

# **e/ $\mu$ /Z/Higgs reconstruction with releases 8.x.0**



**Stathes Paganis**

**with**

**K.Loureiro, B. Mellado, W. Quayle,  
Sau Lan Wu**

**Higgs WG Sep-01-04**

**Univ. Of Wisconsin, Madison**

# Outline (everything is very preliminary)

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- ◆ EMC Longitudinal Weights (DC2)
  - Applied by default in Athena  $e/\gamma$  since 8.4.0, but:
  - Calculated with 8.2.0
- ◆ Single electron beams with 8.2.0
  - Energies: 10, 20, 50 and 100GeV
  - Pseudo-Rapidity: from 0 to 2.5 in 100 bins
  - 1000 electrons per eta bin per energy
- ◆  $H \rightarrow ZZ \rightarrow 4\text{lepton}$  Samples with 8.5.0
  - ~1.5k events with 8.5.0 (produced slowly @ LXPLUS)

# Longitudinal Weights (DC2): what's new

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- ◆ Geant-4
- ◆ microA -> MeV includes (average sampling fractions, calculated by GU using G4).
- ◆ Digitization on (default).
- ◆ Upstream material corrections NOT applied at the cell level anymore.
- ◆ **All other corrections ARE applied ( $\eta, \phi, \text{out-of-cone}$ )**
- ◆ After-8.4.0 Upstream mater. corrections are applied at the cluster level (**5x5 only**)
  - Can be applied at other clusterings via joboptions
  - Can be removed/applied at the CBNT level (easy).
  - User can produce/test her own weights.

# General References on Calibration

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- ◆ “EM Calorimeter Calibration Strategy”  
Atlas EM group (in preparation)
- ◆ “Linearity of the response to test beam electrons for EM Barrel Module P13”, G. Graziani (ATL-LARG-2004-01)

## On MC longitudinal weights:

- ◆ “Electron-based longitudinal weights for the ATLAS EM Barrel Calorim...”  
(ATL-COM-CAL-2004-002)

# e-based Longitudinal EMC weights

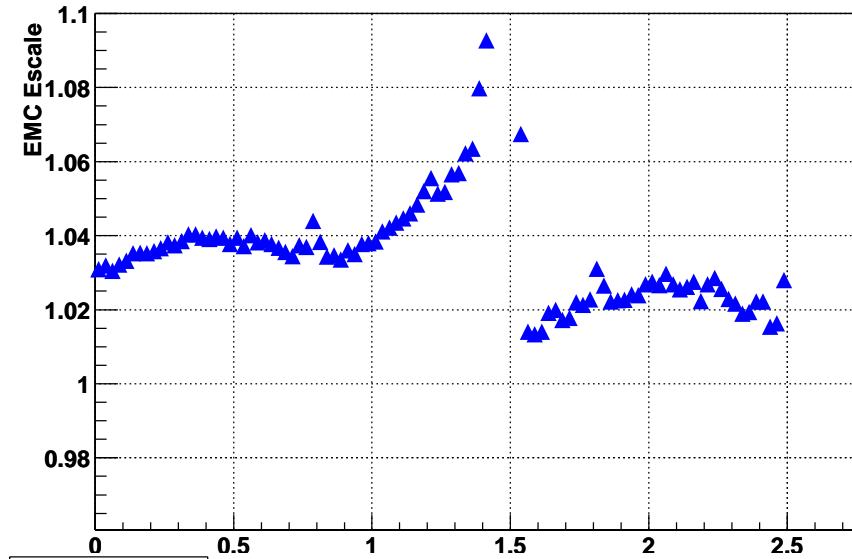
- ◆ Longitudinal weights calculated using:

$$E_{rec} = \lambda \left( b + W_0 E_{pres} + E_1 + E_2 + W_3 E_3 \right)$$

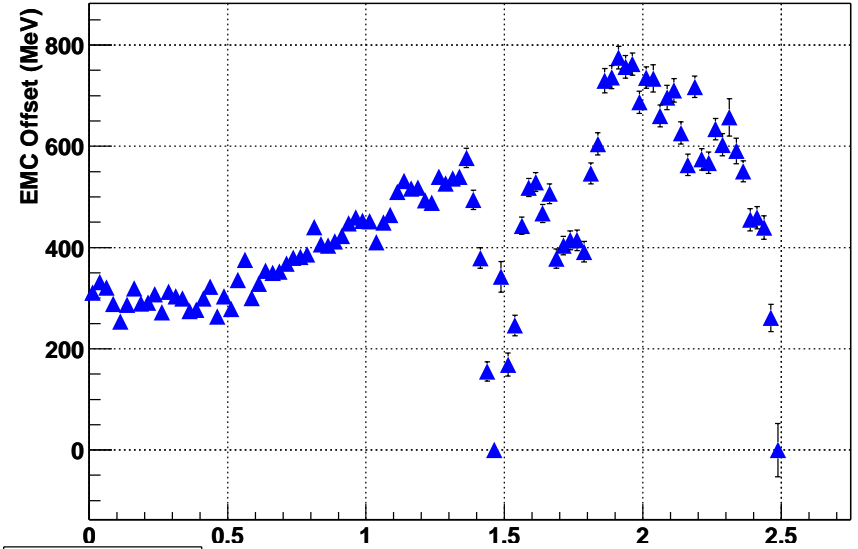
- ◆ In 100  $\eta$  bins from 0 to 2.5
- ◆ Currently through electron beams
- ◆ 8.2.0: sim+dig+rec
- ◆ In-situ: from Z (1 per sec), W (10/s)
- ◆ CAUTION: the MC doesn't simulate miss-inter-calibration (must also be solved in situ)

# EMC Longitudinal Weights (DC2)

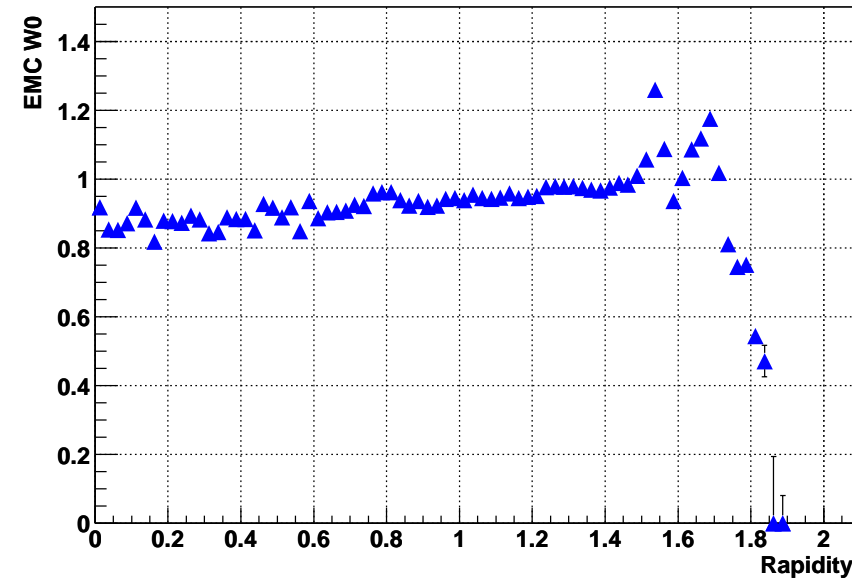
LAr EMC Escale



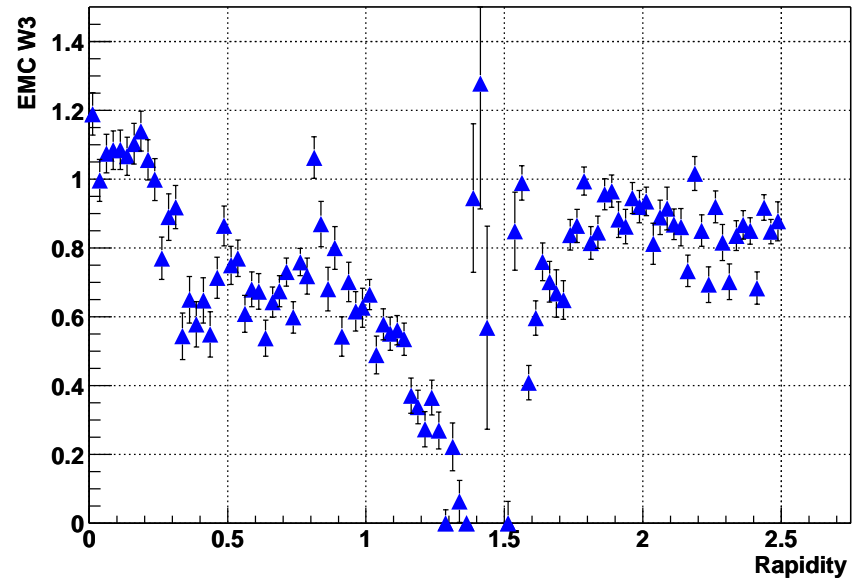
LAr EMC Offset



LAr EMC W0

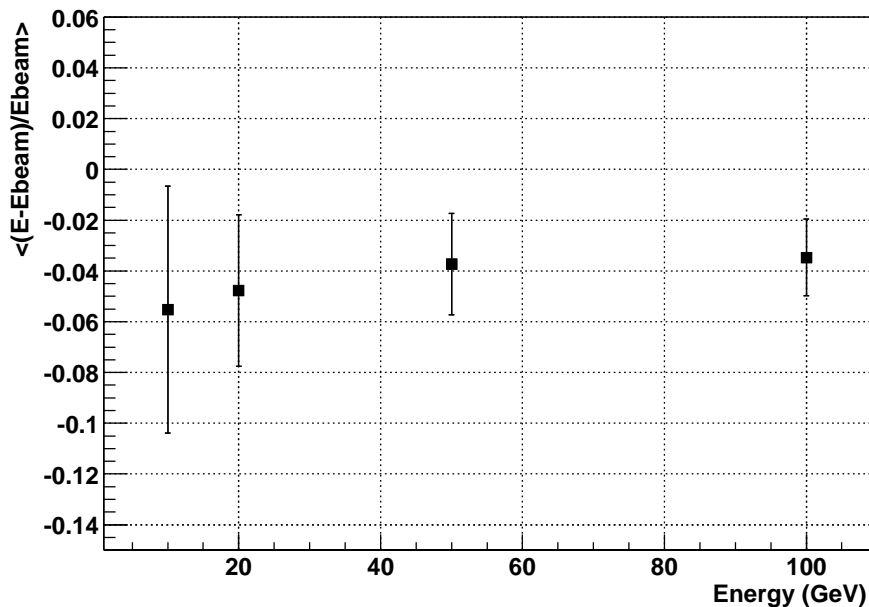


LAr EMC W3



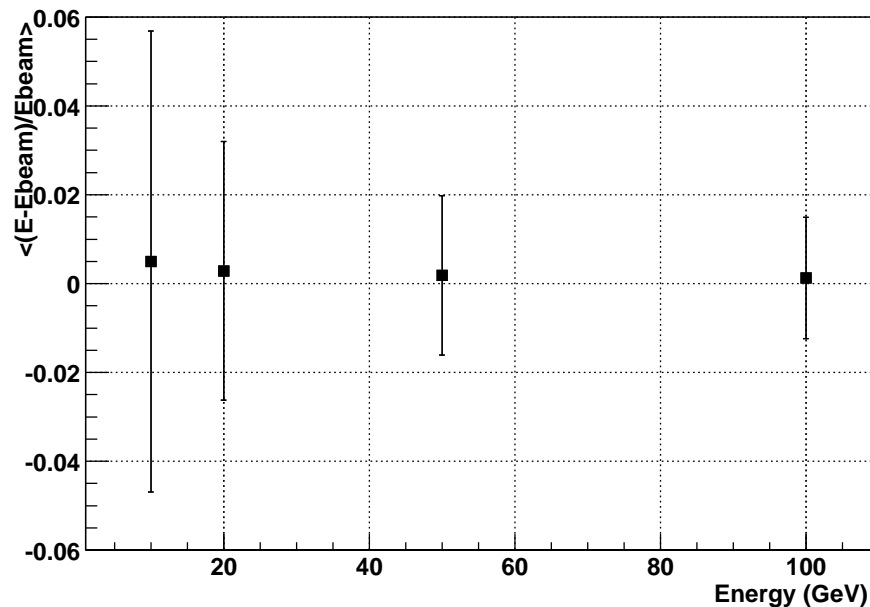
# First look: Linearity for $|\eta| < 2.5$

Linearity



Without weights

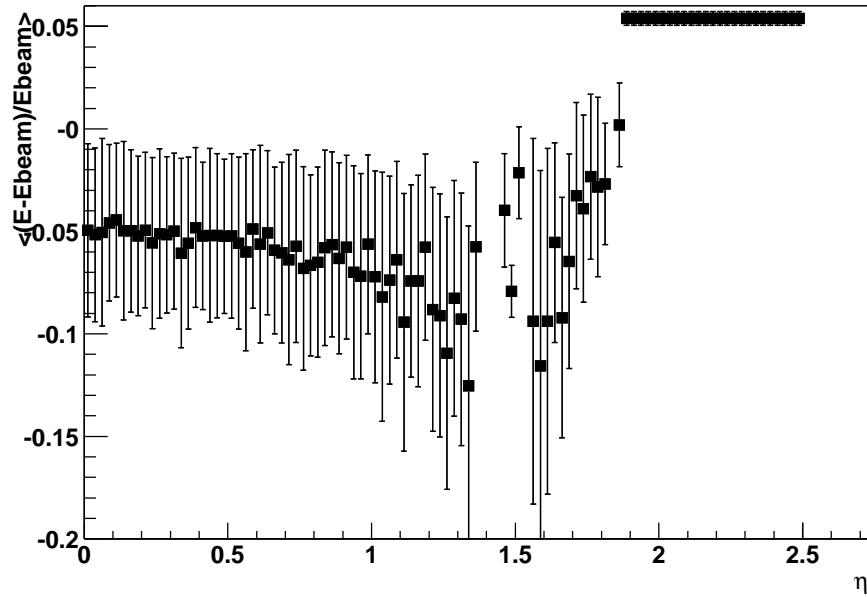
Ebeam=10GeV



With new weights

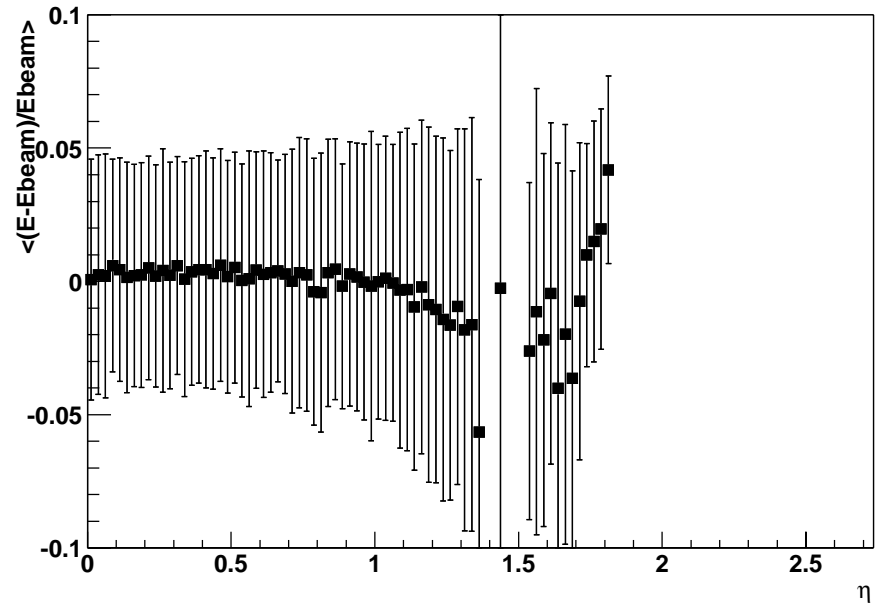
# Performance 10GeV electrons

Ebeam=10GeV



Without weights

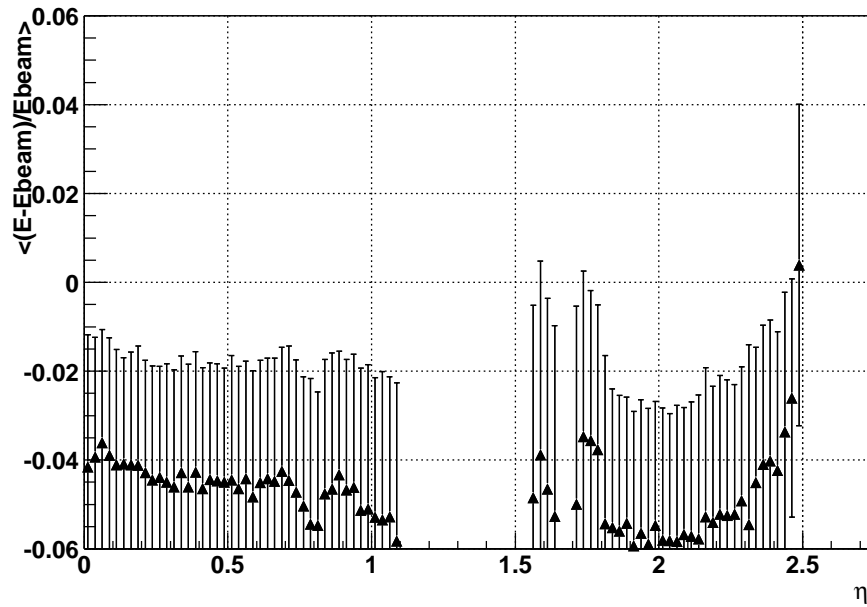
Ebeam=10GeV



With new weights

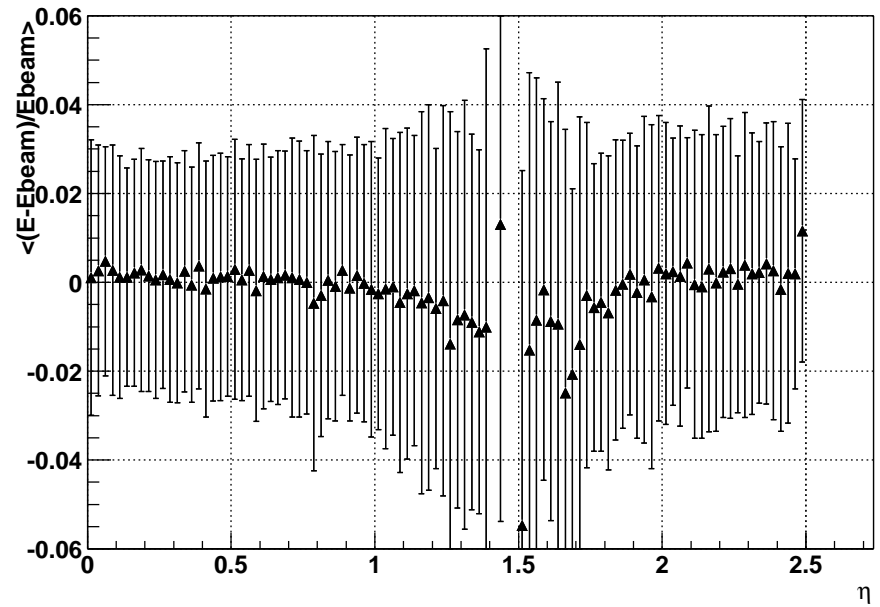
# Performance: 20GeV electrons

Ebeam=20GeV



Without weights

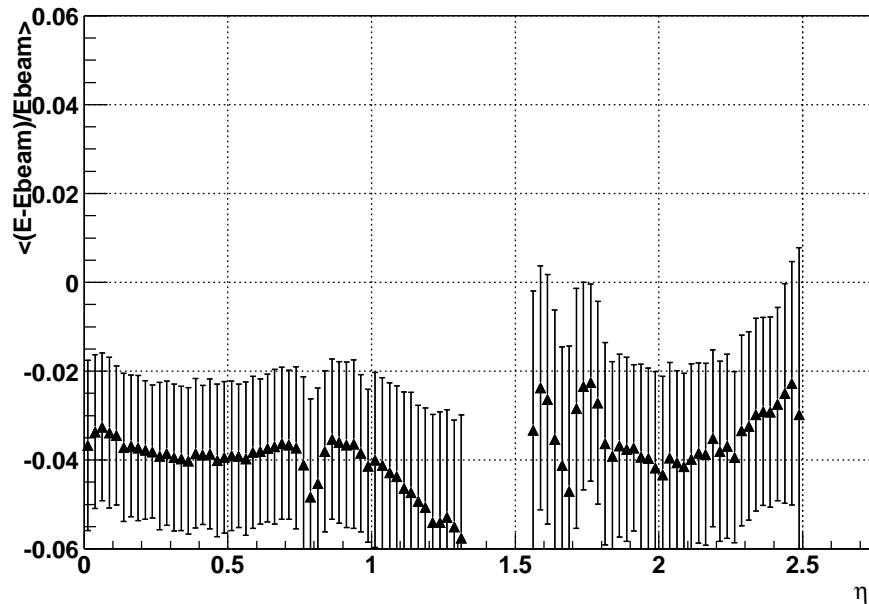
Ebeam=20GeV



With new weights

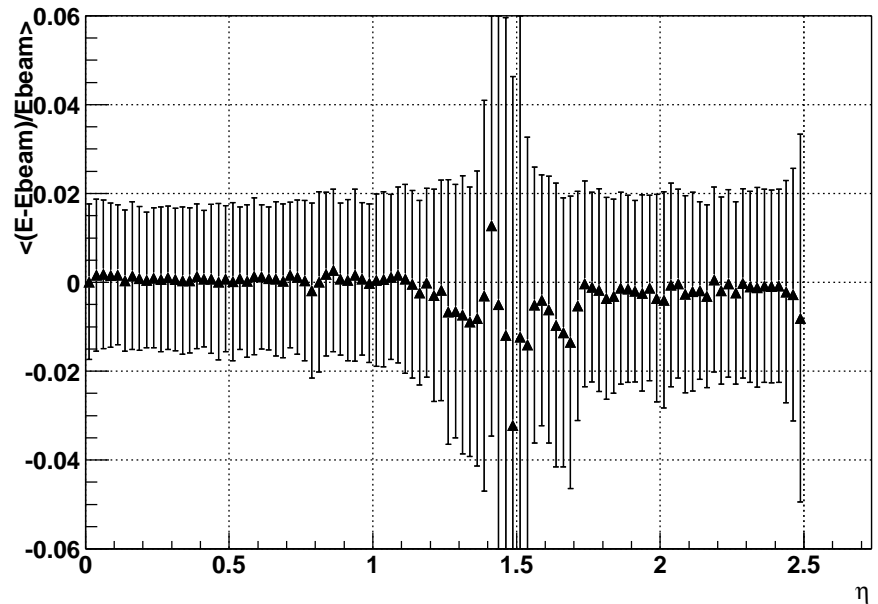
# Performance 50GeV electrons

Ebeam=50GeV



Without weights

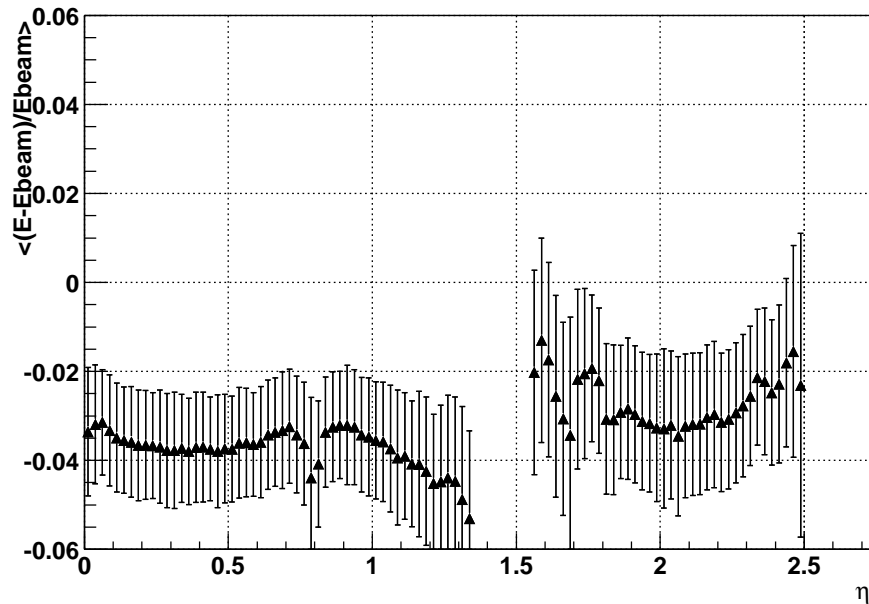
Ebeam=50GeV



With new weights

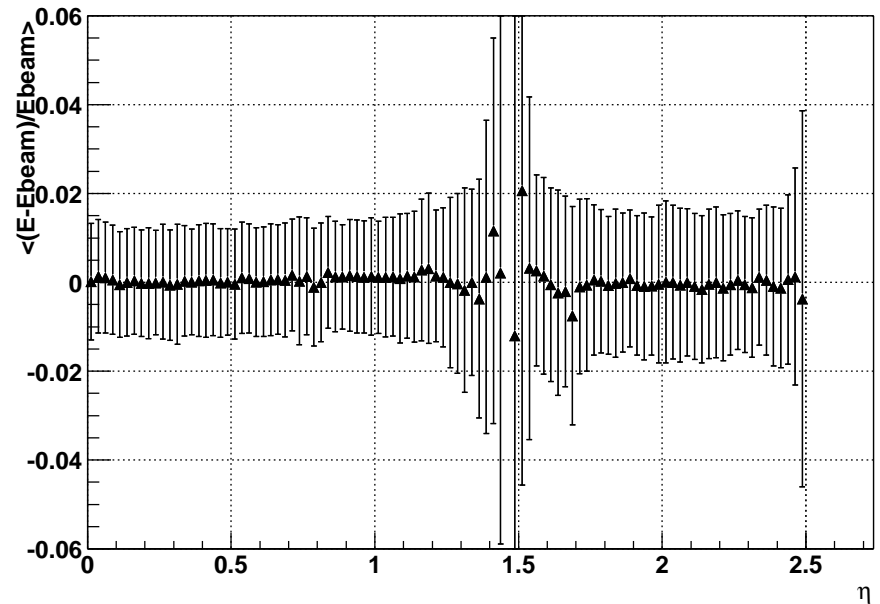
# Performance 100GeV electrons

Ebeam=100GeV



Without weights

Ebeam=100GeV



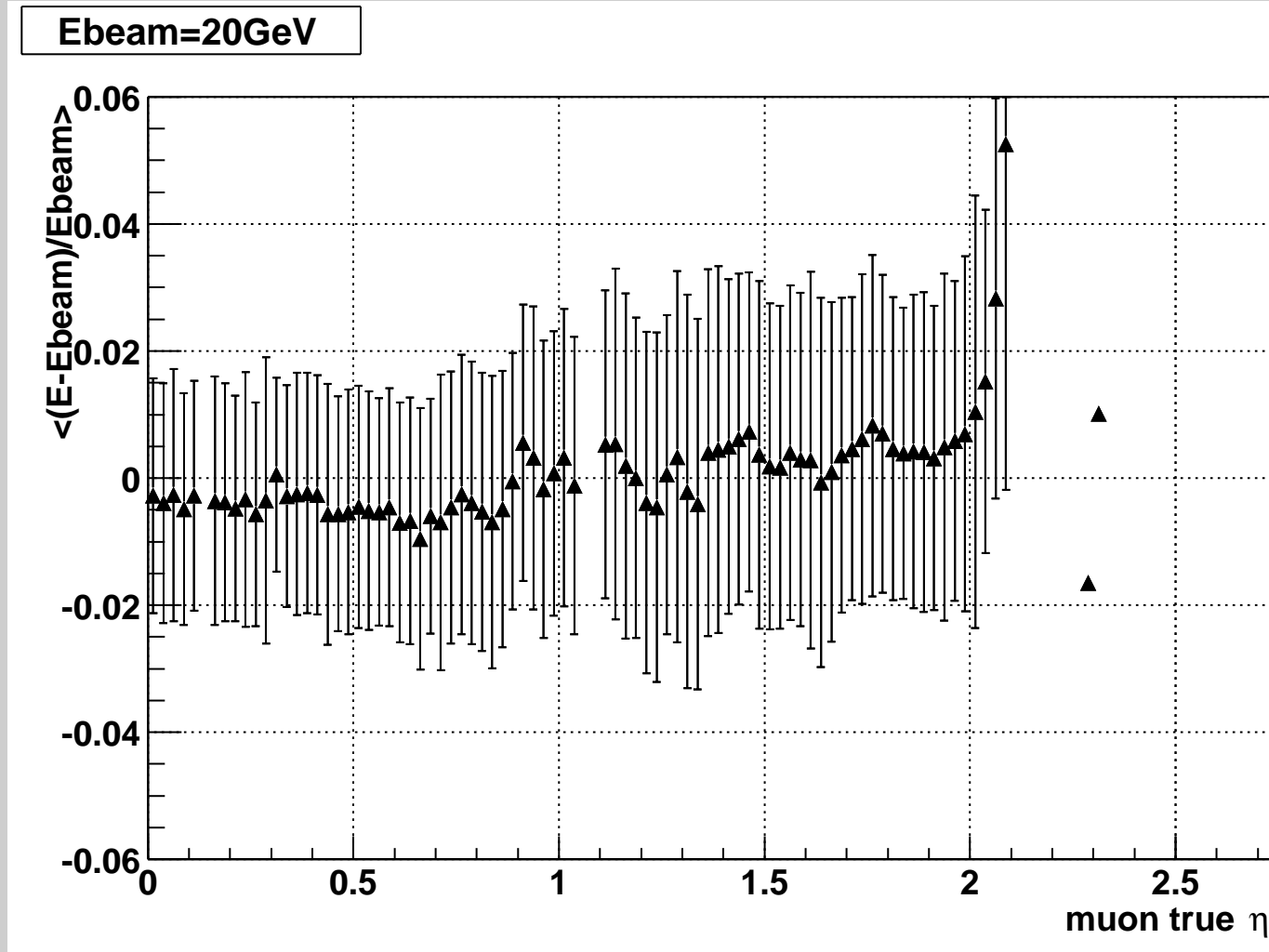
With new weights

# Muon Beams 20GeV:

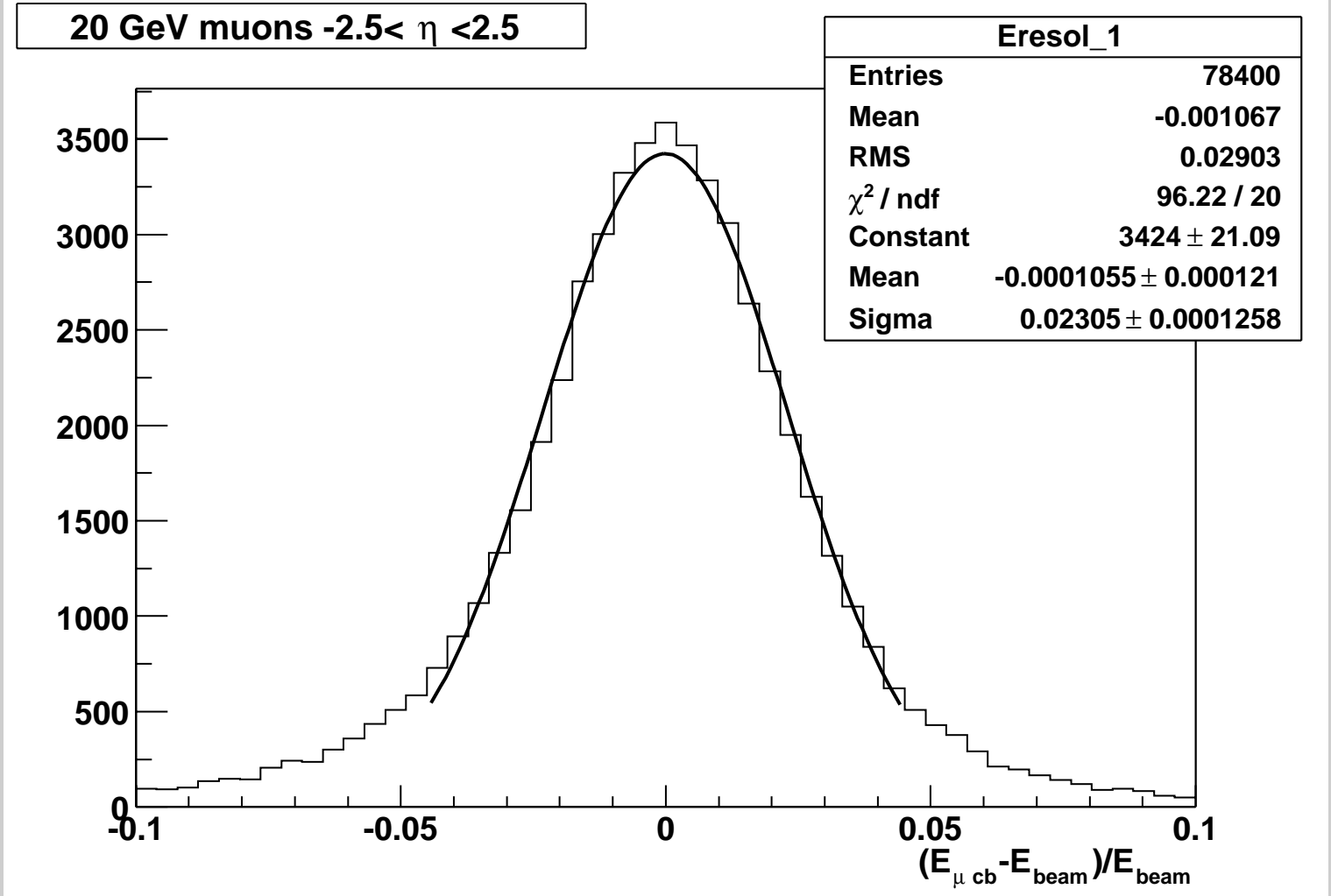
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- ◆ Sim+dig+rec 8.2.0
- ◆ Use stand-alone MuID reconstruction
  - Muon Spectrometer
  - Calorimeter
- ◆ Use combined MuID reconstruction
  - Muon Spectrometer
  - Calorimeter
  - Inner Detector

# Single muon linearity with 8.2.0

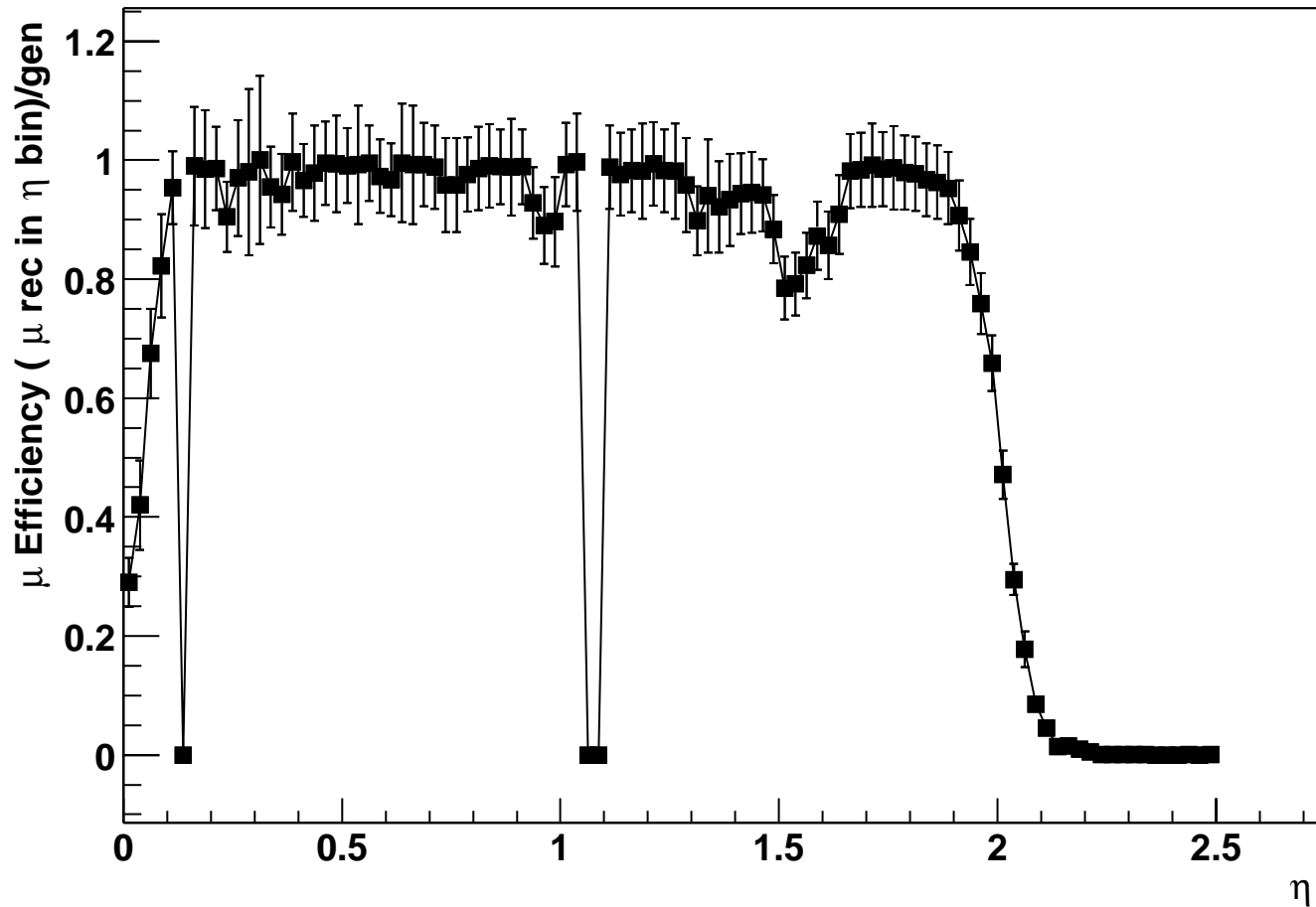


# Single 20GeV muon resolution with 8.2.0



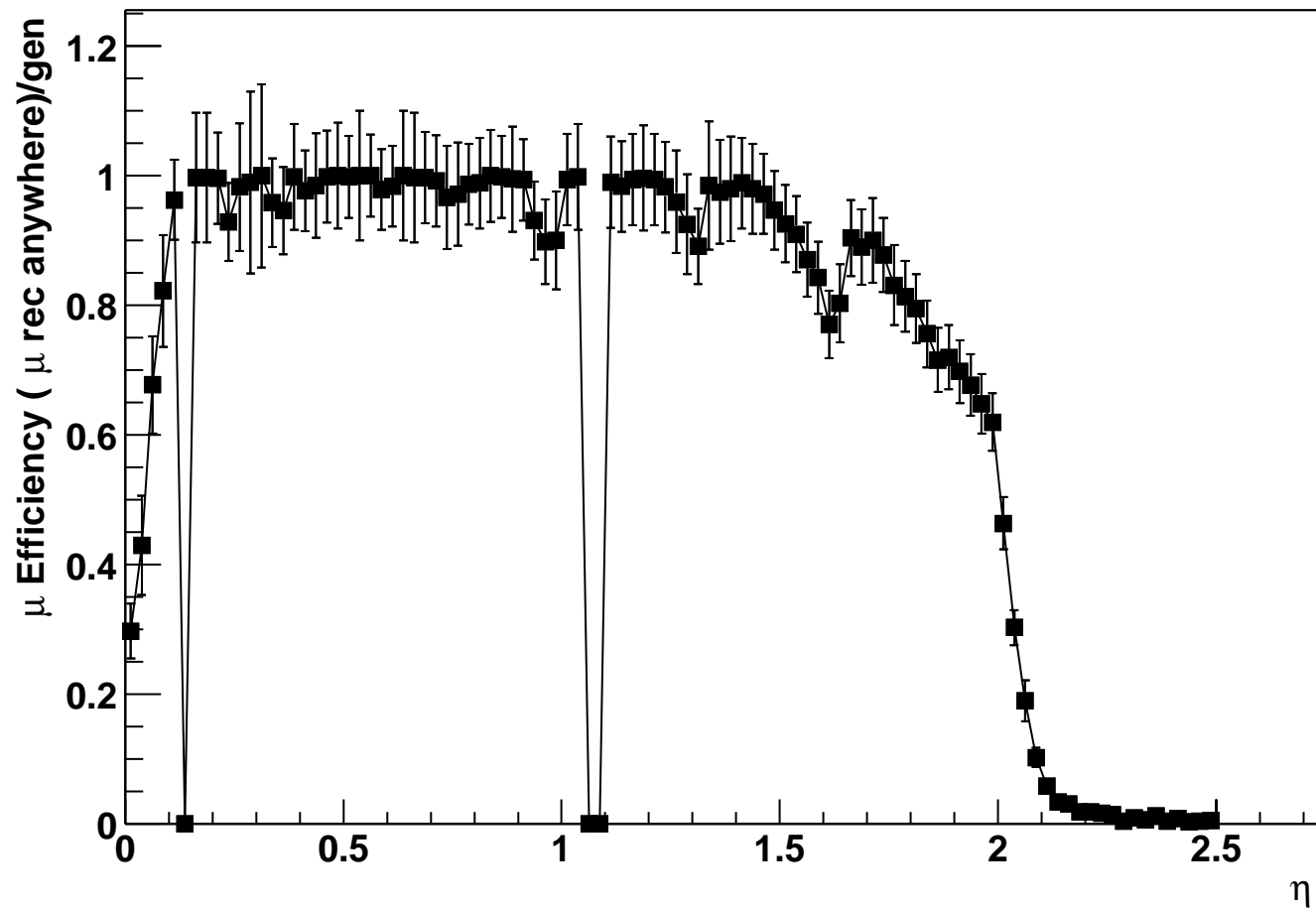
# Single muon efficiency with 8.2.0

Combined Muon Reconstruction



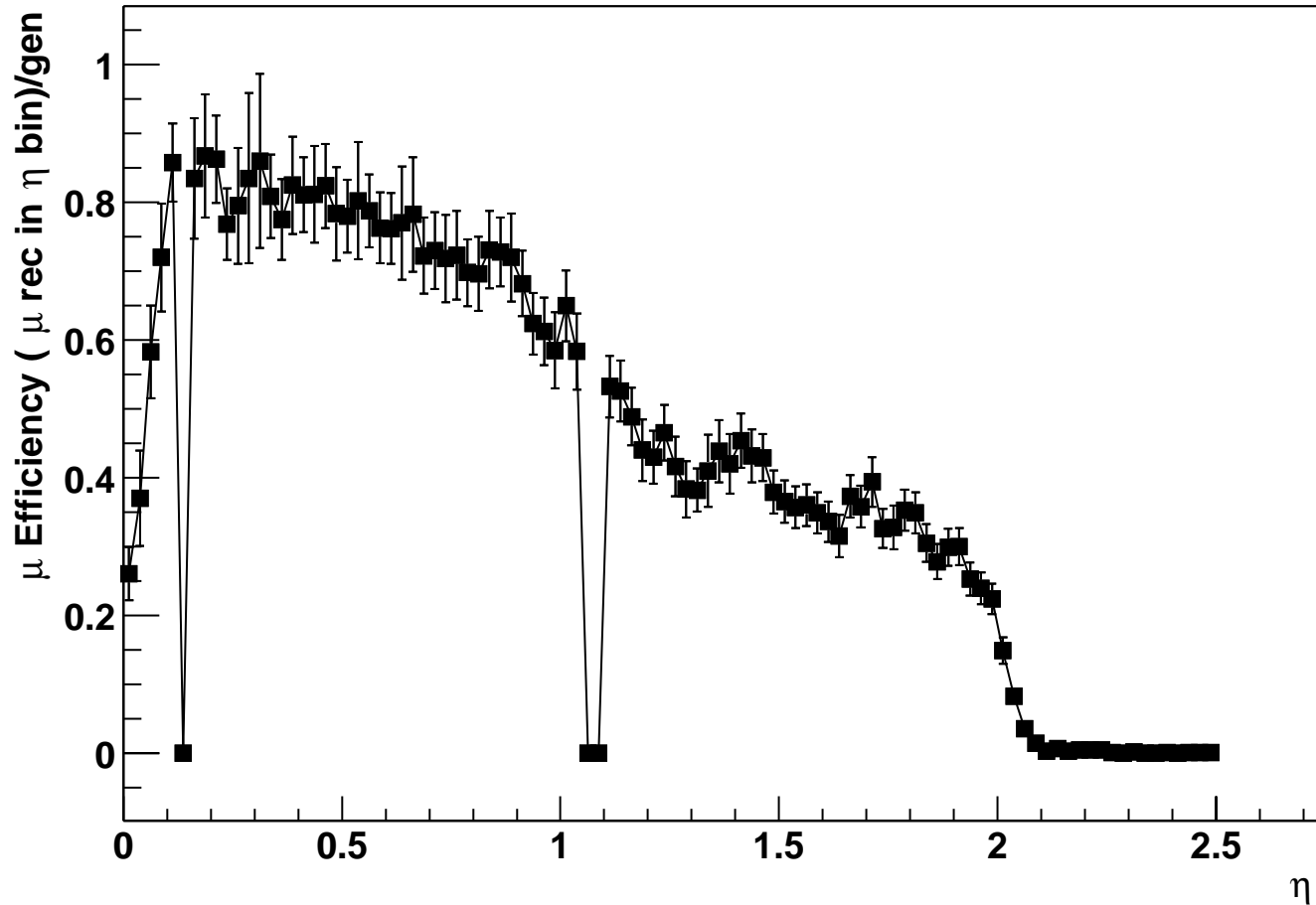
# Single muon efficiency with 8.2.0

Standard Muon Reconstruction



# Single muon efficiency with 8.2.0

Standard Muon Reconstruction



# H- $\rightarrow$ ZZ- $\rightarrow$ 4l with 8.5.0

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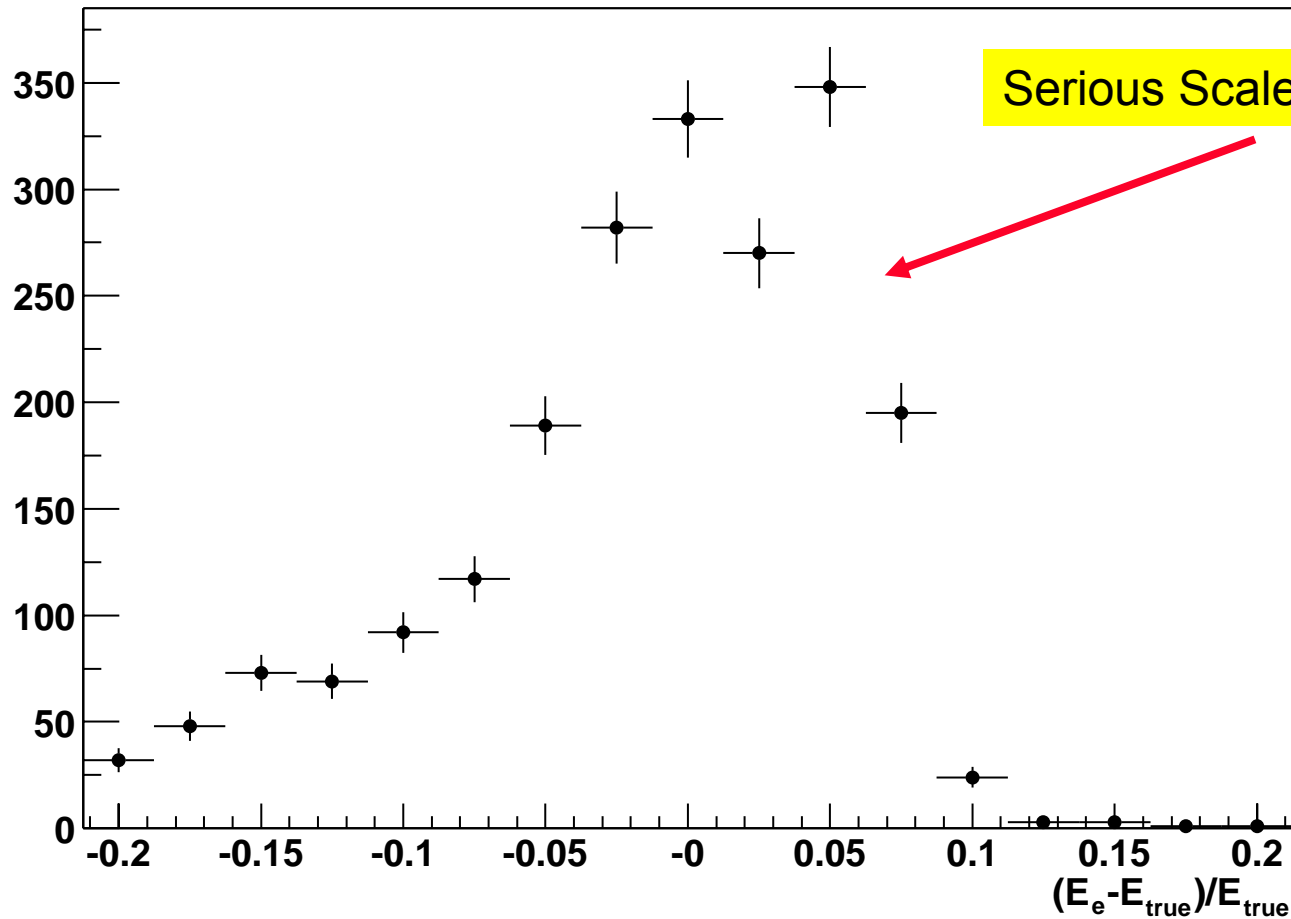
## ◆ Sim-Dig-Rec H- $\rightarrow$ 4l

- with underlying event (Pythia in 8.5.0)
- with inner photon bremsstrahlung
- iPatRec was off (no muon cb information)

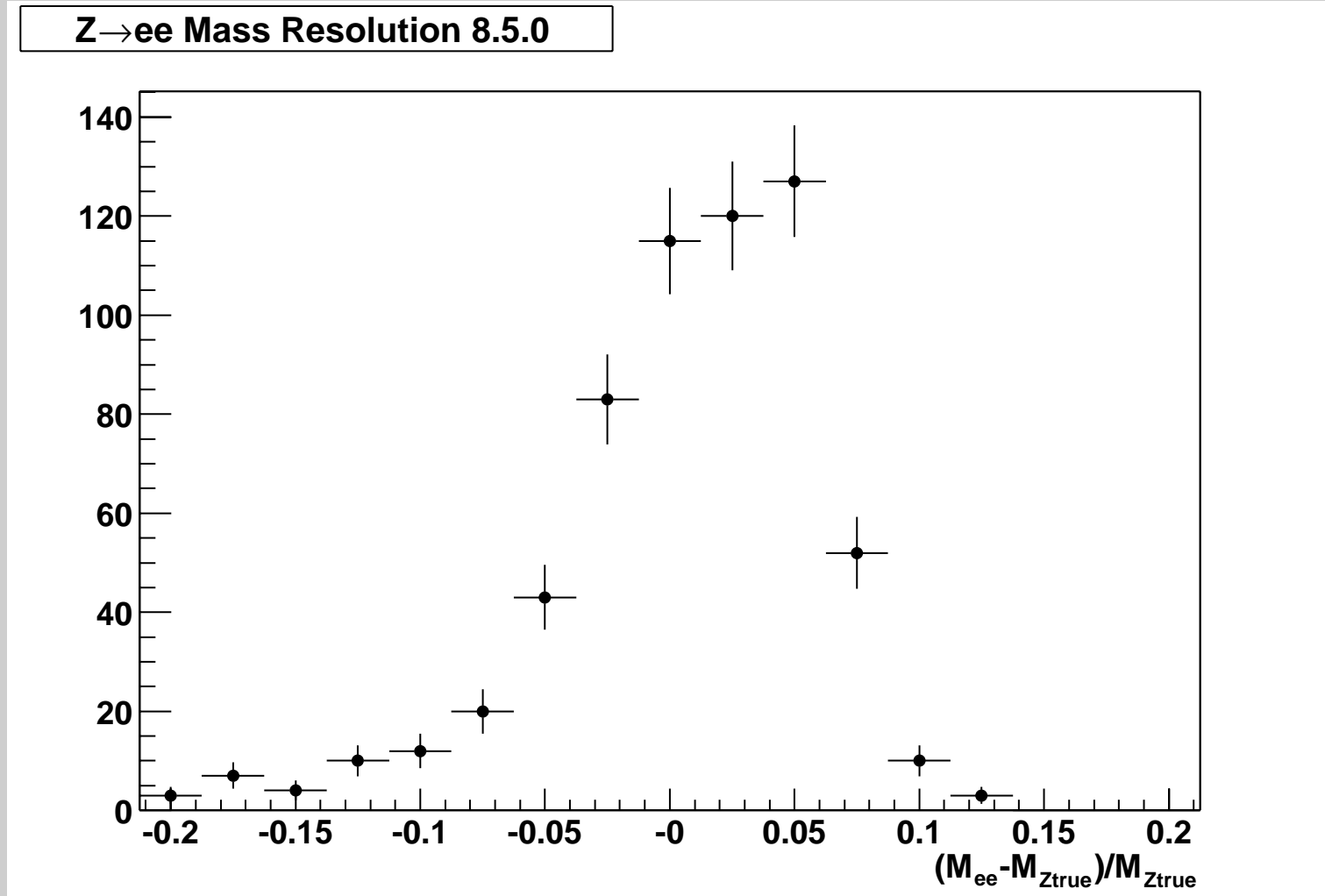
## ◆ Analyzed also some official DC2 electron samples that were sim-dig with 8.0.5. We reconstructed those with 8.5.0 (and 8.6.0 KL)

# H- → ZZ → 4l e resolution with 8.5.0

Electron Resolution 8.5.0

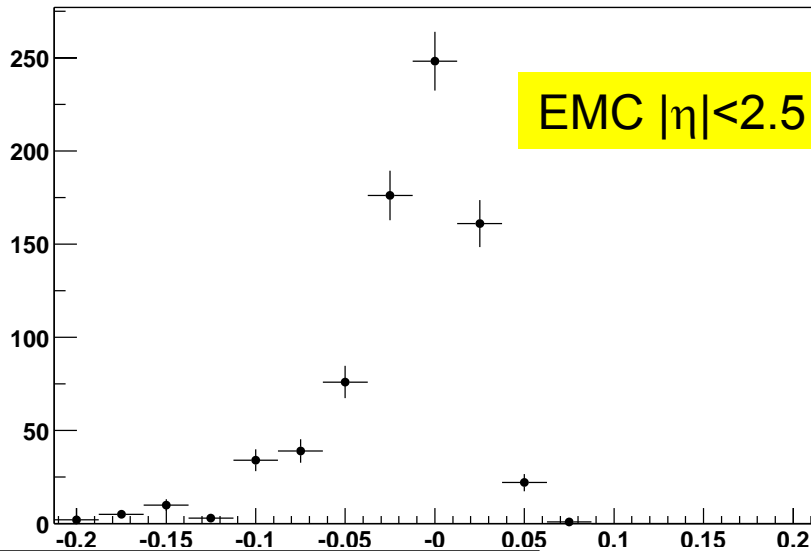


# H $\rightarrow$ ZZ $\rightarrow$ 4l | Z $\rightarrow$ ee resolution with 8.5.0

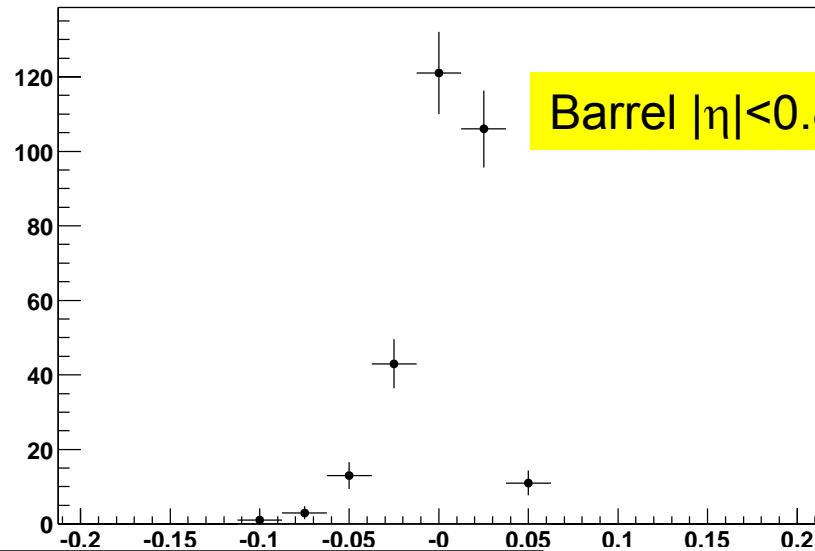


# Official DC2 electrons (8.0.5 sim+dig) reconstructed by 8.5.0 (with weights)

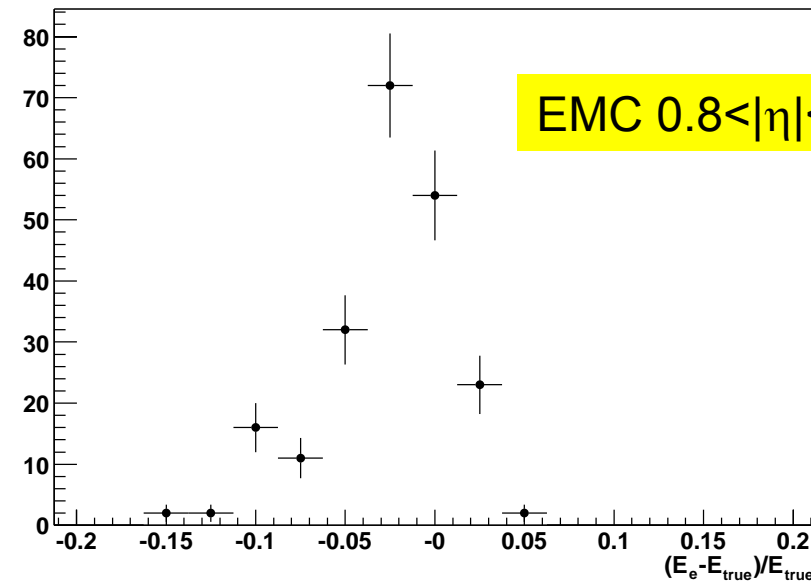
Electron Resolution sim-dig: 8.0.5 rec: 8.5.0



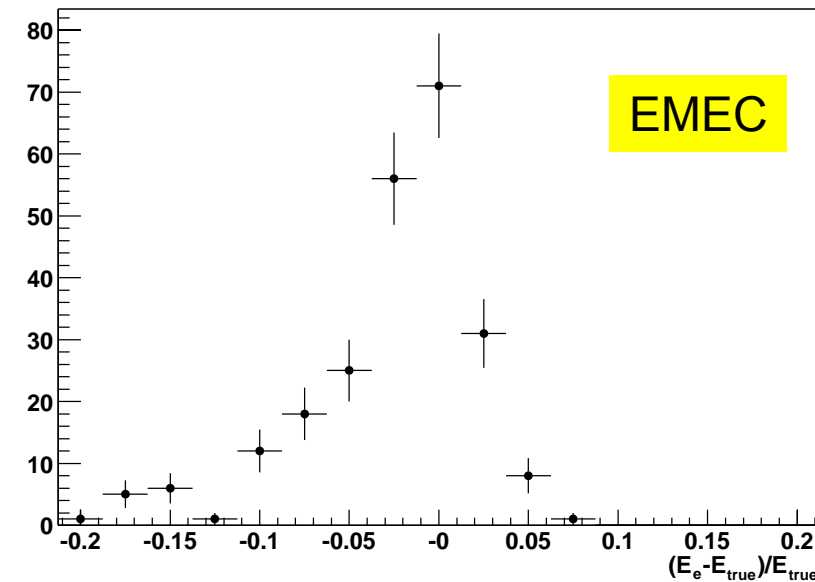
Electron Resolution sim-dig: 8.0.5 rec: 8.5.0



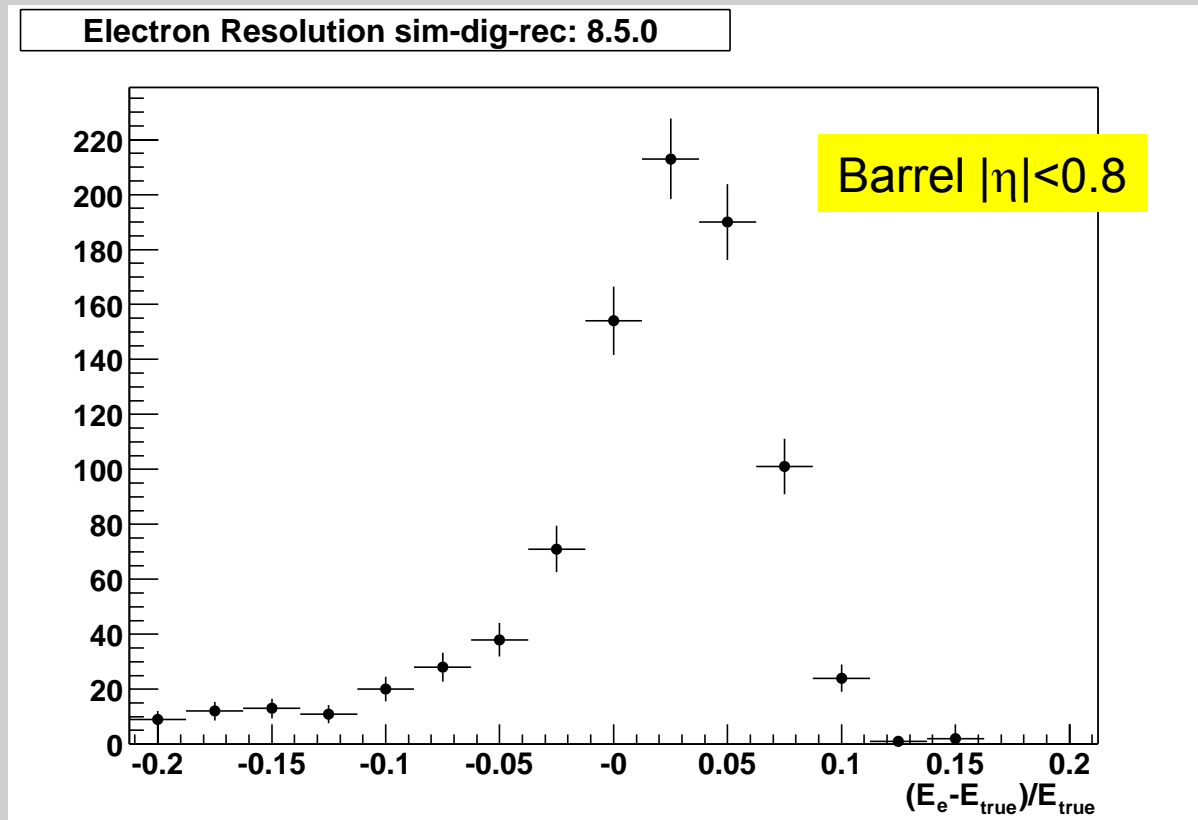
Electron Resolution sim-dig: 8.0.5 rec: 8.5.0



Electron Resolution sim-dig: 8.0.5 rec: 8.5.0



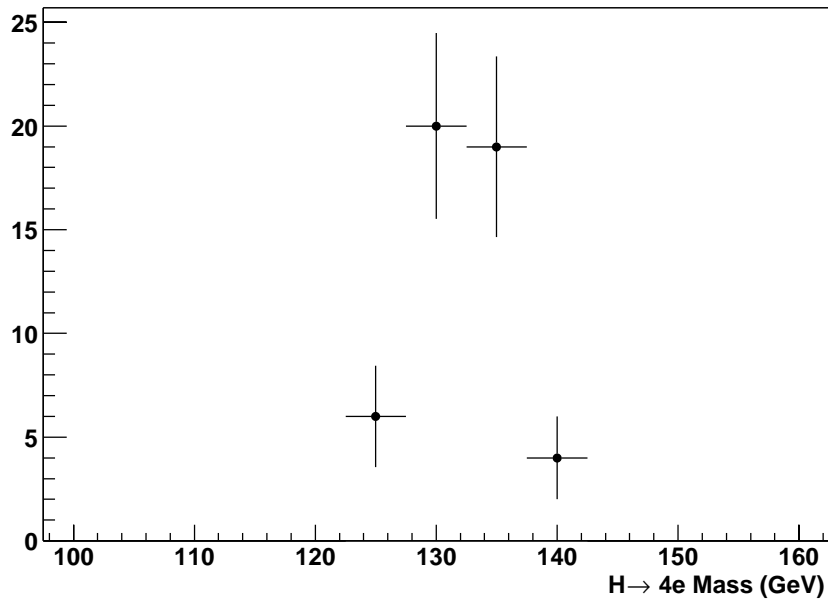
# Electrons sim-dig-rec 8.5.0: problem



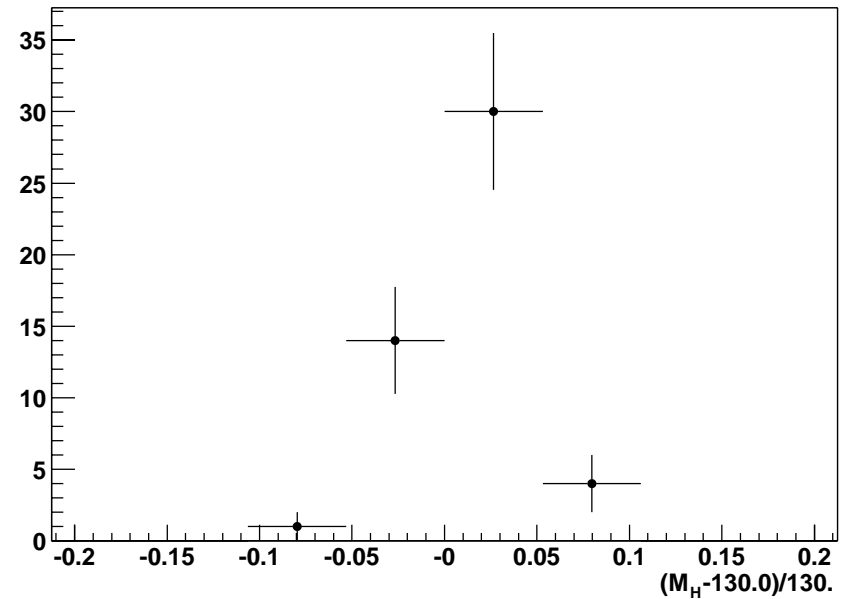
- ◆ Recon is not the problem
- ◆ G4 version is the same (8.0.5 vs 8.5.0)
- ◆ Maybe the digitization different?

# H $\rightarrow$ ZZ $\rightarrow$ 4e resolution with 8.5.0

H  $\rightarrow$  ZZ Mass 8.5.0



Higgs Resolution 8.5.0

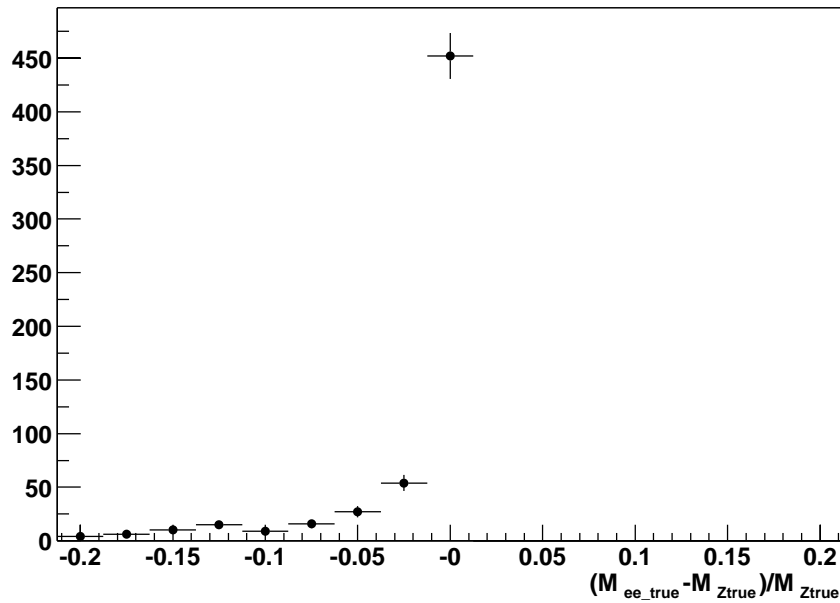


# Inner Brems. for $Z \rightarrow ee$ $Z \rightarrow \mu\mu$

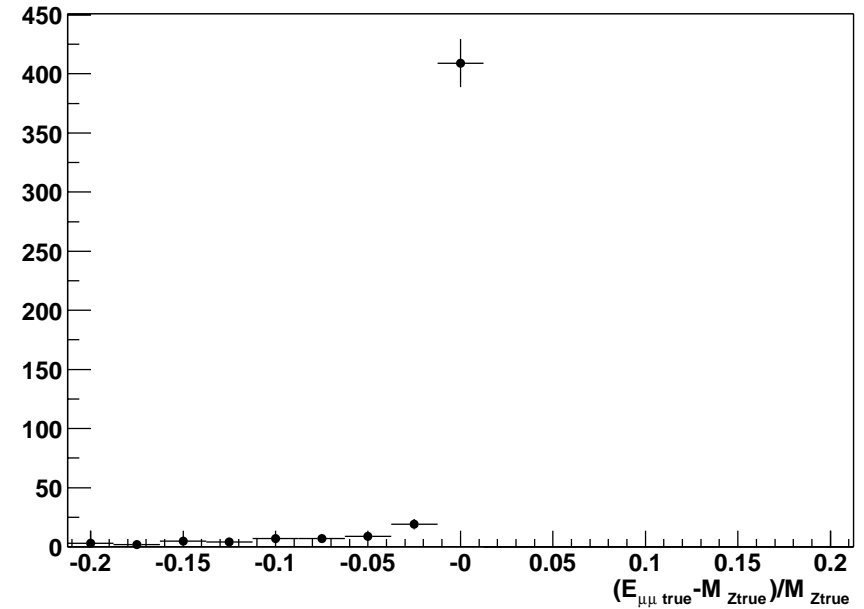
## Electron Inner Brem

## Muon Inner Brem

$Z \rightarrow ee$  Mass Resolution 8.5.0

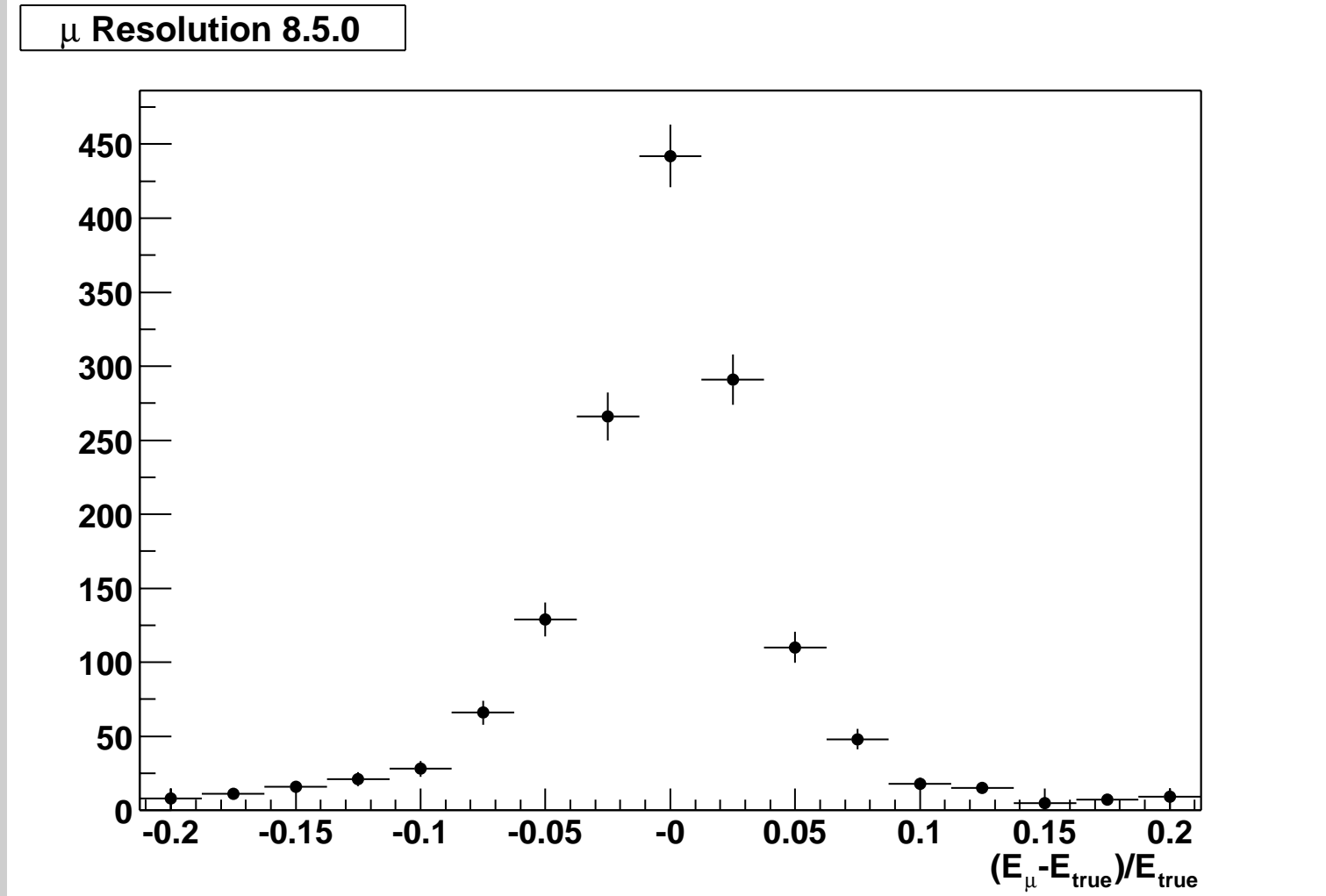


$Z \rightarrow \mu\mu$  Mass Resolution 8.5.0

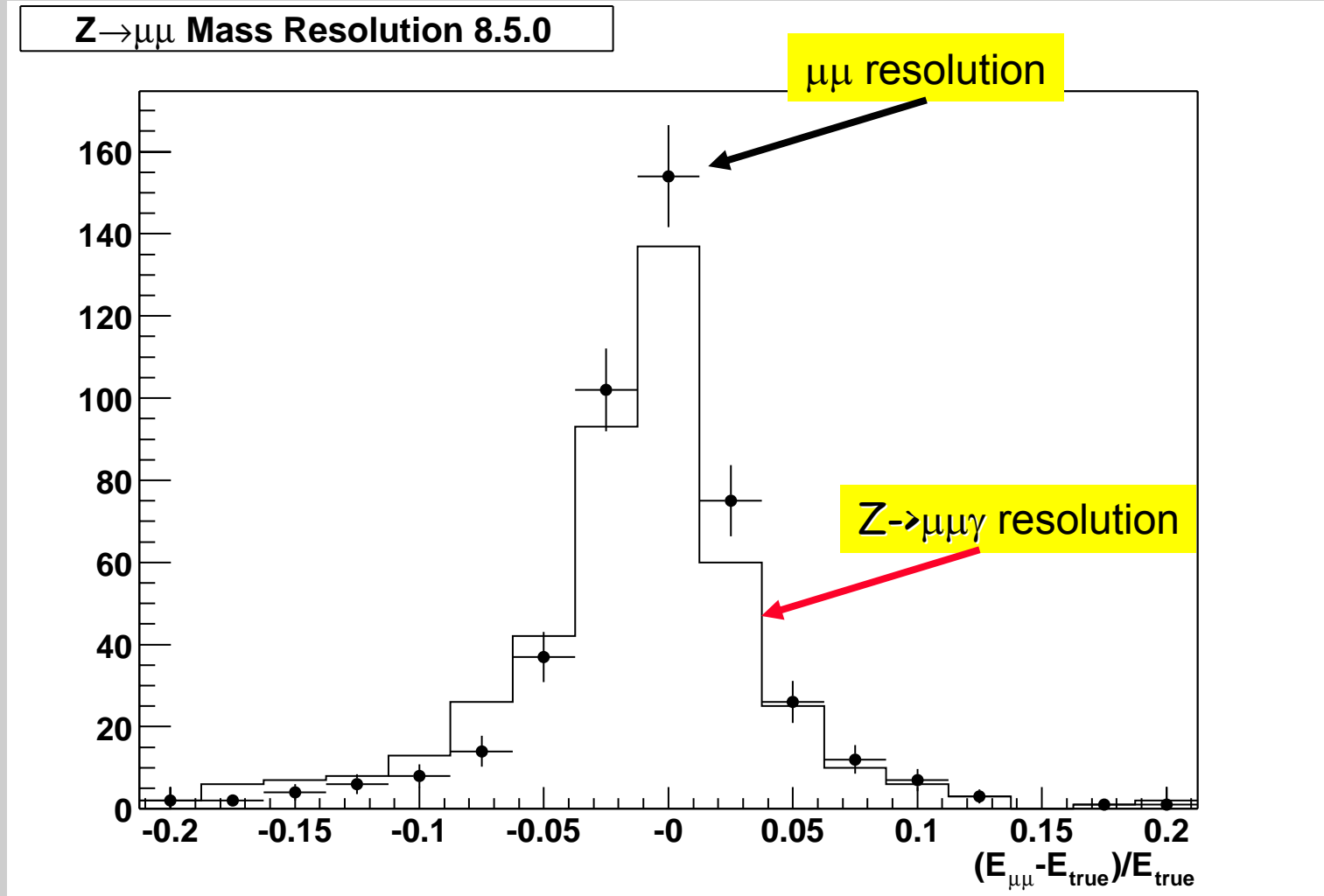


Inner Brem: an extra headache in in-situ Z based calibration

# H → ZZ → 4l muon resolution with 8.5.0

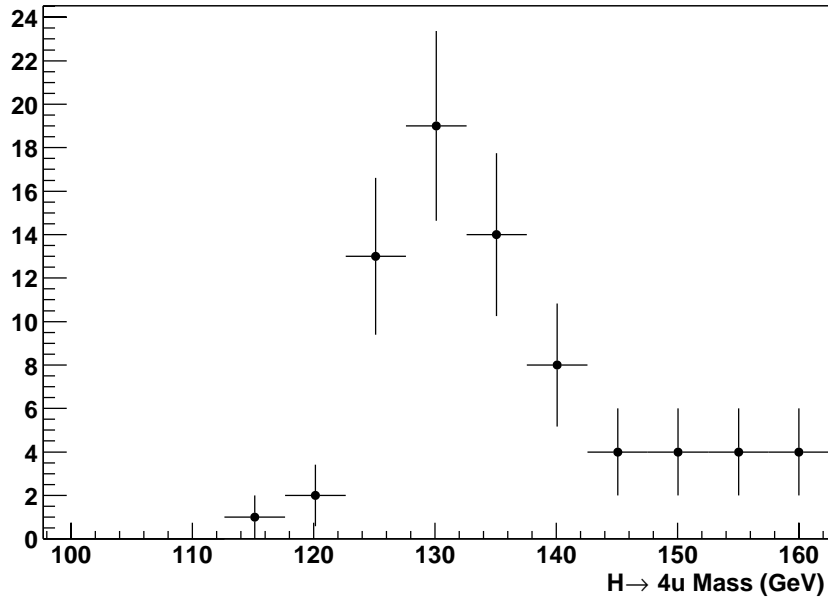


# Z $\rightarrow$ $\mu\mu$ resolution with 8.5.0

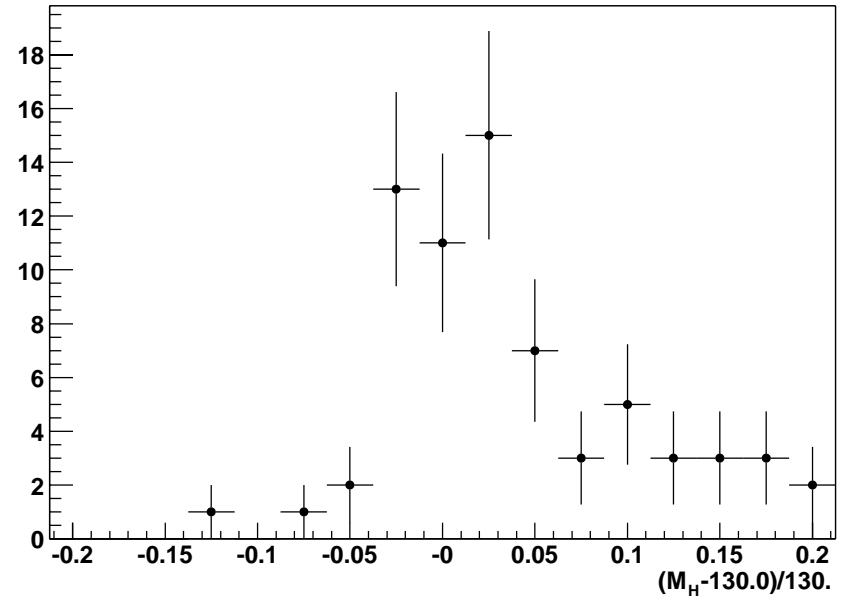


# $H \rightarrow ZZ \rightarrow 4\mu$ with 8.5.0

$H \rightarrow ZZ \rightarrow 4\mu$  Mass 8.5.0



Higgs Resolution 8.5.0



First low statistics full sim samples

# Summary

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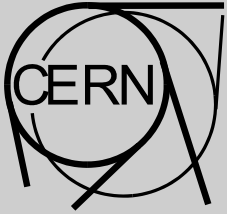
- ◆ First look at  $e/\mu/Z$  full simulation with 8.x.x versions with application of new e-based longitudinal weights
- ◆ New MC weights improve linearity and resolution but should be recalculated when changes that affect them take place.
  - Caution: default weights should work ~fine for official 8.0.5 DC2 samples, BUT NOT for 8.5.0 sim+dig samples
  - $H \rightarrow 4e, 2e2\mu$  takes a serious hit from miscalibrations
- ◆ Muons are in good shape (prelim)

# Open Questions (very Higgs related)

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- ◆ How well can we get the weights using  $Z \rightarrow ee$  from proton-proton ?
- ◆ Can we decouple the upstream corrections from inter-calibration (cosmics-Fabiola) ?
- ◆ What can we learn from the CTB04?
  - In the TBeam there is no inter-calibration issue, so the upstream material effect is isolated.
- ◆ Currently we apply the weights “on top” of an out-of-cone (lateral) correction (cluster size dependent). It seems natural to absorb these corrections in the weights.

Coming soon



# Signals of a fine-tuned world at Atlas



Stathes Paganis (Wisconsin)

with

Savas Dimopoulos (Stanford)

Giacomo Polesello (CERN)

SUSY WG, CERN, 22-Sep-2004