ECL software validation

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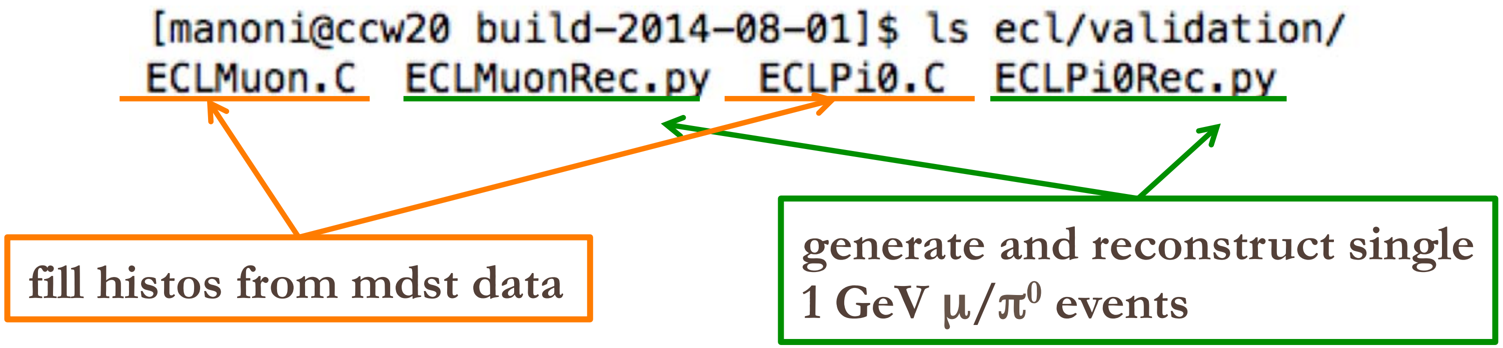
Introduction

- Structure of validation code common to all sub-detectors
  - sub-detector validation code in: sub_detector_name/validation
  - content: .py script to generate and reconstruct event and to produce output ntuple, .C macro to fill histos from ntuple

- For ECL (prior to our work):



```
[manoni@ccw20 build-2014-08-01]$ ls ecl/validation/
 ECLMuon.C   ECLMuonRec.py   ECLPi0.C   ECLPi0Rec.py
```

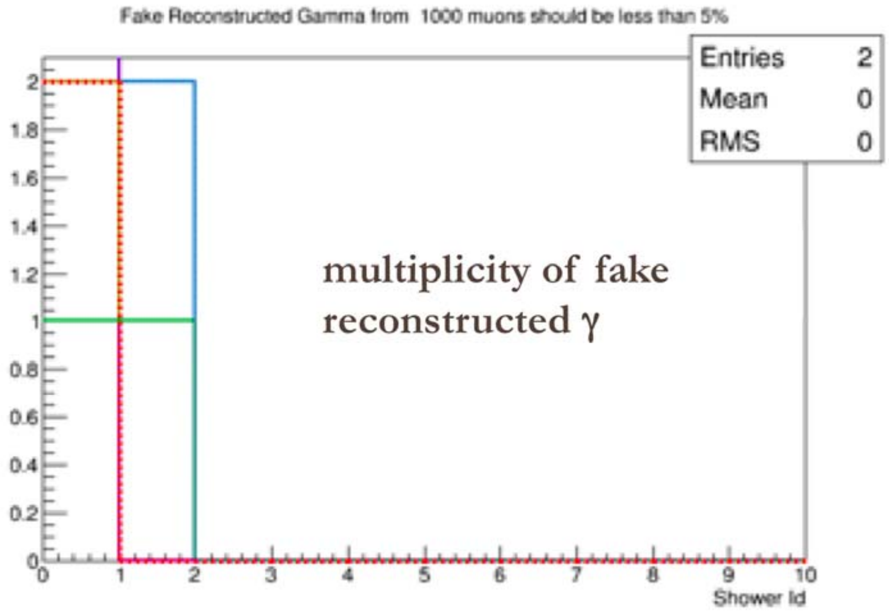
fill histos from mdst data

generate and reconstruct single 1 GeV μ/π^0 events

- All sub-detector scripts run daily by centralized script and checked by software shifters

- Our work on validation is a by-product of the deep investigation we are doing on ECL code for performance studies

ECL validation plots (I)
(prior to our work)

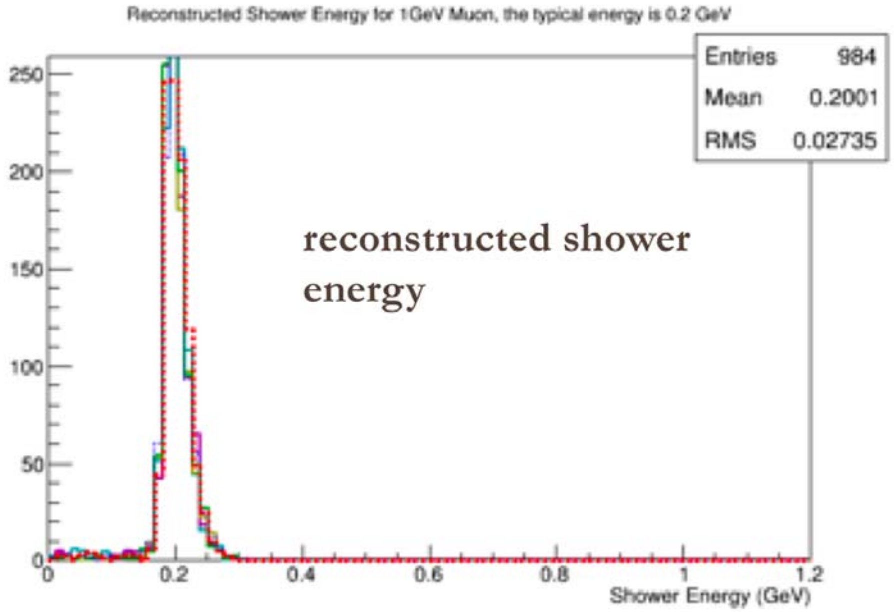

Fake Reconstructed Gamma from 1000 muons should be less than 5%

multiplicity of fake reconstructed γ

No reference plot

No description

No check


Reconstructed Shower Energy for 1GeV Muon, the typical energy is 0.2 GeV

reconstructed shower energy

No reference plot

No description

No check

Legend:

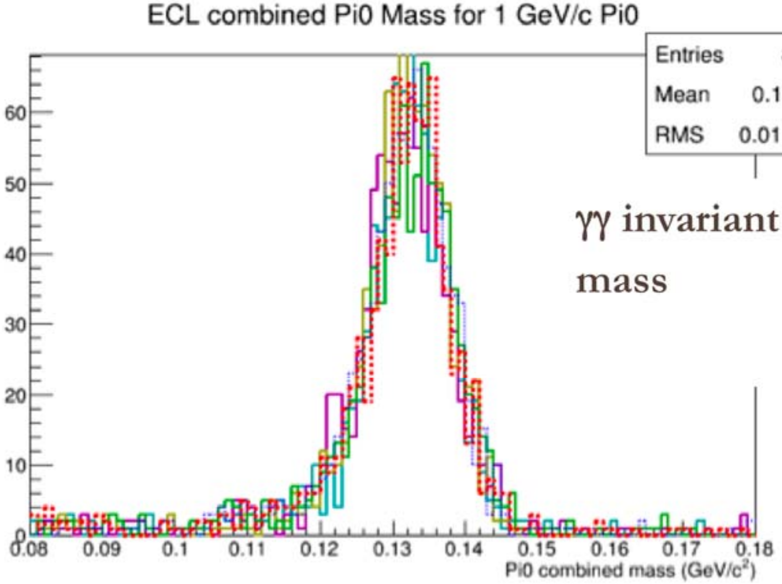
- ● reference
- ● 14455 (current)
- ● 14452
- ● 14437
- ● 14416
- ● build-2014-10-17
- ● build-2014-10-01

Plots for 1 GeV single-μ sample

ECL validation plots (II)
(prior to our work)

Legend:

- ● reference
- ● 14455 (current)
- ● 14452
- ● 14437
- ● 14416
- ● build-2014-10-17
- ● build-2014-10-01



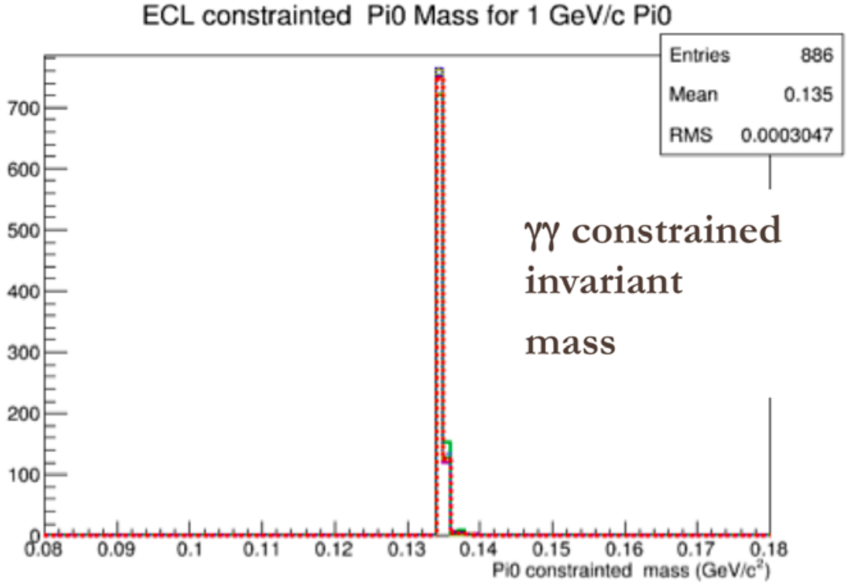
γγ invariant mass

No reference plot

No description

No check

Plots for 1 GeV single-π^0 sample

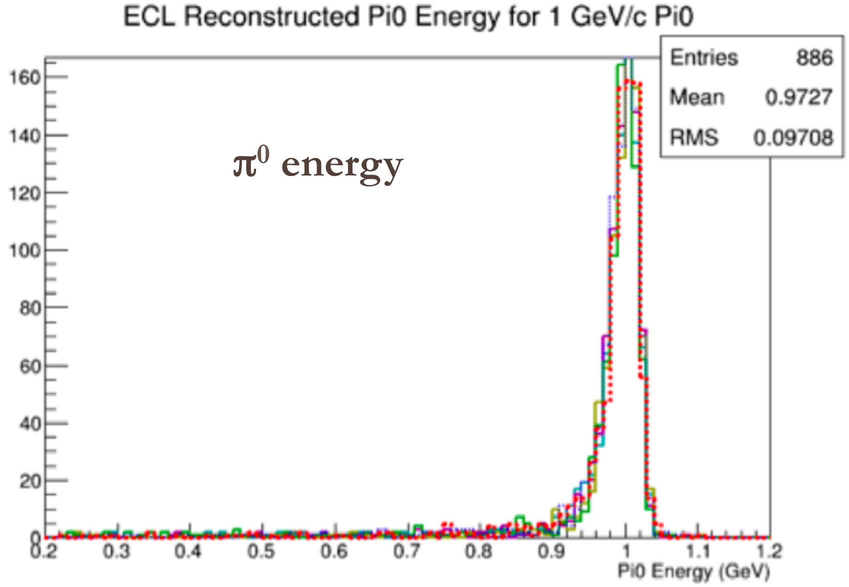


γγ constrained invariant mass

No reference plot

No description

No check



π^0 energy

No reference plot

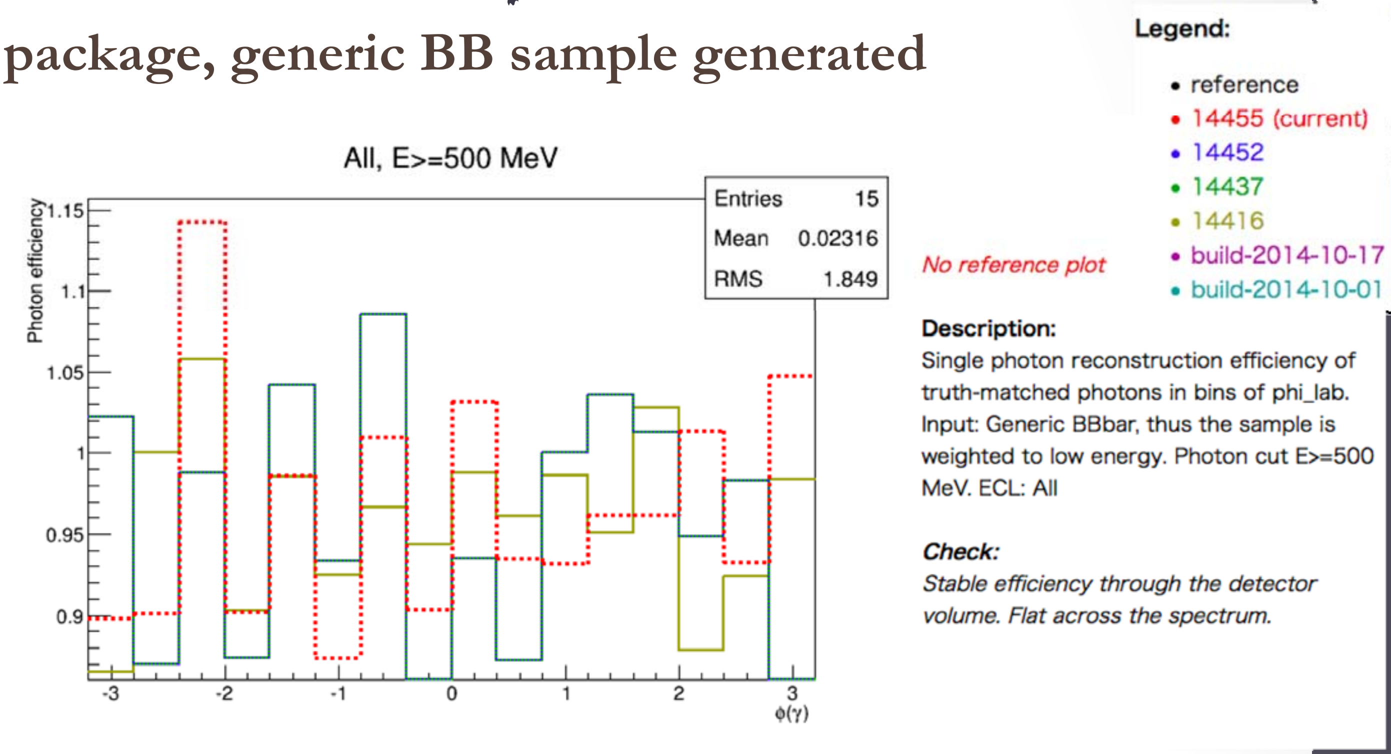
No description

No check

Other checks on ECL quantities

- Implemented in analysis package, generic BB sample generated

  - single-γ eff. vs θ, ϕ, E;
  one example:



Legend:

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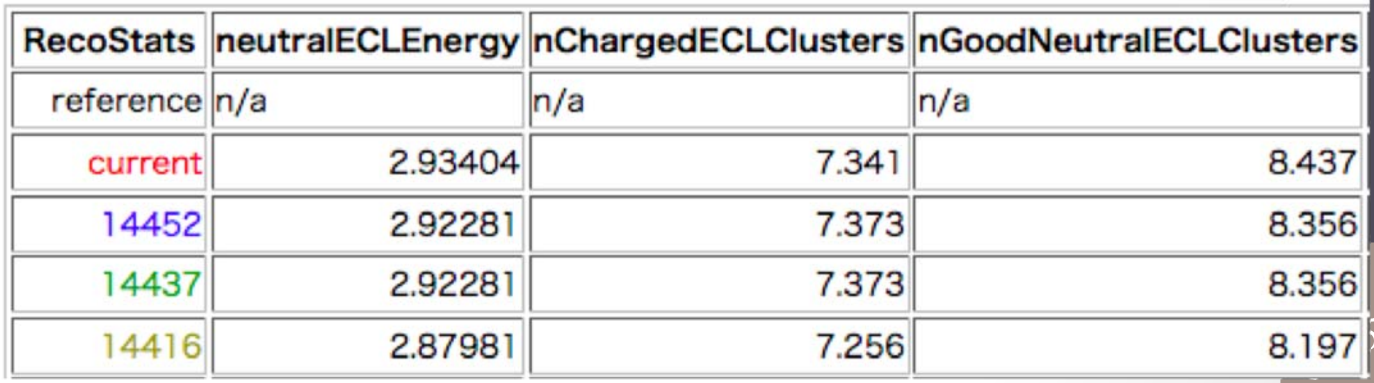
- ● build-2014-10-01

No reference plot

Description:
Single photon reconstruction efficiency of truth-matched photons in bins of phi_lab. Input: Generic BBbar, thus the sample is weighted to low energy. Photon cut E>=500 MeV. ECL: All

Check:
Stable efficiency through the detector volume. Flat across the spectrum.

  - average MDST reconstruction object multiplicity per event;
  one example:



RecoStats	neutralECLEnergy	nChargedECLClusters	nGoodNeutralECLClusters
reference	n/a	n/a	n/a
current	2.93404	7.341	8.437
14452	2.92281	7.373	8.356
14437	2.92281	7.373	8.356
14416	2.87981	7.256	8.197

EclDataAnalysis Module

- As shown by Benjamin yesterday, basf2 Ntuple maker tools were found to be not ideal for ECL performance study
  - entries not stored event-wise
  - some vars not properly filled

- We've implemented, tested and committed our own ntuple maker module:

ecl/modules/EclDataAnalysis

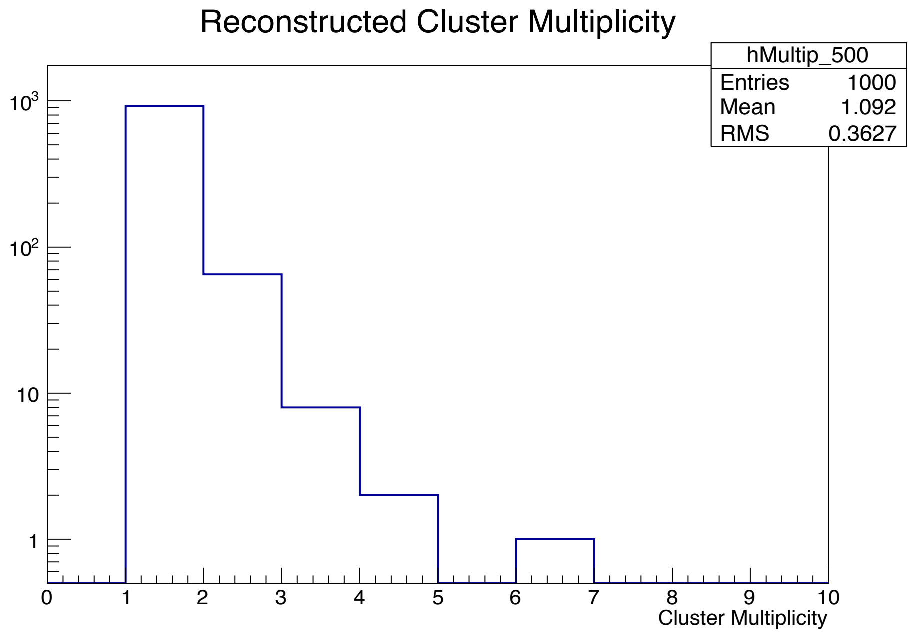
  - read dst data
  - fill
    - ECLSimHit, ECLHit,
    - ECLDigit, ECLShower, ECLCluster,
    - ECLGamma, ECLPi0,
    - MCParticle, TrackFitResult

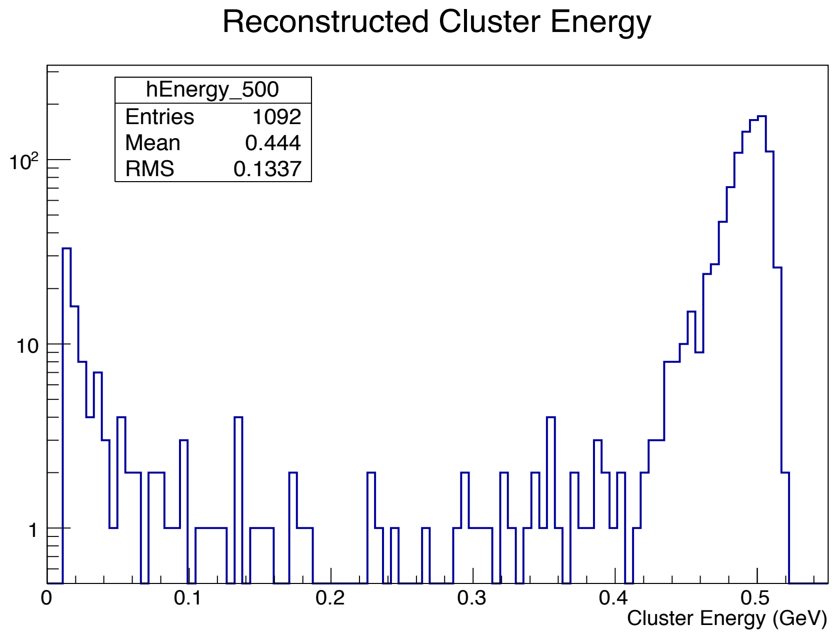
  blocks, event-wise

  - added info from RelationArray which link, for example, ShowerToGamma, ClusterToShower, Pi0ToGamma (not present in official NtupleTools)
  - save root file with an ntuple
- The output nutple can be used to fill histos suitable for ECL validation

Some examples: ECLCluster checks (I)

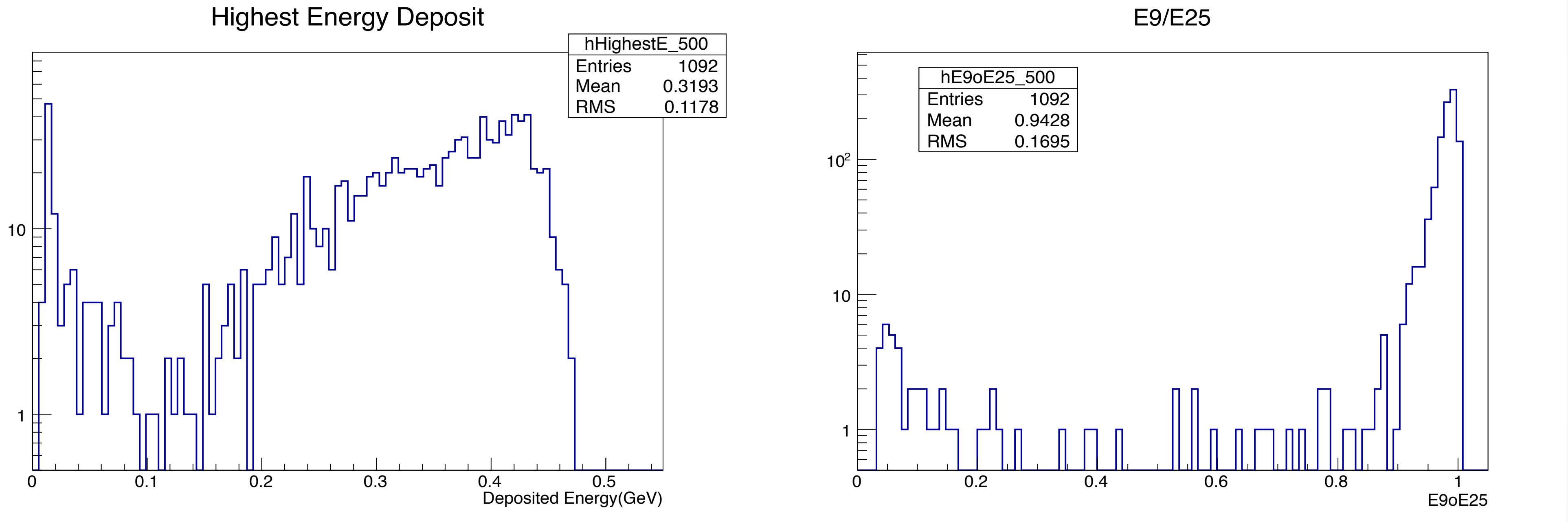
- **generate 500 MeV single-γ, no selection applied**





Some examples: ECLCluster checks (II)

- generate 500 MeV single-γ, no selection applied



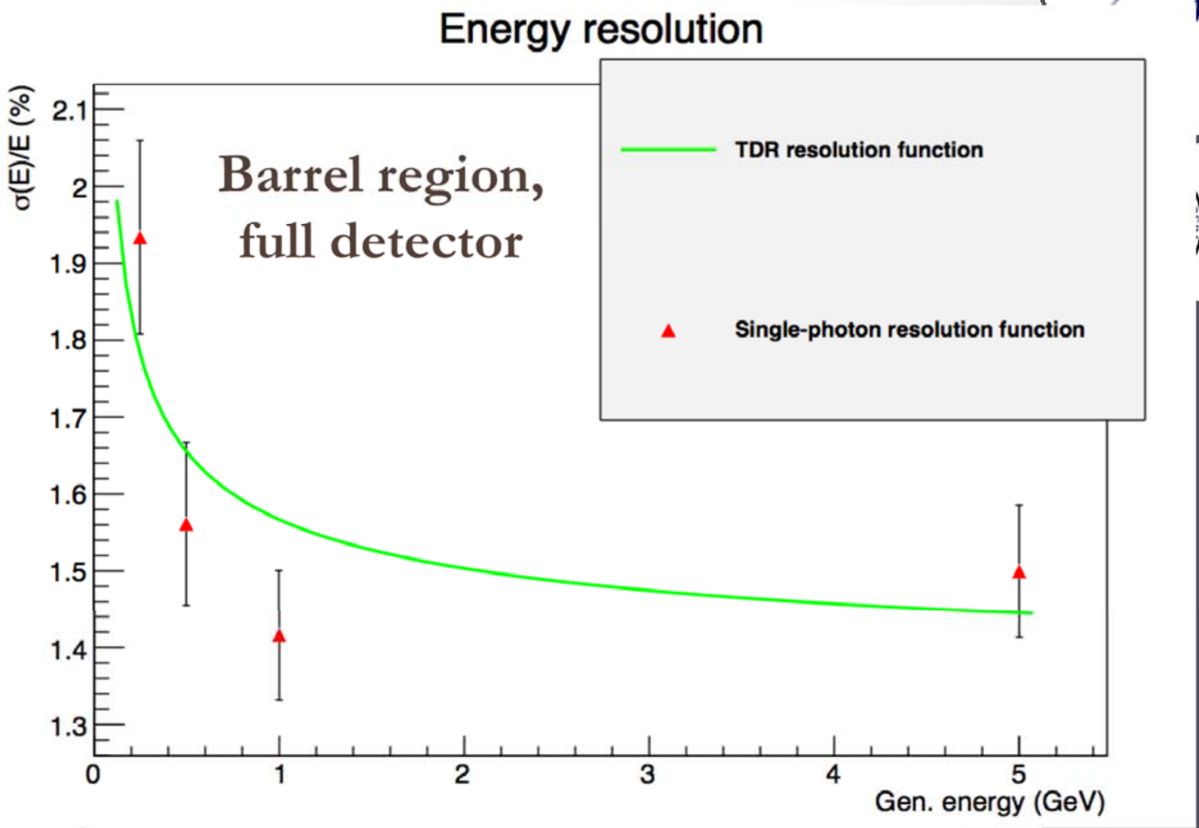
- First set of validation plots on ECLCluster implemented, reasonable distributions

Resolution plots

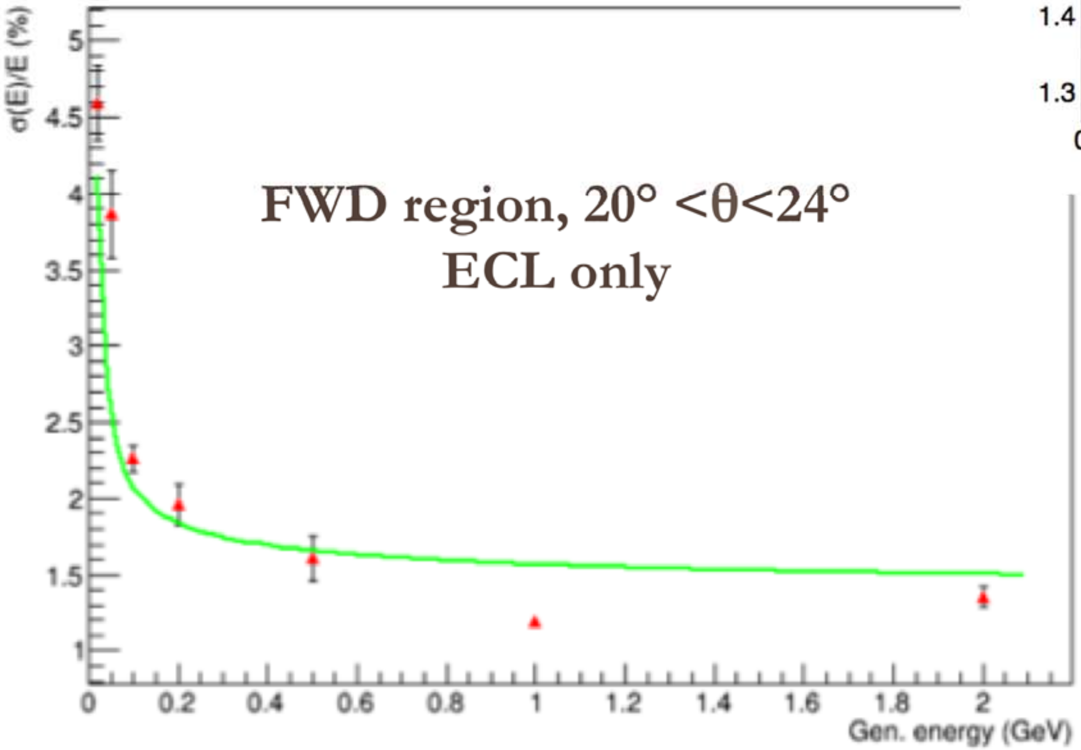
- TDR resolution function:

$$\frac{\sigma_E}{E} = \sqrt{\left(\frac{0.066\%}{E}\right)^2 + \left(\frac{0.81\%}{\sqrt[4]{E}}\right)^2 + (1.34\%)^2}$$

- Single-γ resolution:
  - Crystal-Ball fits to reco energy for single energy single-γ samples



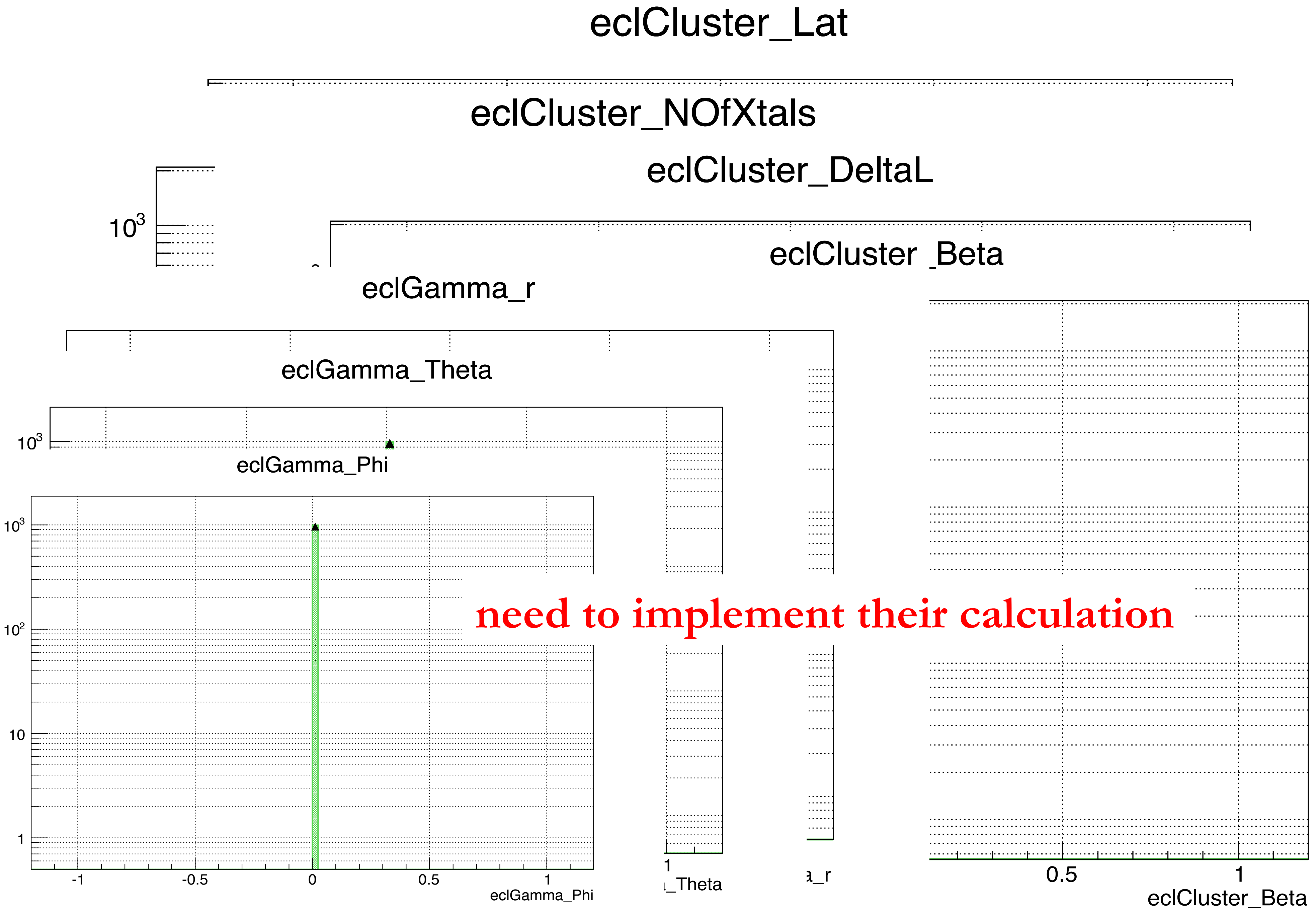
Barrel region, full detector



FWD region, 20° <θ<24°
ECL only

- same discrepancy between "reco" and TDR resolutions
- need to check various steps of the reconstruction to understand

Other useful vars
(not yet implemented in ECL reconstruction)



need to implement their calculation

Plans on validation

- EclDataAnalysis module (and example script) committed

- Script and root macro on EclCluster validation committed at the beginning of the week
  - more variables to be added (variables in previous page, hit distribution vs theta,…) and checks to be performed (more single-energies, generate also electrons)

- Validation plots on other ECL-related objects (π^0, γ,…) to come soon
  - responsibility of validation plots shared with Benjamin and Erika