Subject: EMC cluster energy correction
Posted by Dima Melnychuk on Wed, 15 Feb 2012 12:53:29 GMT
View Forum Message <> Reply to Message

Dear colleagues,
I have committed an updated on emc cluster energy correction.

To start from the beginning, emc cluster energy correction should correct for the energy leakage
in dead material and via rear side of crystals. The energy leakage is dependent on energy and polar angle.

Up to now energy correction with parametrization was available via
PndEmcCluster::GetEnergyCorrected() and it was based on the study performed in Babar framework.

Later Ola Biegun implemented energy-angle correction from 2-dimensional histogram, but that correction was not integrated in full pandaroot reconstruction chain.

After that I tried to merge two approaches via one class
PndEmcClusterHistCalibrator(Int_t method, Int_t version)
where first input parameter:
method=1 - correction from the interpolation on 2-dimensional histogram
method=2 - correction from parametrization.
Second parameter "version" should take into account different versions of correction based for example on different geometries, including dead material or Geant3 vs Geant4.
At the the moment only one version is provided based on Geant3 simulation.

Till now it didn't provide reliable results.
But I made several correction in the code and calculated corrections on above 1 million events statistics.

Data to calculate correction are produced with
/macro/emc/dedicated/EnergyPosCorrection/emc_correction_data_production. C.
Then to calculate correction from histogram in emc_correction_hist.C
energy and theta range is divided into intervals, and for each interval a histogram with MonteCarlo energy divided by Reconstructed energy is filled
Mean value of histogram for given interval is calculated. Finally there are four histograms for barrel emc,
forward, backward endcaps and shashlyk.

To obtain correction with parametrization in emc_correction_parametrization.C at the beginning similar histograms are calculated but in addition for barrel low and
high energies are separated. Histograms are fitted and parameters are stored in
PndEmcClusterCalibrationPar containers.

Performance of correction is studied on 3 data sets with emc_correction_QA.C macro

1. Photons with energy from 0 to 10 GeV within whole theta range.
Four histograms are compared (no correction, correction from histogram, correction with parametrization and old correction from PndEmcCluster::GetEnergyCorrected())
as a ratio of reconstructed energy divided by MonteCarlo energy

vs energy:

and vs theta:

The overall performance look reasonable

2. 1 GeV photon separately for target spectrometer:

and shashlyk calorimeter

Visually energy peaks are centred around 1 GeV whereas for old correction peak is slightly shifted toward higher energy.
Important remark here is that non-corrected shashlyk energy is close to 1 GeV since sampling factor 3 is included in digitization and here only fine correction is applied.

3. pi0 invariant mass

Here both methods give pi0 mass 135.7 MeV and 135.5 MeV close to nominal mass and it is improvement of old correction (138 MeV).

As a conclusion there is some improvement in comparison with old parametrization and both implemented methods give comparable results.
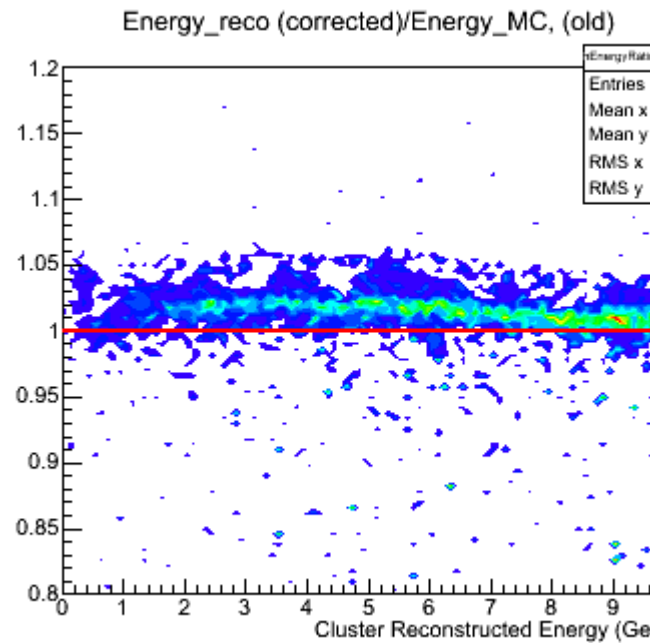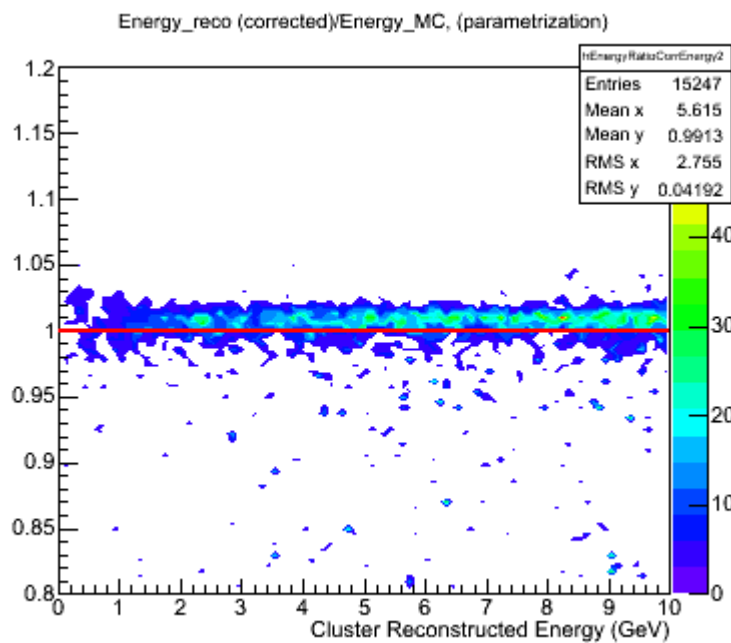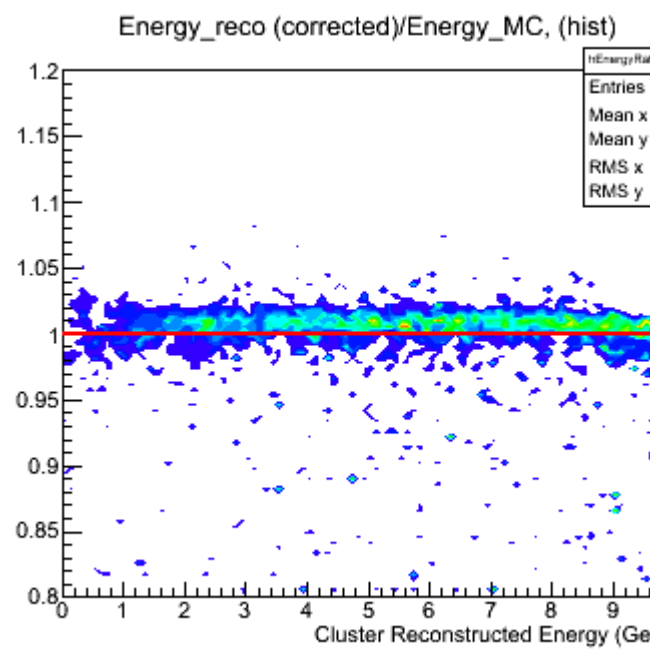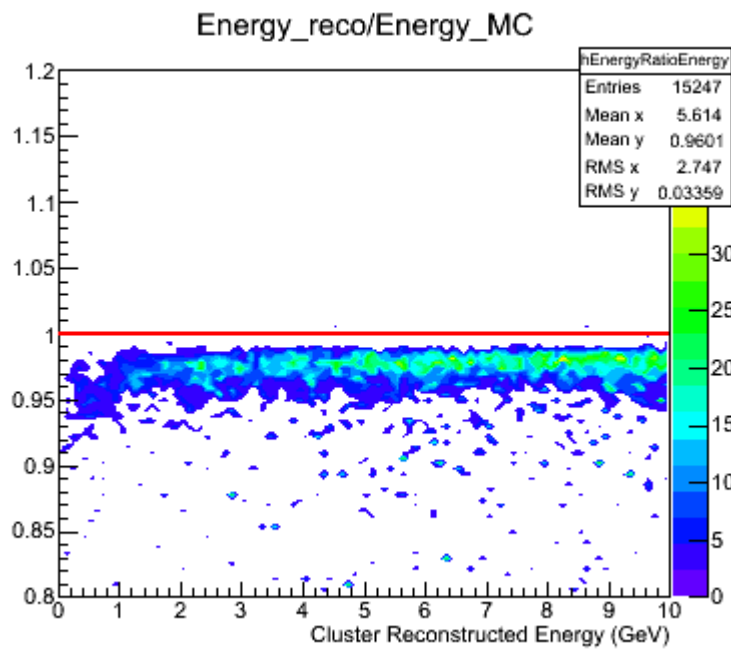Cluster energy correction with PndEmcClusterHistCalibrator still should be implemented inside PndPidCorrelator.
When it will be done I will remove PndEmcCluster::GetEnergyCorrected() function and PndEmcClusterHistCalibrator should be used instead.

I planed to do the same study with Geant4 but Dirc crashes and I would rather not exclude it and I'm waiting
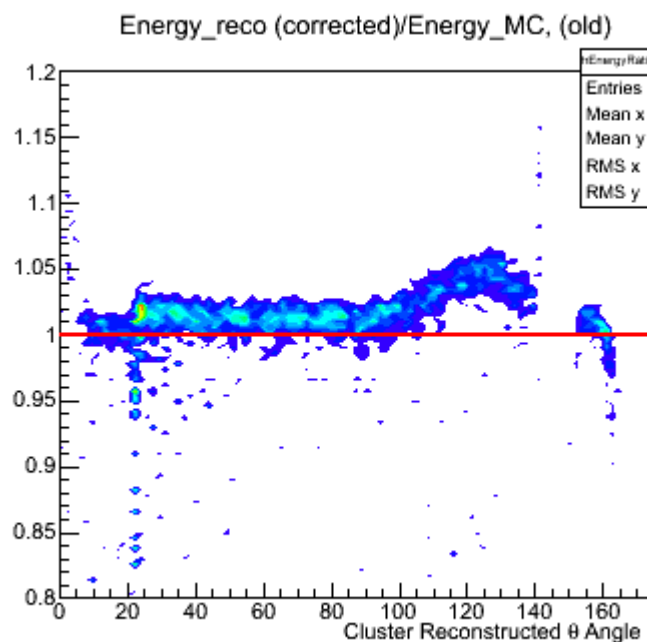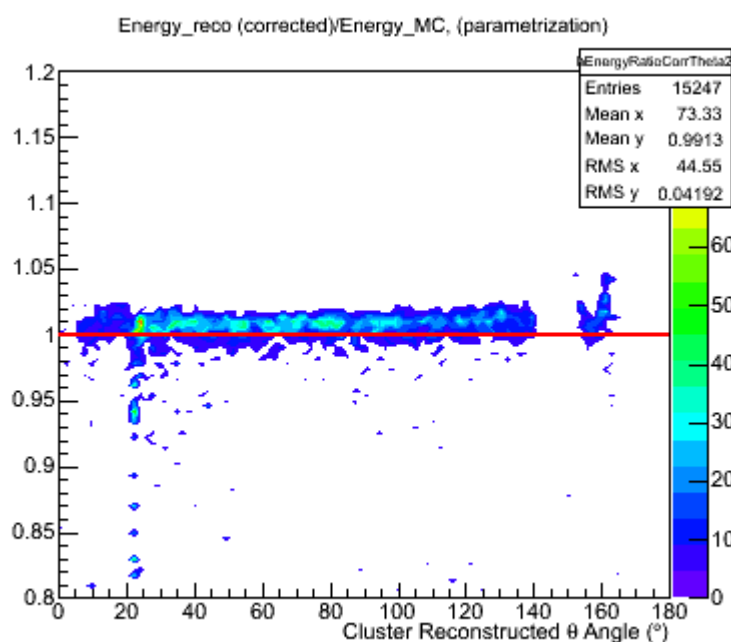when the problem with Dirc in Geant4 will be solved.

Dima

File Attachments
1) e_vs_e.png, downloaded 1242 times

Energy_reco/Energy_MC

hEnergyRatioEnergy

Entries	15247
Mean x	5.614
Mean y	0.9601
RMS x	2.747
RMS y	0.03359

Energy_reco (corrected)/Energy_MC, (hist)

hEnergyRa

Entries	
Mean x	
Mean y	
RMS x	
RMS y	

Energy_reco (corrected)/Energy_MC, (parametrization)

hEnergyRatioCorrEnergy2

Entries	15247
Mean x	5.615
Mean y	0.9913
RMS x	2.755
RMS y	0.04192

Energy_reco (corrected)/Energy_MC, (old)

hEnergyRat

Entries	
Mean x	
Mean y	
RMS x	
RMS y	

2) e_vs_theta.png, downloaded 1205 times

Energy_reco/Energy_MC

hEnergyRatioTheta	
Entries	15247
Mean x	73.85
Mean y	0.9601
RMS x	44.24
RMS y	0.03359

Energy_reco (corrected)/Energy_MC, (hist)

Energy_reco (corrected)/Energy_MC, (parametrization)

hEnergyRatioCorrTheta2	
Entries	15247
Mean x	73.33
Mean y	0.9913
RMS x	44.55
RMS y	0.04192

Energy_reco (corrected)/Energy_MC, (old)
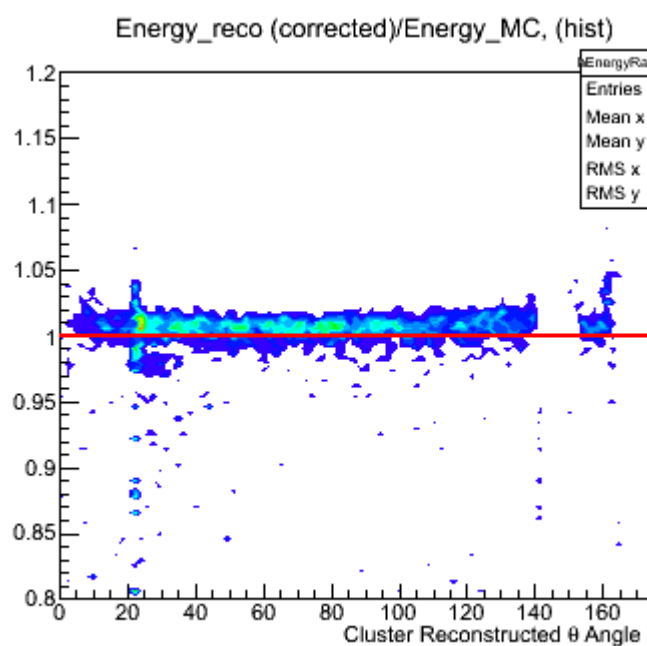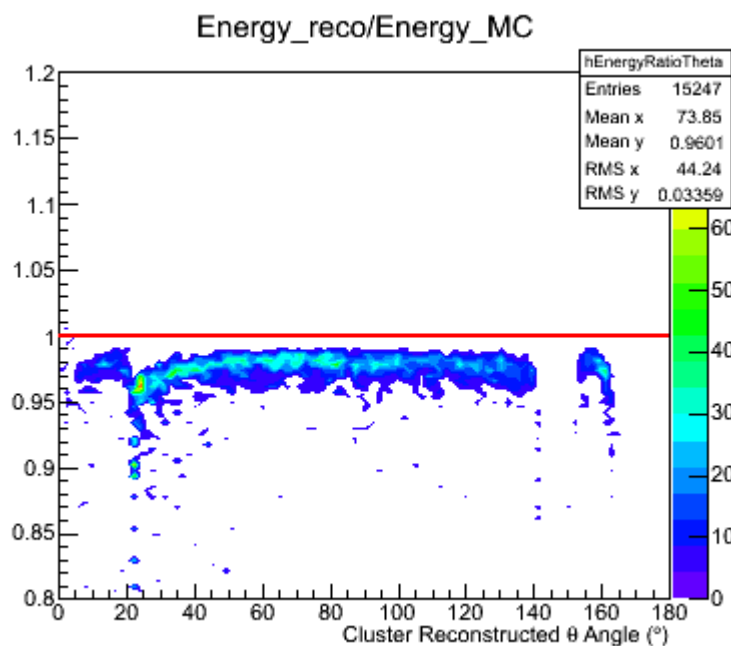
3) e_gamma_1gev_ts.png, downloaded 1222 times

Cluster energy

h_energy	
Entries	62075
Mean	0.8888
RMS	0.1531

Cluster energy (corrected), (hist)

h_ener	
Entries	
Mean	
RMS	

Cluster energy (corrected), (parametrization)

h_energy_corr2	
Entries	62075
Mean	0.9889
RMS	0.04152

Cluster energy (corrected), (old)

h_energ	
Entries	
Mean	
RMS	
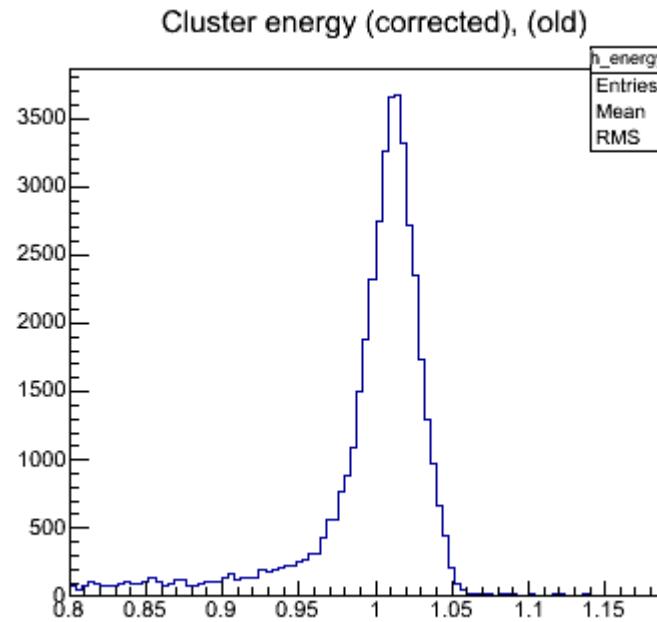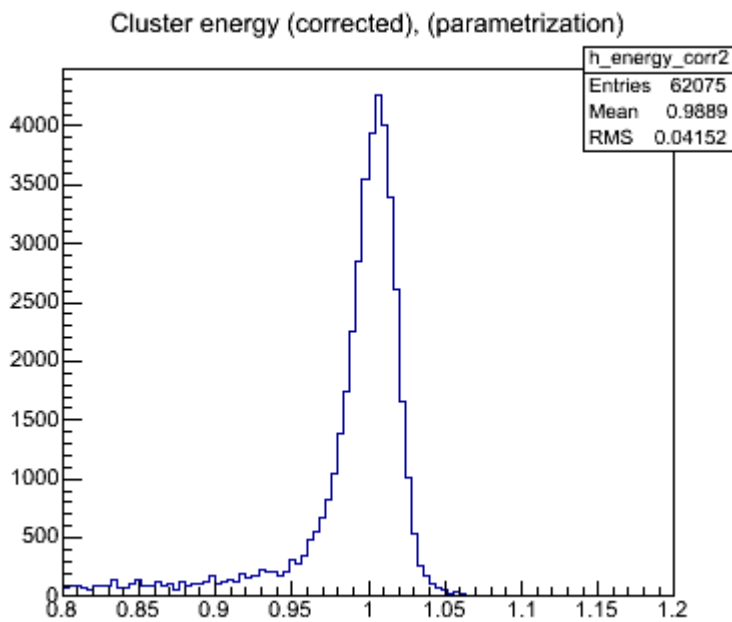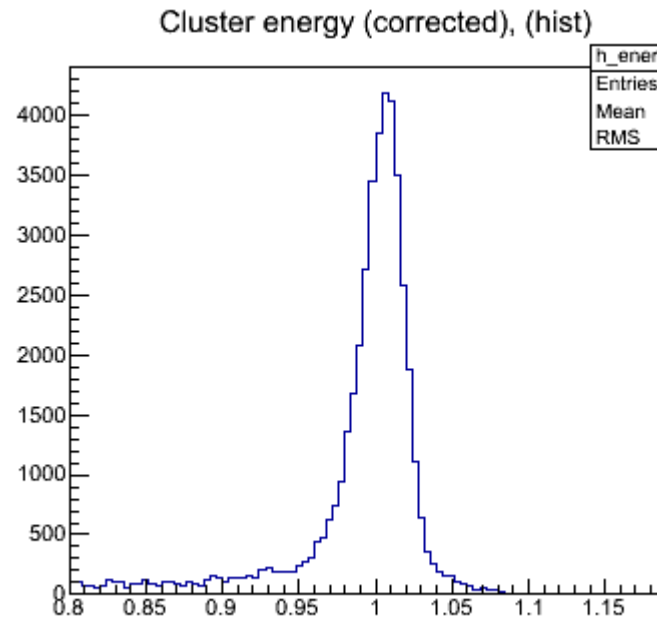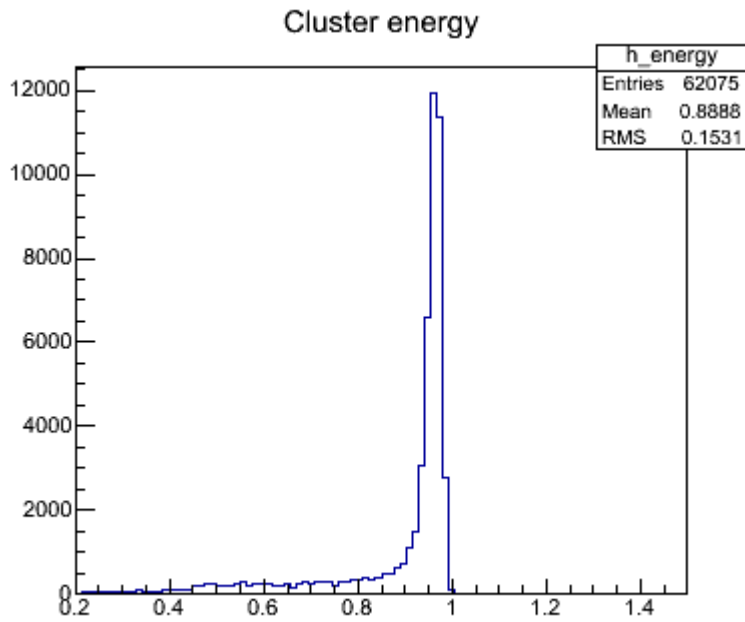
4) e_gamma_1gev_shashlyk.png, downloaded 1214 times

Cluster energy (shashlyk)

h_energy_shashlyk	
Entries	1599
Mean	0.9468
RMS	0.04446

Cluster energy (shashlyk) (corrected), (hist)

h_energy_	
Entries	
Mean	
RMS	

Cluster energy (shashlyk) (corrected), (parametrization)

h_energy_shashlyk_corr2	
Entries	1599
Mean	0.9961
RMS	0.04707

Cluster energy (shashlyk) (corrected)

h_energy_sh	
Entries	
Mean	
RMS	
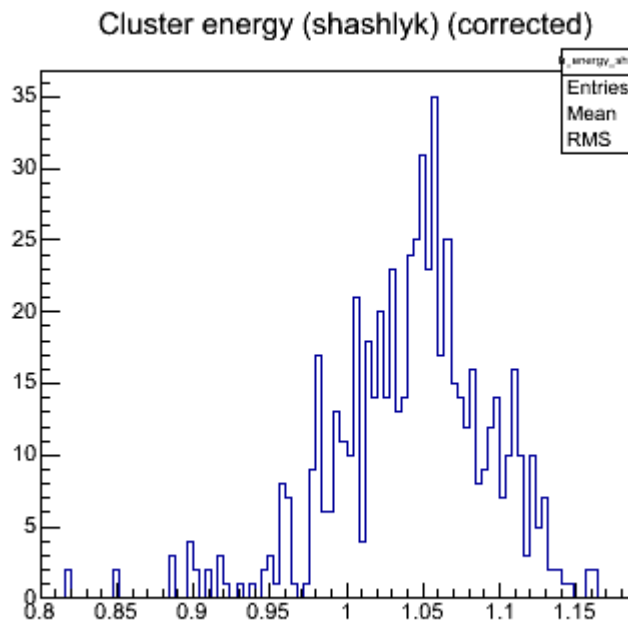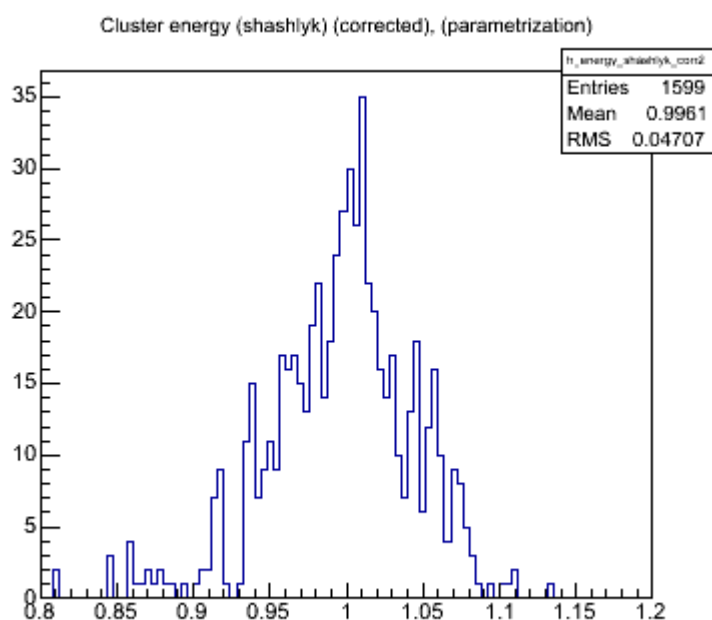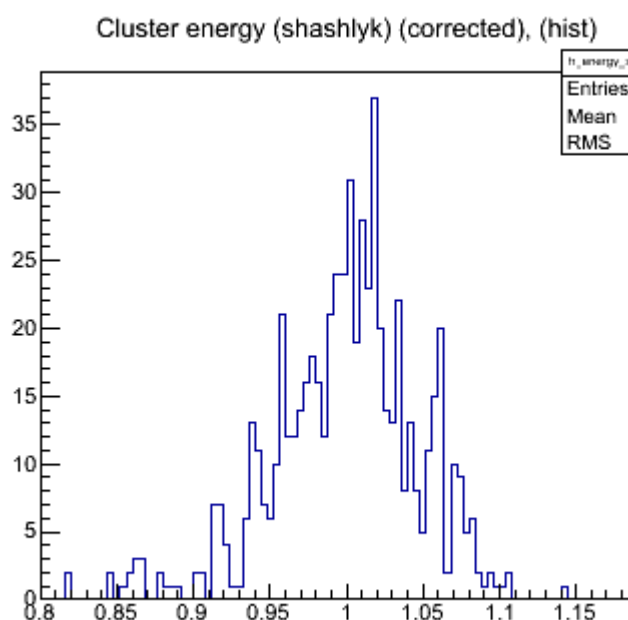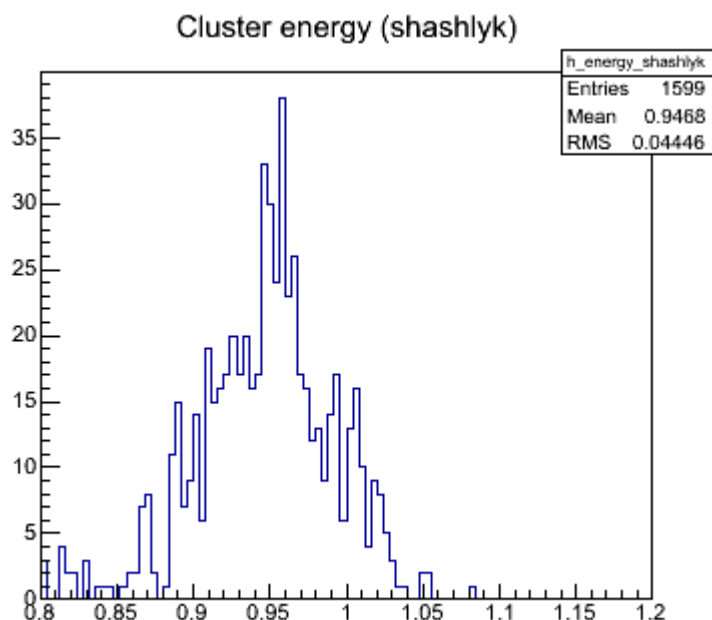
5) m_pi0.png, downloaded 1271 times

pi0 invariant mass

h_mpi0	
Entries	67897
Mean	0.1165
RMS	0.03014
χ^2 / ndf	171.8 / 62
p0	676.4 ± 12.9
p1	0.128 ± 0.000
p2	0.004852 ± 0.000075
p3	146.9 ± 4.6
p4	-717.2 ± 30.4

pi0 invariant mass (corrected) (hist)

h_mpi0_cor	
Entries	
Mean	
RMS	
χ^2 / ndf	17
p0	672.
p1	0.1357 ± 0.
p2	0.004945 ± 0.
p3	139
p4	-650.
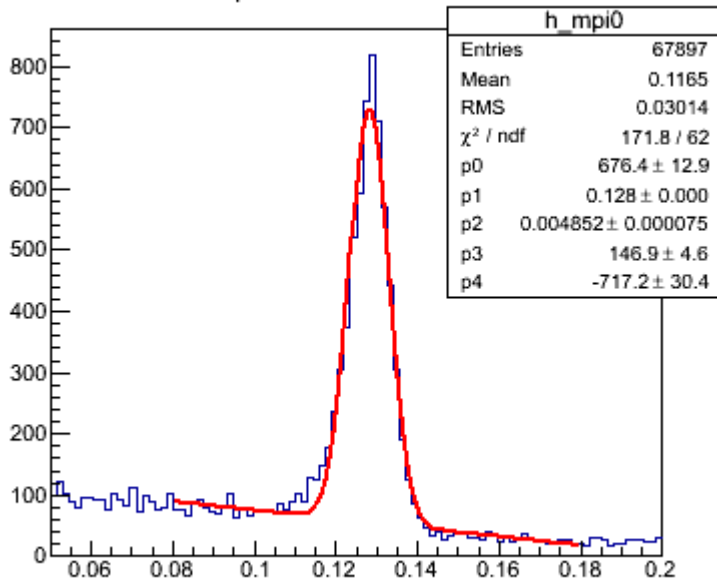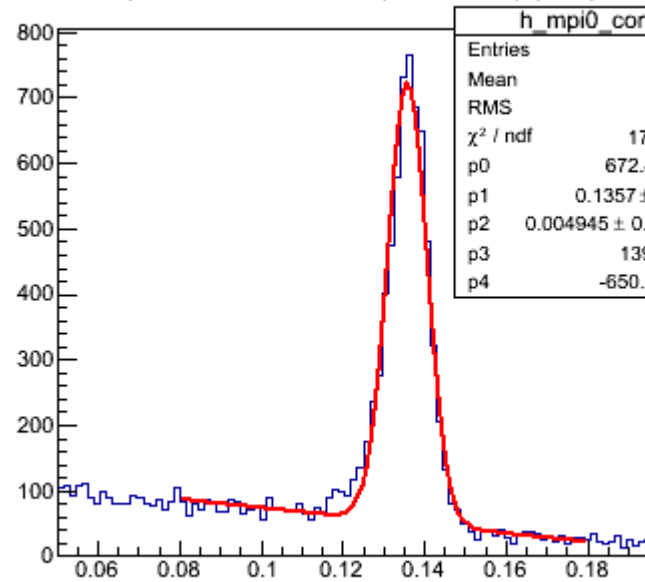
pi0 invariant mass (corrected) (parametrization)

h_mpi0_corr2	
Entries	67897
Mean	0.1215
RMS	0.03171
χ^2 / ndf	169.3 / 62
p0	668.7 ± 12.4
p1	0.1355 ± 0.0001
p2	0.004956 ± 0.000073
p3	133.8 ± 4.4
p4	-603.1 ± 30.2

pi0 invariant mass (corrected) (old)

h_mpi0_corr_	
Entries	
Mean	
RMS	
χ^2 / ndf	91
p0	586.
p1	0.138
p2	0.005751 ± 0.
p3	135
p4	-607.