Subject: EMC cluster energy correction
Posted by Dima Melnychuk on Wed, 15 Feb 2012 12:53:29 GMT
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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).

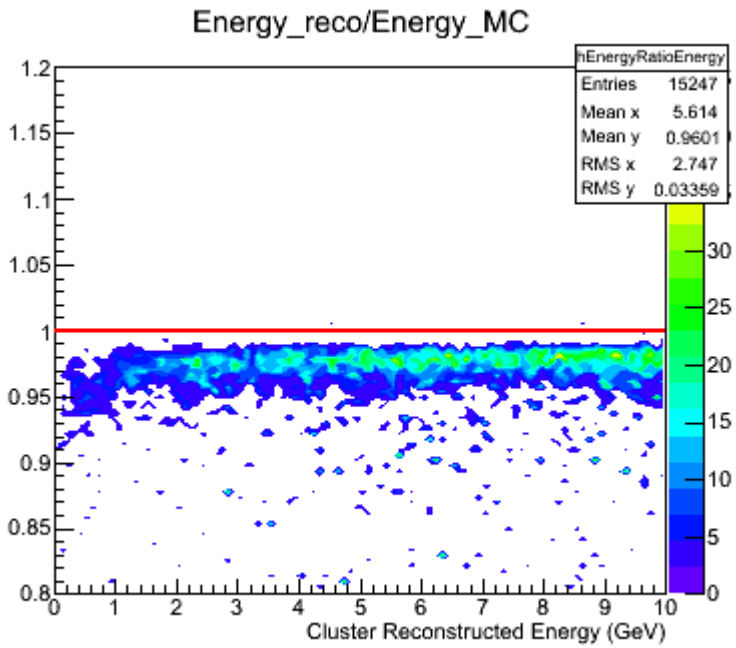
As a conclusion there is some improvement in comparison with old parametrization and both implemented methods give comparable results.
Cluster energy correction with PndEmcClusterHistCalibrator still should be implemented inside PndPidCorrelator.
When it will be done I will remove PndEmcCluster::GetEnergyCorrected()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

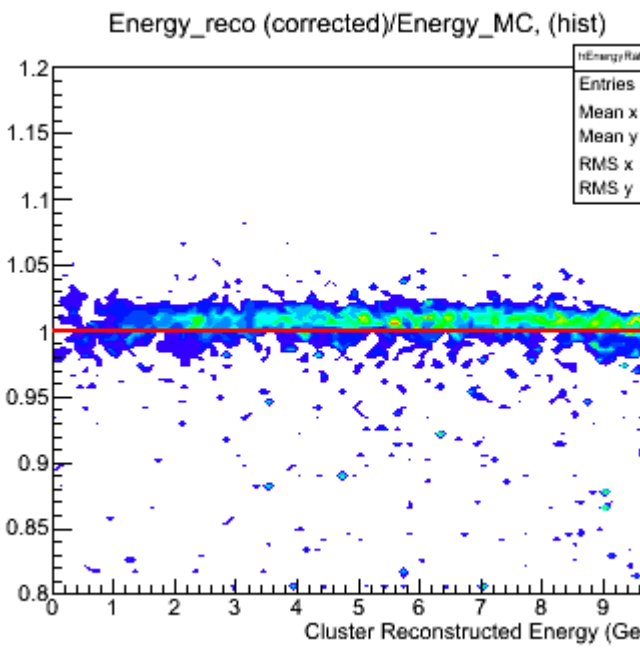
I planed to do the same study with Geant4 but Dirc crashes and I would rather not exclude it and I'm waiting
when the problem with Dirc in Geant4 will be solved.

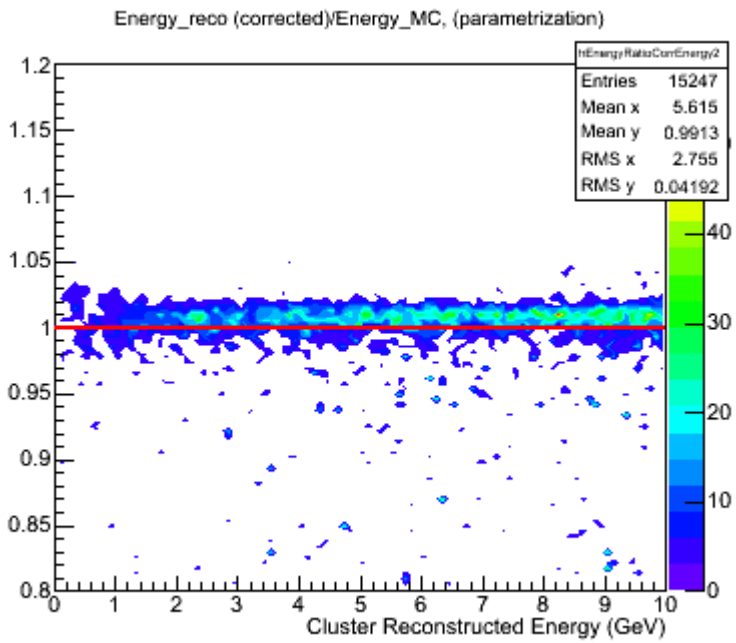
Dima

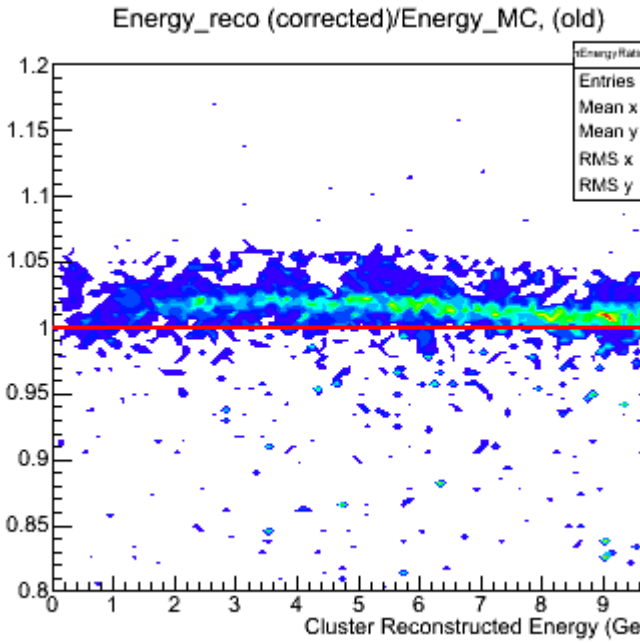
File Attachments

1) e_vs_e.png, downloaded 1897 times

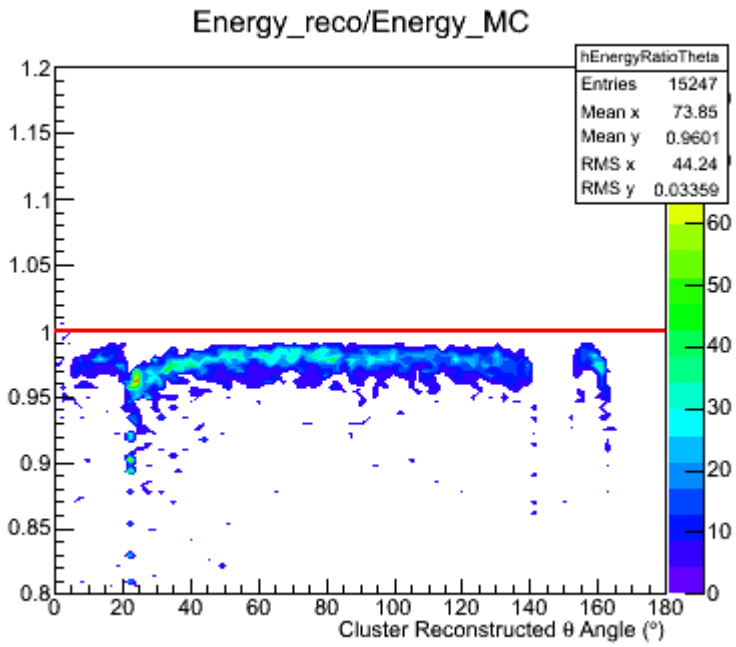


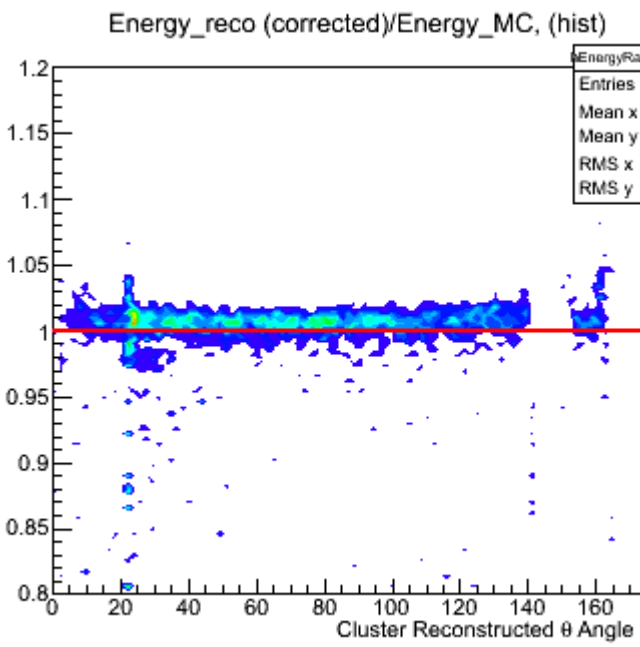


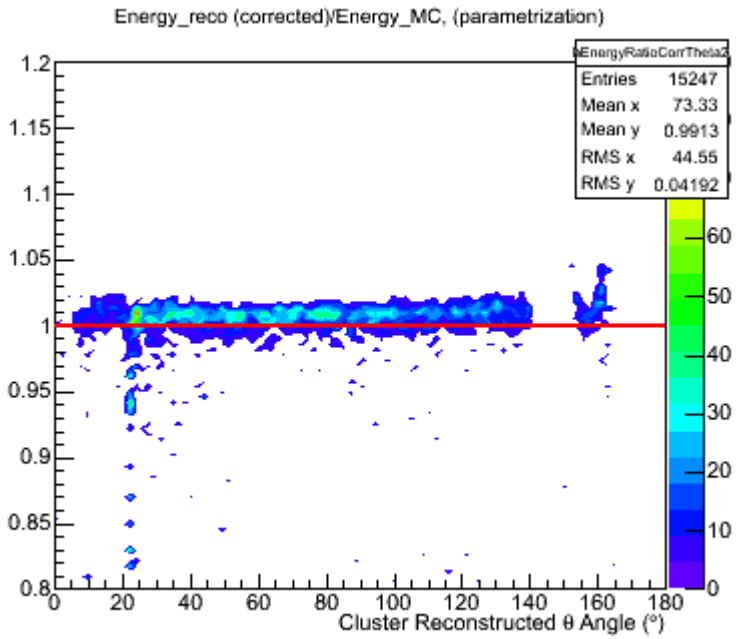


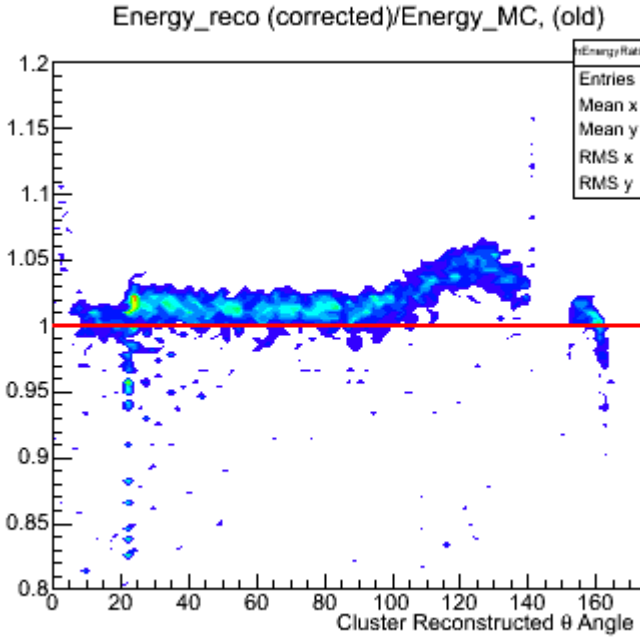


2) e_vs_theta.png, downloaded 1942 times

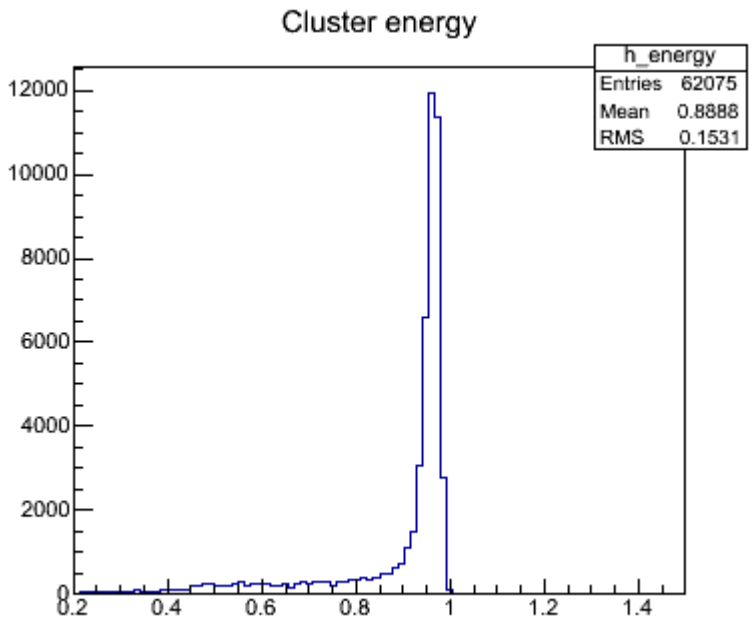


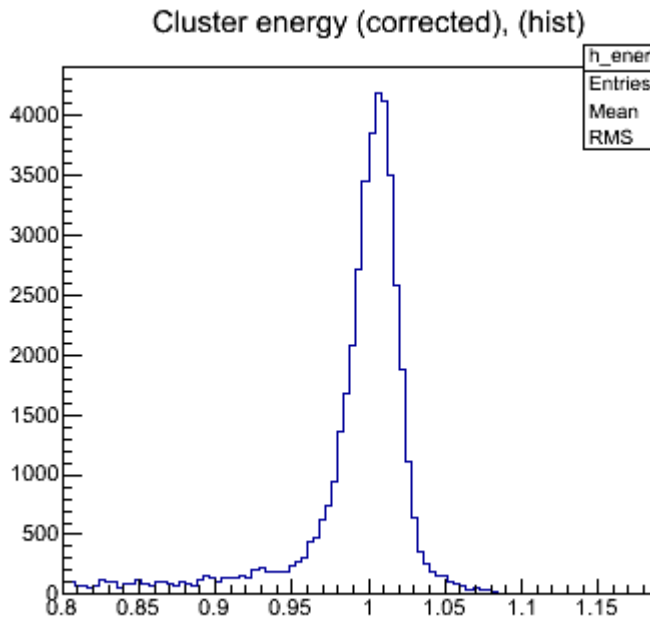


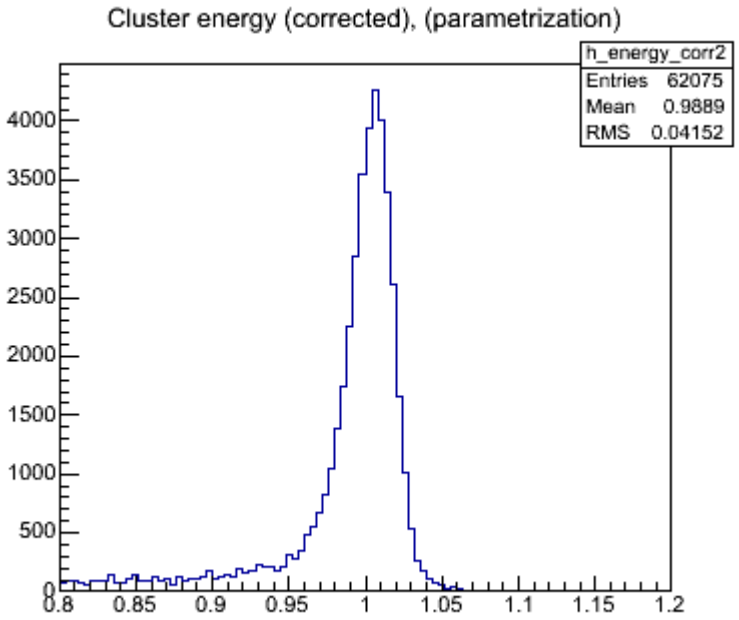


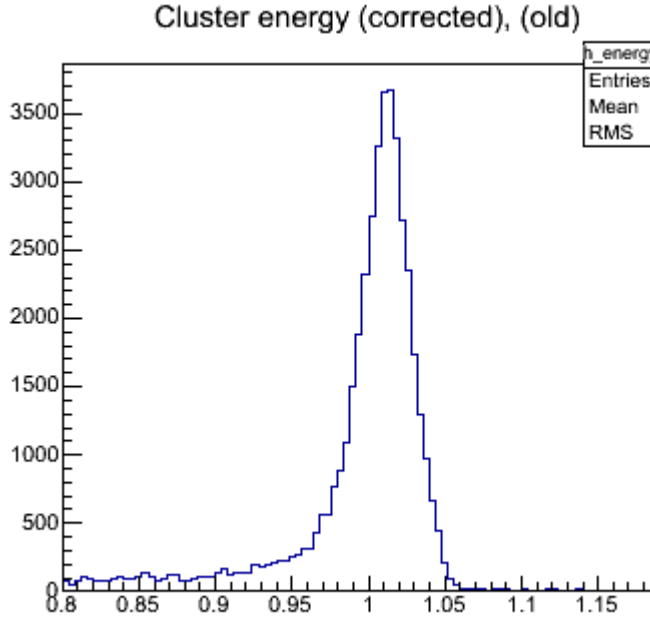


3) e_gamma_1gev_ts.png, downloaded 1880 times

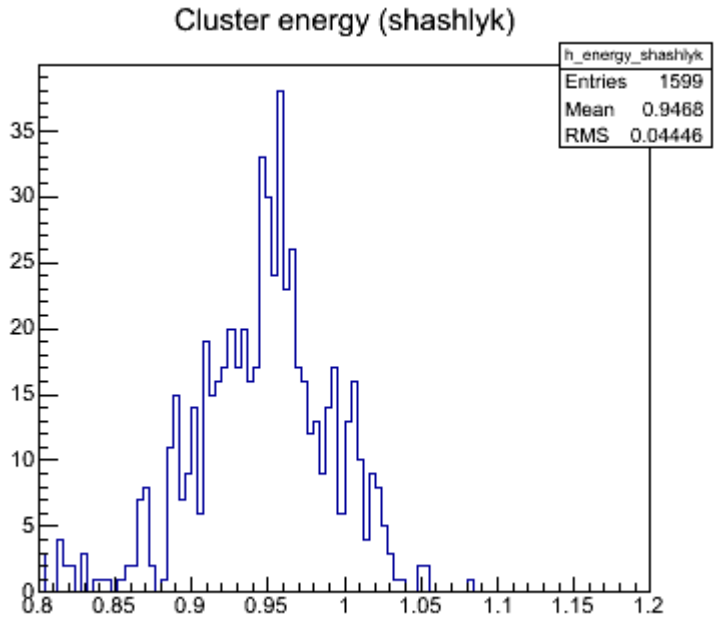


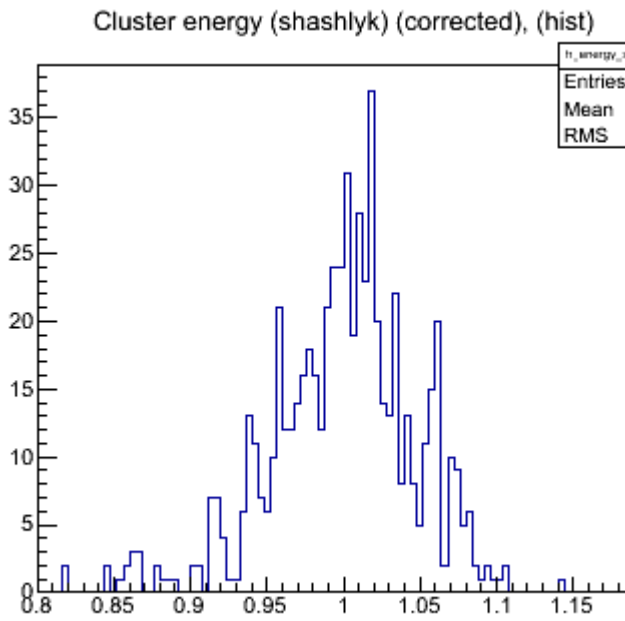


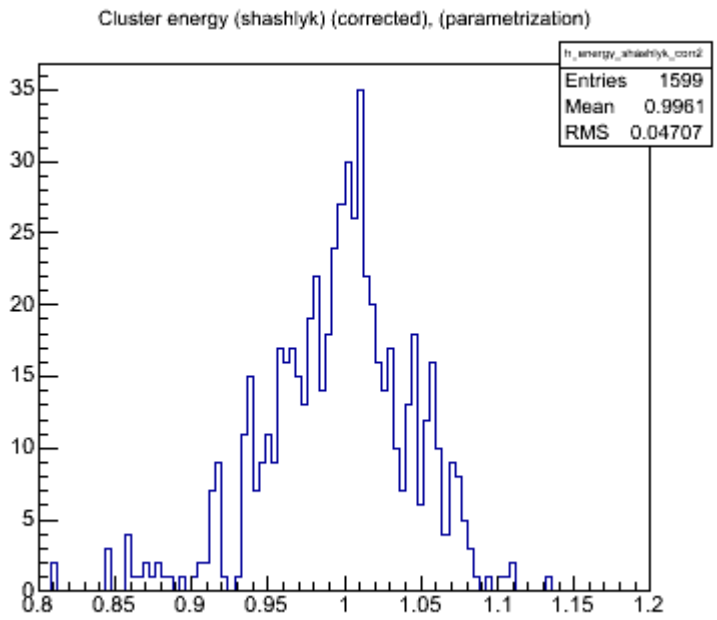


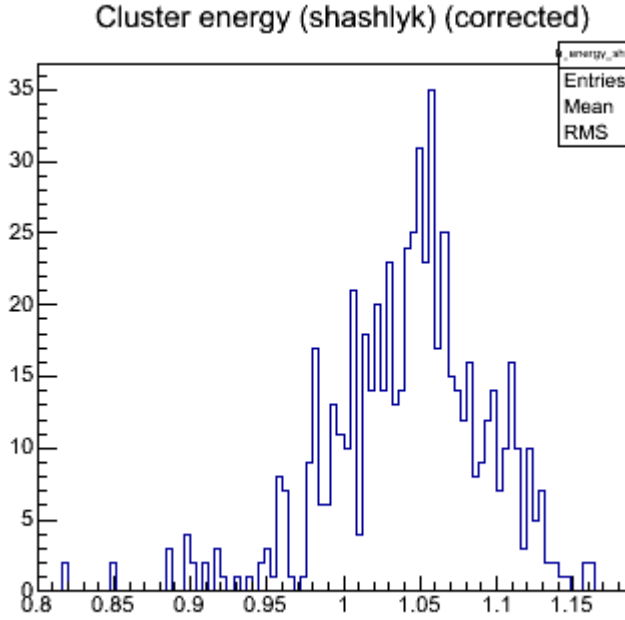


4) e_gamma_1gev_shashlyk.png, downloaded 1855 times

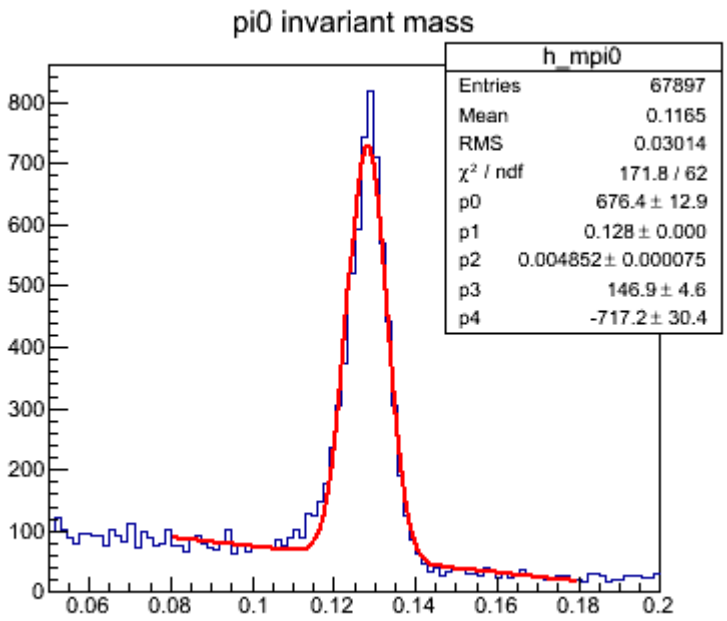


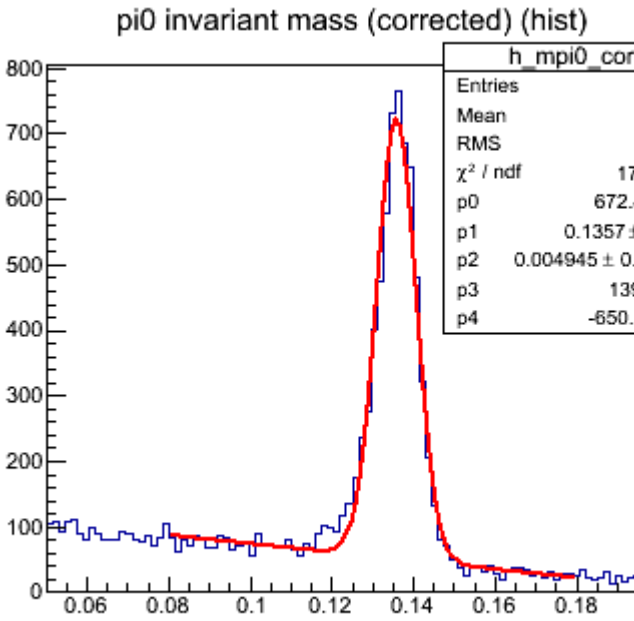


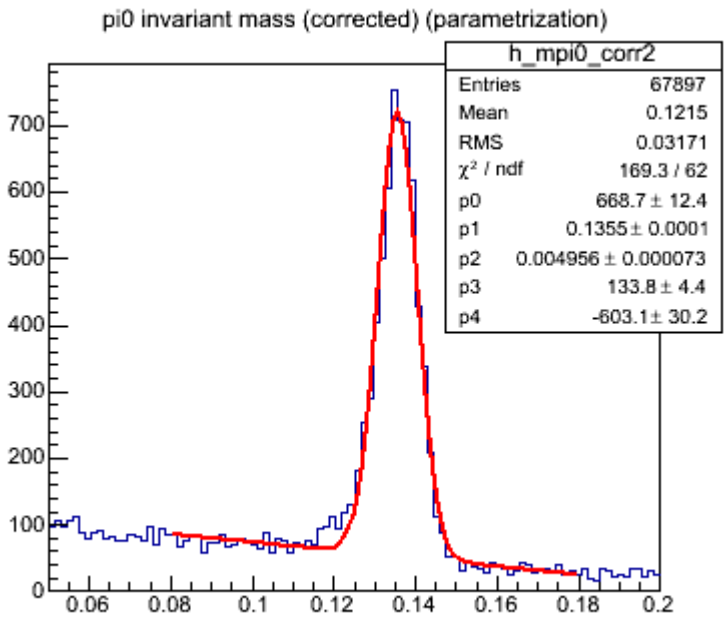


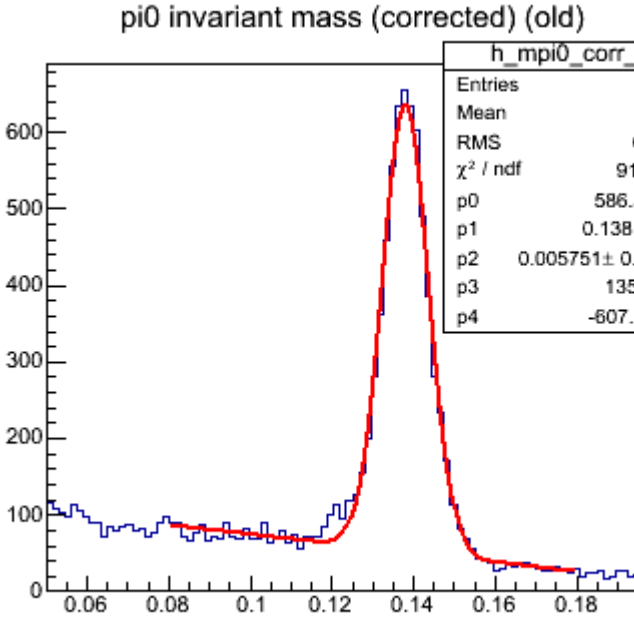


5) m_pi0.png, downloaded 1828 times


pi0 invariant mass
h_mpi0
Entries 67897
Mean 0.1165
RMS 0.03014
χ² / 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
χ² / ndf 17
p0 672.
p1 0.1357 ±
p2 0.004945 ± 0.
p3 13
p4 -650.


pi0 invariant mass (corrected) (parametrization)
h_mpi0_corr2
Entries 67897
Mean 0.1215
RMS 0.03171
χ² / 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
χ² / ndf 91
p0 586.
p1 0.138
p2 0.005751 ± 0.
p3 135
p4 -607.