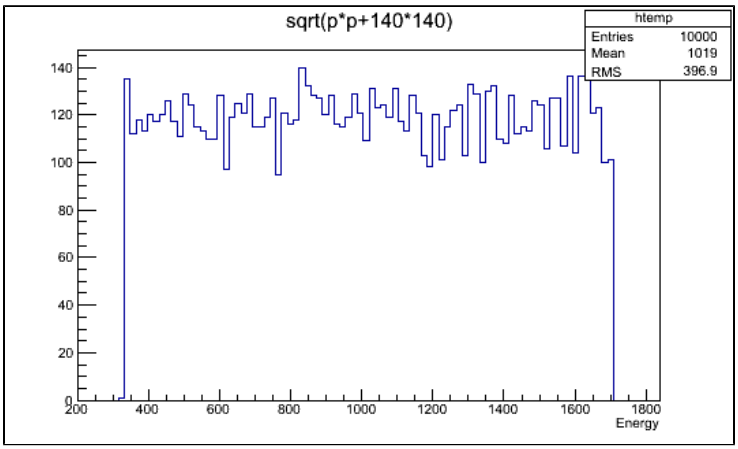
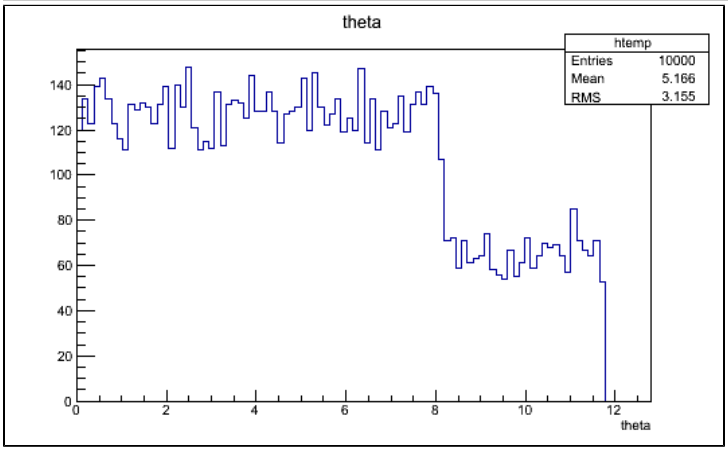
ECal Pi0 Acceptance

Using GEMC simulation of HPS, I simulated 100 000 pi0 originating from two different vertexes: the target position and the proposed extra target position (1m in front of the usual one placed on the photon beam line).

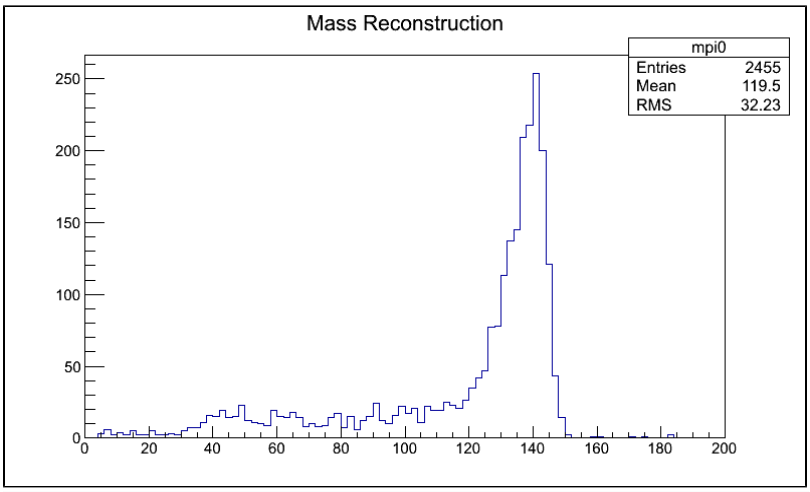
(There is no background included in this simulation)

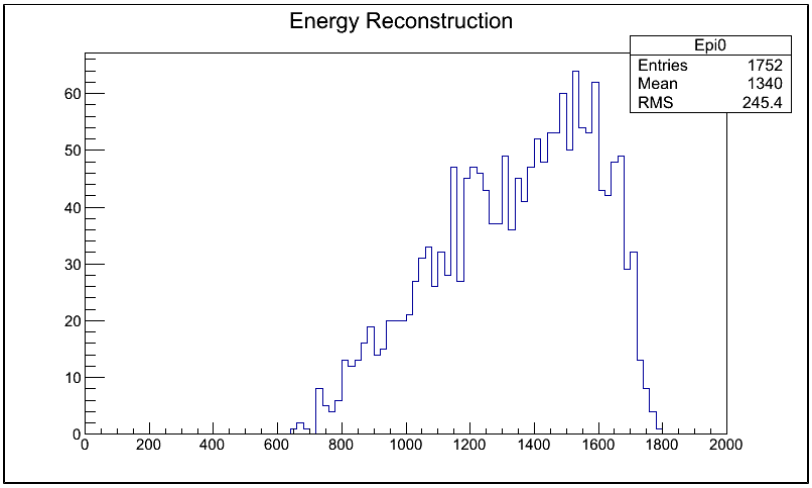
The Energy (MeV) and theta distribution are shown here:

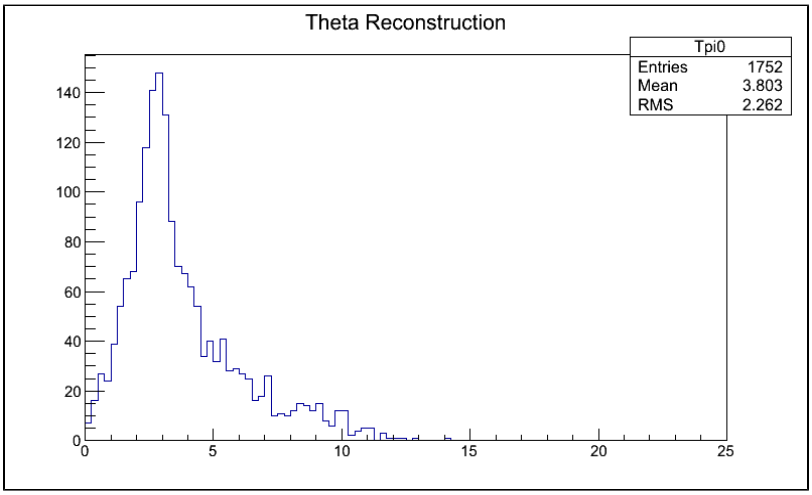


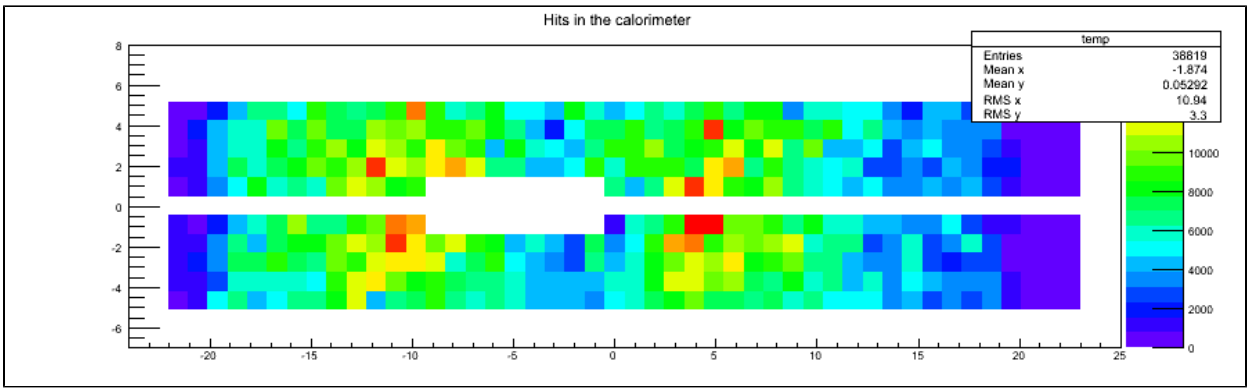


The reconstructed distributions (MeV, MeV, degrees) for the normal target:

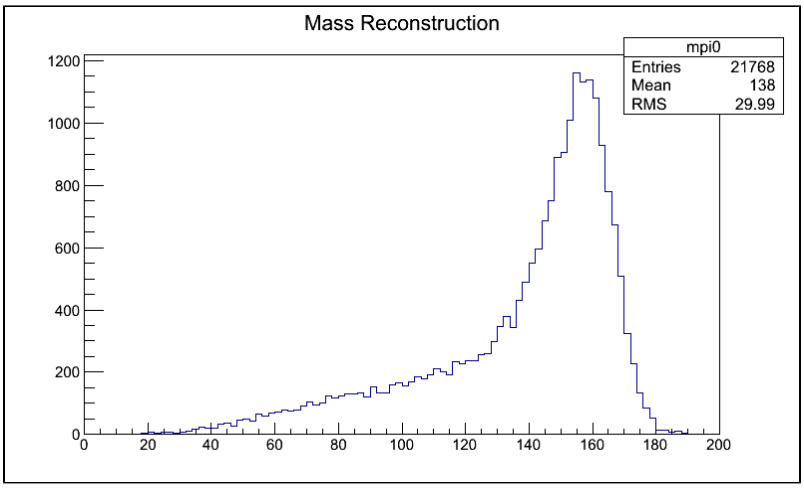

Mass Reconstruction
mpi0
Entries 2455
Mean 119.5
RMS 32.23
0 20 40 60 80 100 120 140 160 180 200
0 50 100 150 200 250

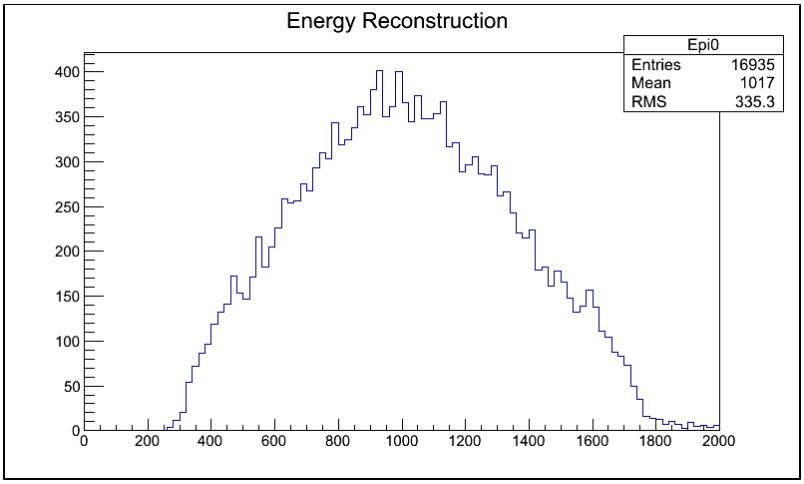

Energy Reconstruction
Epi0
Entries 1752
Mean 1340
RMS 245.4
0 200 400 600 800 1000 1200 1400 1600 1800 2000
0 10 20 30 40 50 60

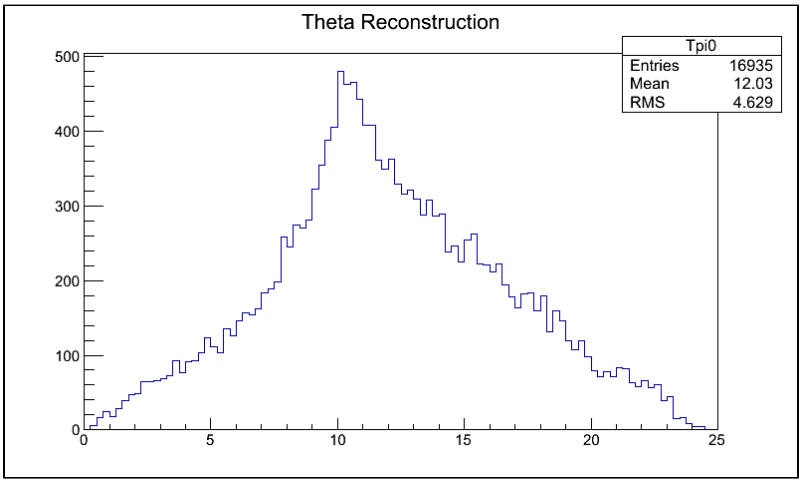

Theta Reconstruction
Tpi0
Entries 1752
Mean 3.803
RMS 2.262
0 5 10 15 20 25
0 20 40 60 80 100 120 140

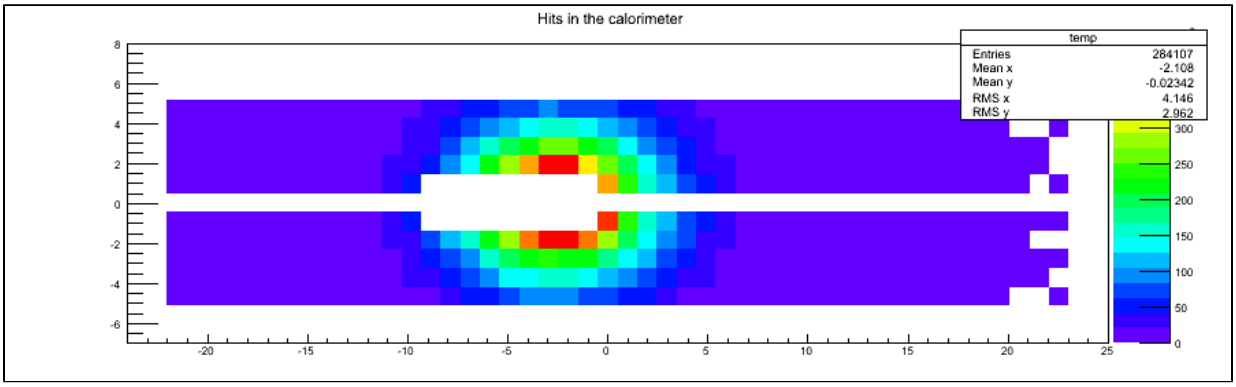


The reconstructed distributions (MeV, MeV, degrees) for the advanced target:


Mass Reconstruction
mpi0
Entries 21768
Mean 138
RMS 29.99


Energy Reconstruction
Epi0
Entries 16935
Mean 1017
RMS 335.3


Theta Reconstruction
Tpi0
Entries 16935
Mean 12.03
RMS 4.629


Hits in the calorimeter
temp
Entries 284107
Mean x -2.108
Mean y -0.02342
RMS x 4.146
RMS y 2.962

Conclusions:

- The advanced target gives much larger acceptance, but needs large angles to cover the whole ECal.

- The best energy for the advanced target is around 1 GeV and extend to the lower energy. This is important for the 2.2 GeV energy run.

- The normal target gives few pi0 (~2% acceptance) with better efficency for high energy (>1 GeV) low angle (~5 degrees) pi0.

- The normal target gives a better coverage of the calorimeter and the reconstructed events give an almost complete coverage of the crystals.

TODO: evaluate pi0 production cross section to estimate the expected rates for direct electron beam and for the secondary photon beam.