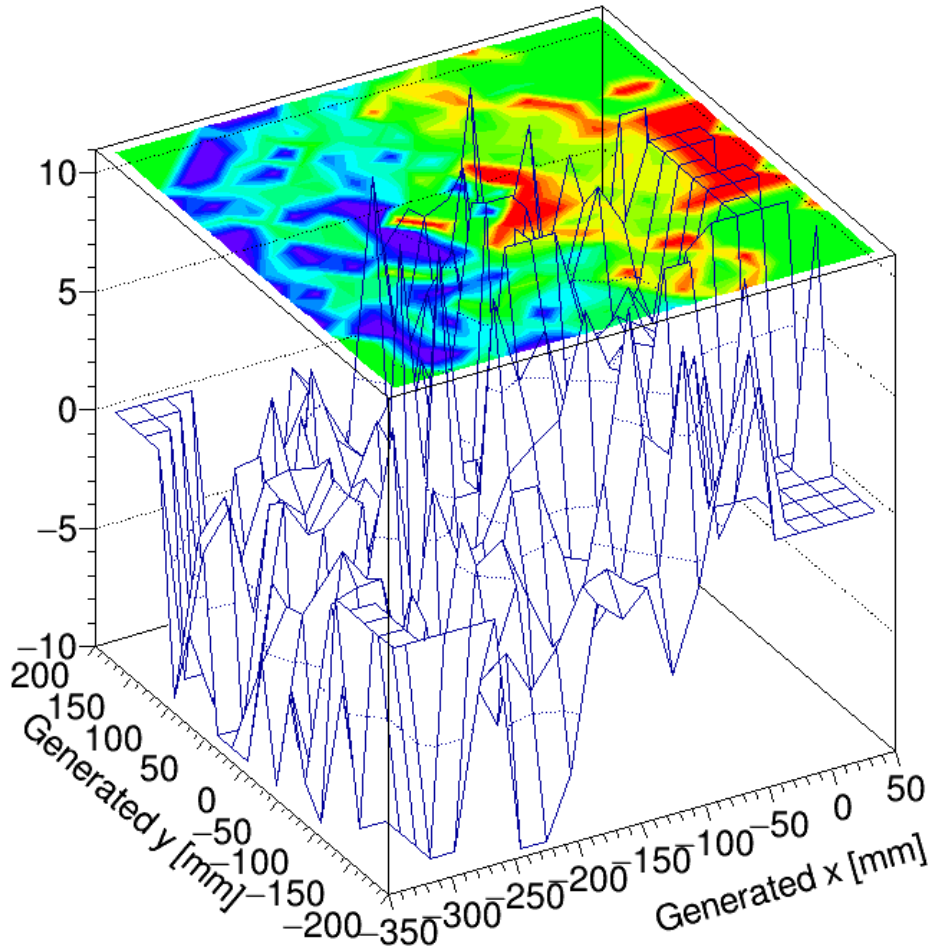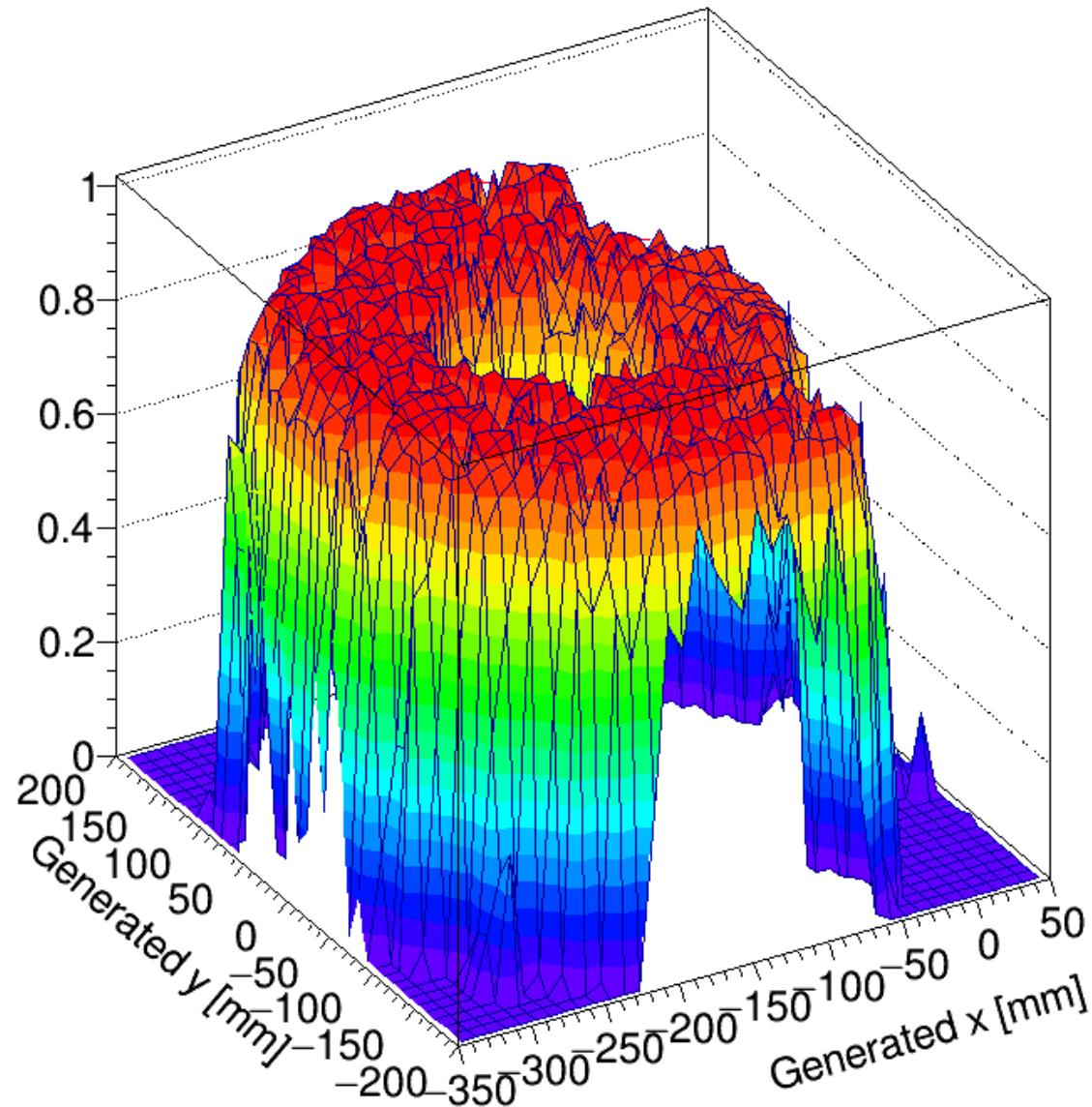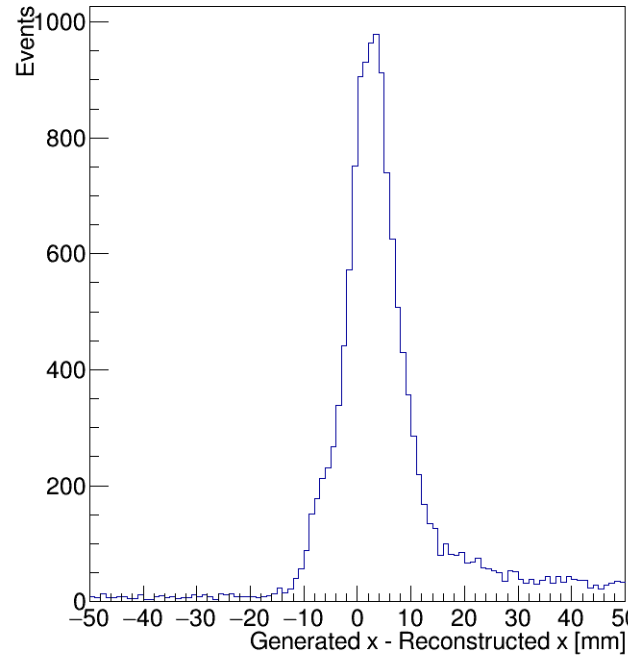
Y-resolution as a function of x-y coordinate

Energy containment

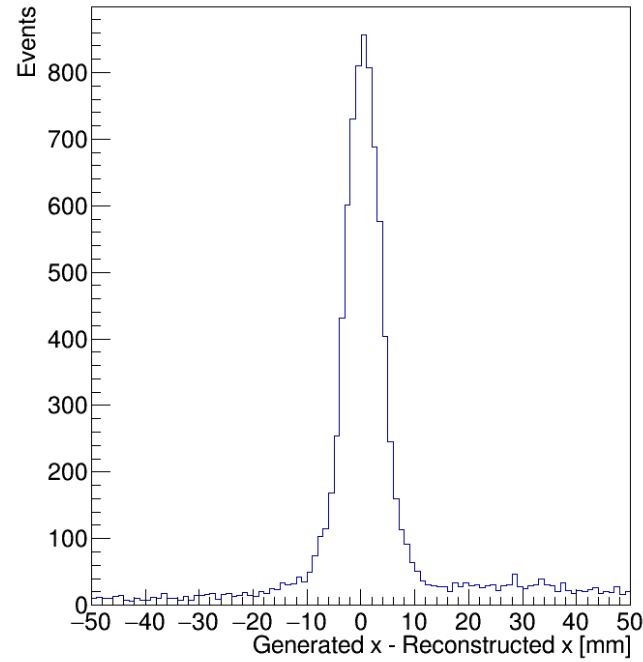Energy resolution as a function of x-y coordinates
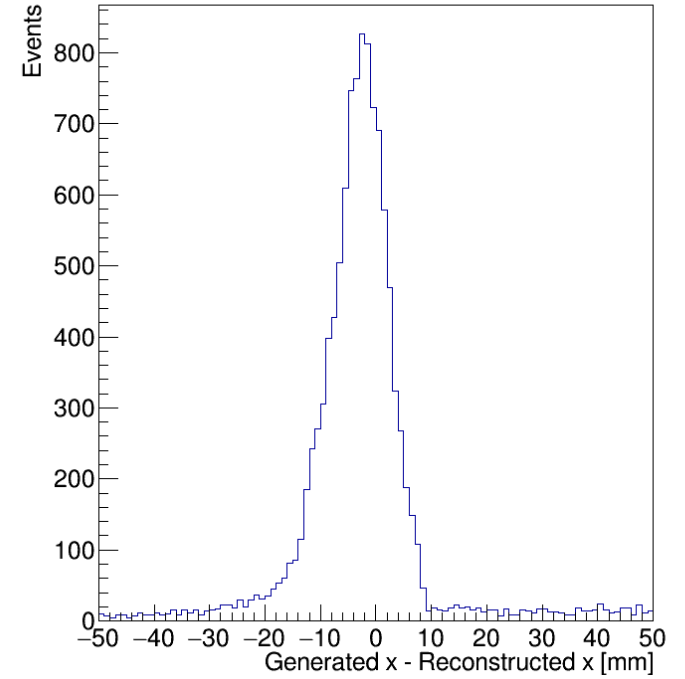
Hadrons