PROGRESS UPDATE

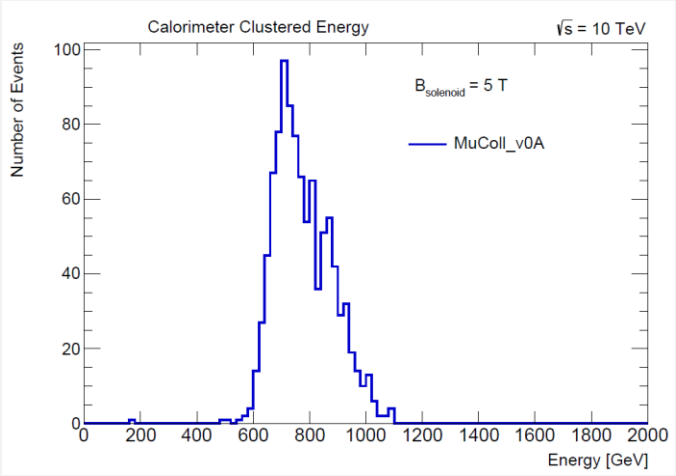
Junjia Zhang

Princeton University

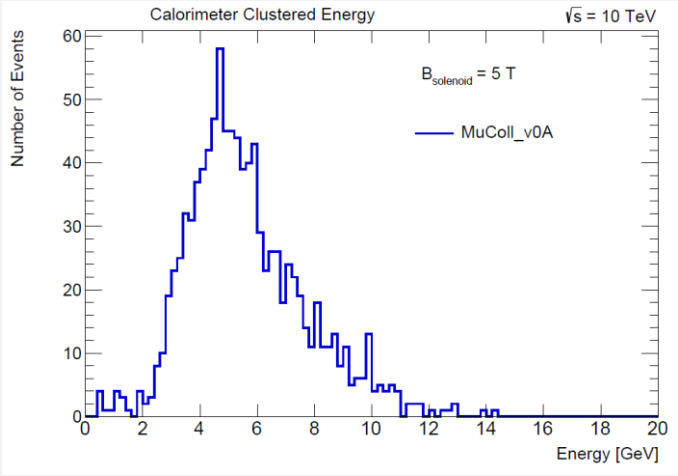
ENERGY RESOLUTION

- looked at clustered energy: sum of energy of hits in the calorimeter in a cone of 0.1 radian in theta/phi around the generator level pion
- Energy resolution: $\frac{\sigma}{E}$, where E is the true energy (energy of the pion from the pion gun), and σ is the standard deviation of the Gaussian fit to (clustered energy – true energy)
- studied single pion gun samples with pions with energy 10GeV and 1000GeV and momentum along one direction, with v1 and v0A geometries, recoBIB

PION GUN WITH V0A GEOMETRY

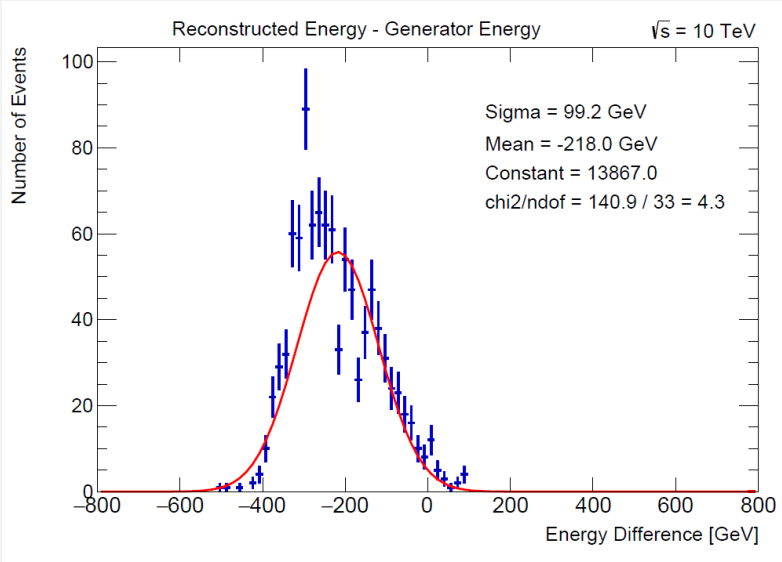


1000GeV pion gun

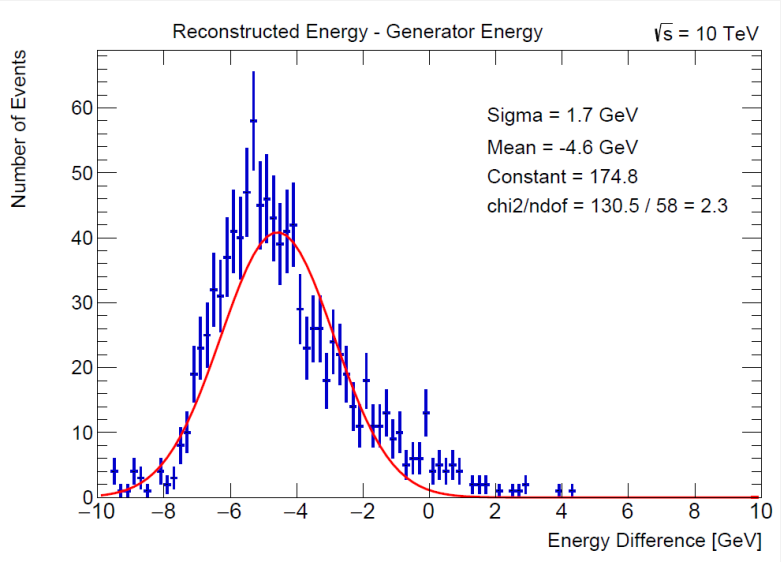


10GeV pion gun

PION GUN WITH V0A GEOMETRY

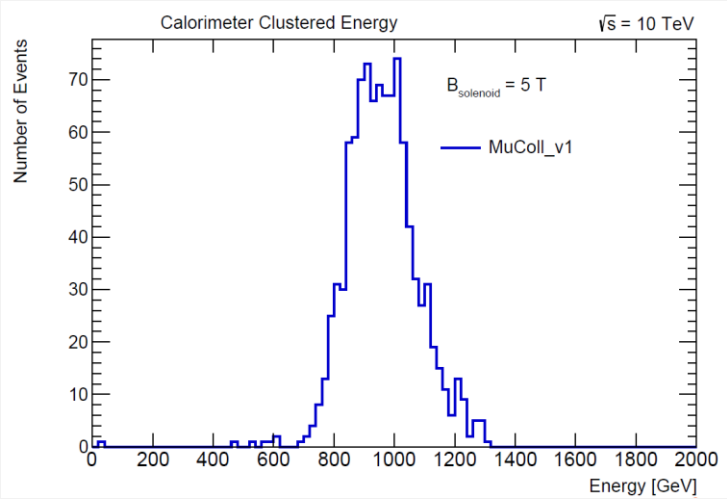


resolution: 0.0992
1000GeV pion gun

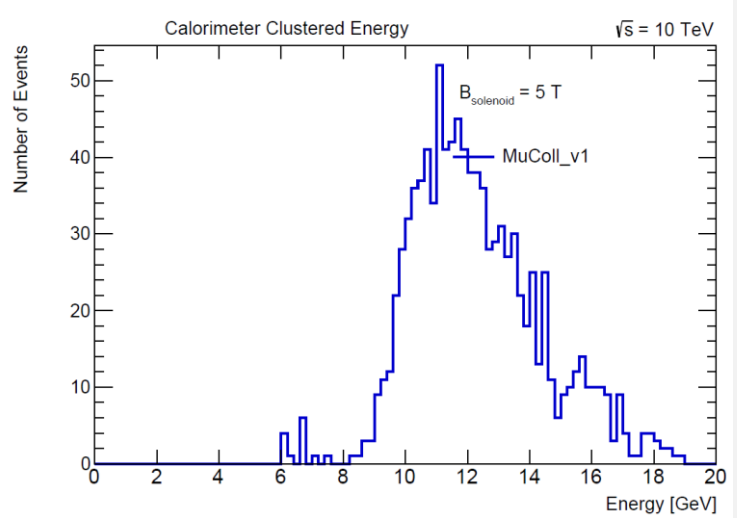


resolution: 0.17
10GeV pion gun

PION GUN WITH V1 GEOMETRY

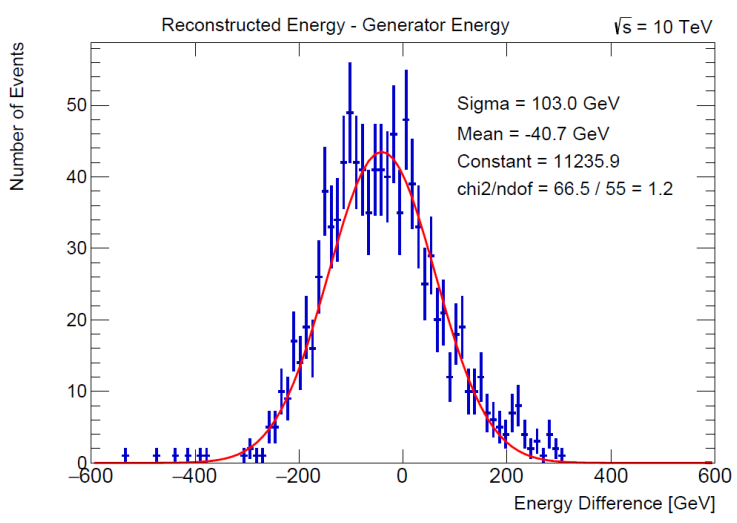


1000GeV pion gun

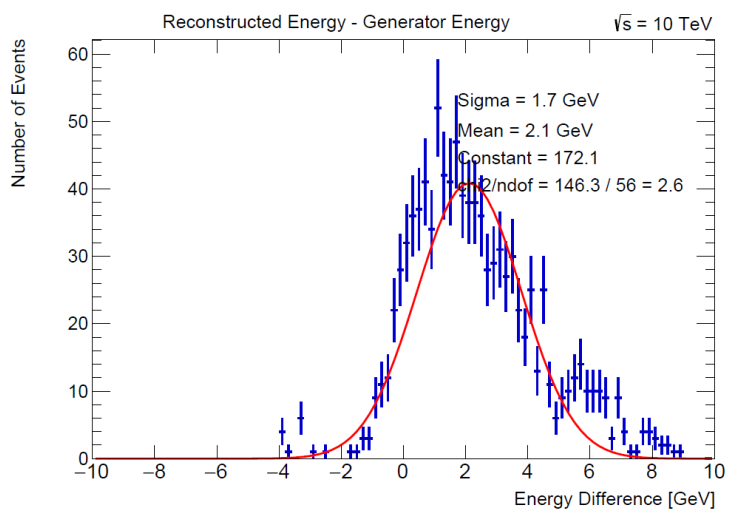


10GeV pion gun

PION GUN WITH V1 GEOMETRY



resolution: 0.103
1000GeV pion gun



resolution: 0.17
10GeV pion gun

OBSERVATIONS

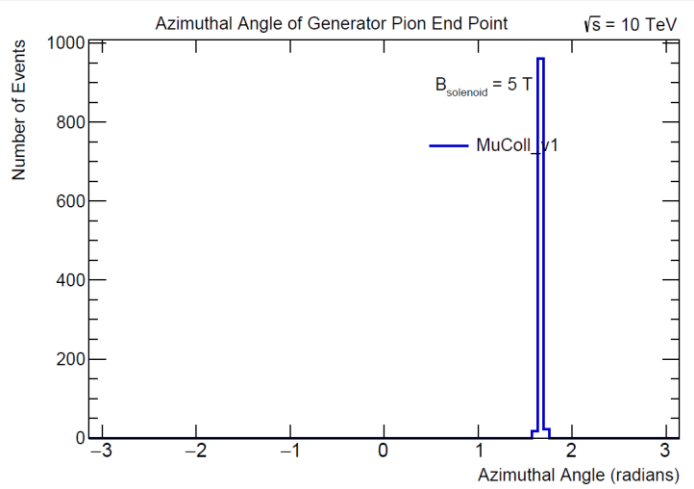
- pion gun momentum along y direction, and ECALEndcap and HCALEndcap does not contribute to clustered energy as expected
- the main contribution to total clustered energy is from hits to the ECALBarrel in the 10GeV case, and from hits to the HCALBarrel in the 1000GeV case
- contribution from 10GeV pion gun does not seem significant compared to the background, contribution from 1000GeV pion gun is significant
- 1000GeV case has better resolution than 10GeV case
- clustered energy lower for v0A geometry than that for v1 geometry for both the 10GeV and 1000GeV case (because selonoid is placed in from of ECAL?)
- polar and azimuthal distribution of hit energy in calorimeter is not uniform (probably due to BIB)

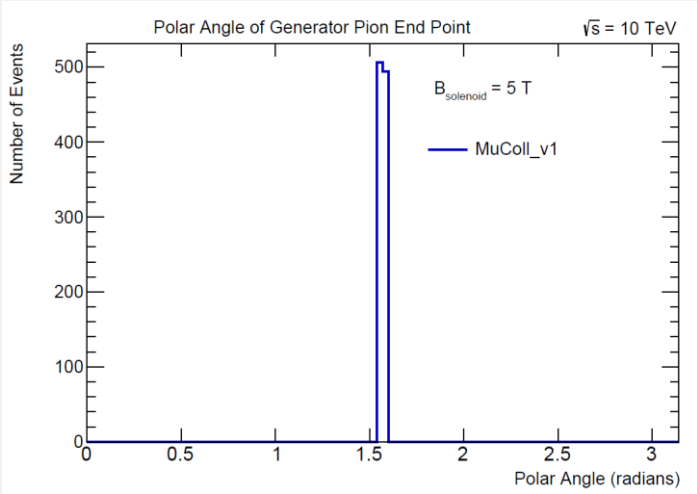
NEXT STEPS

- examine pion gun samples with uniform energy / momentum angle distribution
- examine di-jet pion gun samples

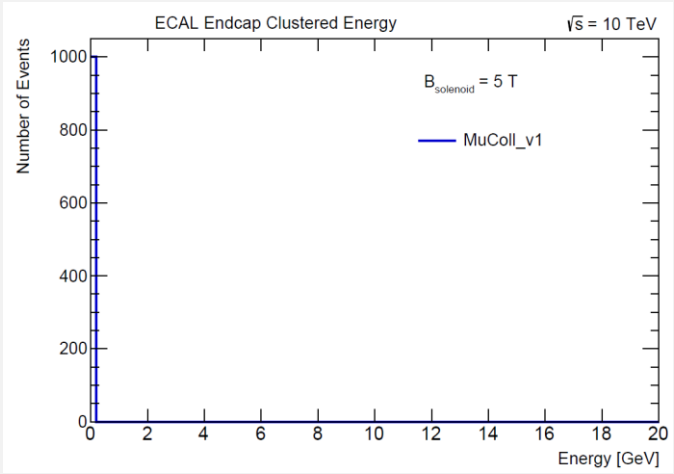
V1 GEOMETRY DETAILS

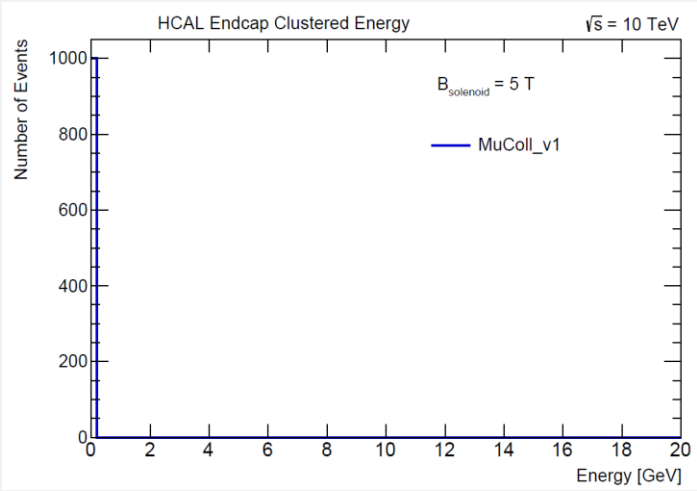
10GEV PION GUN (SANITY CHECK)





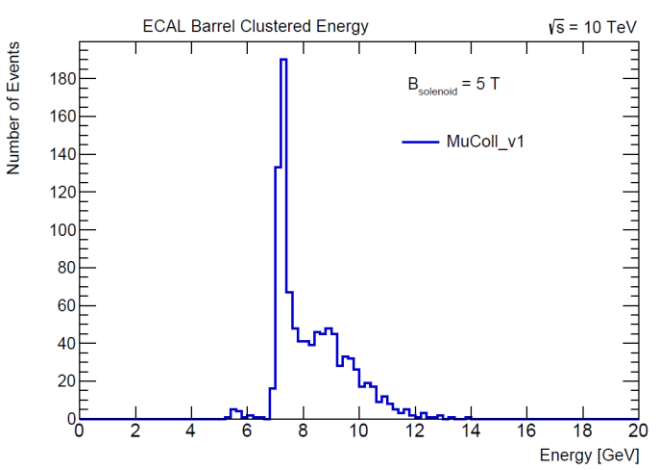
pion endpoint at polar angle ~ pi/2 and azimuthal angle ~ pi/2

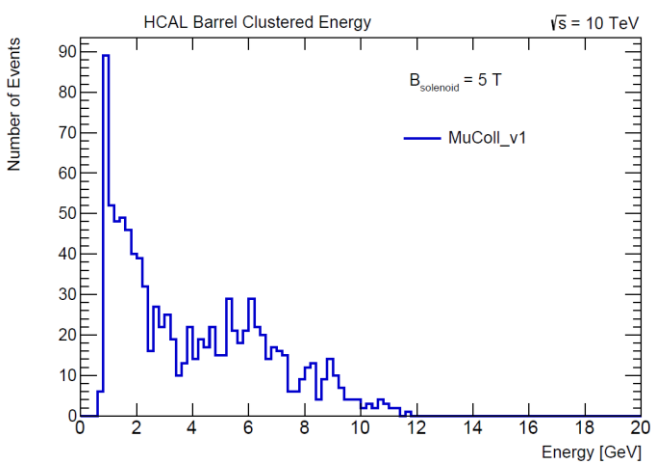




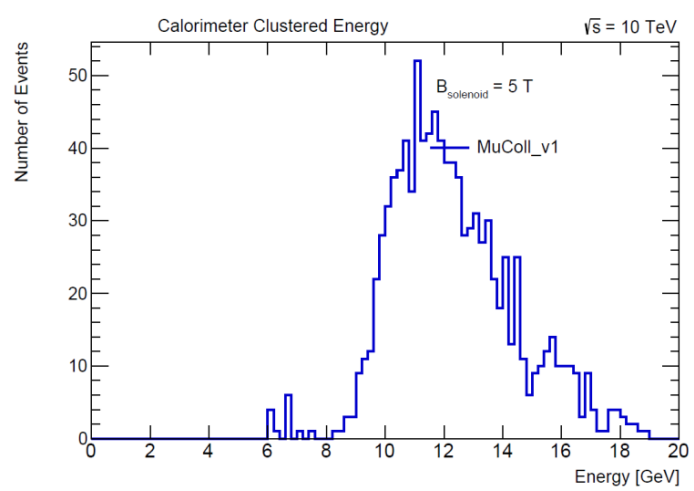
no contribution to clustered energy from the endcaps

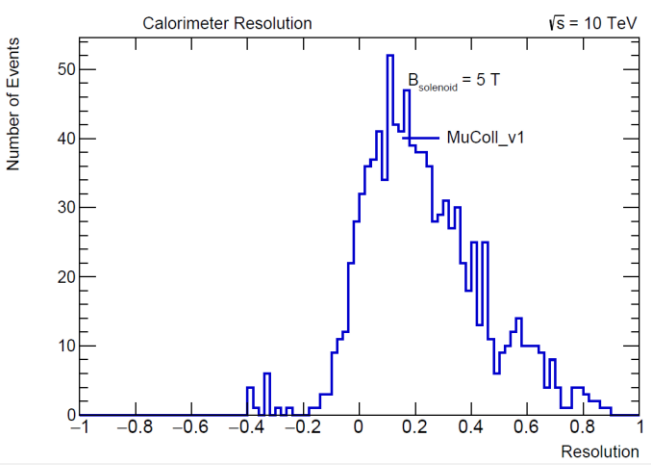
10GEV PION GUN (CLUSTERED ENERGY)





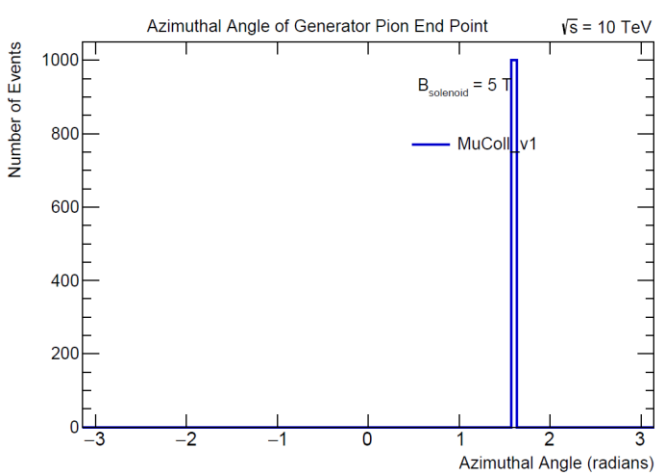
in general, ECAl Barrel contributes more to clustered energy

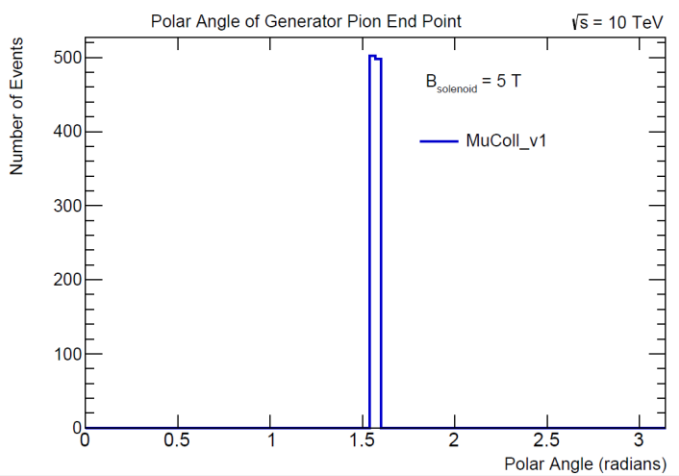




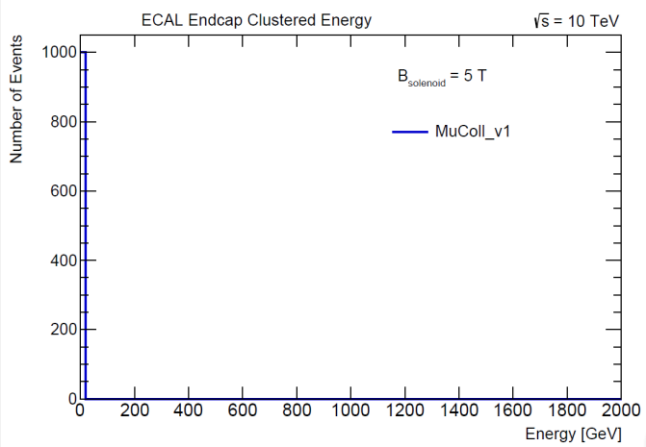
the resolution plot is the distribution of (clustered_energy – generator_energy)/generator_energy

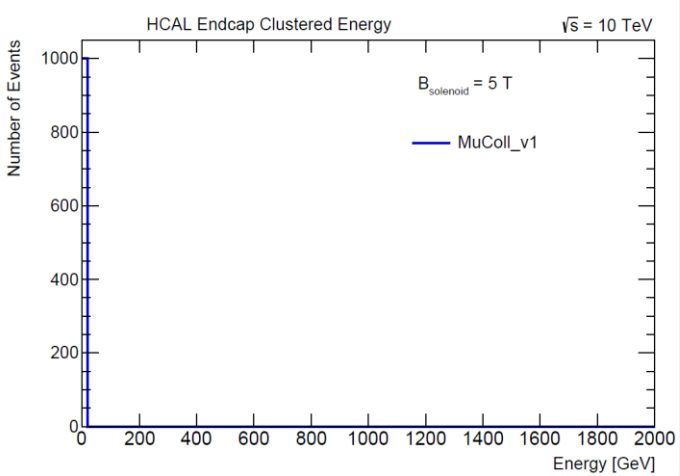
1000GEV PION GUN (SANITY CHECK)





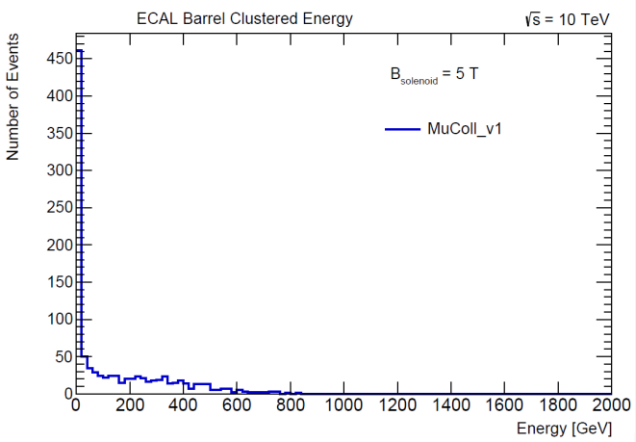
pion endpoint at polar angle ~ pi/2 and azimuthal angle ~ pi/2

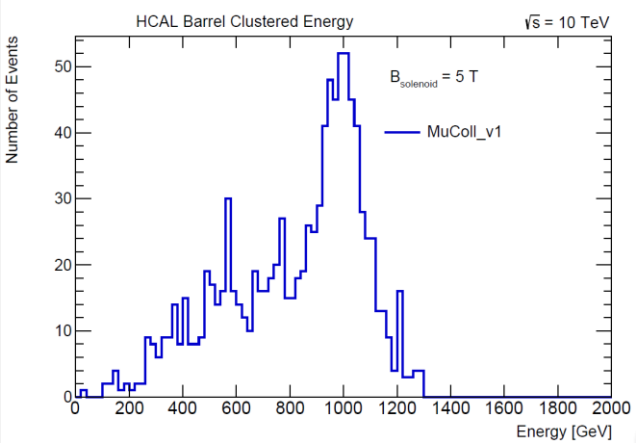




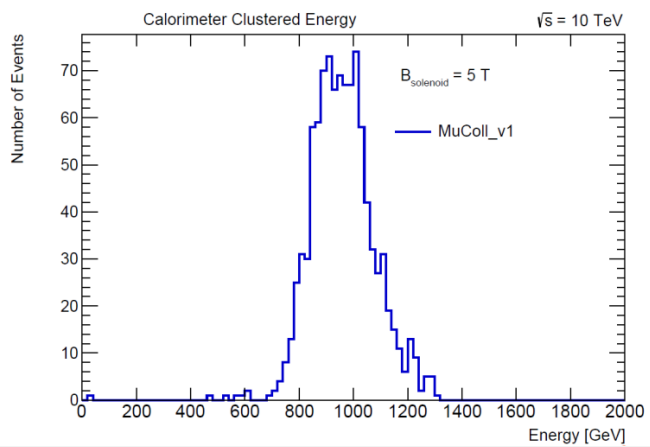
no contribution to clustered energy from the endcaps

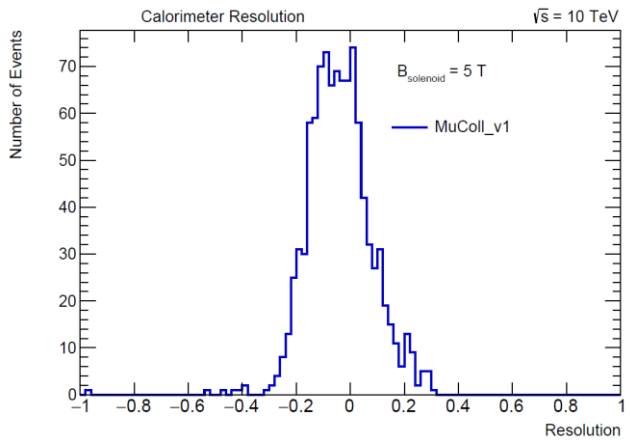
1000GEV PION GUN





in general, HCAL Barrel contributes more to clustered energy

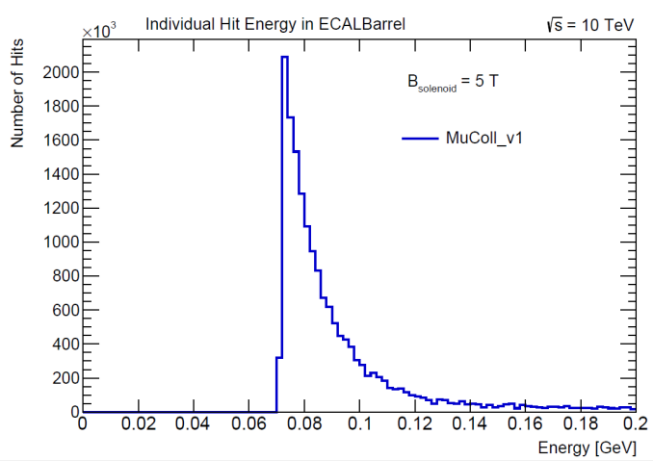


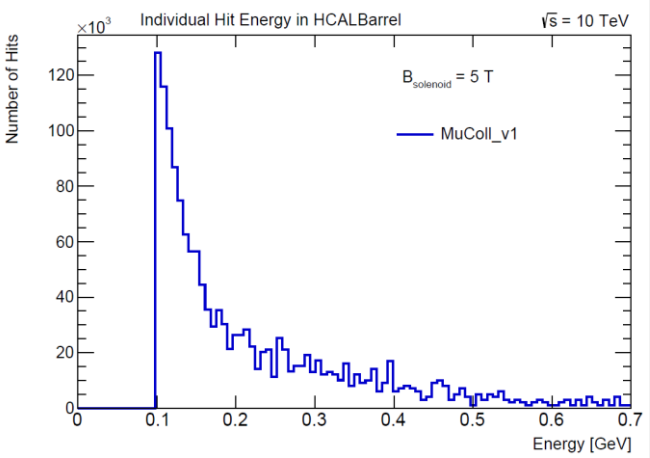


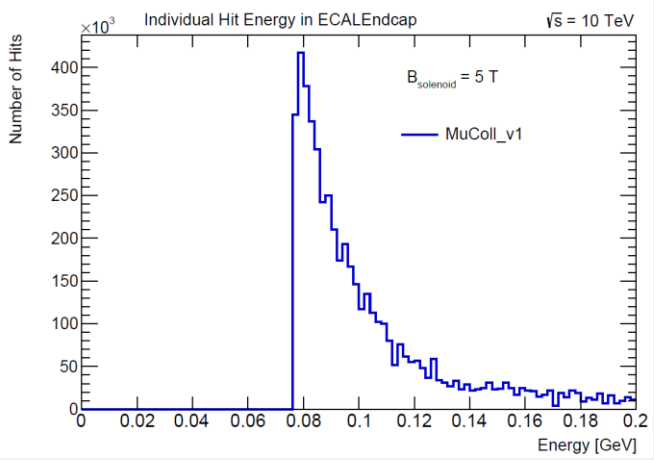
the resolution plot is the distribution of (clustered_energy – generator_energy)/generator_energy

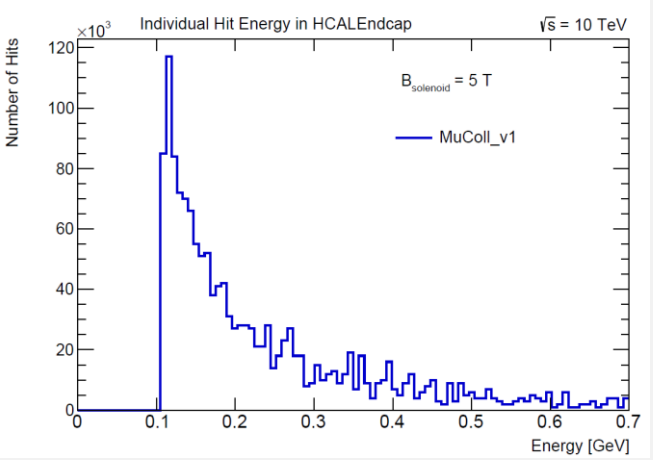
from this value it seems that 1000GeV Pion Gun has better resolution

10GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)

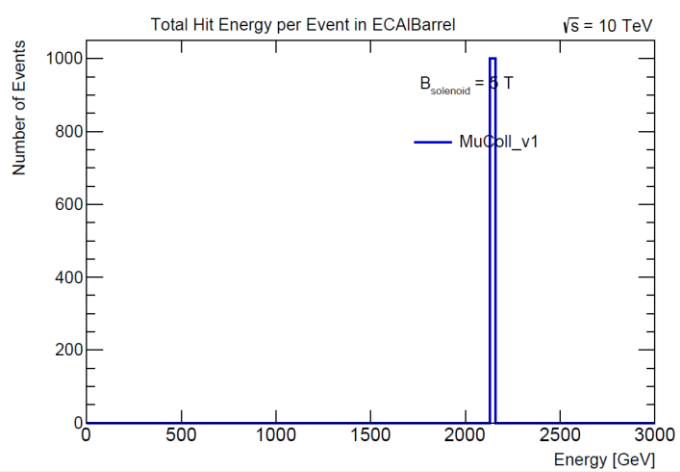


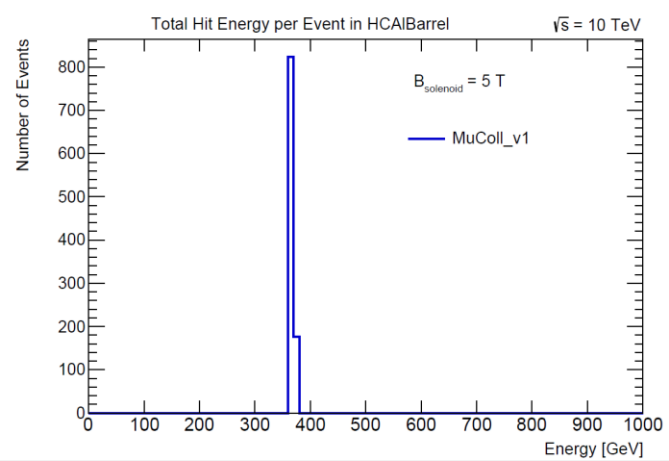


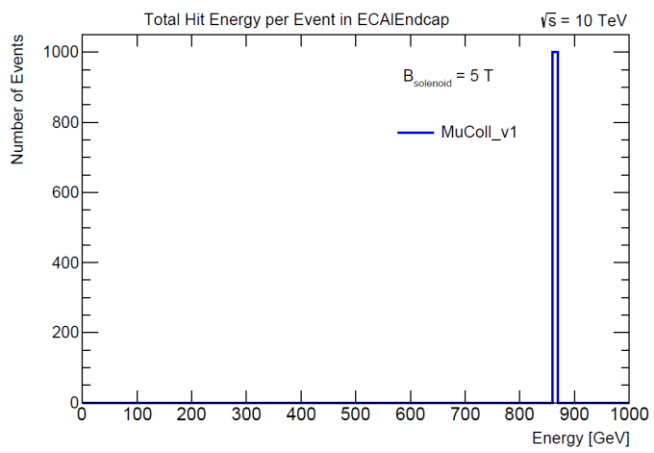


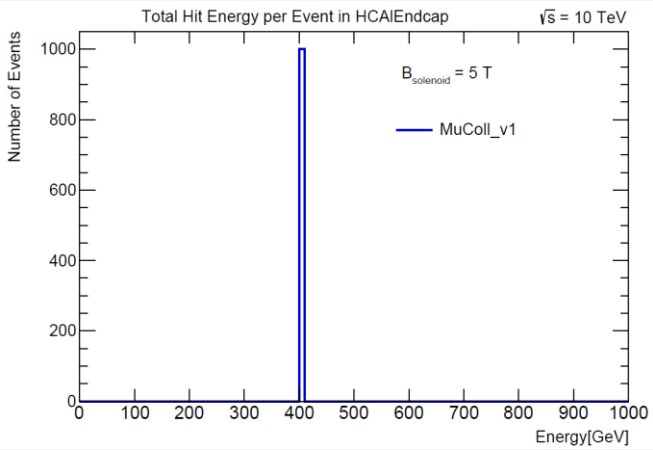


10GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)







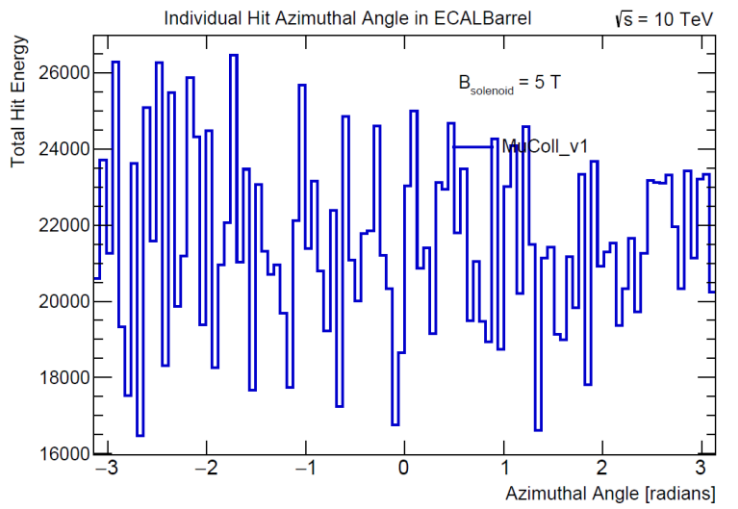


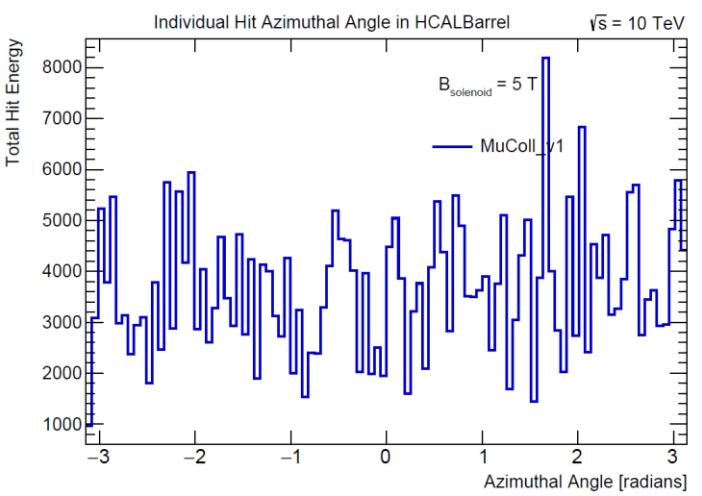
total hit energy is just the sum of the energies of all hits in one single event

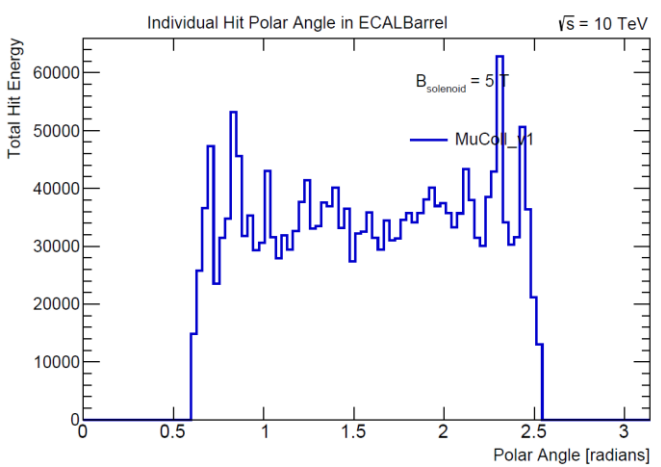
for the endcaps, contribution is solely from BIB, so each event has the same total hit energy

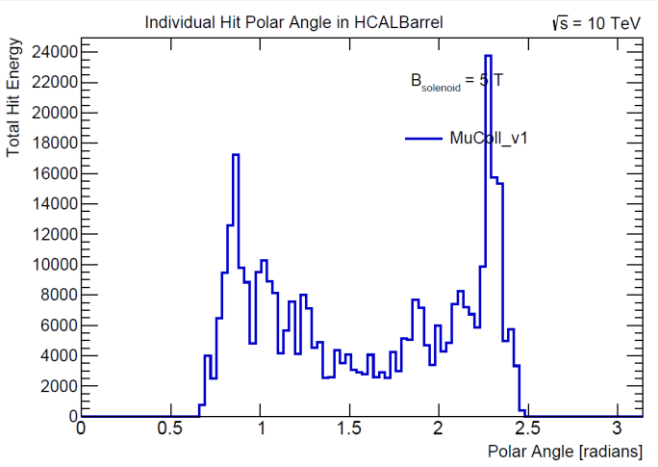
for the barrels, contribution is still mainly from BIB, so distribution of total hit energy is narrow

10GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)

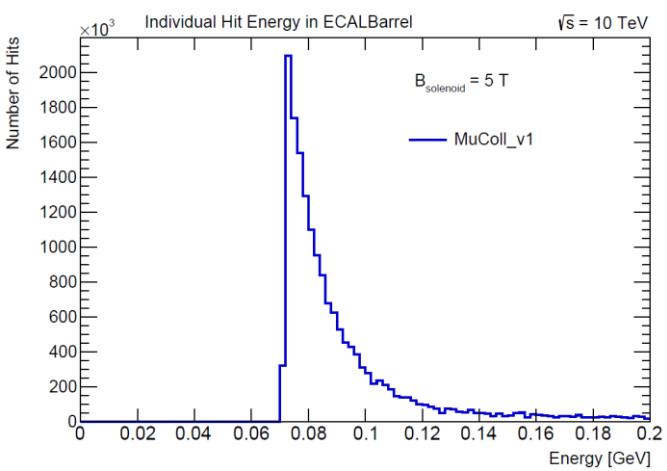


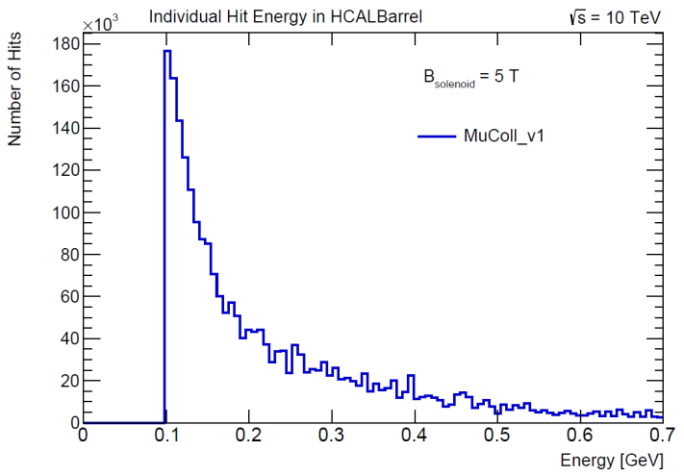




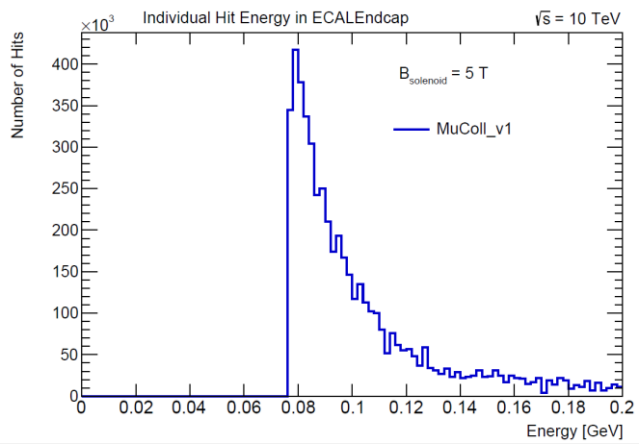


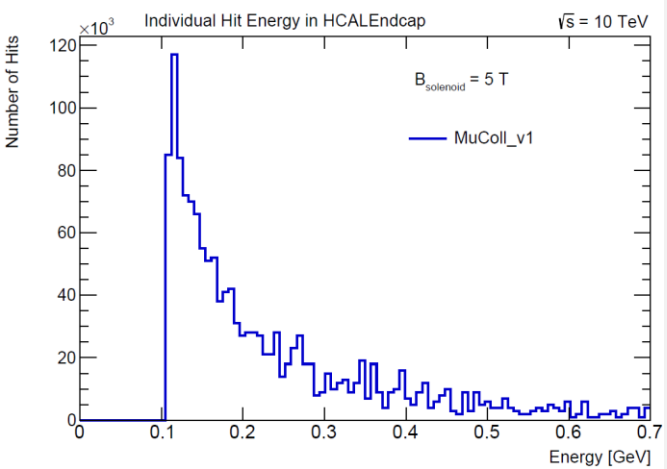
1000GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)



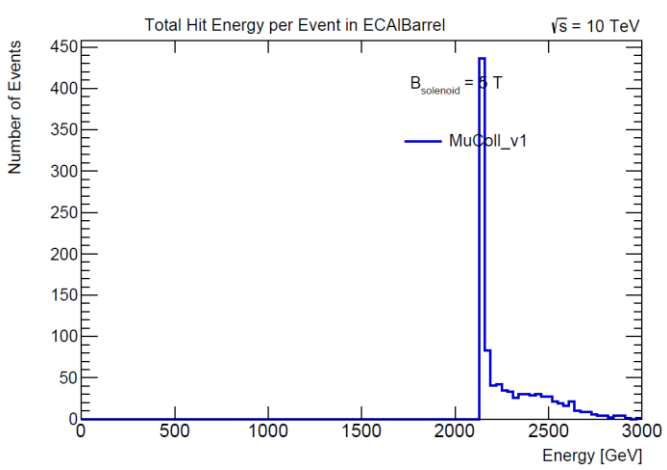


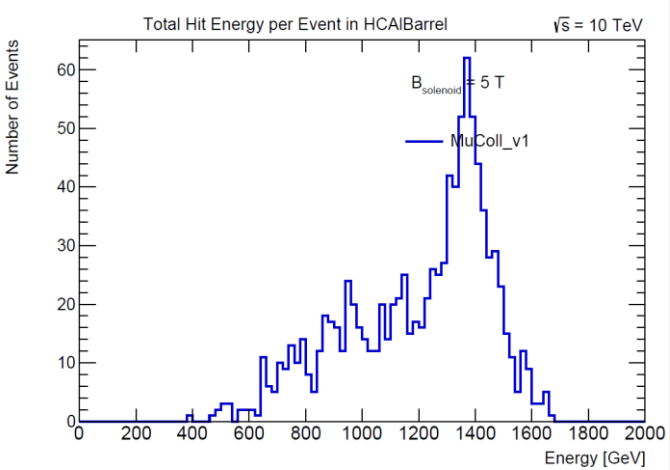
more hits in HCAL Barrel than the case with 10GeV pion gun

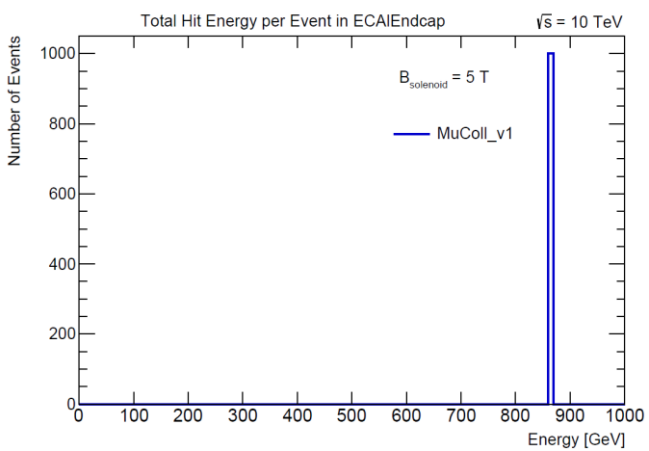


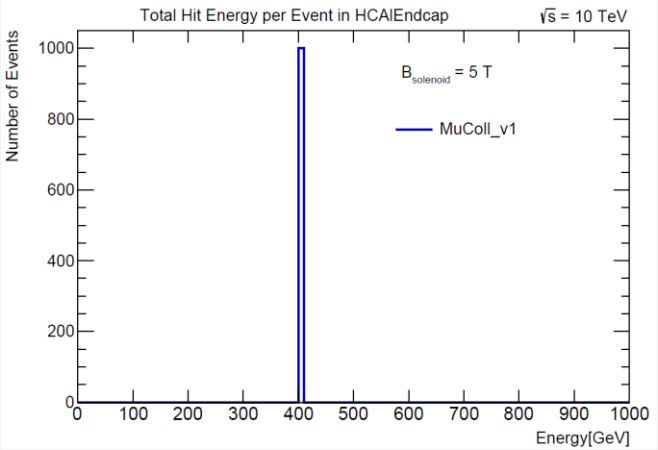


1000GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)







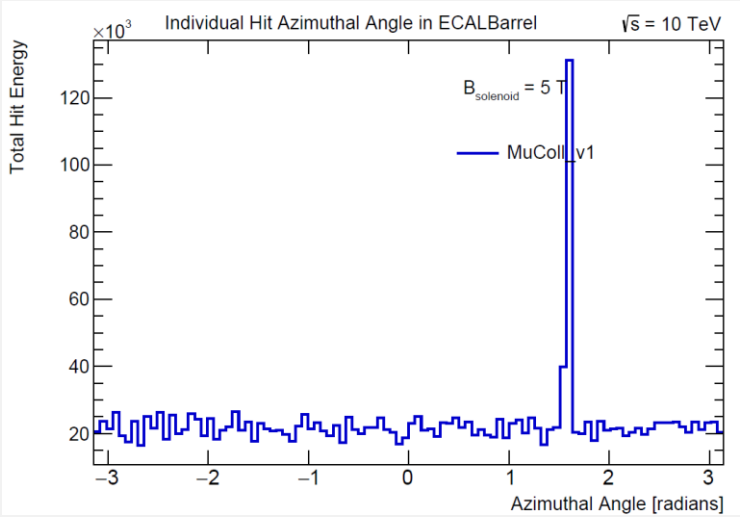


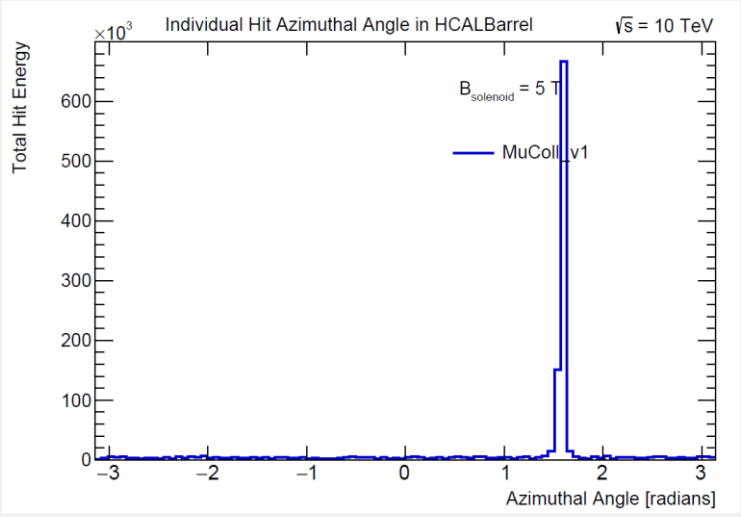
total hit energy is just the sum of the energies of all hits in one single event

for the endcaps, contribution is solely from BIB, so each event has the same total hit energy

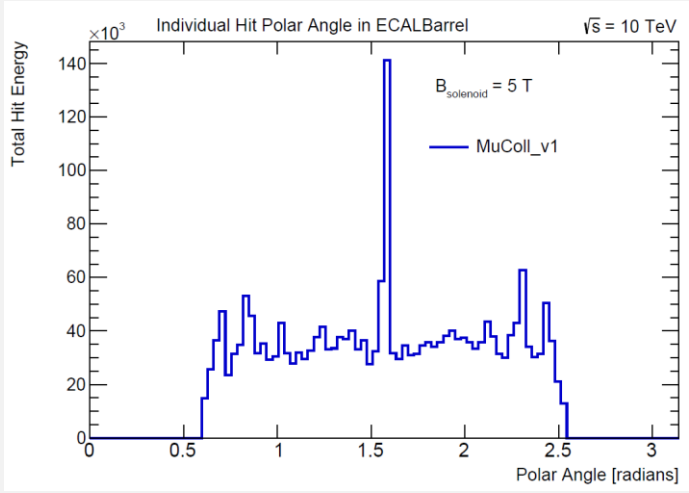
for the barrels, contributions from the pion gun is significant

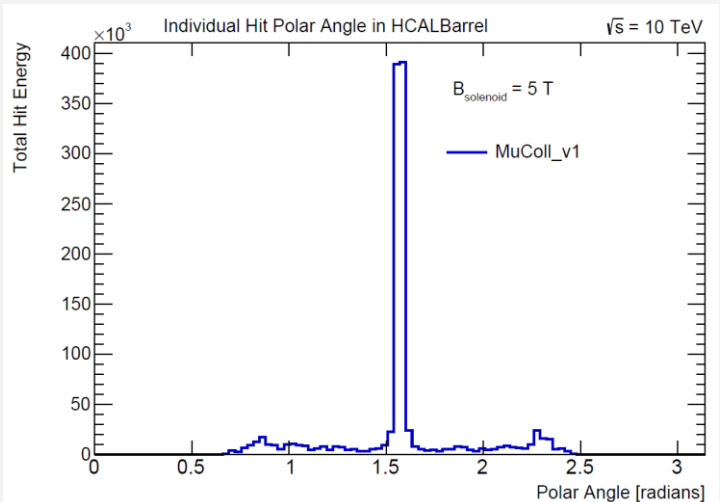
1000GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)





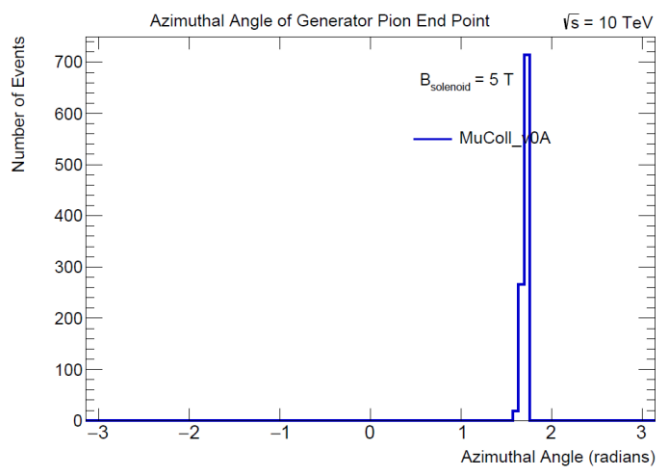
peak of energy contribution from at azimuthal and polar angle = pi/2, which is the contribution from the 1000GeV pion gun

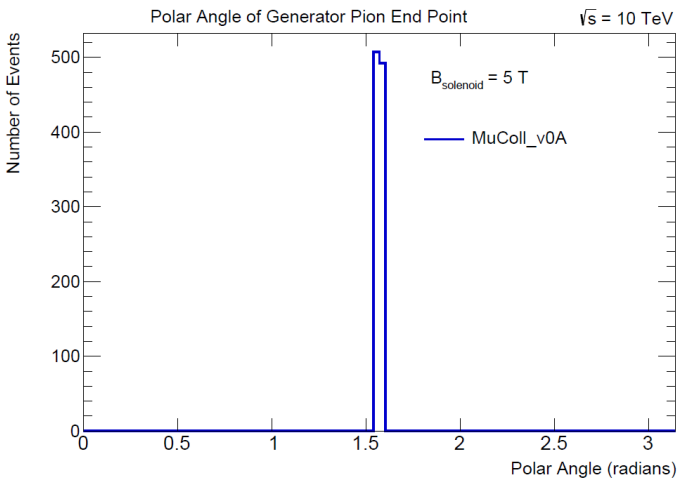


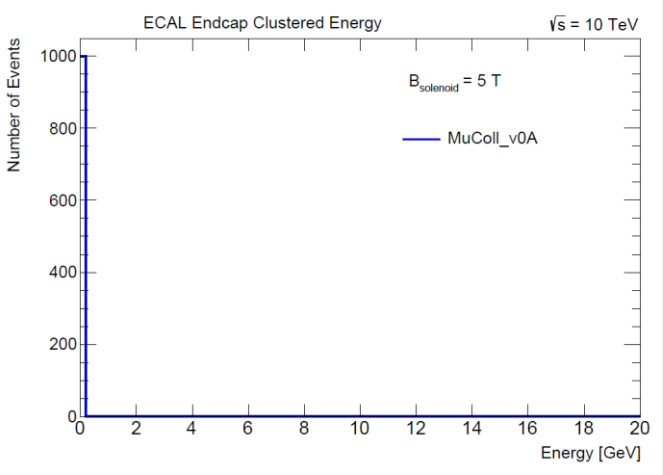


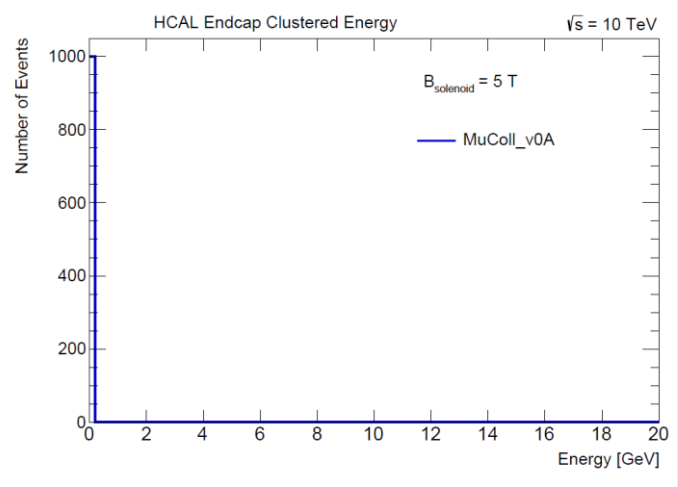
V0A GEOMETRY DETAILS

10GEV PION GUN, V0A GEOMETRY, RECOBIB

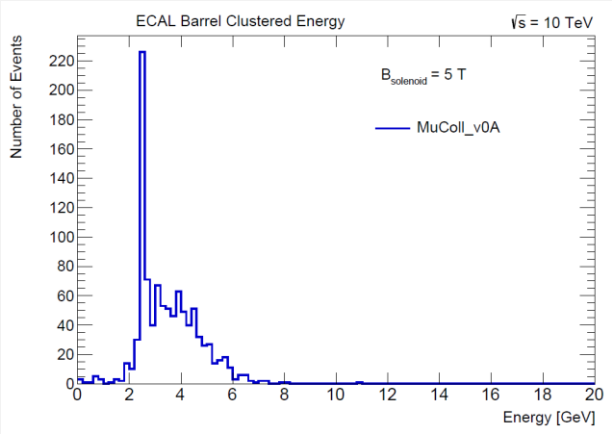


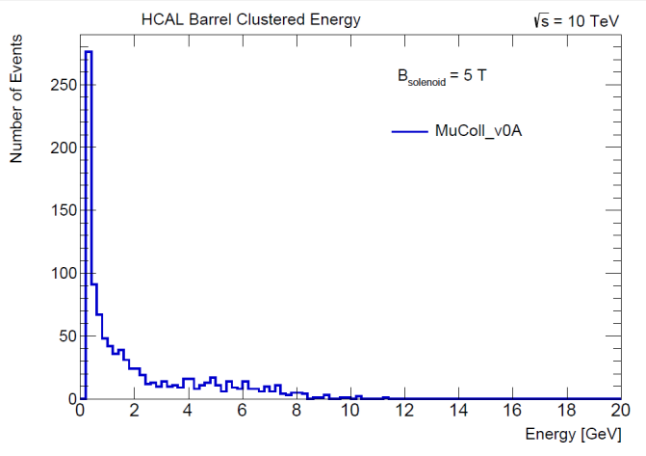


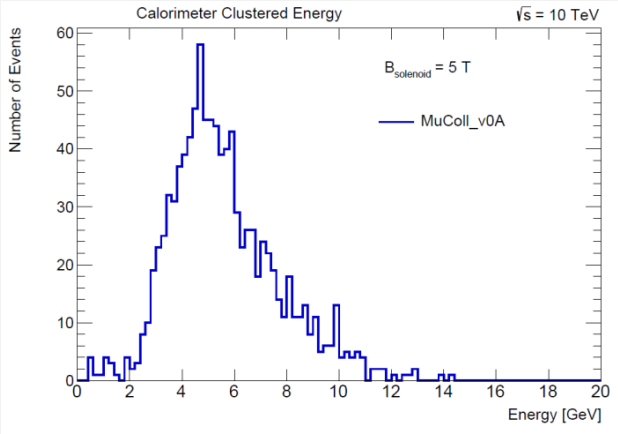


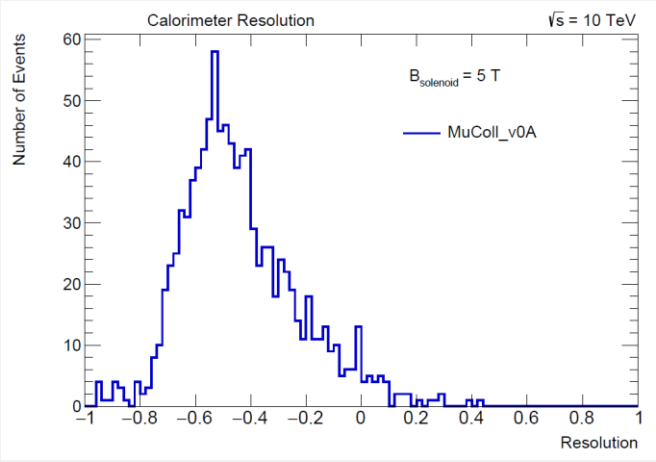


10GEV PION GUN (CLUSTERED ENERGY)



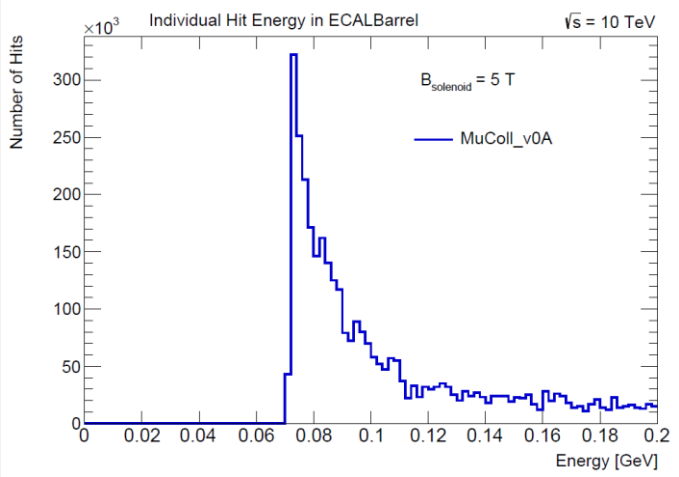


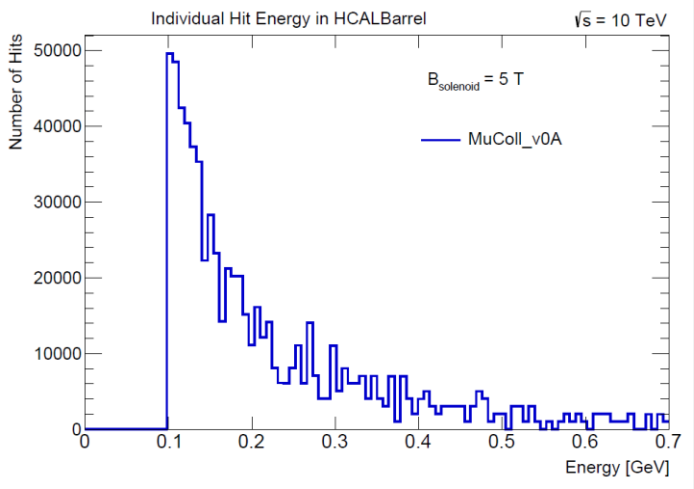


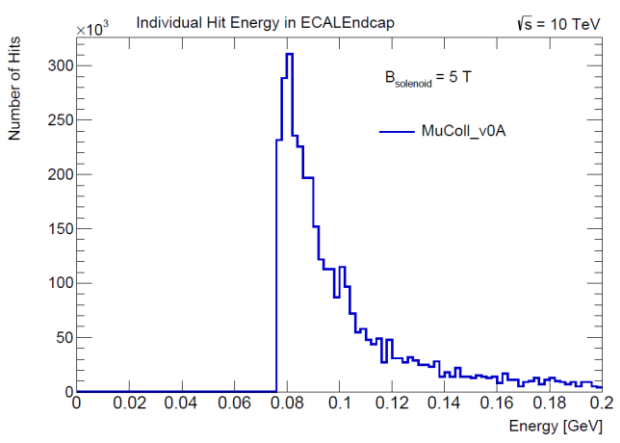


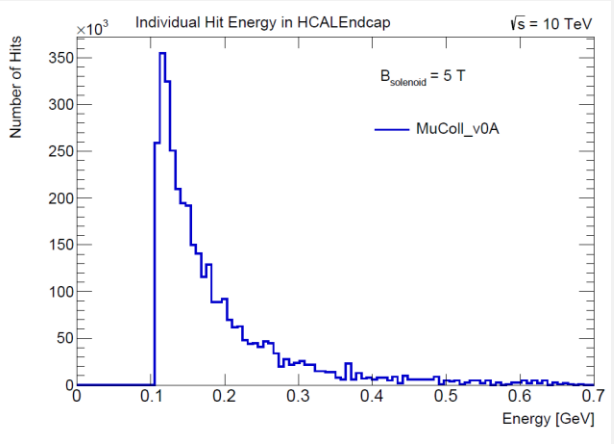
the resolution plot is the distribution of (clustered_energy – generator_energy)/generator_energy

10GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)

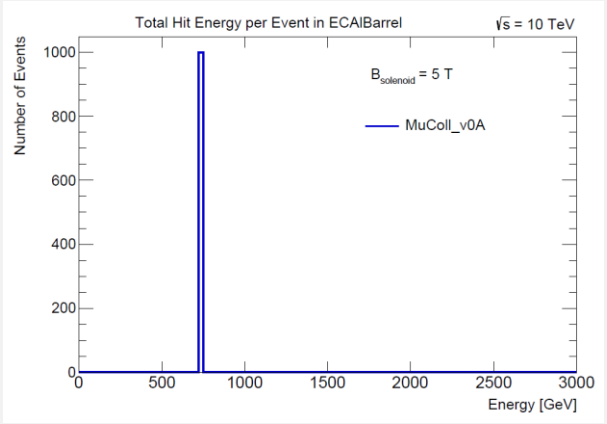


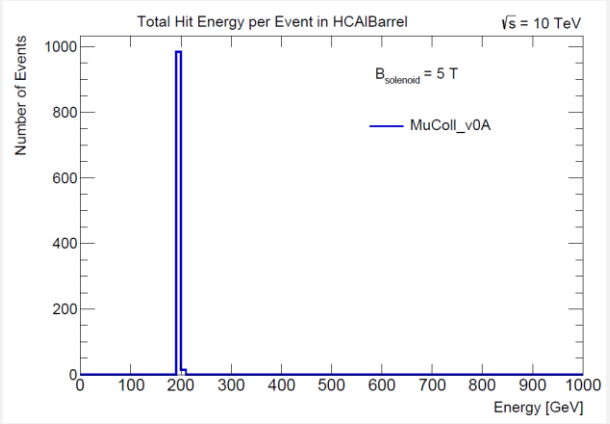


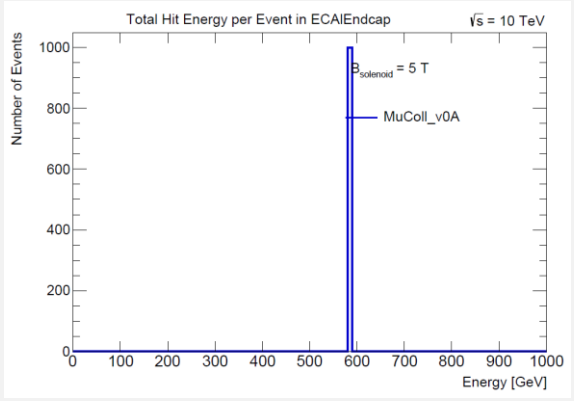


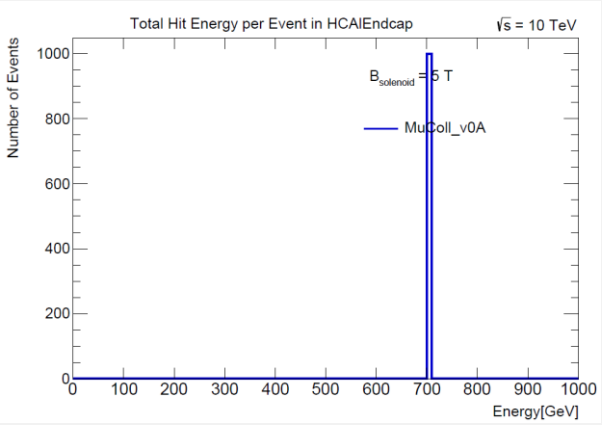


10GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)

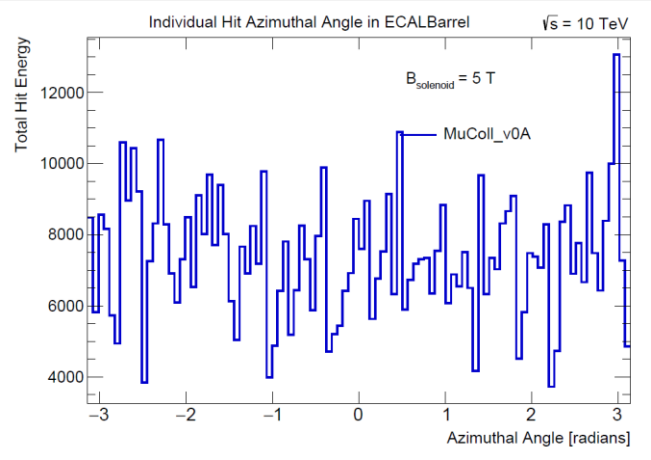


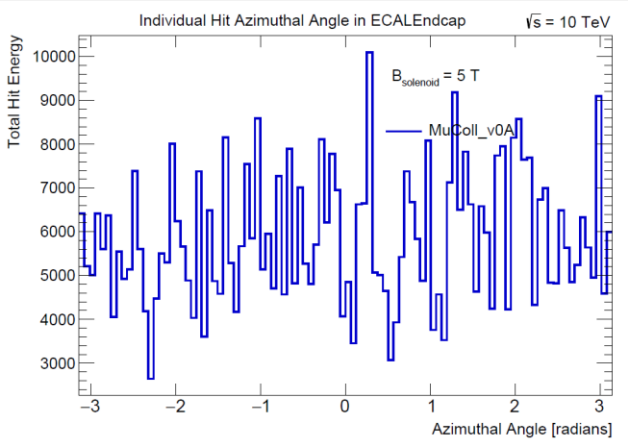


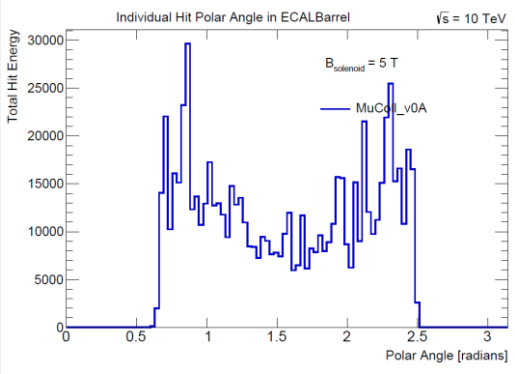


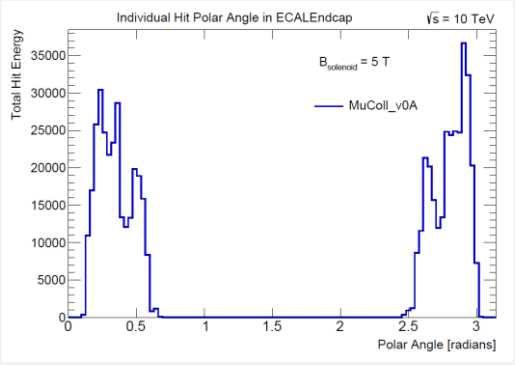


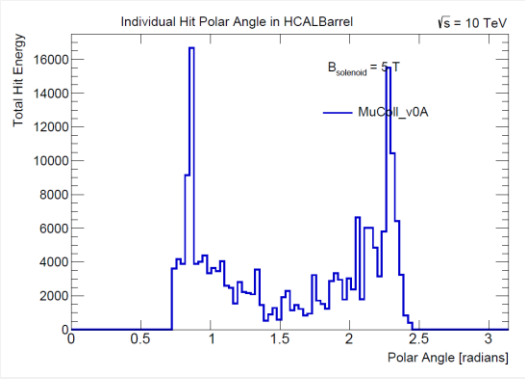
10GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)

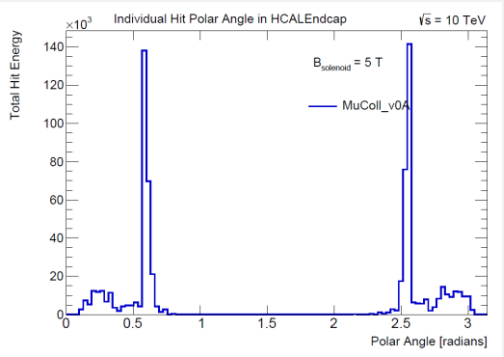




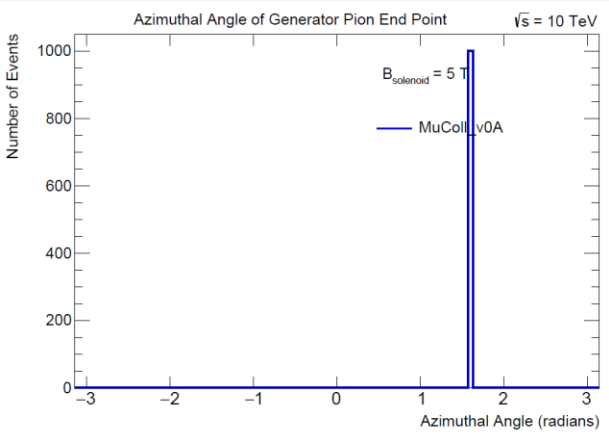


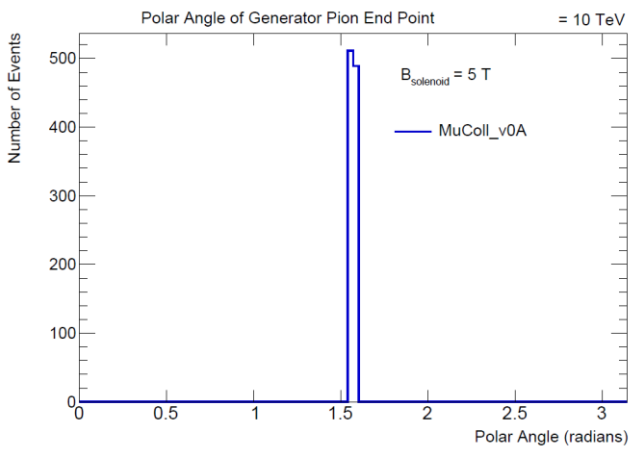


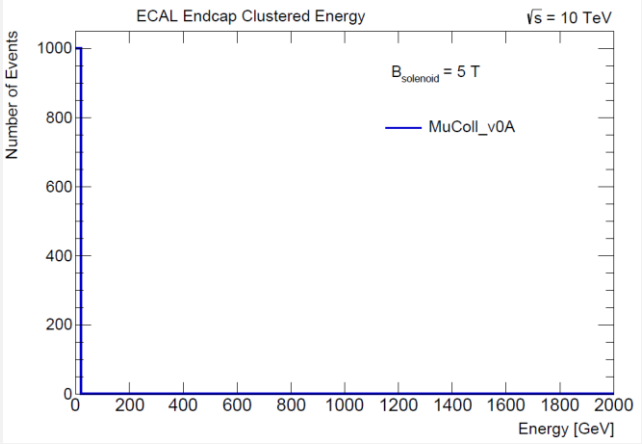


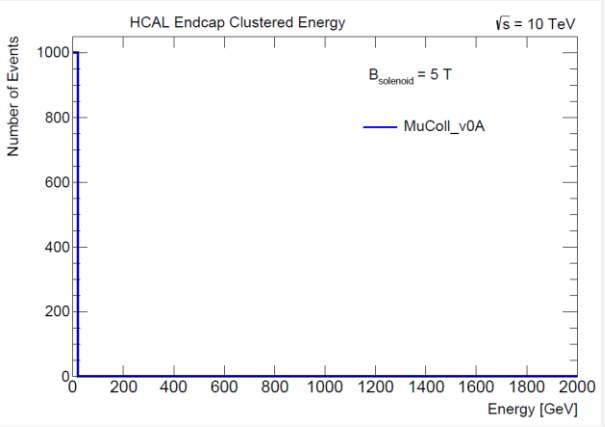


1000GEV PION GUN, V0A GEOMETRY, RECOBIB

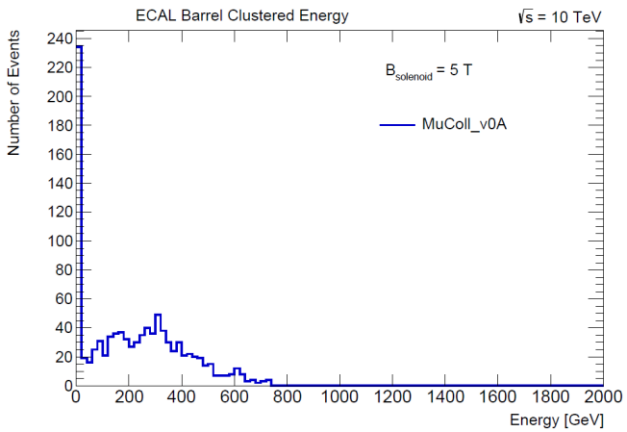


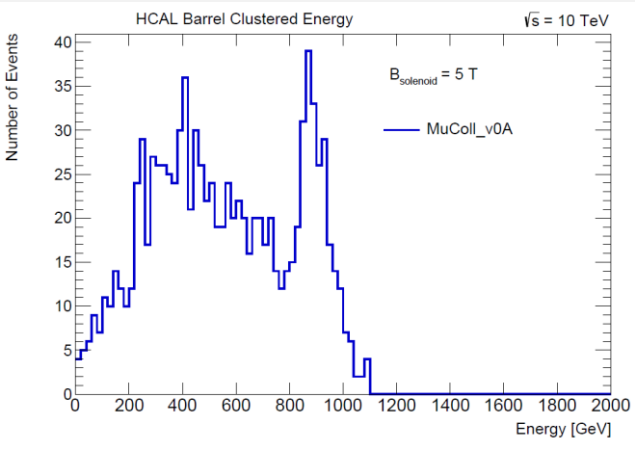


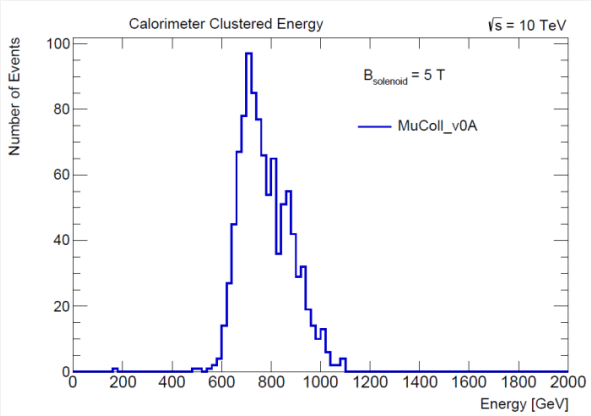


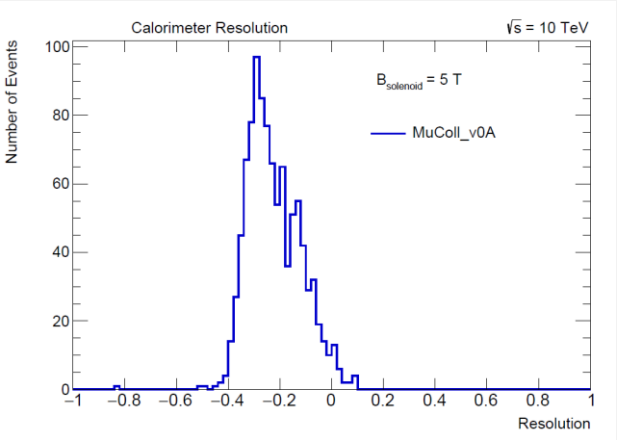


1000GEV PION GUN (CLUSTERED ENERGY)



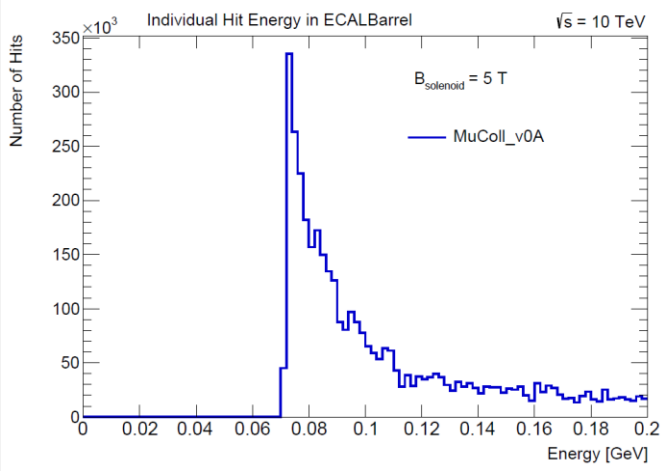


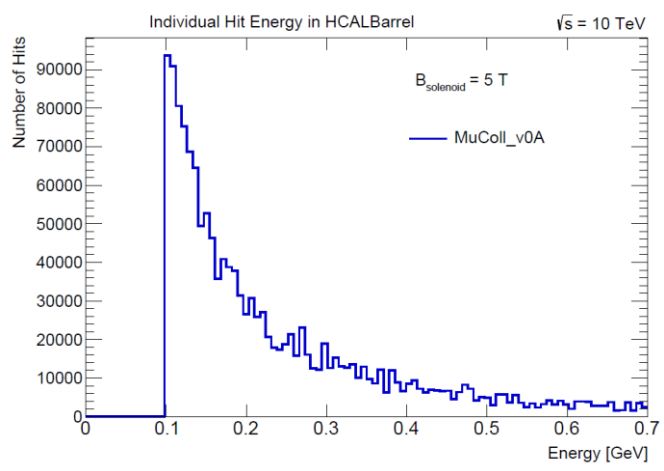


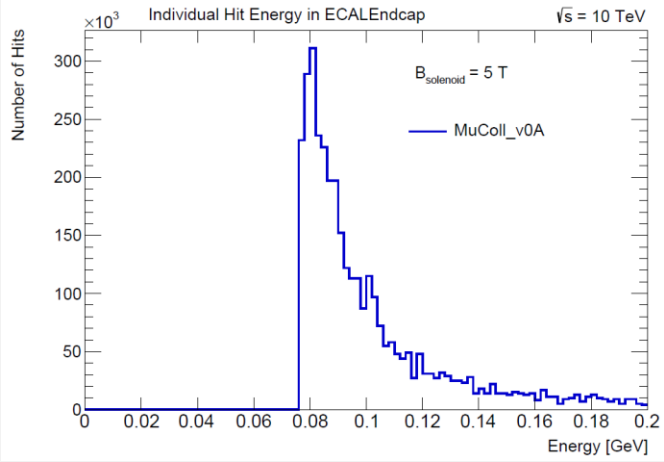


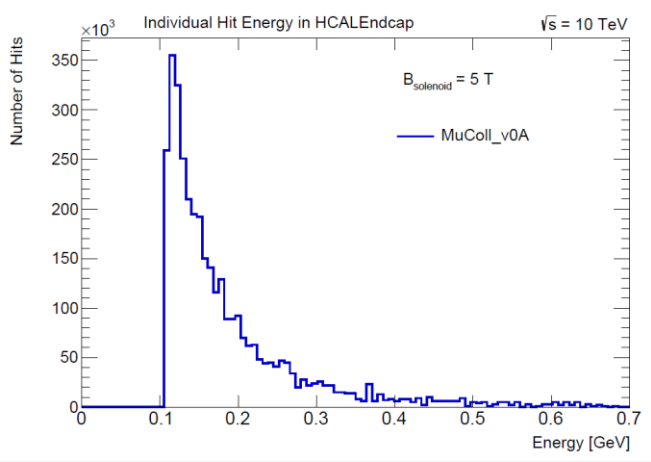
the resolution plot is the distribution of (clustered_energy – generator_energy)/generator_energy

1000GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)

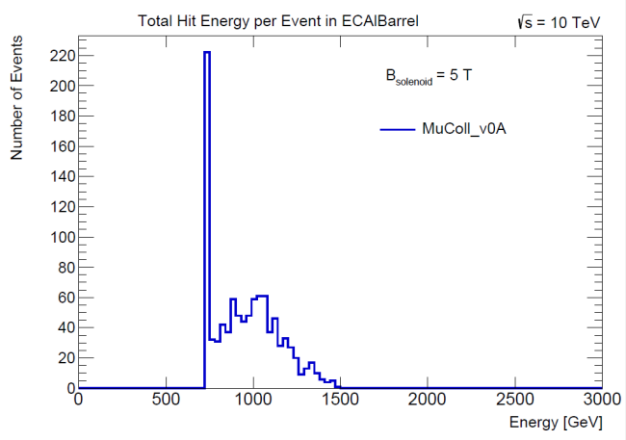


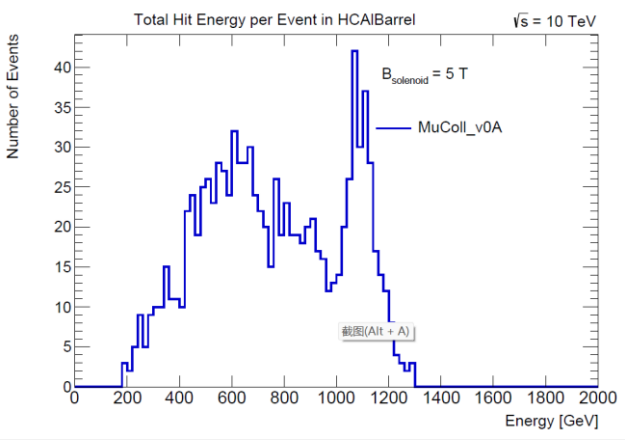


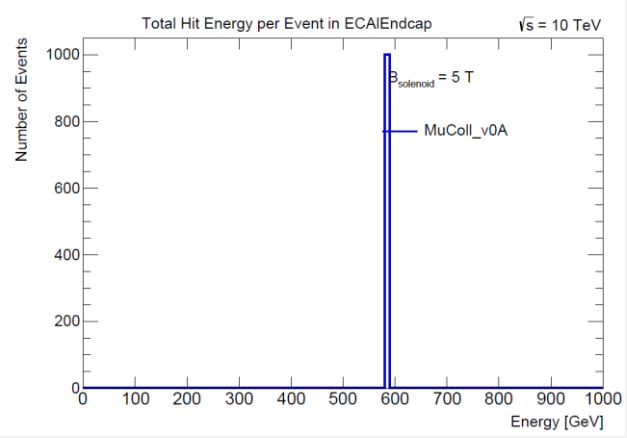


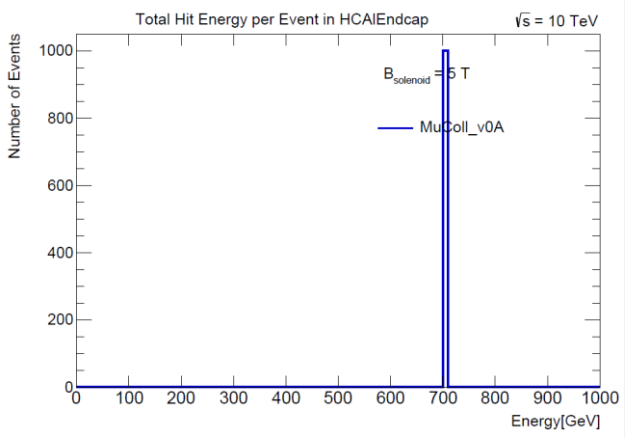


1000GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)

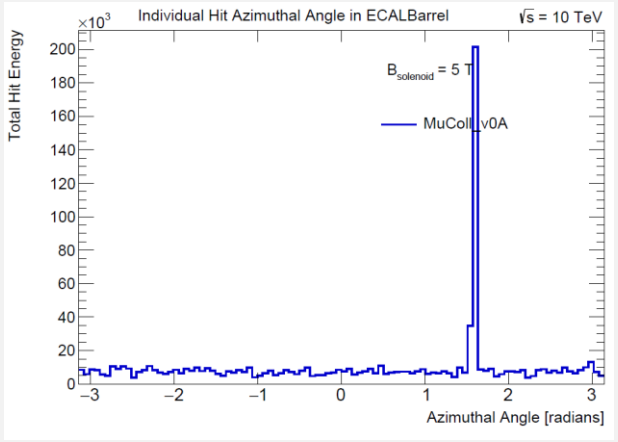


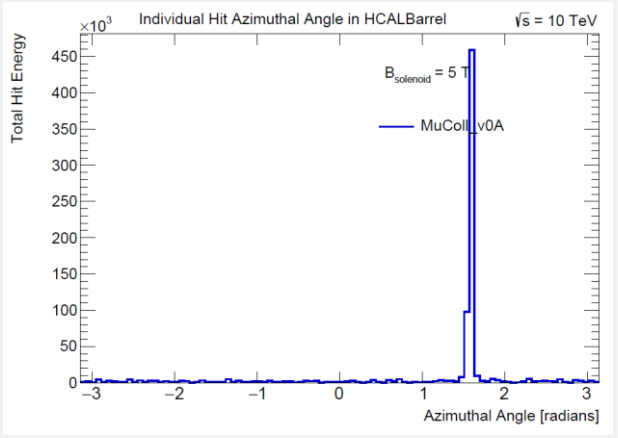


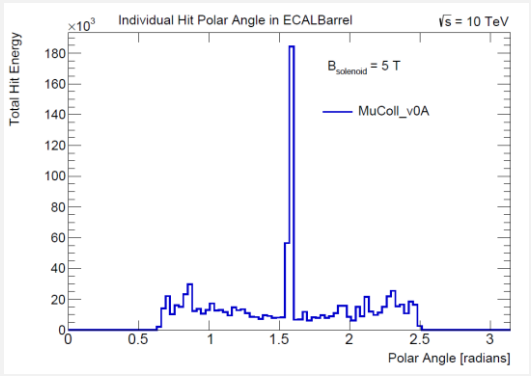


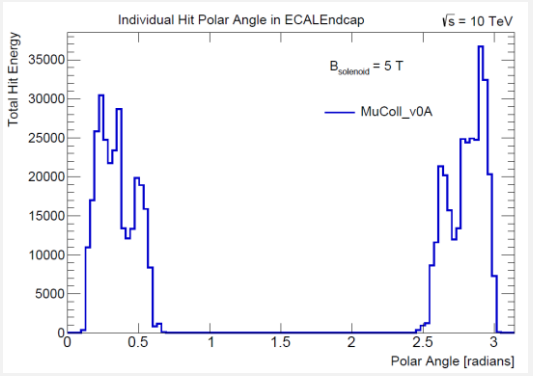


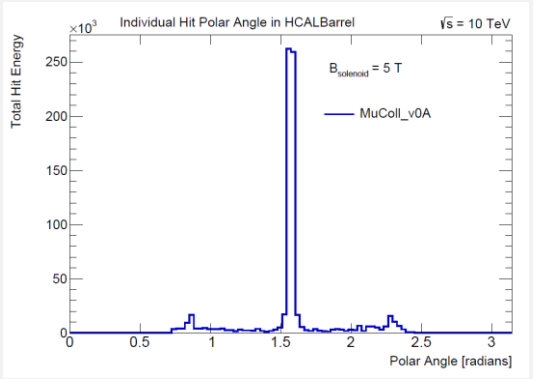
1000GEV PION GUN (QUICK LOOK AT CALORIMETER HITS)

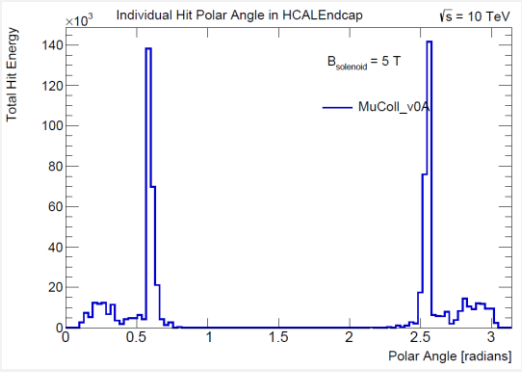












BACKUP (FIT RESULTS)

```
Calorimeter Resolution.pdf has been created
 FCN=140.934 FROM MINOS     STATUS=SUCCESSFUL     40 CALLS         203 TOTAL
                     EDM=8.39458e-10    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  Constant     1.38670e+04   4.73758e+02  -2.79546e-01  -3.14751e-07
   2  Mean        -2.17966e+02   4.13872e+00  -2.93909e-02   4.62865e-05
   3  Sigma        9.91924e+01   2.73781e+00   2.73781e+00   8.93020e-03
```

1000GeV, v0A

```
FCN=130.518 FROM MINOS     STATUS=SUCCESSFUL     40 CALLS         199 TOTAL
                     EDM=7.76486e-08    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  Constant     1.74783e+02   5.93365e+00   6.67298e-03  -5.16300e-05
   2  Mean        -4.58012e+00   7.94633e-02   7.67681e-04   1.71376e-02
   3  Sigma        1.70690e+00   6.71009e-02   6.71009e-02   6.07702e-02
```

10GeV, v0A

```
Info in <TCanvas::MakeDefCanvas>:  created default TCanvas with name c1
 FCN=66.46 FROM MINOS     STATUS=SUCCESSFUL     40 CALLS         192 TOTAL
                     EDM=3.11186e-08    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  Constant     1.12359e+04   3.68050e+02   2.74808e-01   2.55959e-08
   2  Mean        -4.06607e+01   3.70990e+00   9.88664e-03  -6.23870e-05
   3  Sigma        1.03008e+02   2.86753e+00   2.86753e+00  -9.18494e-02
```

1000GeV, v1

```
FCN=146.34 FROM MINOS     STATUS=SUCCESSFUL     40 CALLS         197 TOTAL
                     EDM=2.44946e-11    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  Constant     1.72070e+02   5.89337e+00   1.21131e-02  -2.48143e-05
   2  Mean         2.11422e+00   7.56128e-02   9.88895e-04   7.42679e-03
   3  Sigma        1.67971e+00   5.99108e-02   5.99108e-02   7.66327e-04
```

10GeV, v1