

pECal energy response in JANA

Zhongling Ji

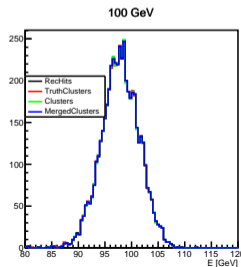
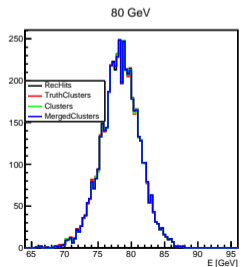
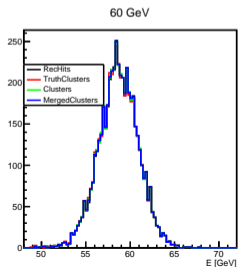
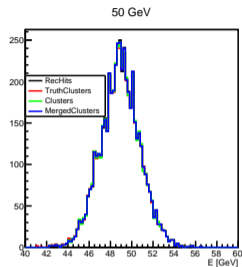
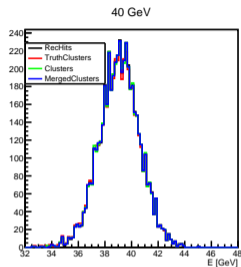
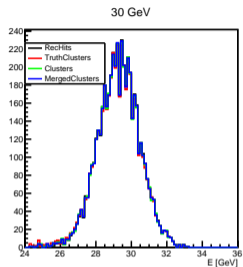
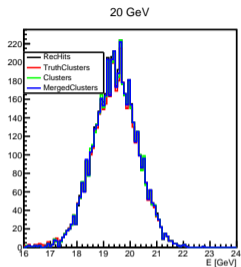
UCLA

November 15, 2022

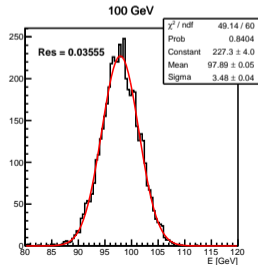
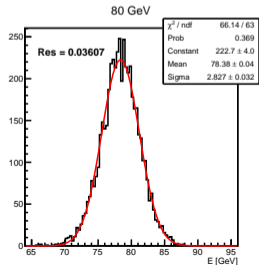
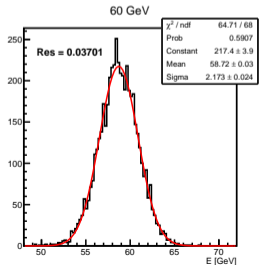
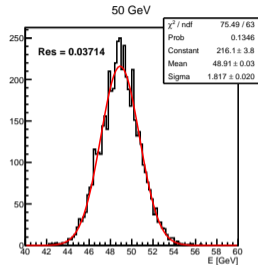
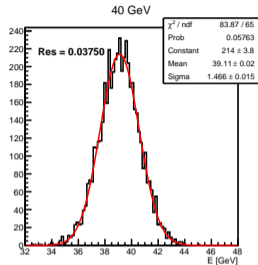
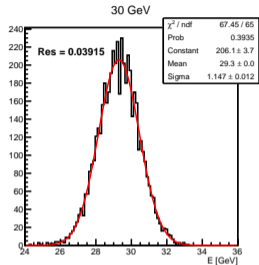
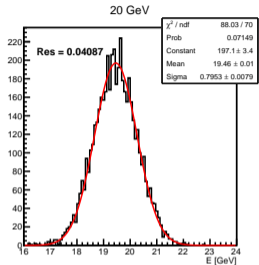
The UCLA logo consists of the letters "UCLA" in a bold, white, sans-serif font, centered within a solid blue rectangular background.

- Corrected the *scaleResponse* of raw hits in digitization for pECal and pECal insert in *reco_flags.py*.
- The digitization in *signal_sum_digi* was fixed similar to that in *single_hits_digi* in *CalorimeterHitDigi.cc*.
- Added factories to produce truth clusters from proto-truth clusters.
- Corrected the proto-cluster tag-name for pECal insert in *reco_flags.py*.
- The nested clusters in *CalorimeterClusterMerger.cc*, which prevented merged clusters to be written out, was temporarily commented out. This is a global issue with podio reference.
- Added dummy factories to let cluster associations written out.
- Renamed all tag-names that end with *ClusterAssociations* to *ClustersAssociations*. This makes the naming uniform by just adding *Associations* without removing *s* in *Clusters*.
- Fixed some typos of filenames for the pECal insert.
- The code has been tested by 5000 events for each energy.
 - It did not produce any error related to EEMC.
 - The energy responses of truth, reco, and merged clusters were reasonable.
 - The cluster associations were successfully written out.

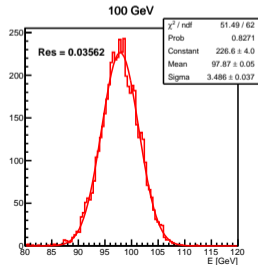
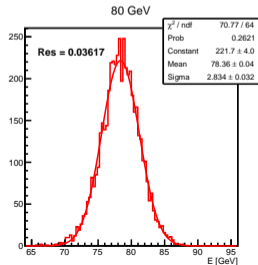
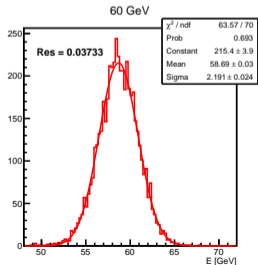
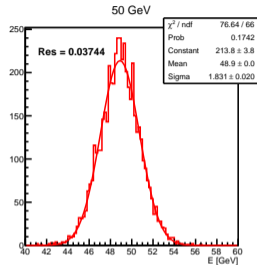
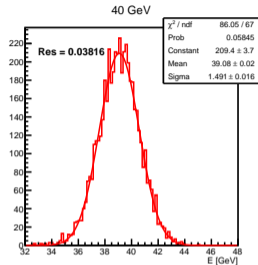
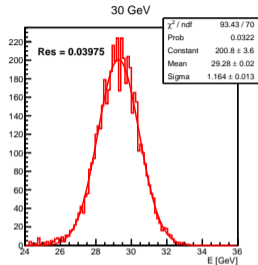
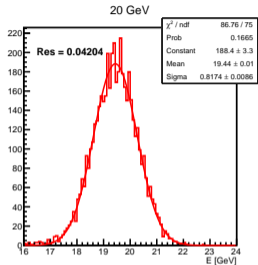
Clusters energy deposit: single photon input



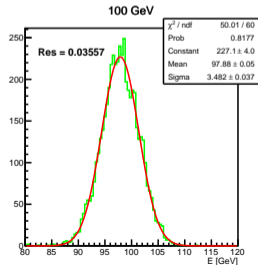
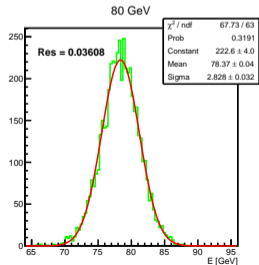
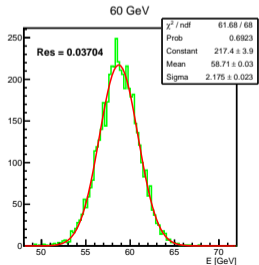
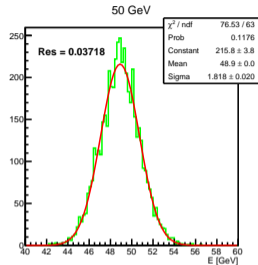
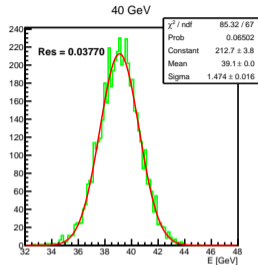
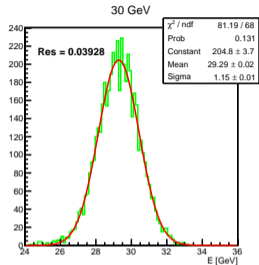
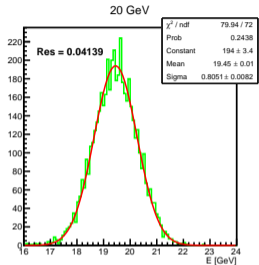
Clusters energy resolution: sum of reco hits



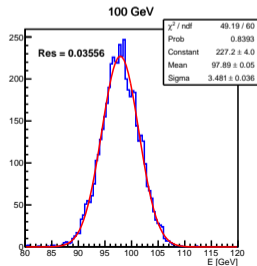
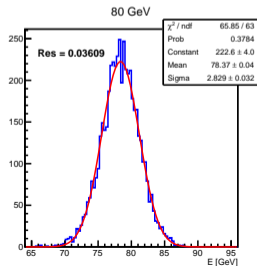
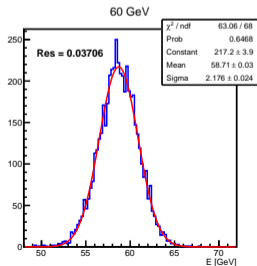
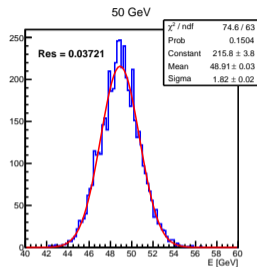
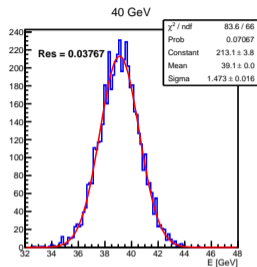
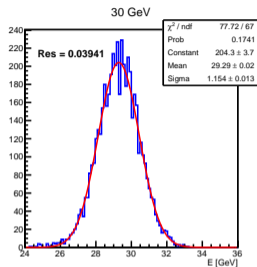
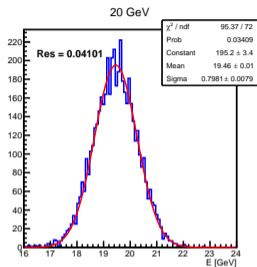
Clusters energy resolution: truth clusters



Clusters energy resolution: island clusters

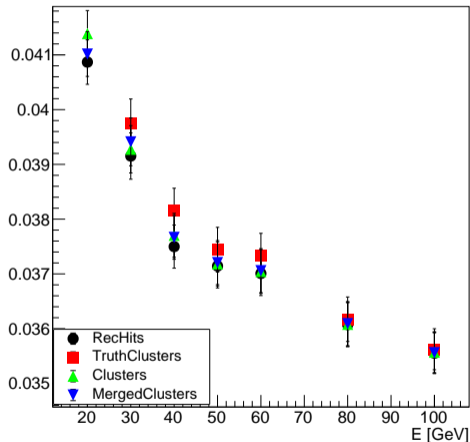


Clusters energy resolution: merged island clusters



Clusters energy resolution: comparisons

Resolution

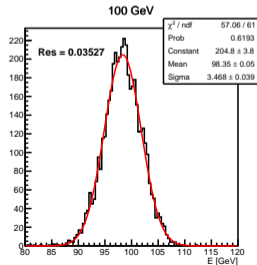
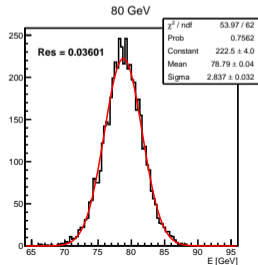
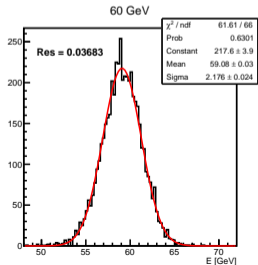
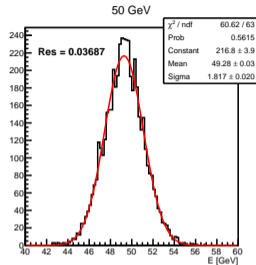
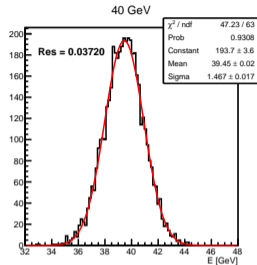
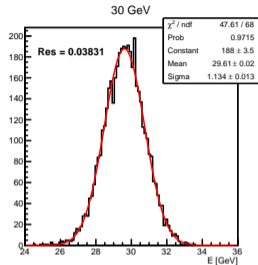
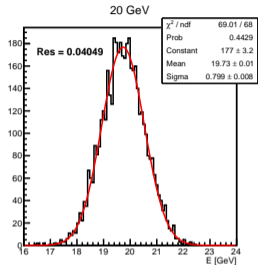


Photon energy resolution

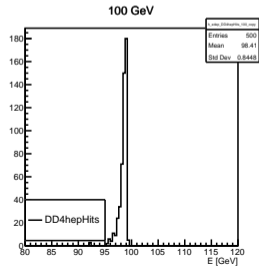
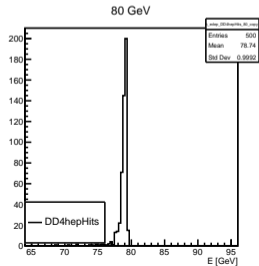
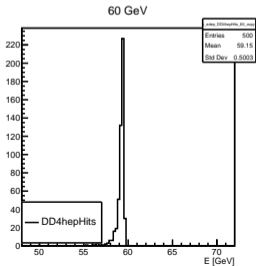
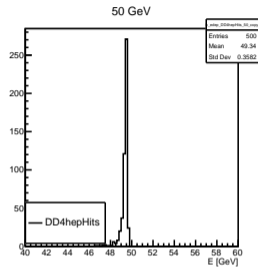
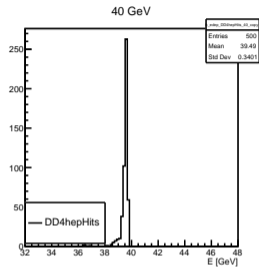
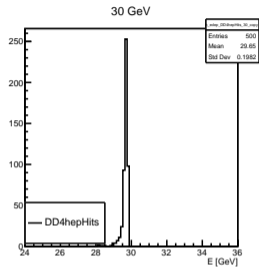
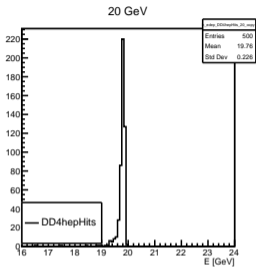
	Fiber energy resolution	Reconstructed 1	Ratio	Reconstructed 2	Ratio
		a = 0.1, b = 0.0015		a = 0.1, b = 0.0014	
500 MeV	0.1503	0.1560	1.0379	0.1557	1.0360
1 GeV	0.1163	0.1113	0.9569	0.1112	0.9564
2 GeV	0.0851	0.0812	0.9539	0.0797	0.9363
5 GeV	0.0570	0.0574	1.0068	0.0562	0.9855
10 GeV	0.0473	0.0452	0.9568	0.0441	0.9332
20 GeV	0.0391	0.0382	0.9772	0.0367	0.9399
30 GeV	0.0323	0.0352	1.0896	0.0335	1.0390
40 GeV	0.0313	0.0332	1.0599	0.0315	1.0075
50 GeV	0.0283	0.0323	1.1381	0.0306	1.0783

Electron energy resolution from Geant4

Sum of reco hits w/o threshold



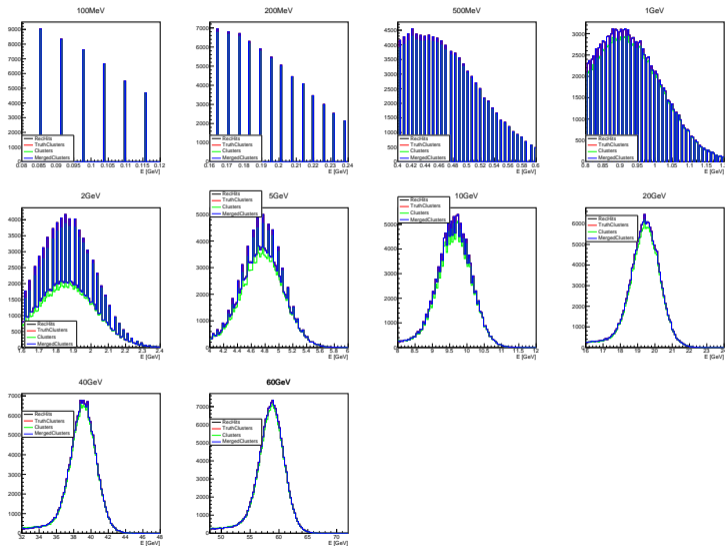
Source of 3% energy loss: sum of DD4hep hits



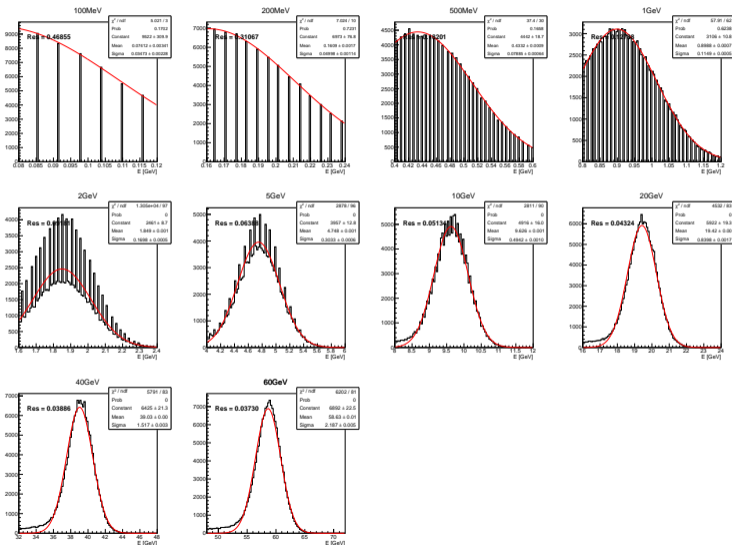
- The energy responses look reasonable except 3% energy loss, which comes from DD4hep and may be due to the finite detector length.
- The energy resolutions are consistent with previous Geant4 simulations.
- Truth, island, and merged clustering algorithms work as expected for single particle input.

EIC Test Dataset

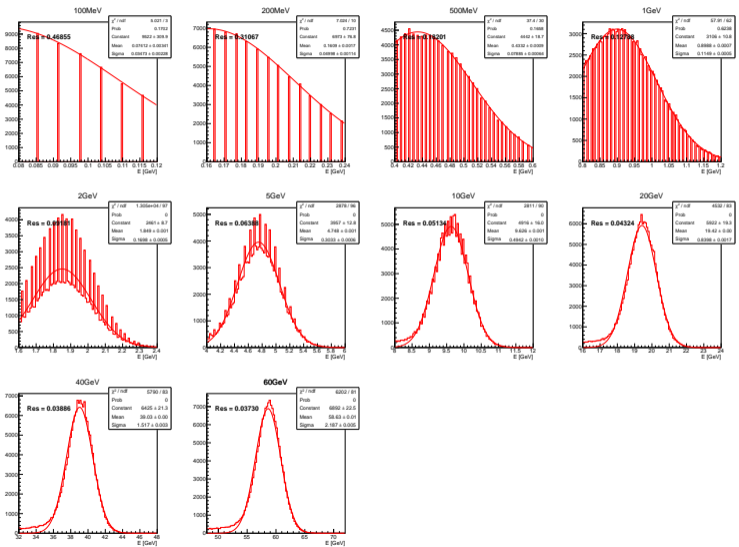
Clusters energy deposit: single photon input



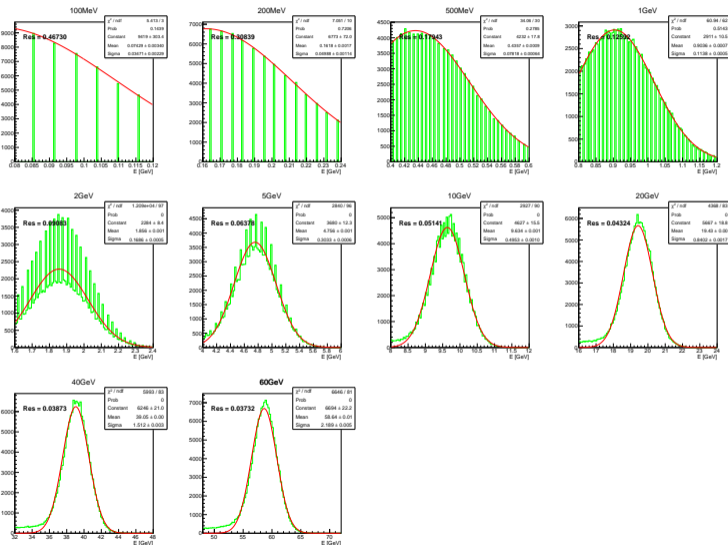
Clusters energy resolution: sum of reco hits



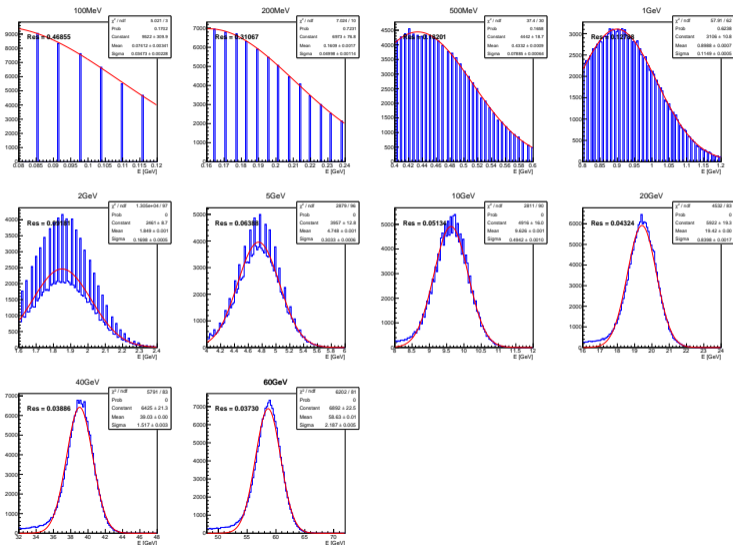
Clusters energy resolution: truth clusters



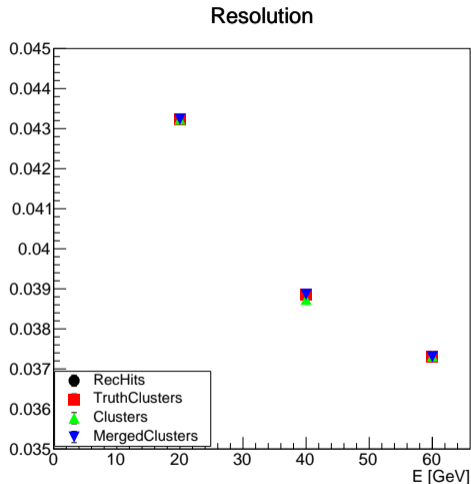
Clusters energy resolution: island clusters



Clusters energy resolution: merged island clusters



Clusters energy resolution: comparisons



	Fiber energy resolution	Reconstructed 1	Ratio	Reconstructed 2	Ratio
		a = 0.1, b = 0.0015		a = 0.1, b = 0.0014	
500 MeV	0.1503	0.1560	1.0379	0.1557	1.0360
1 GeV	0.1163	0.1113	0.9569	0.1112	0.9564
2 GeV	0.0851	0.0812	0.9539	0.0797	0.9363
5 GeV	0.0570	0.0574	1.0068	0.0562	0.9855
10 GeV	0.0473	0.0452	0.9568	0.0441	0.9332
20 GeV	0.0391	0.0382	0.9772	0.0367	0.9399
30 GeV	0.0323	0.0352	1.0896	0.0335	1.0390
40 GeV	0.0313	0.0332	1.0599	0.0315	1.0075
50 GeV	0.0283	0.0323	1.1381	0.0306	1.0783

Electron energy resolution from Geant4

- The energy responses look reasonable for high energy but low energy suffers from digitization.
- The energy resolutions are consistent with previous Geant4 simulations.
- Truth, island, and merged clustering algorithms work as expected for single particle input.