“On IeIe π^0 Stability and MC Matching”

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FOCUS Meeting

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Abstract / Outline

- A follow-up of Salvador corrections for the π^0 detected in the inner calorimeter is presented.
- These corrections were applied to the IE ADC data block instead of DST
- MC and RAW π^0 reconstruction invariant mass distributions are compared to study their agreement and stability. This study included:

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  - ☞ **π^0 Opening Angle**
  - ☞ **X Photon Position across IE**
  - ☞ **Run Dependance**

Corr 0

IE Generation & Reconstruction

MC Only

(Taking $\simeq$ Salvador Corrections not for DST but for ADC)

✔ Gen: $\rightarrow$ Call IeSim.sf

- (X,Y) IE Shifted: **25 cm** (to match the Shower Maximum)

✔ Gen: $\rightarrow$ Call PbgFill.sf

- Energy Resolution: $\sigma_E = \frac{\mathbf{5}\%}{\sqrt{E}} + \mathbf{5}\%$
- Position Smearing: I "believe" it is a Flat Random Distribution

✔ Rec: $\rightarrow$ Call McIePed.sf [TO MATCH RAW DATA]

- Scale Factor to match $\pi^{\mathbf{0}}$ mass (took out from pbgfill) LGENER(i) = LGENER(i)***1.07**
- Substract some energy (**5 ADC Counts**) [**1 ADC Count $\approx$ 9 MeV**] from each block: LGENER(i) = LGENER(i) **- 5 * ie_adc2gev(i)**
- Reset to **Zero** if Shower Energy is Negative [LGENER(i) = 0]

✔ Rec: $\rightarrow$ Call IeRecon: [Re-Reconstruct IE Photons] [MC Only]

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$\gamma\ \gamma$ Pair

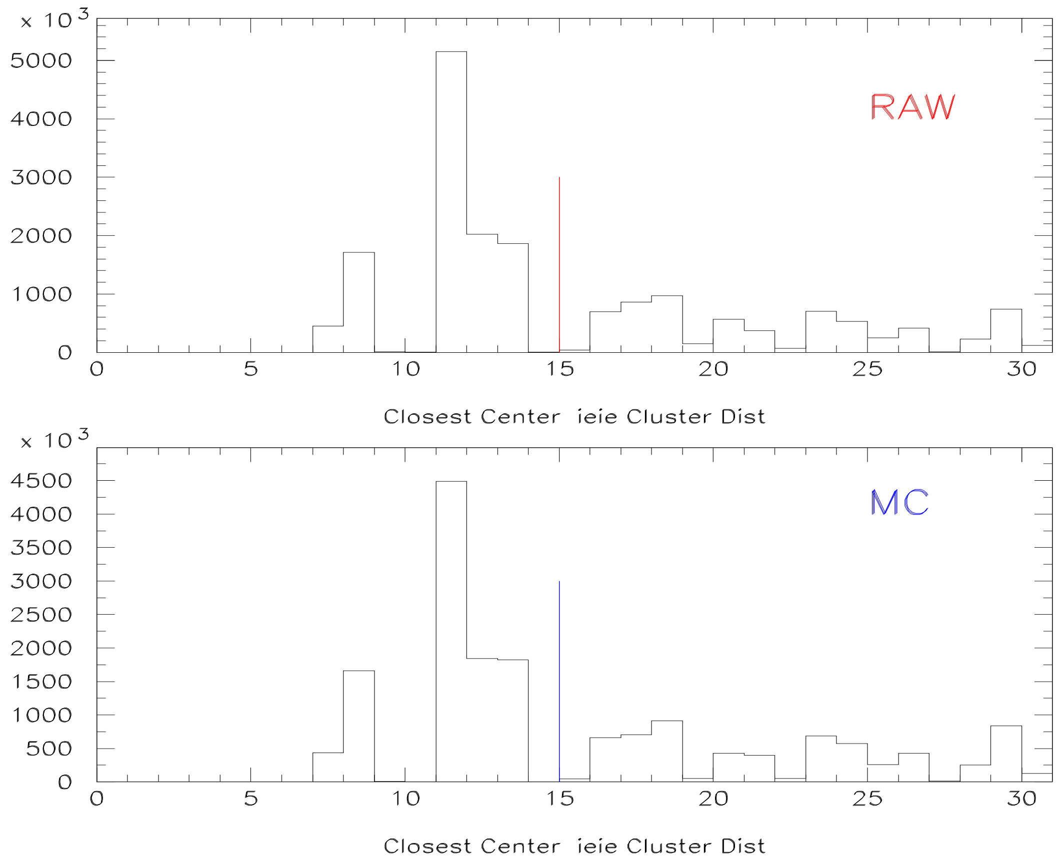
Baseline Cuts for each Photons

- ✔ Clusters not Associated with Charged Tracks: (Nclchg(i) $\geq$ 1)
- ✔ Minimun Number of Blocks per Cluster: ($N_{Blocks} \geq 2$)
- ✔ Minimun Cluster Energy: ($E_\gamma \geq 0.5$ GeV)
- ✔ Photons attached to Primary Vertex:
  - $Px = \frac{Erec*Xrec}{\sqrt{(X_{rec}^2+Y_{rec}^2+Z_{rec}^2)}}$
  - Py = ...
  - Pz = ...
  - Xrec = Lgclxp(i) - Vx (*primary*)
  - Yrec = Lgclyp(i) - Vy (*primary*)
  - Zrec = Lgzpos - Vz (*primary*)
  - Erec = Lgclen(i)
- ✔ Fused Clusters (IDCLUS = 0). Reject Clusters if:
  - $E_{CornerBlock} \geq 2 * E_{AdjacentBlock}$
  - Very Large Energy in 5x5 Outer Ring

$\gamma\,\gamma$ Pair cont.

Baseline Cuts for each Photons

- ✔ Closest Center Cluster Distance $\geq$ 15 cm



- ✔ Central Block Energy $\geq$ 0.3 GeV
- ✔ Ratio: $E_{Central}/E_{Total} \geq 40\%$

Data Sample
$\mathbf{D^0} \rightarrow K^-\pi^+$

- $\pi^{\mathbf{0}}$'s in this study come from my Skim3 on SuperStream 3 (Golden Modes) [66 Tapes] [DST + Muons + ADC]

☞ ⋆ Raw Data from "Skim3" based on SEZDEE:

  - Primary Vertex **CL** ≥ 1
  - Vertex detachment: $\mathbf{L}/\sigma \geq \mathbf{3}$
  - Kaonicity: bf Wobs(2,i)-Wobs(3,i)$\geq$ 1

☞ ⋆ MC Data Generated:

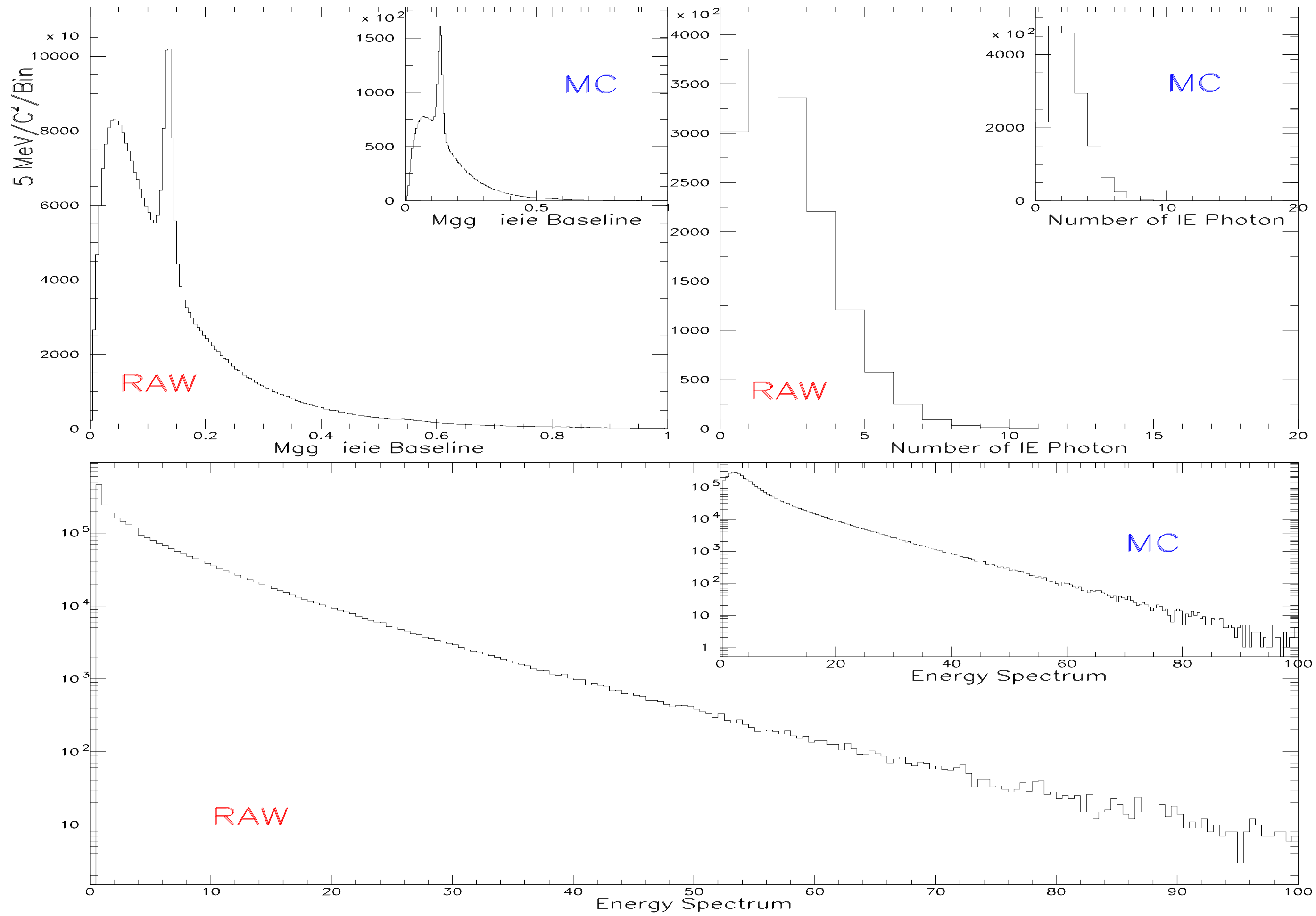
  - $\mathbf{D^{*0}(2007) \rightarrow D^0} + \pi^{\mathbf{0}}$

    where $\mathbf{D^0} \rightarrow K^-\pi^+$ and $\pi^{\mathbf{0}} \rightarrow \gamma\gamma$

☞ ⋆ **Gen** 10^7 MC events, **Rec** & **Skimmed** through my "**Skim3**"

Full Data Sample

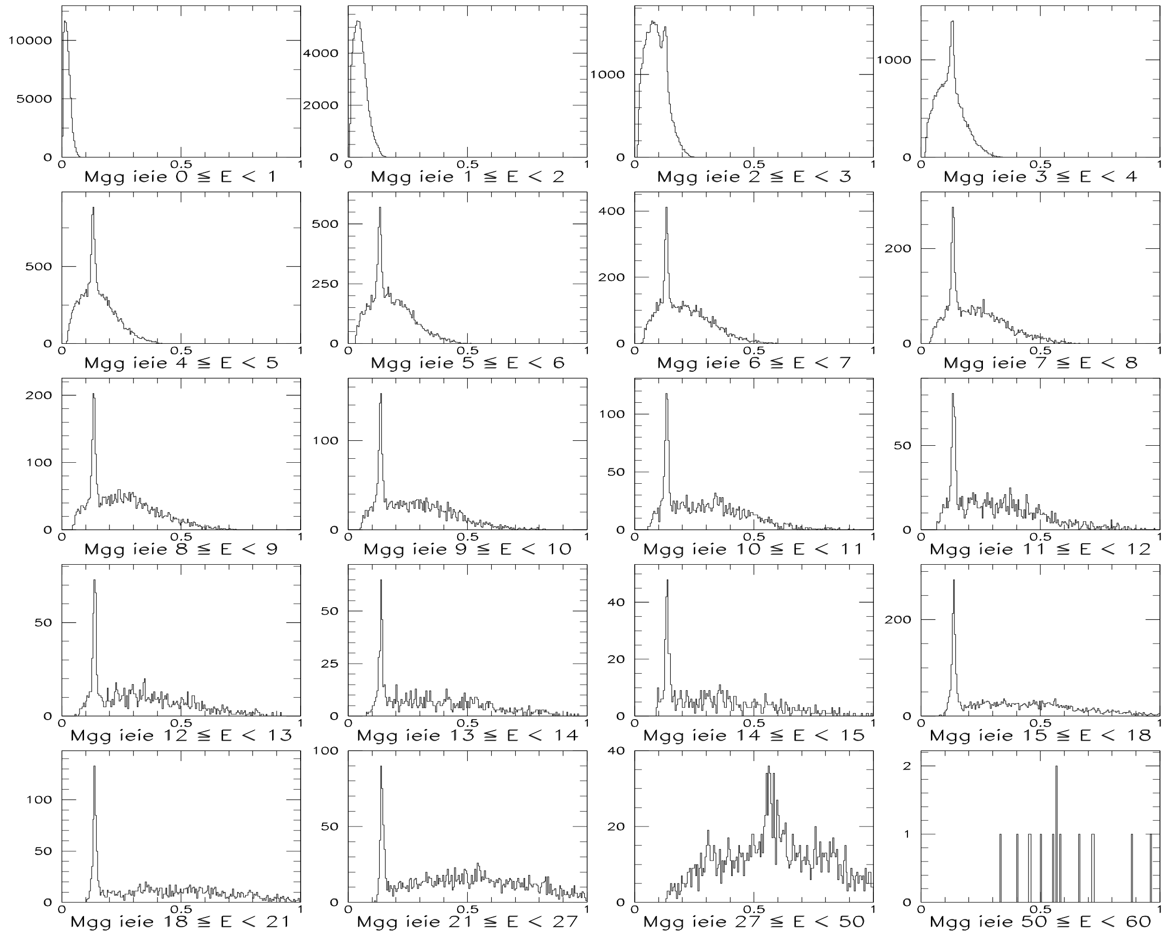
✔ $M_{\gamma\gamma}$,N_γ and E_γ Distributions for Baseline Cuts



✔ Split this Sample in ....

RAW $M_{\gamma\gamma}$ as a Function of E_γ

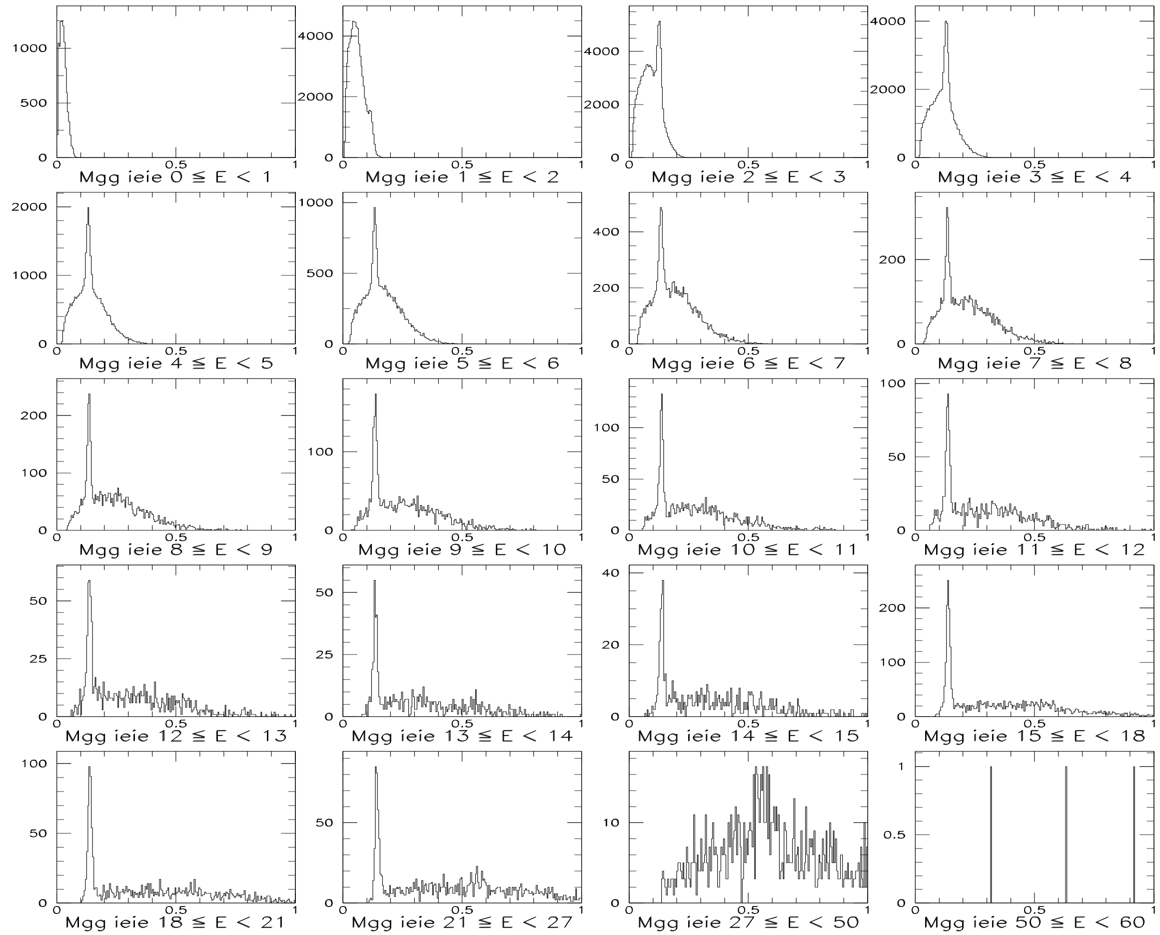
- Both γ in the same range of E_γ [Highly Symmetric]



- (you want to see here how the shape of the background change)

MC $M_{\gamma\gamma}$ as a Function of E_γ

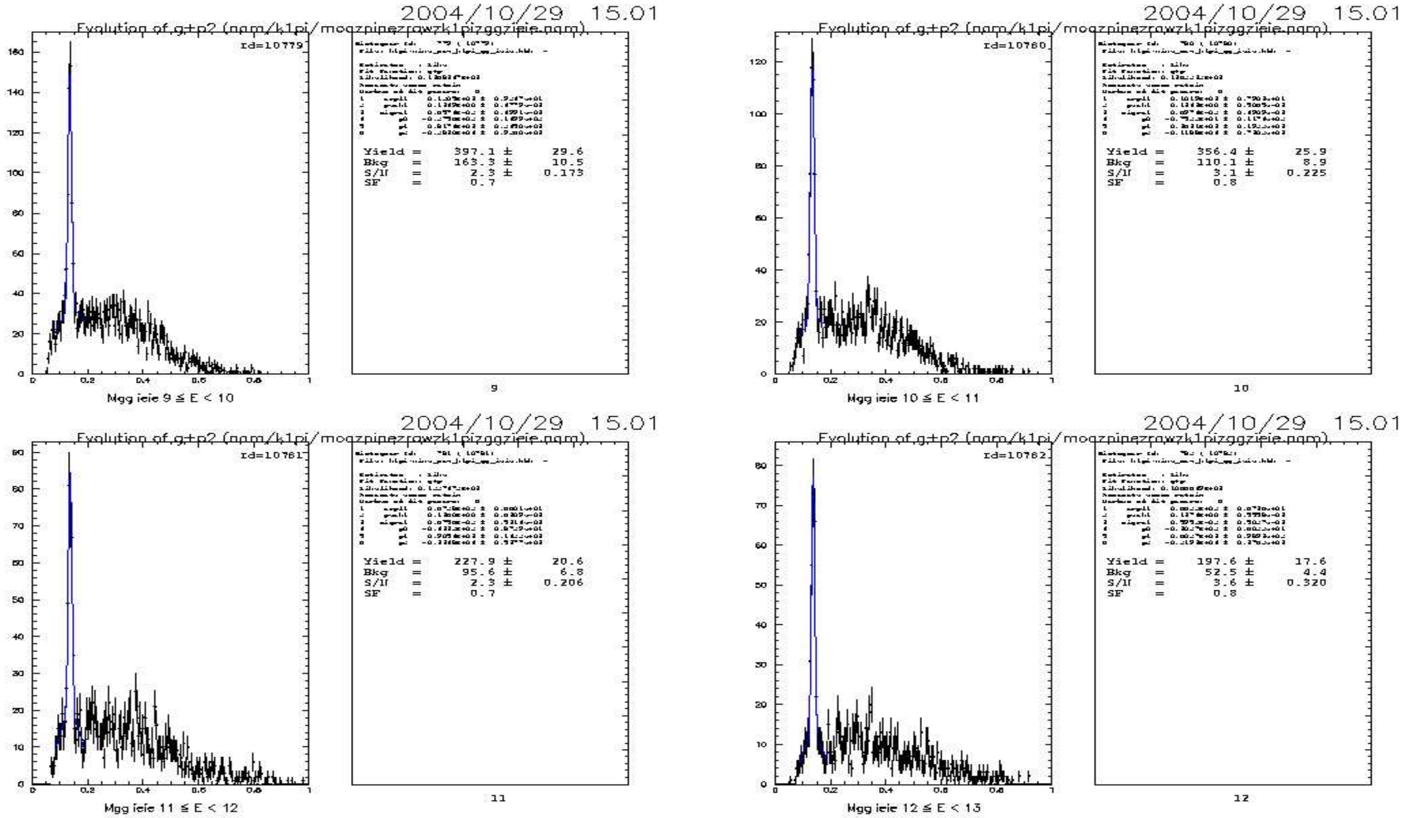
- Both γ in the same range of E_γ [Highly Symmetric]



- (you want to see here how the shape of the background change)

Signal Fit using "moa" (Dario's Program)

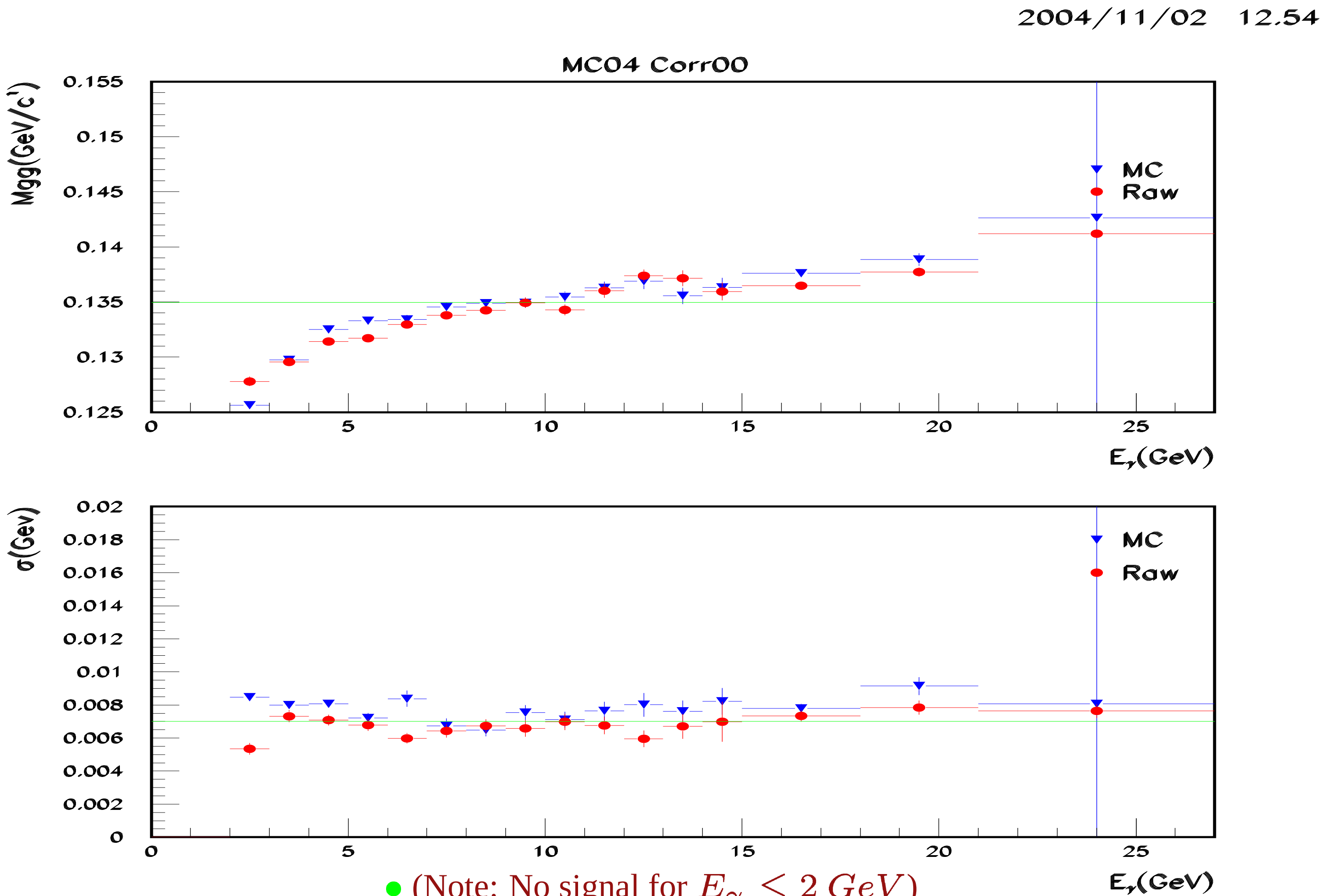
- Fit "just" around the π^0 in each of the "many" $M_{\gamma\gamma}$ Plots
- Fit Function: Gaussian plus a Second degree Polynomial
- Extract mean and sigma (MASS and WIDTH) from each of the fit
- Just a Sample:



- All fi ts are available at: http://charma.uprm.edu/ mendez/

Corr 0

$M\gamma\gamma$ and σ_{π^0} as a function of E_γ for MC and RAW Data



- (Note: No signal for $E_\gamma \leq 2\ GeV$)

Corr 1

IE Reconstruction (Part II)

MC and RAW Data

(Taking $\simeq$ Salvador Corrections for ADC)

- Put back the Block Energy to have the π^{0}'s at their Nominal Mass.

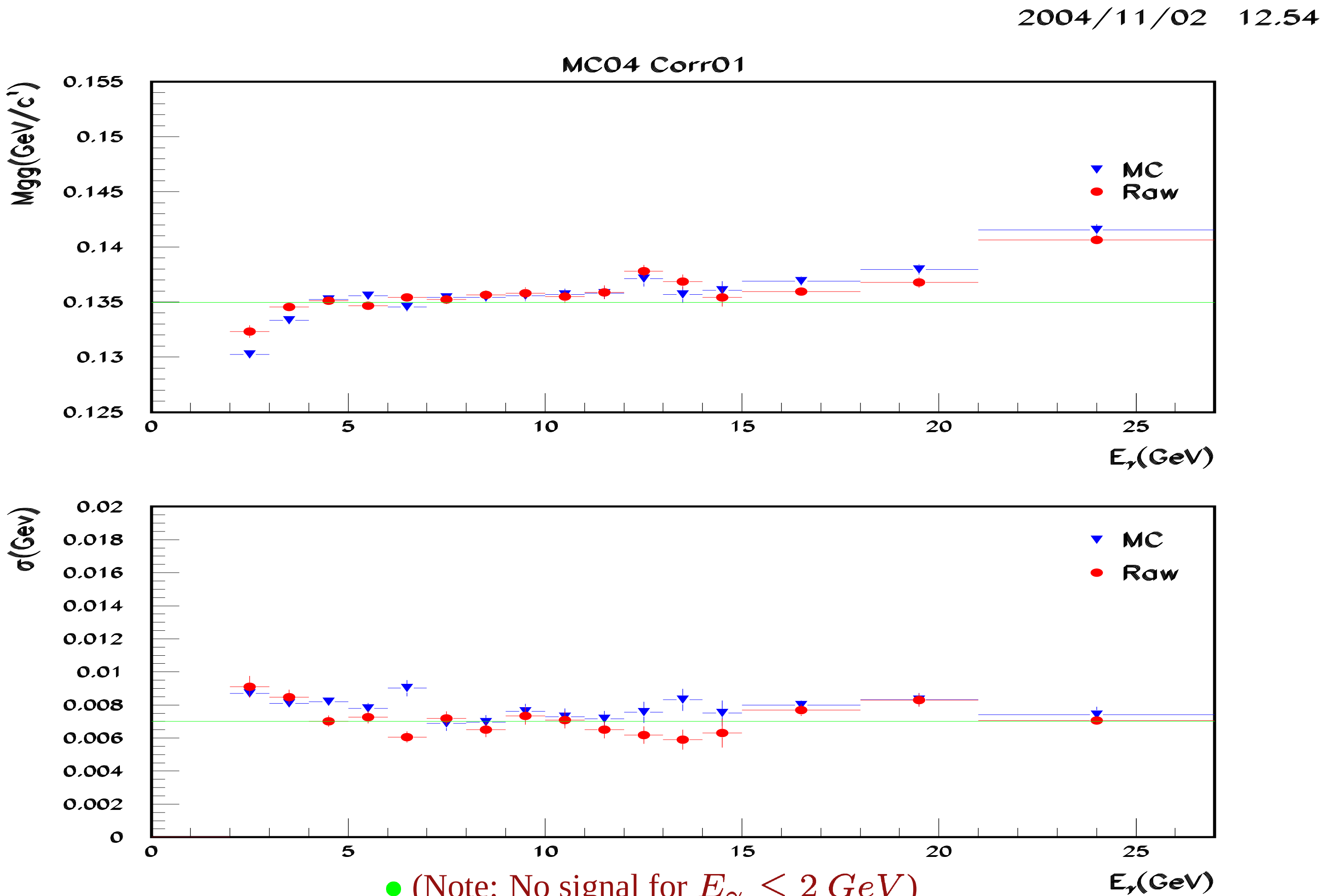
✔ Rec: $\rightarrow$ Call IefixDrift.sf

- Add the energy (**5 ADC Counts**) to each block:
  LGENER(i) = LGENER(i) + **5 * ie_adc2gev(i)**
- Scale Factor to match π^{0} mass:
  LGENER(i) = LGENER(i) / **1.28**

✔ Rec: $\rightarrow$ Call IeRecon: [Re-Reconstruct IE Photons again]

Corr 1

M$\gamma\gamma$ and σ_{π^0} as a function of E_γ for MC and RAW Data



- (Note: No signal for $E_\gamma \leq 2\ GeV$)

Other Dependencies

π^0 Energy Asymmetry

Other Dependencies

More to come

π^0 **Energy Asymmetry**

π^0 **Opening Angle**

Other Dependencies

π^0 Energy Asymmetry

π^0 Opening Angle

X_γ Position at IE Front Face

Other Dependencies

Other Dependencies

π^0 **Energy Asymmetry**

π^0 **Opening Angle**

X_γ **Position at IE Front Face**

Run Dependance

π^0 Energy Asymmetry

π^0 Opening Angle

X_γ Position at IE Front Face

Run Dependance

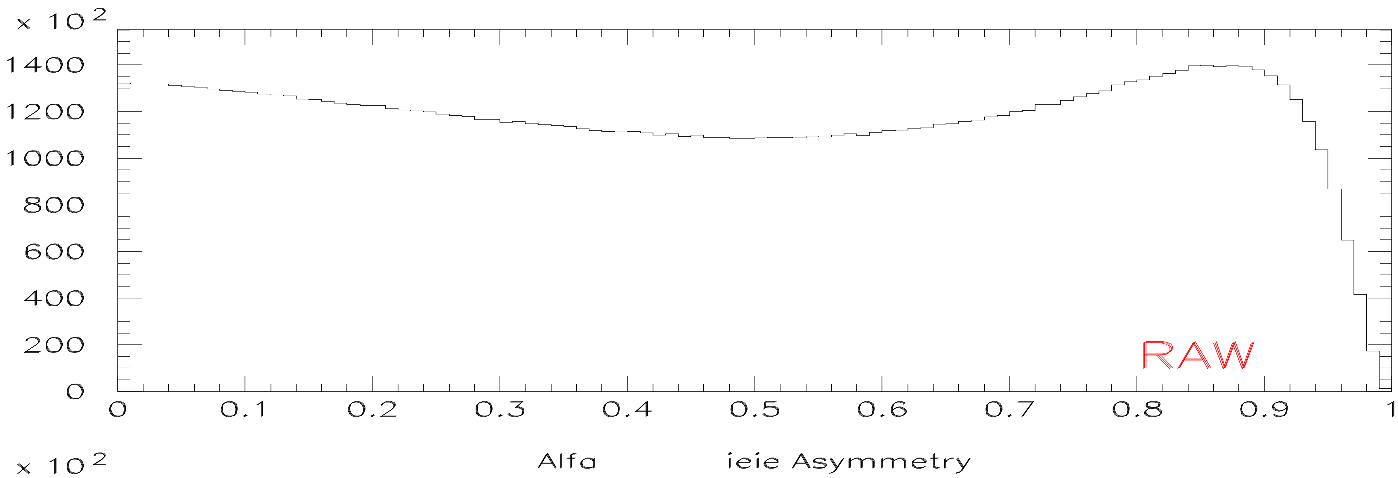
Other Dependencies

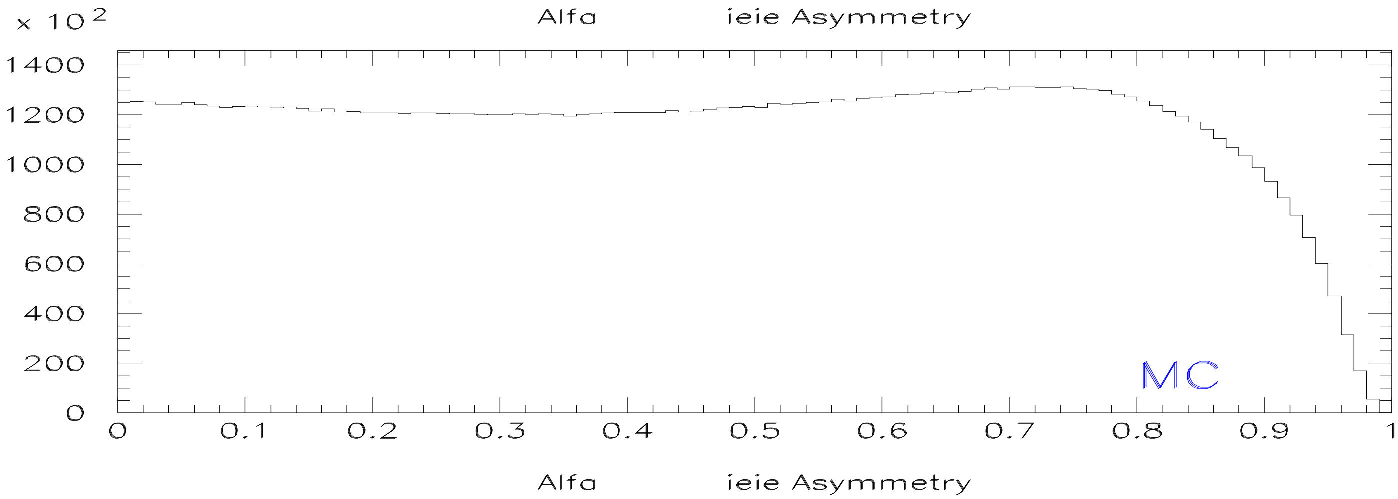
We do the same thing over......

Energy Asymmetry

- $\gamma\ \gamma$ Energy Asymmetry is defined as:

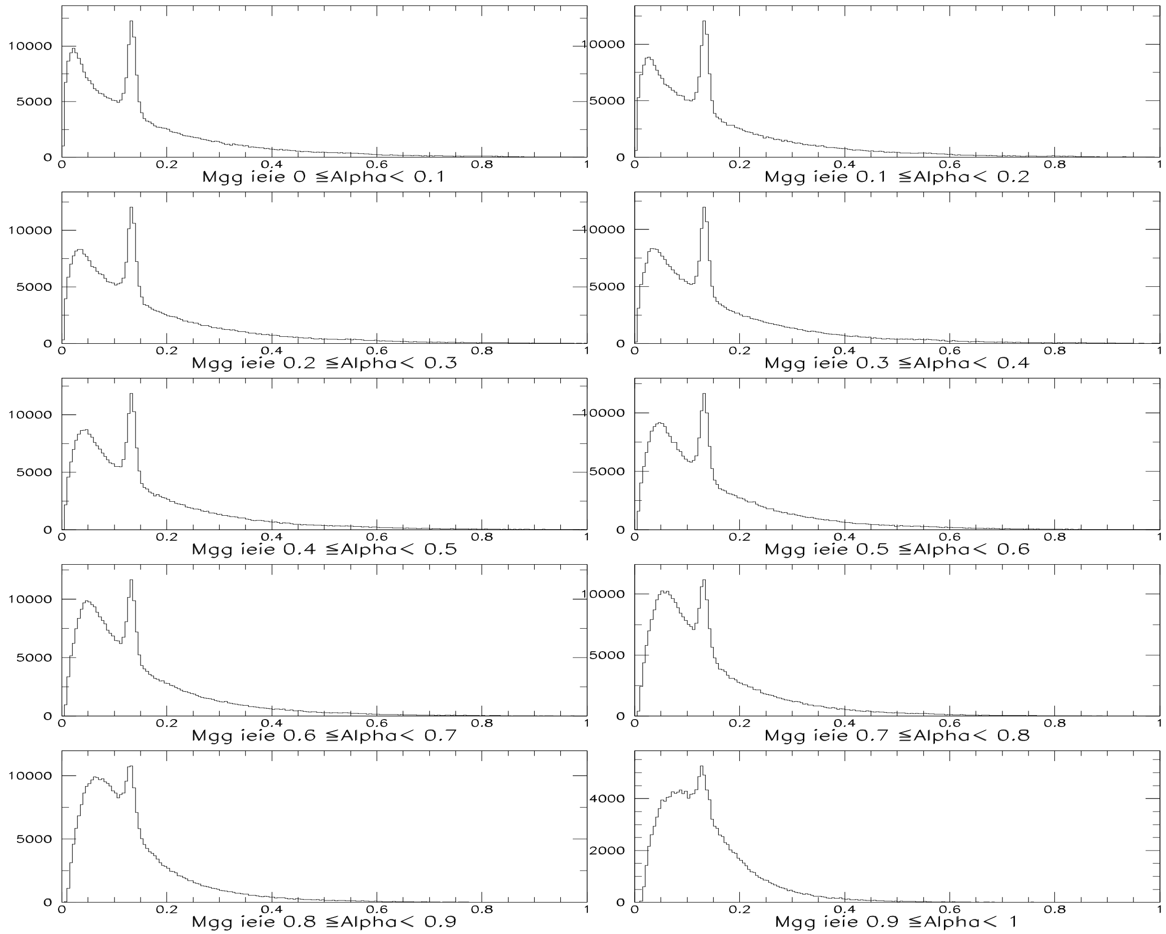
$$\alpha = \left| \frac{E_{\gamma_i} - E_{\gamma_j}}{E_{\gamma_i} + E_{\gamma_j}} \right|$$





RAW $M_{\gamma\gamma}$ as a Function of Asymmetry

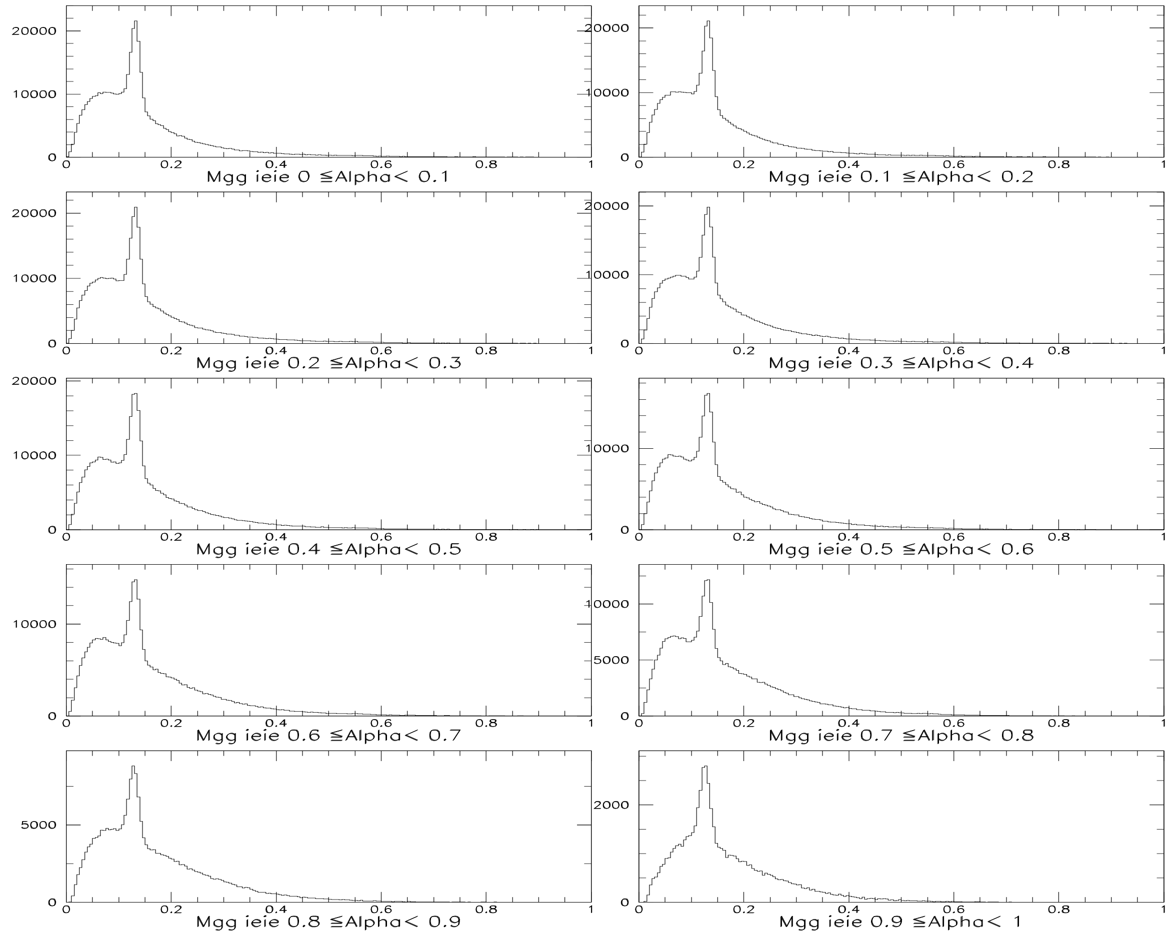
- α interval of 0.1 unit



- (you want to see here how the shape of the background change)

MC $M_{\gamma\gamma}$ as a Function of Asymmetry

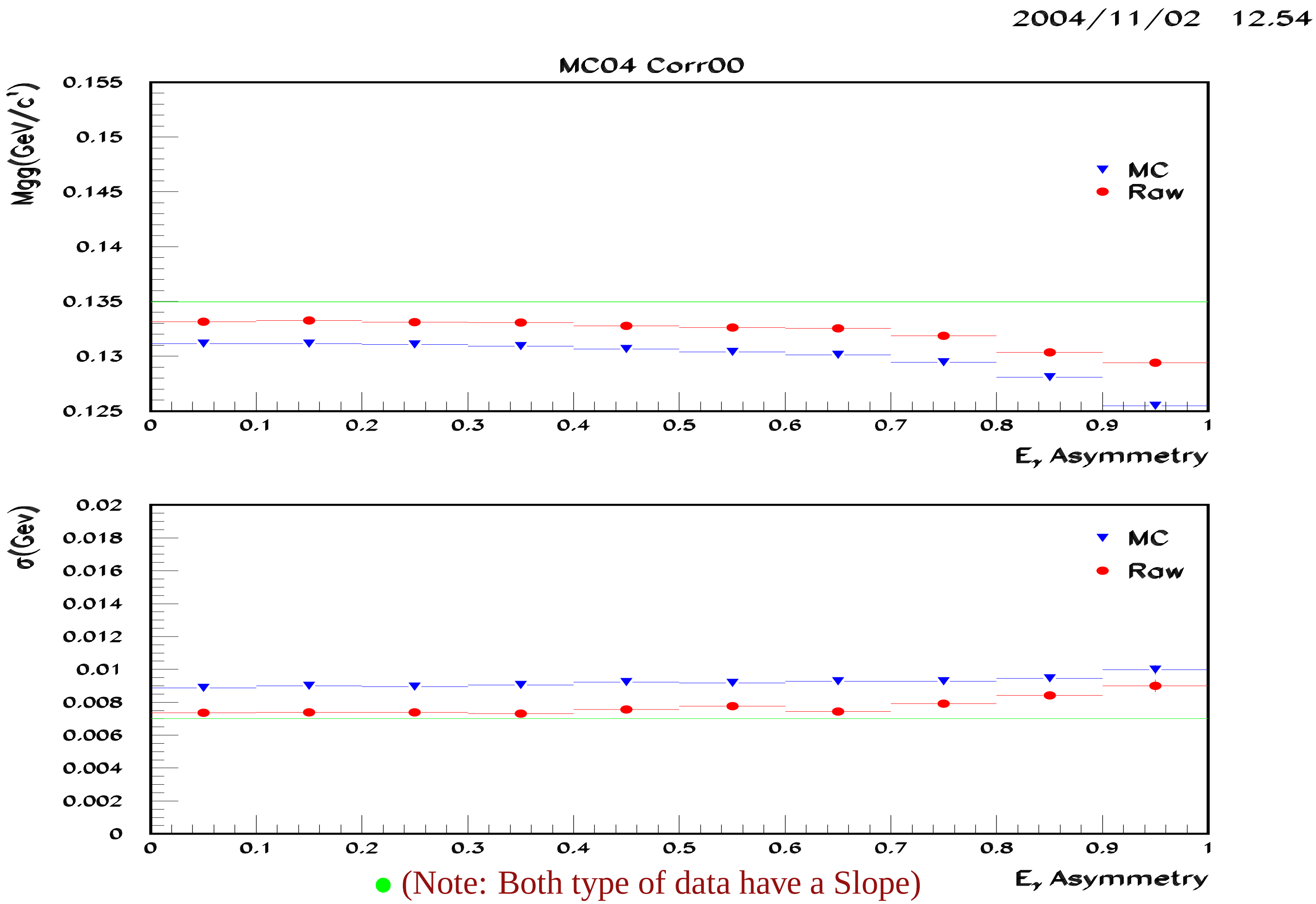
- α interval of 0.1 unit



- (you want to see here how the shape of the background change)

Corr 0

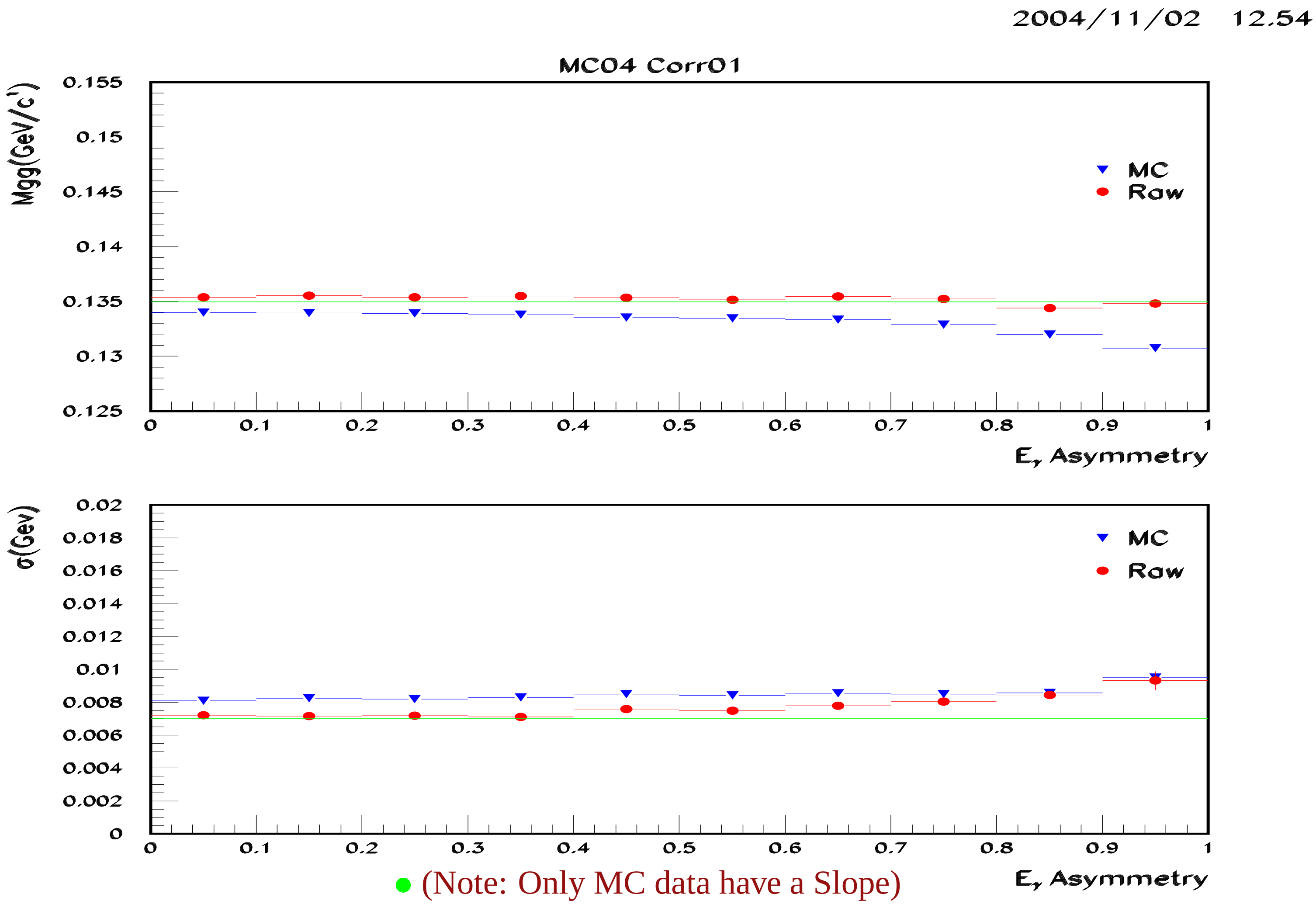
Mγγ and σ_{π^0} as a function of Asymmetry for MC and RAW Data



- (Note: Both type of data have a Slope)

Corr 1

$M\gamma\gamma$ and σ_{π^0} as a function of Asymmetry for MC and RAW Data

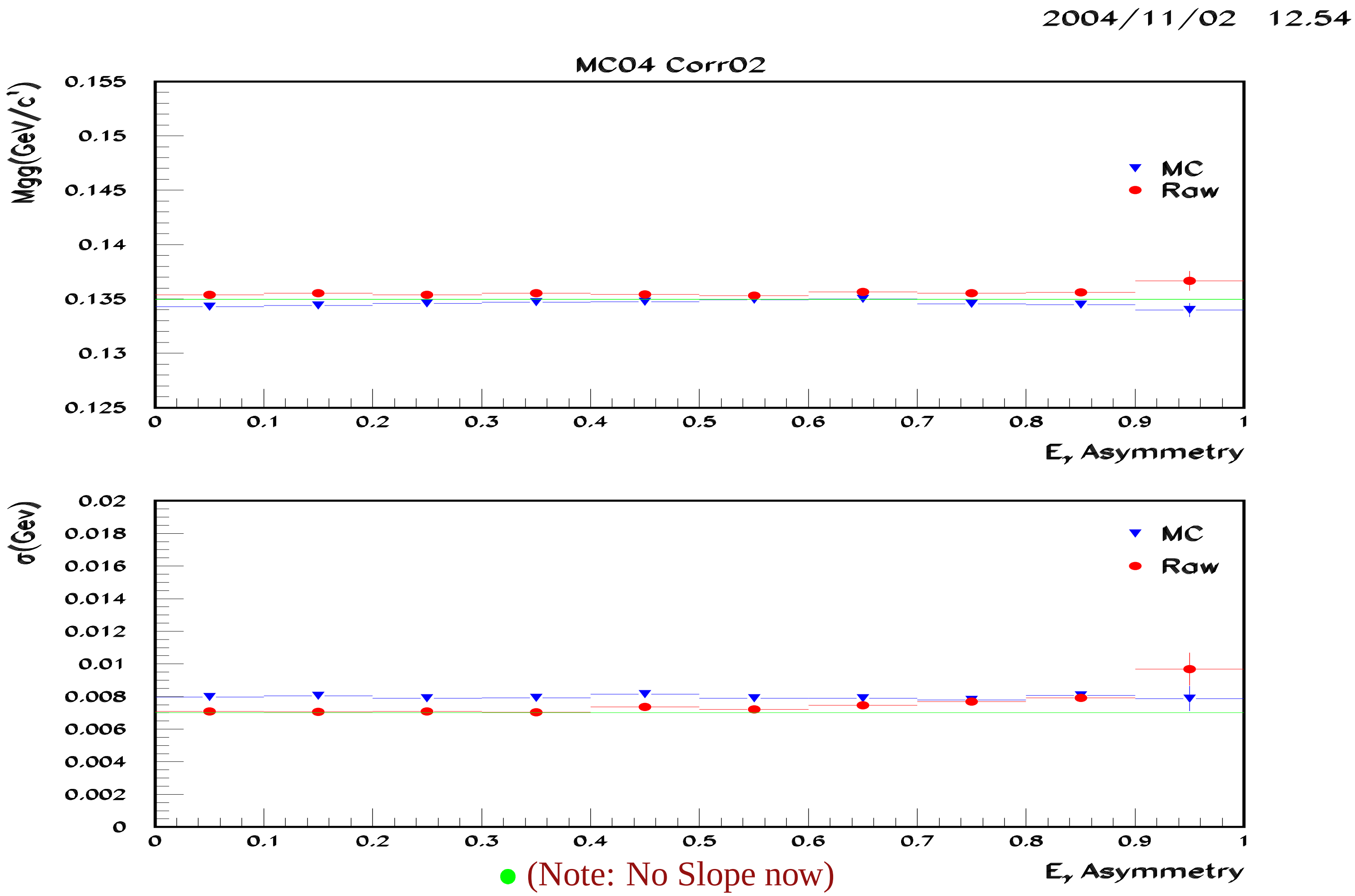


- (Note: Only MC data have a Slope)

Corr 2

• $E_\gamma \geq 2$ GeV for each Photon ← Corr 2

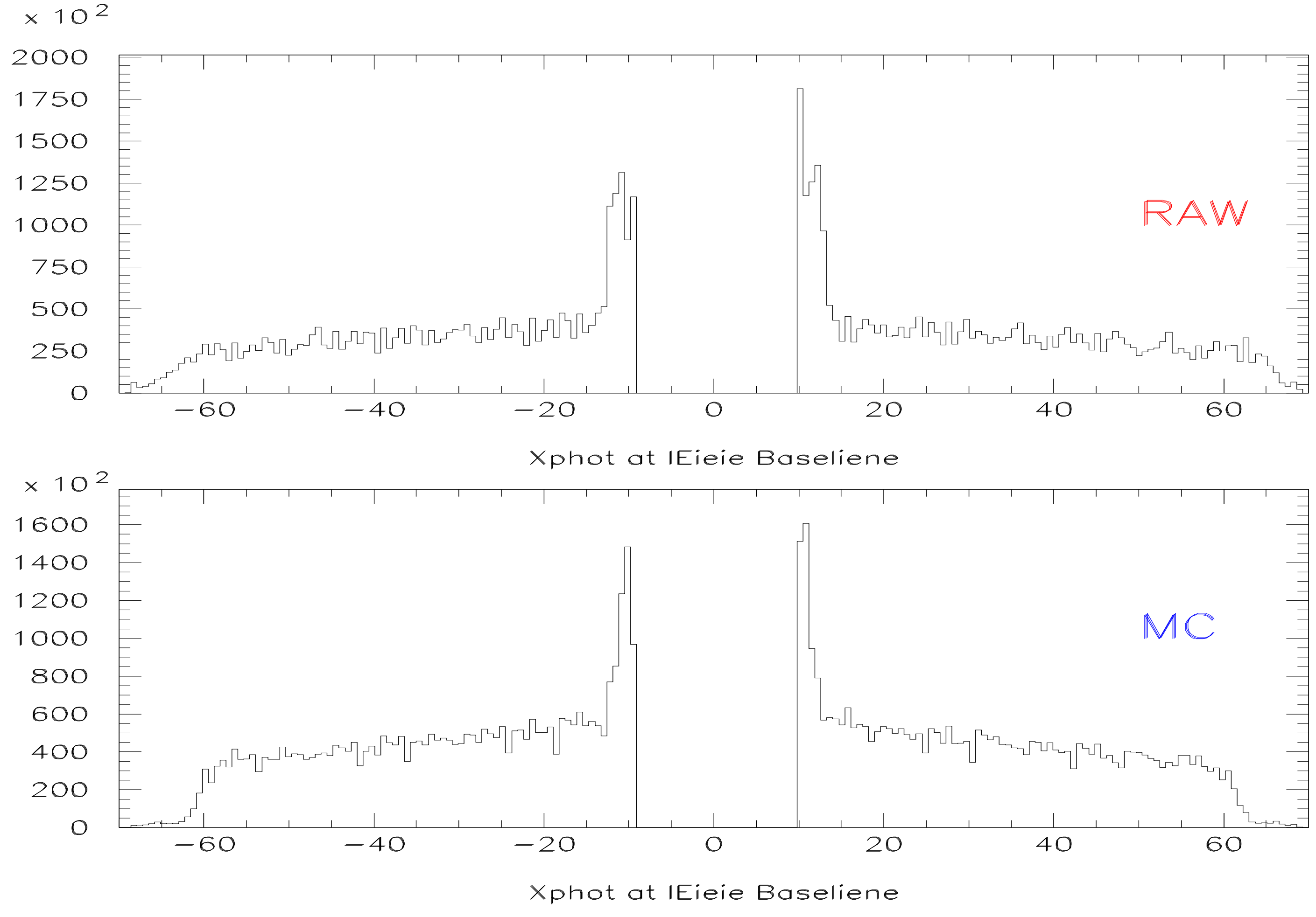
$M\gamma\gamma$ and σ_{π^0} as a function of Asymmetry for MC and RAW Data



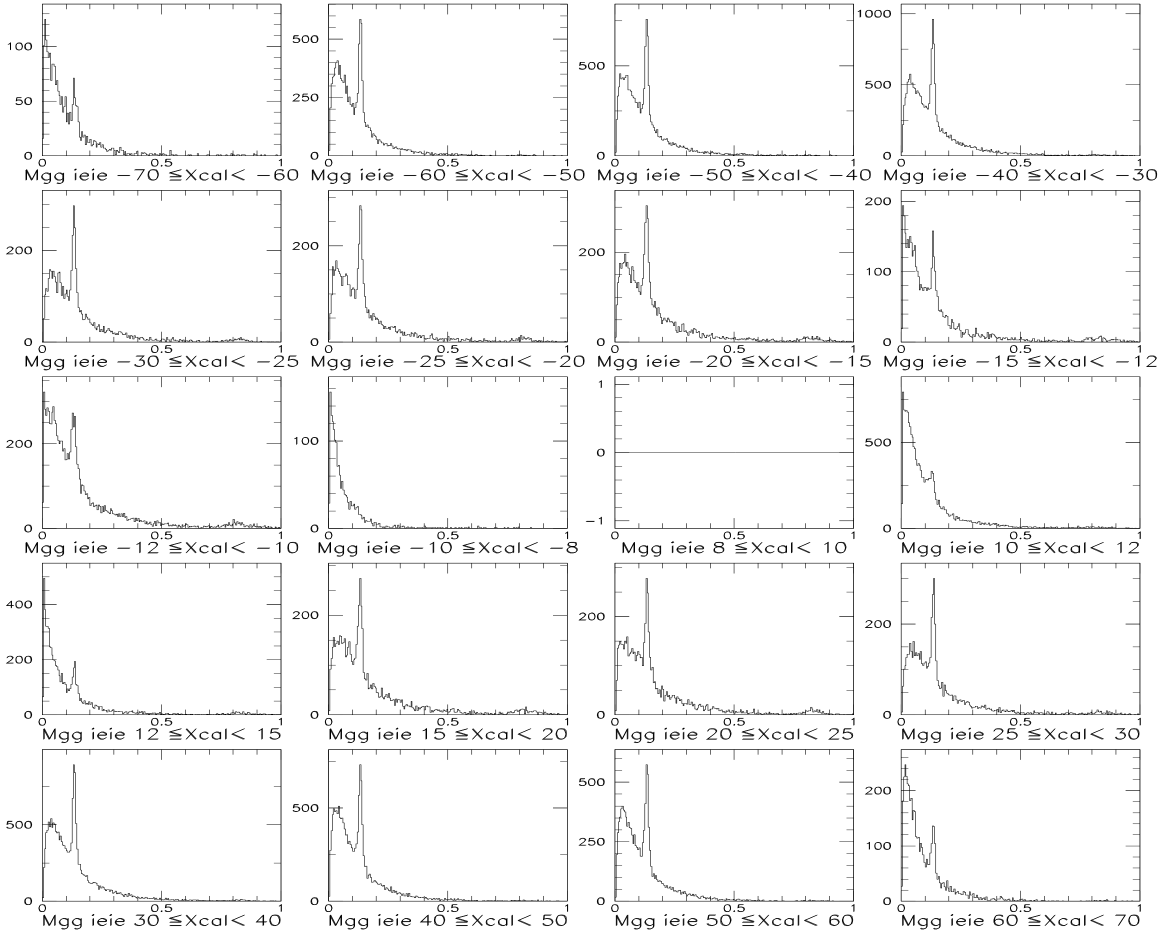
• (Note: No Slope now)

X_γ at IE

- X_γ at IE Front Face

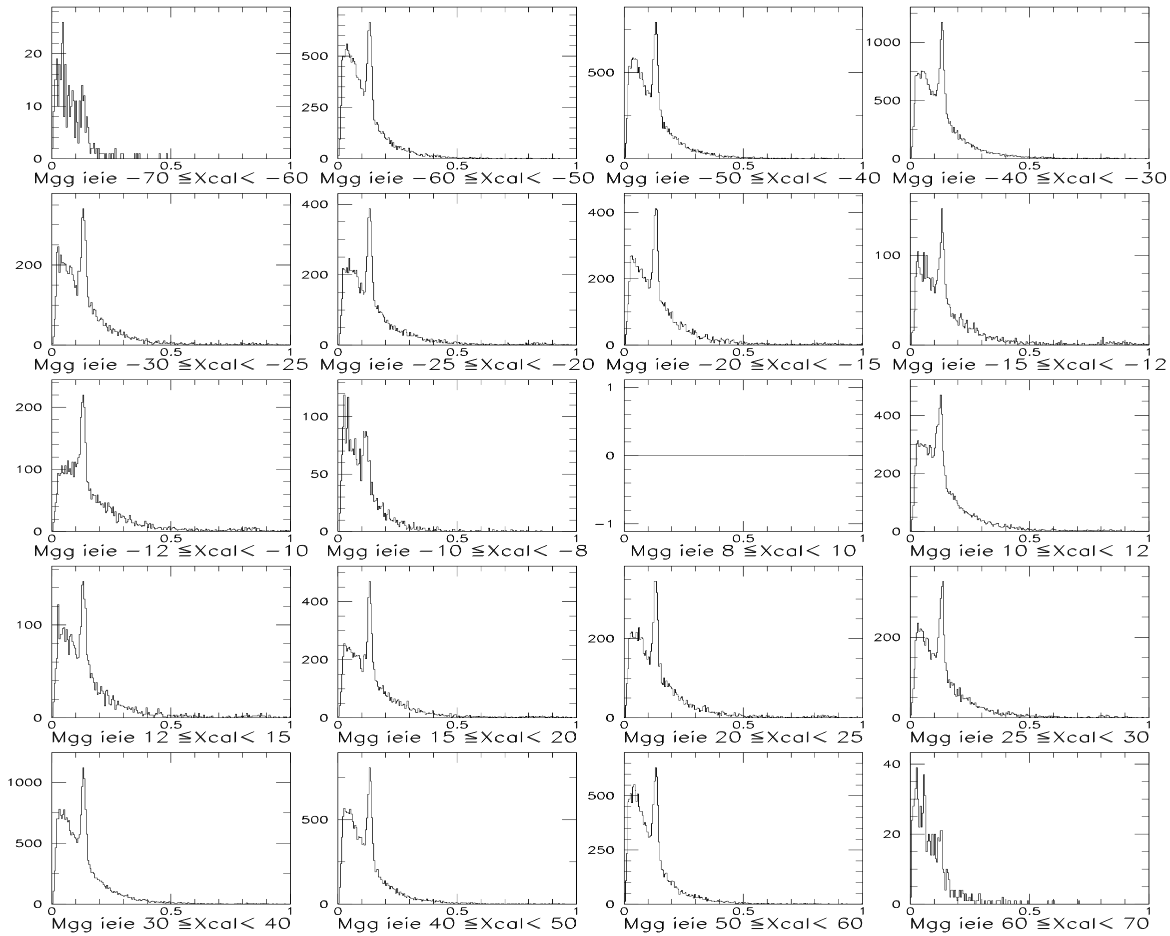


RAW $M_{\gamma\gamma}$ as a Function of X at IE



- (you want to see here how the shape of the background change)

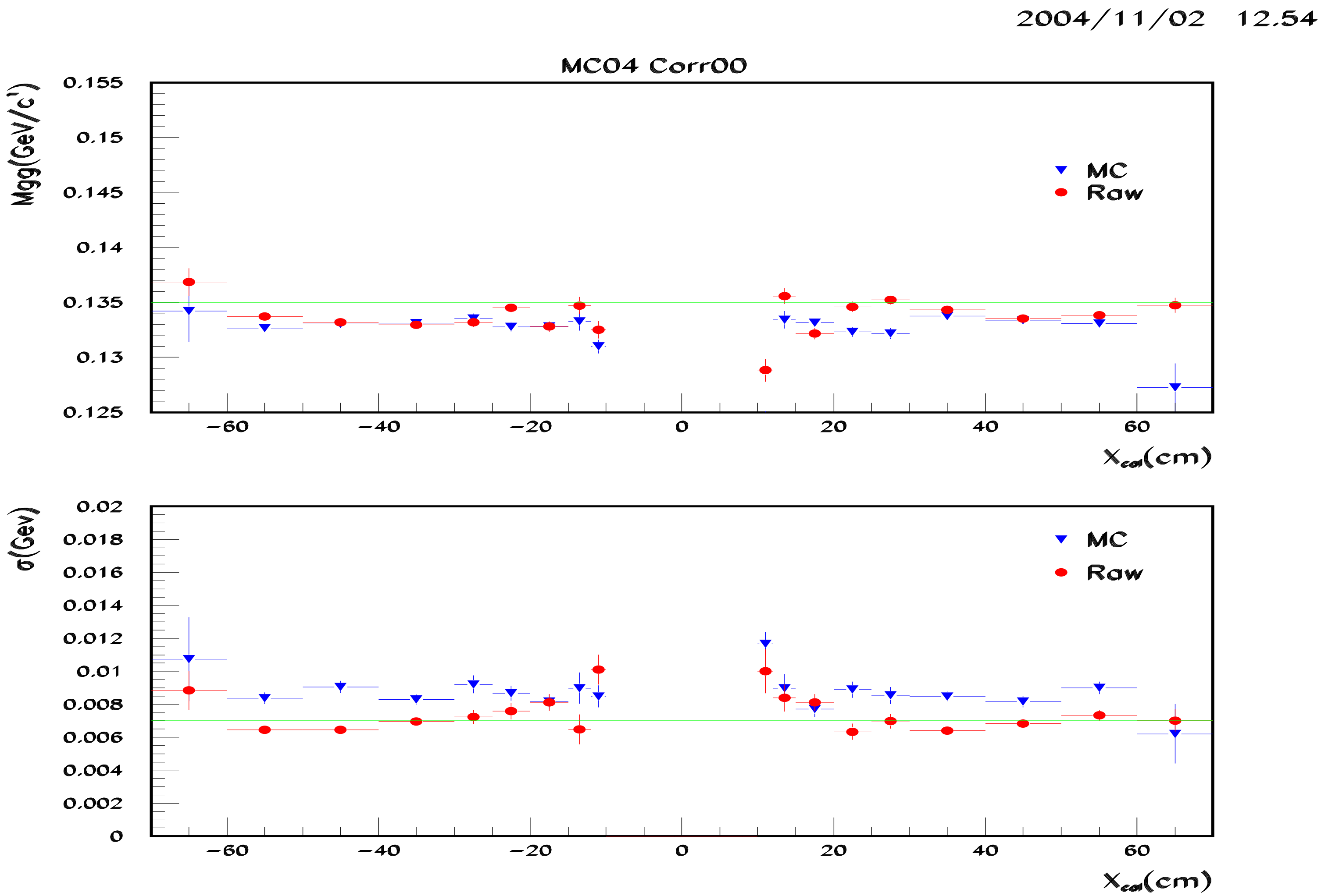
MC $M_{\gamma\gamma}$ as a Function of X at IE



- (you want to see here how the shape of the background change)

Corr 0

$M\gamma\gamma$ and σ_{π^0} as a function of X at IE for MC and RAW Data



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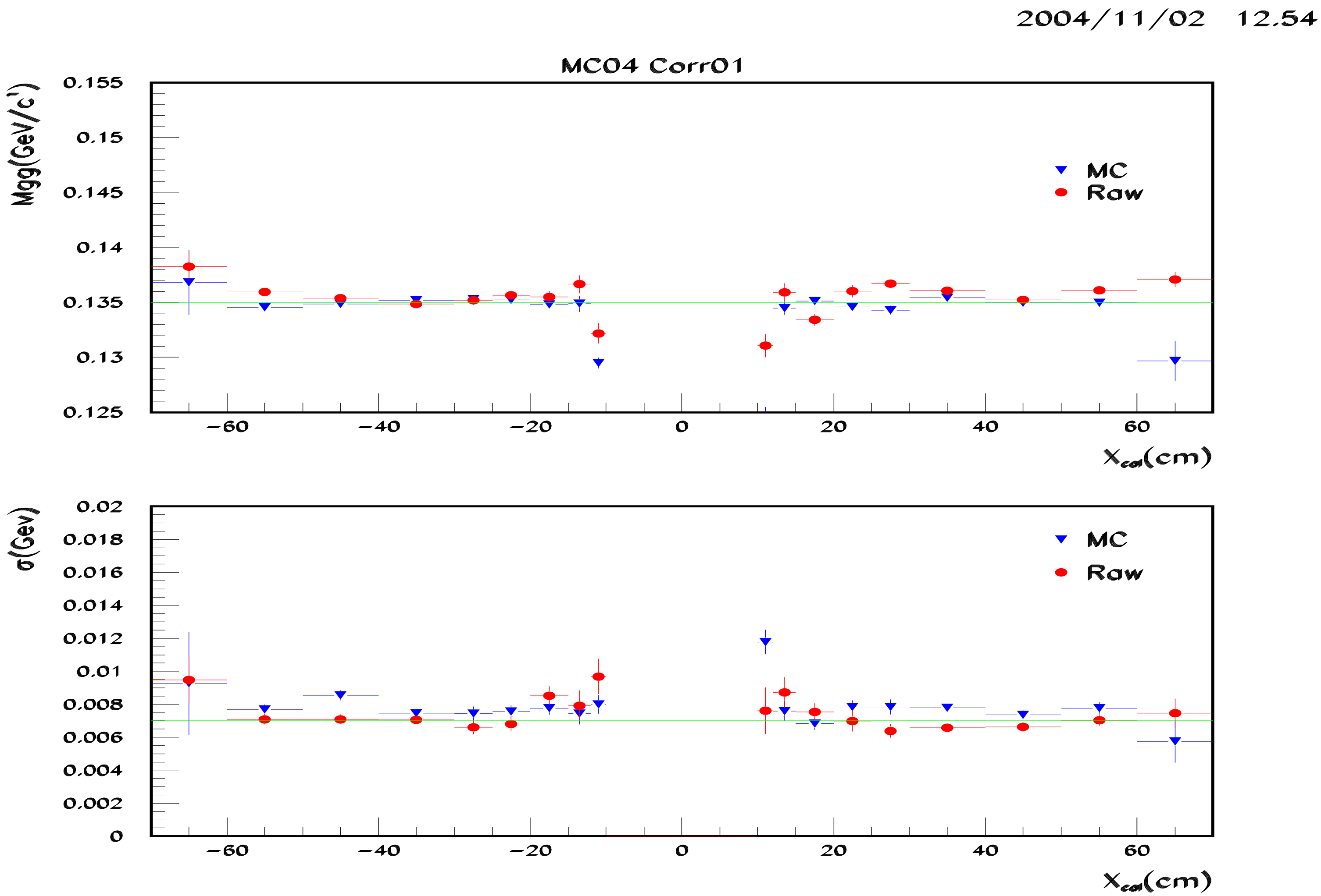
$M\gamma\gamma$ and σ_{π^0} as a function of X at IE for MC and RAW Data



Corr 2

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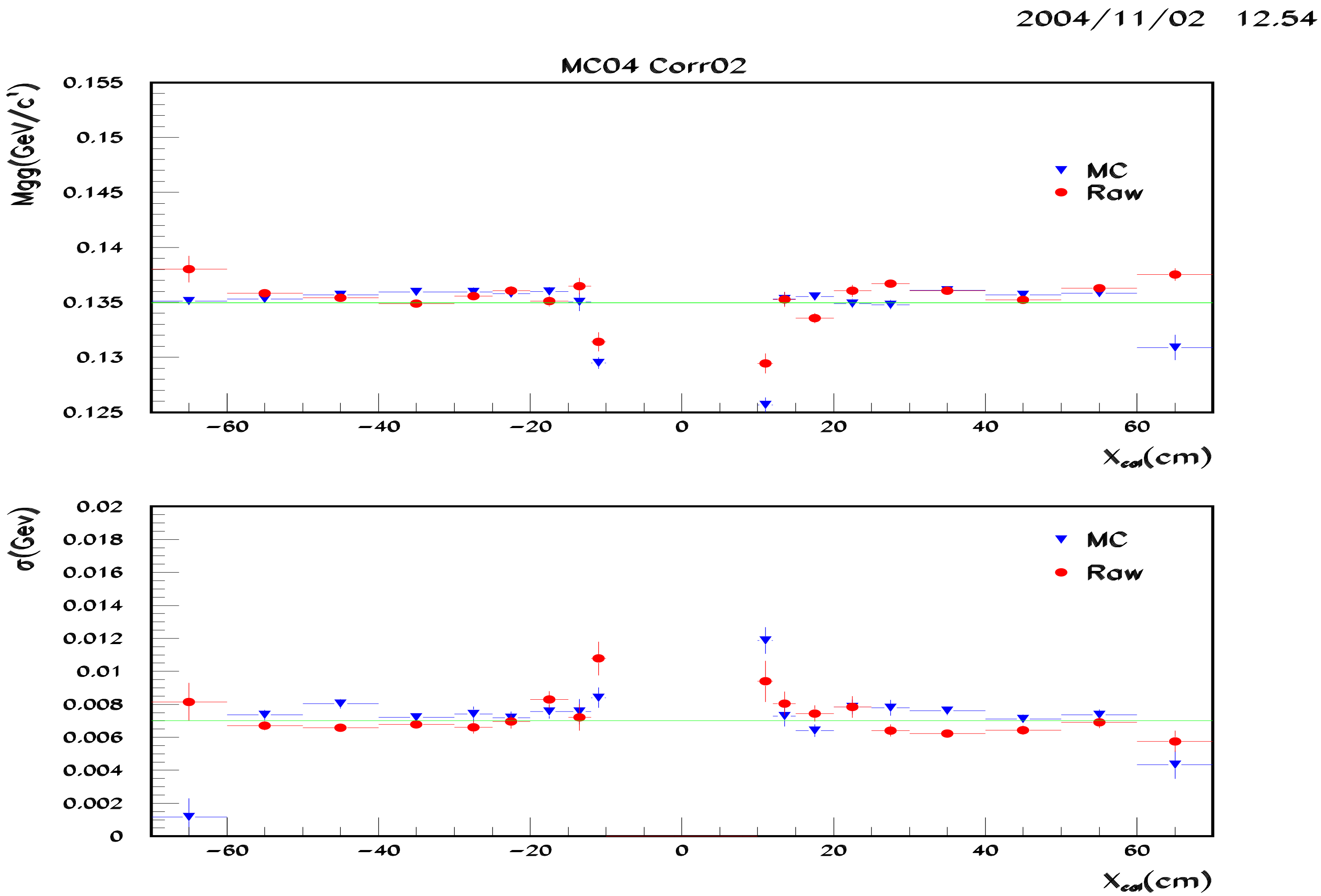
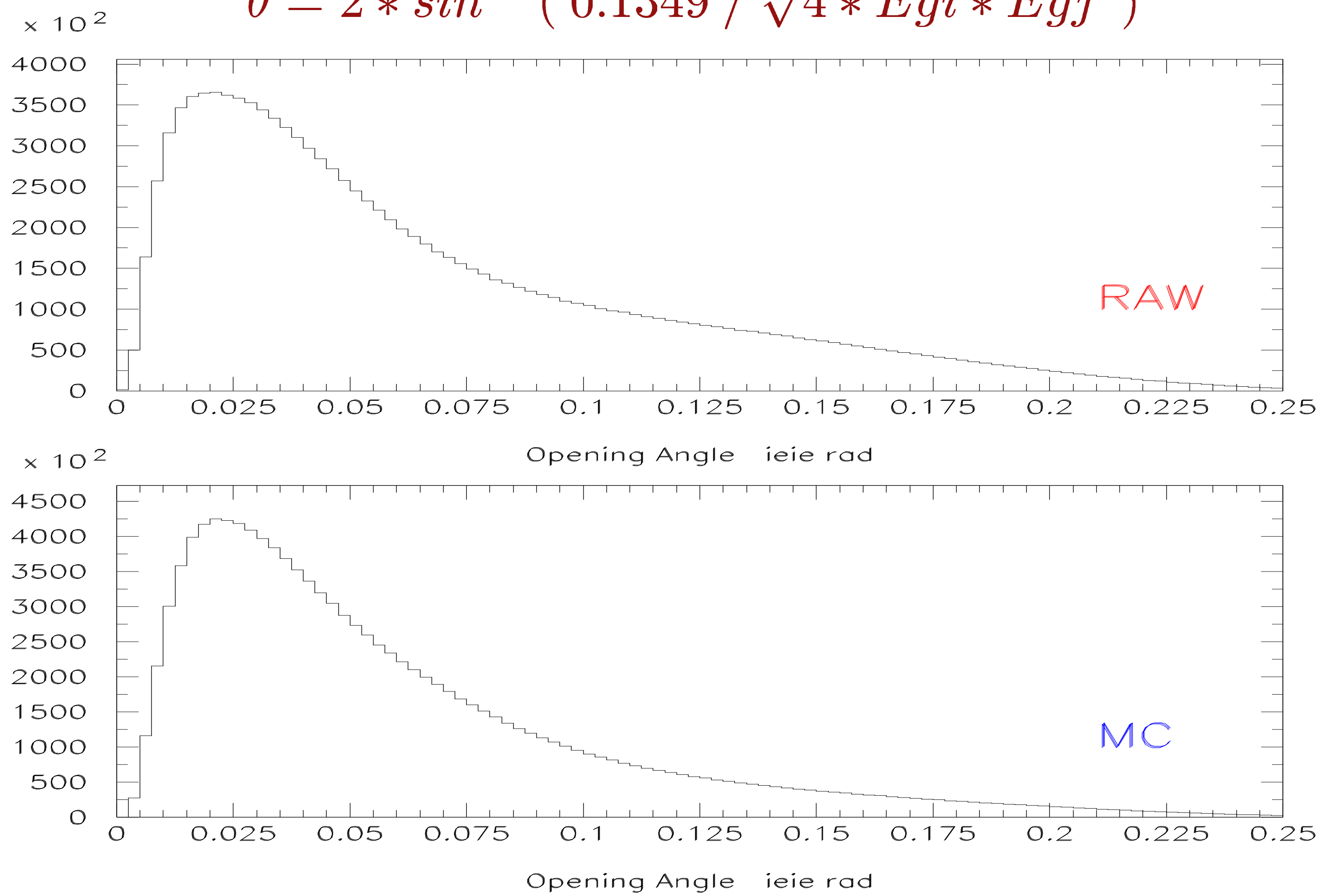


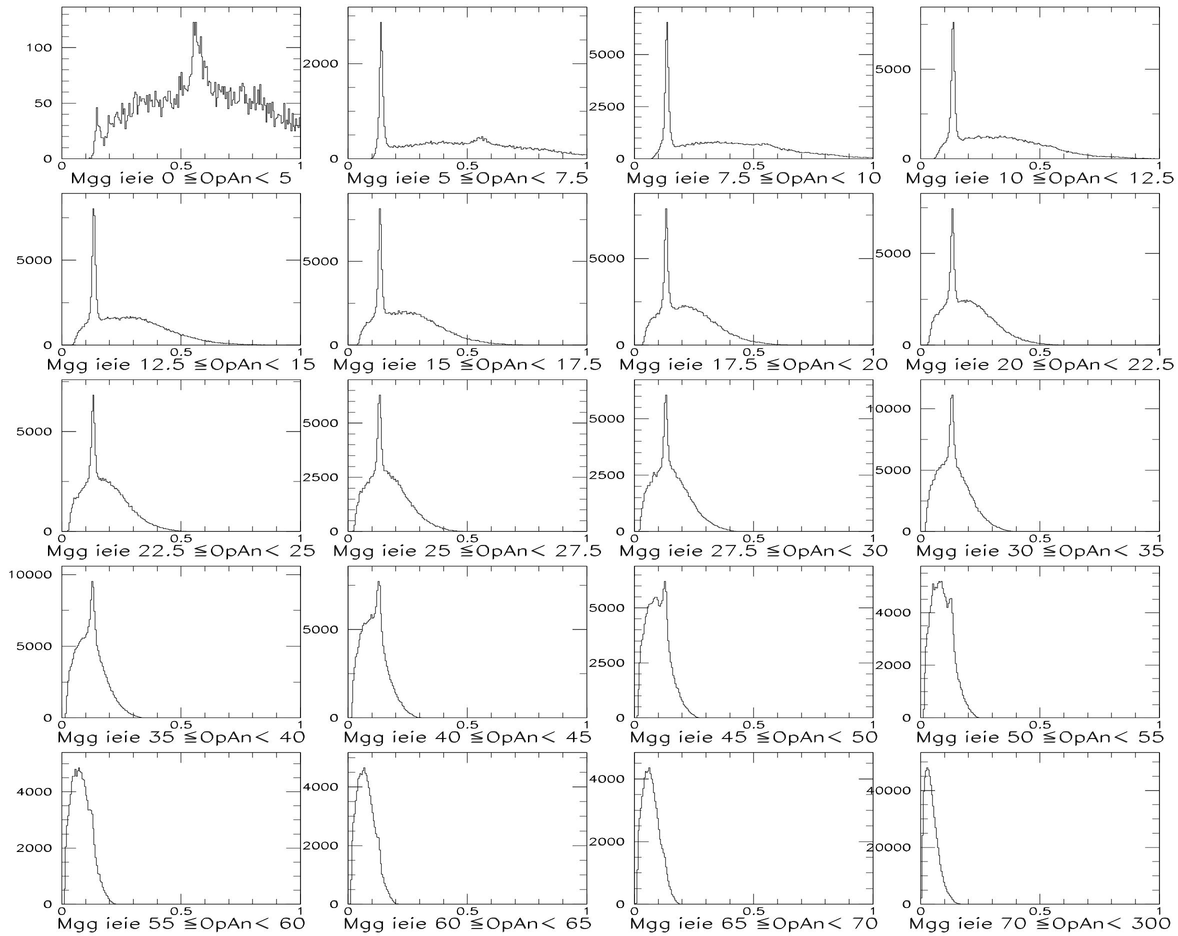
Opening Angle

- $\gamma\ \gamma$ Opening Angle

$$\theta = 2 * sin^{-1}(\,0.1349\,/\,\sqrt{4 * Egi * Egj}\,\,)$$



RAW $M_{\gamma\gamma}$ as a Function of Opening Angle



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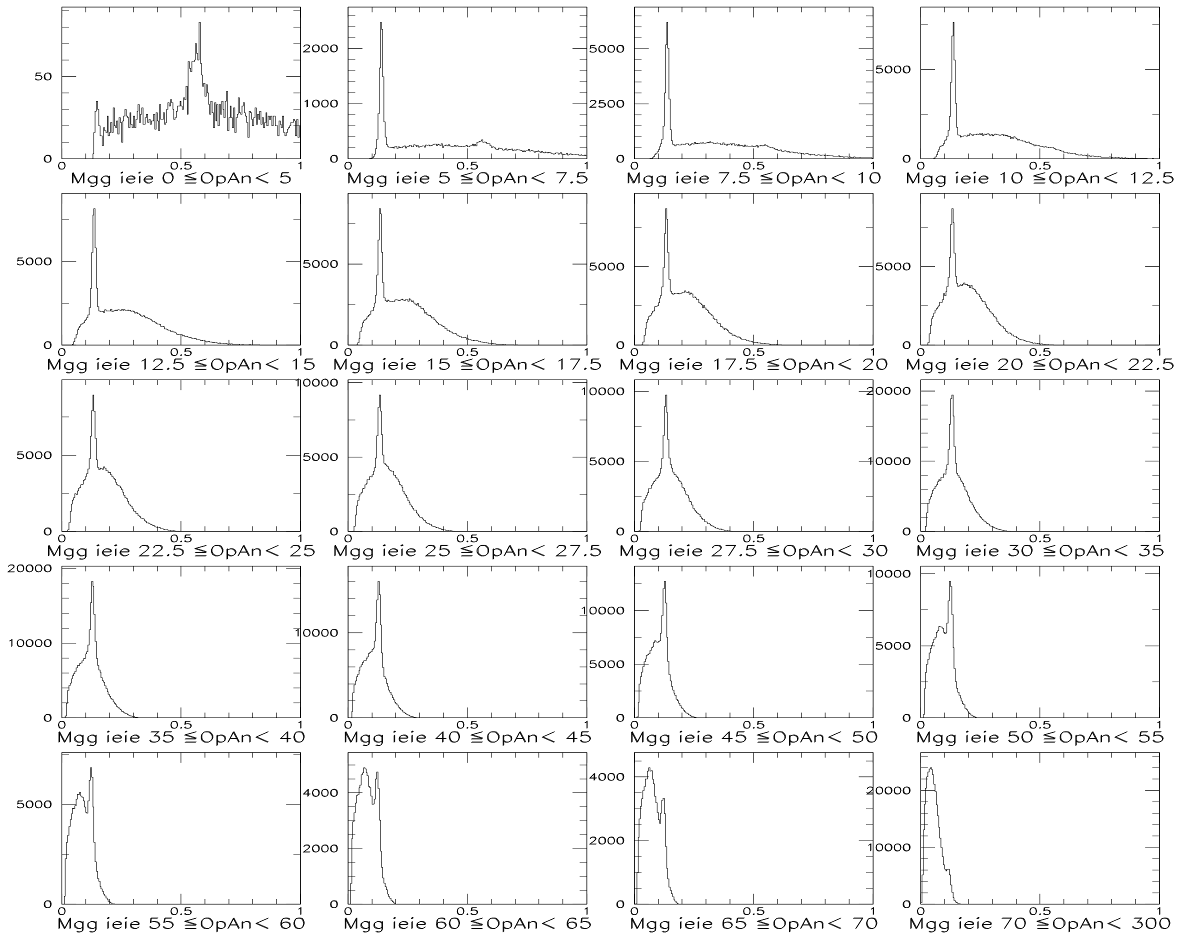
MC $M_{\gamma\gamma}$ as a Function of Opening Angle



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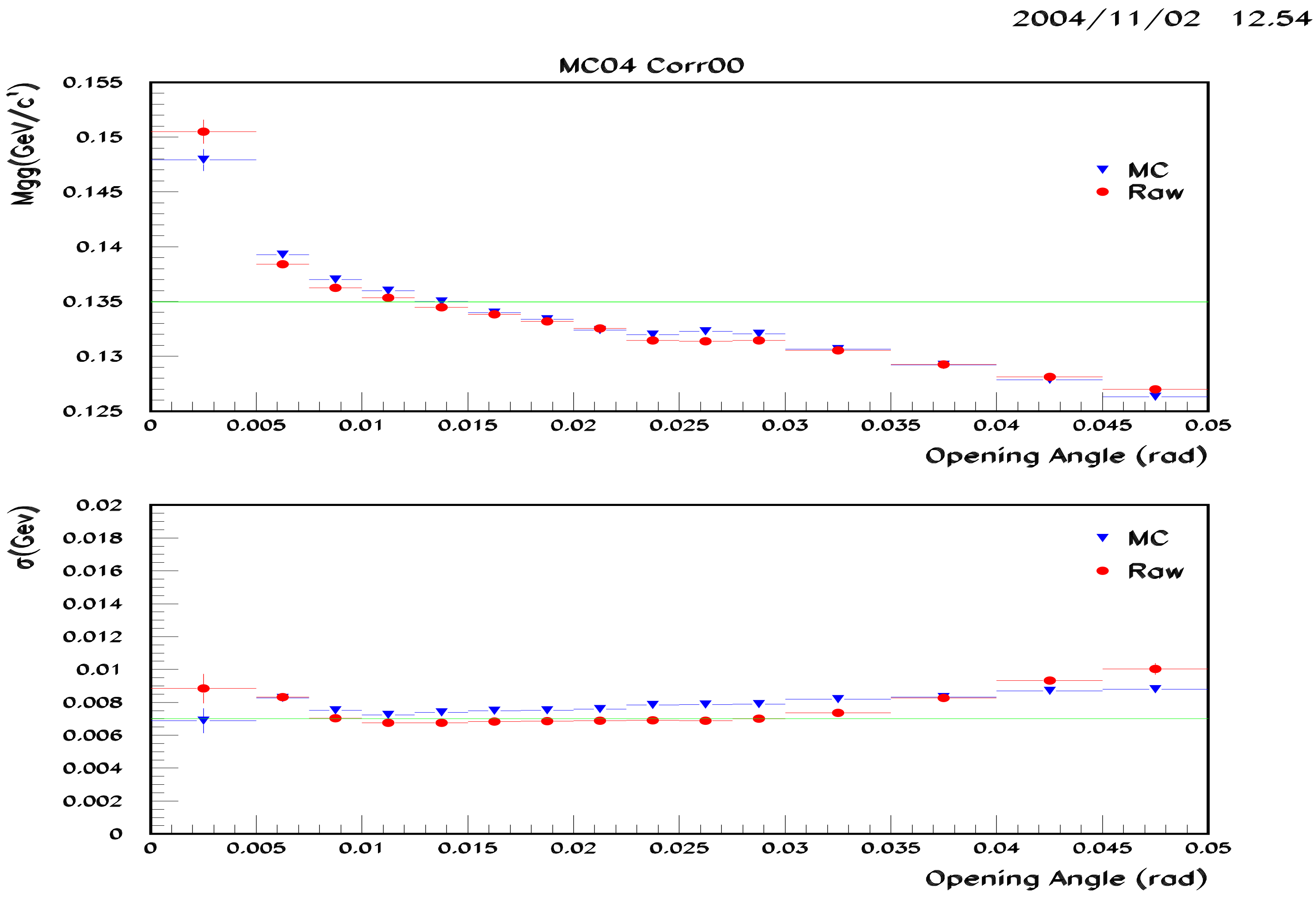
Corr 0

$M\gamma\gamma$ and σ_{π^0} as a function of Opening Angle for MC and RAW Data



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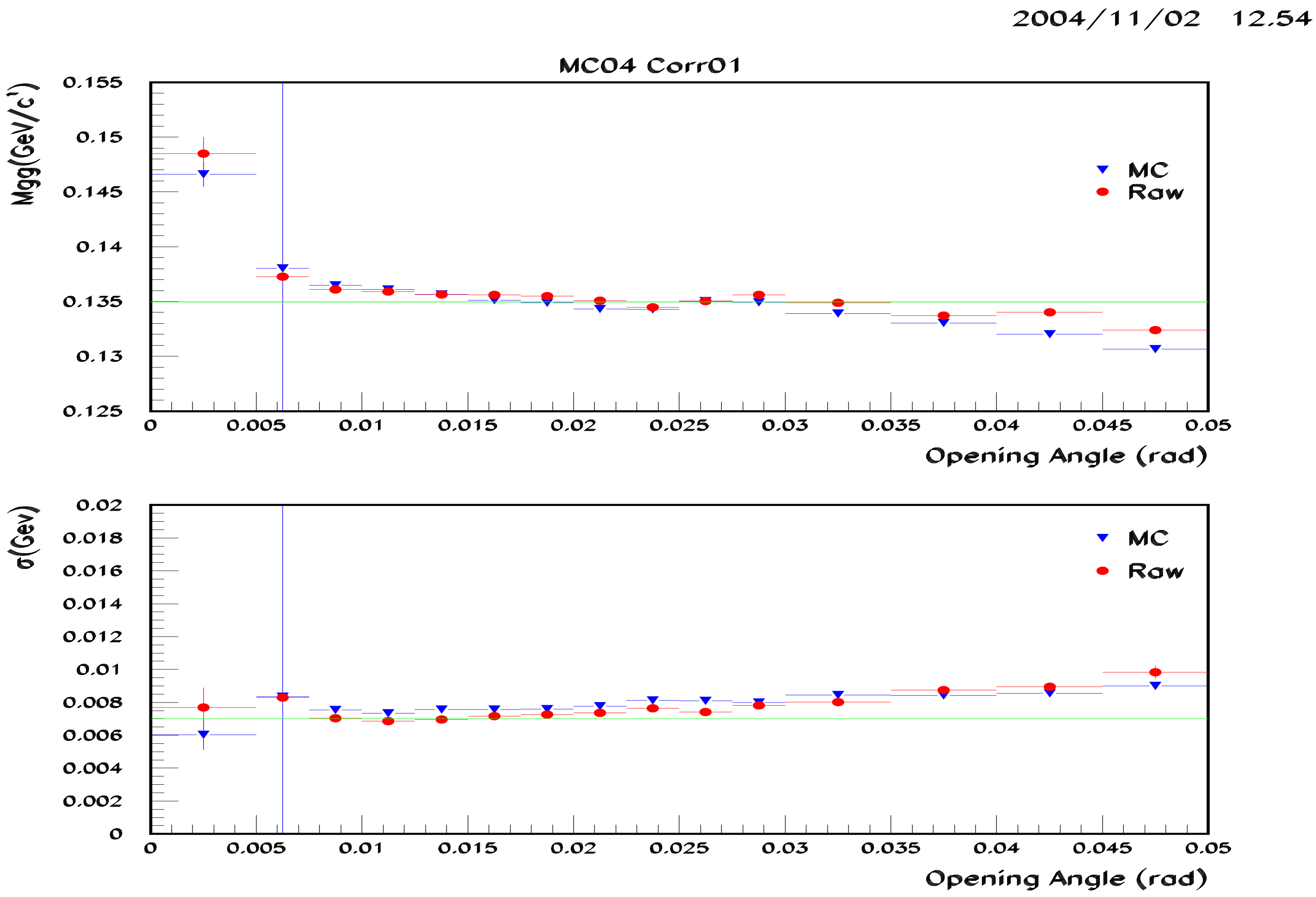
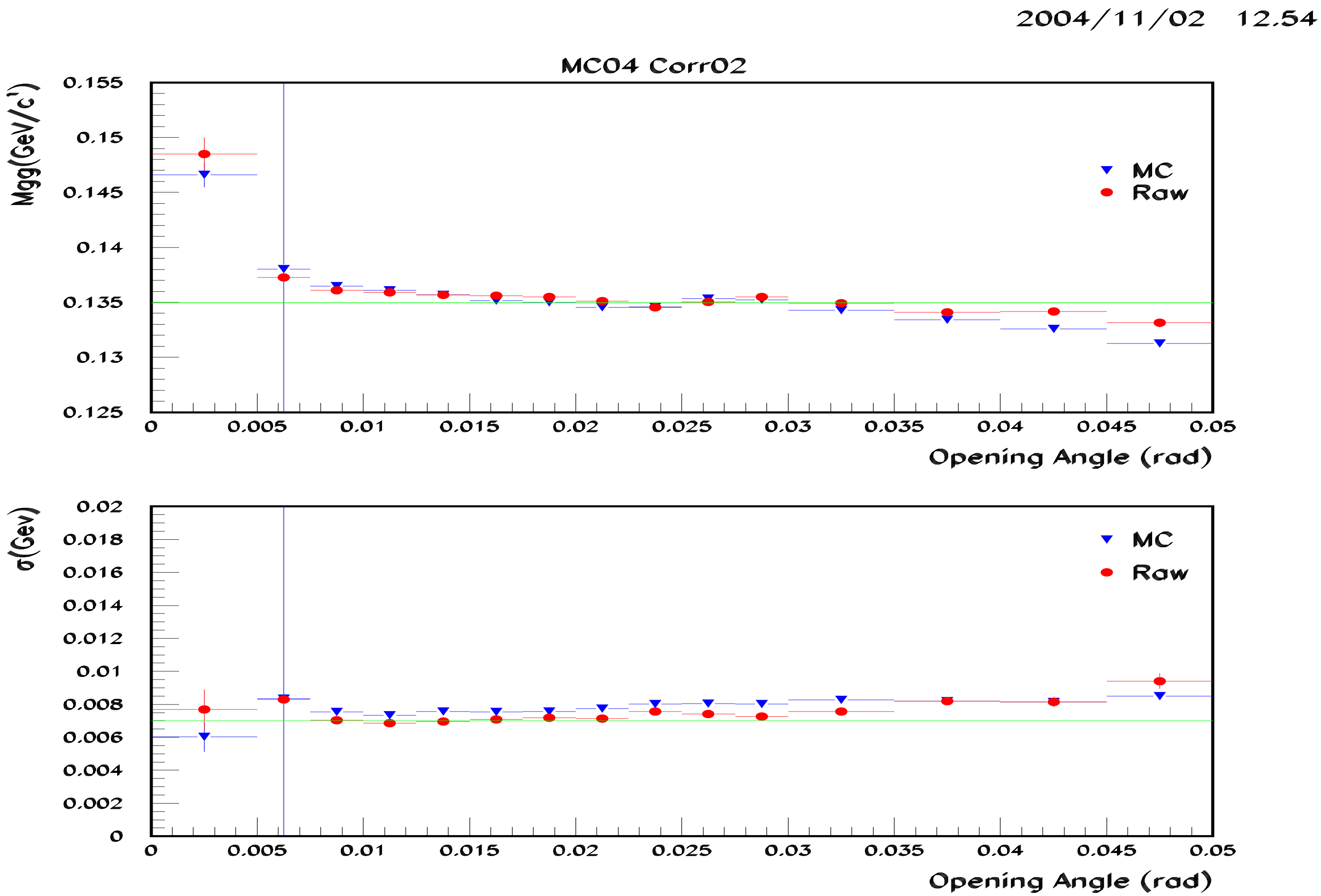


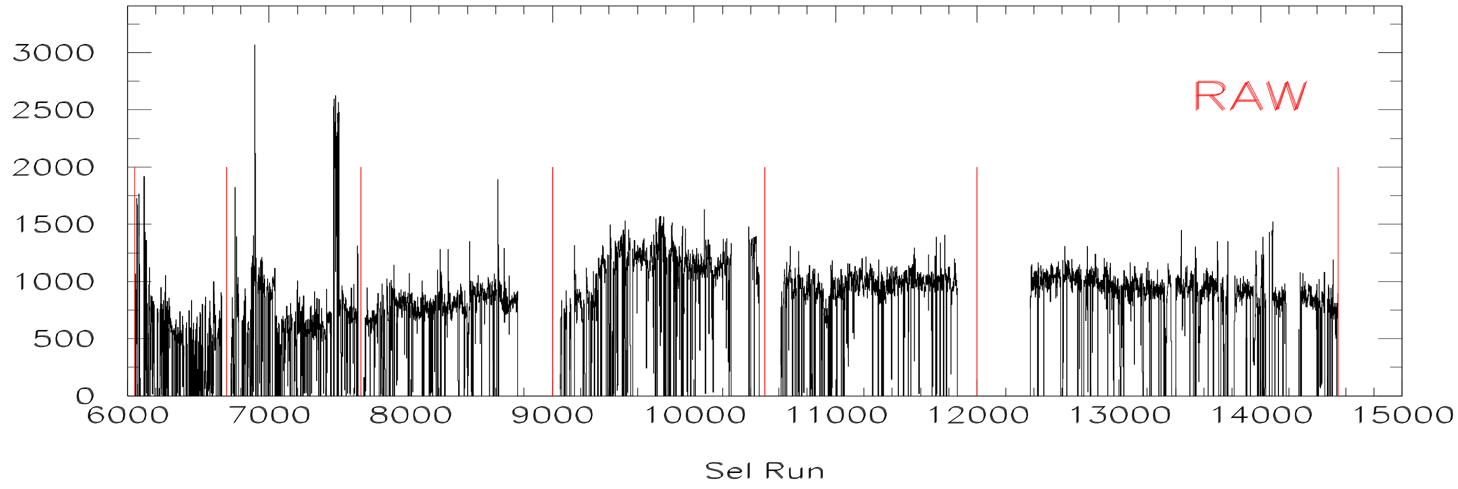
Corr 2

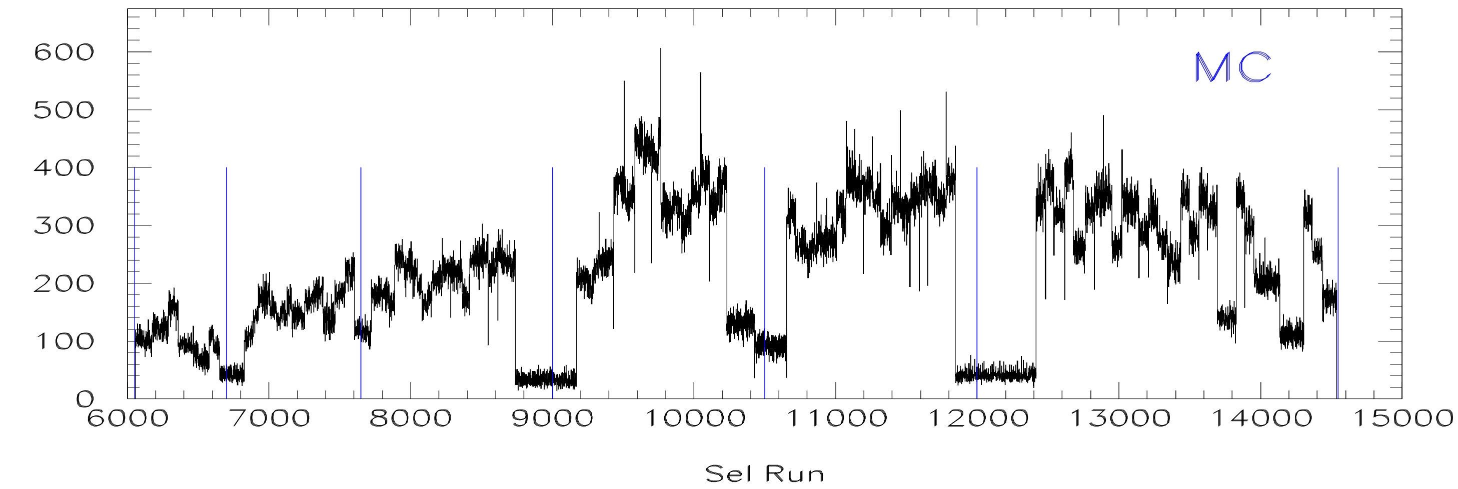
$M\gamma\gamma$ and σ_{π^0} as a function of Opening Angle for MC and RAW Data



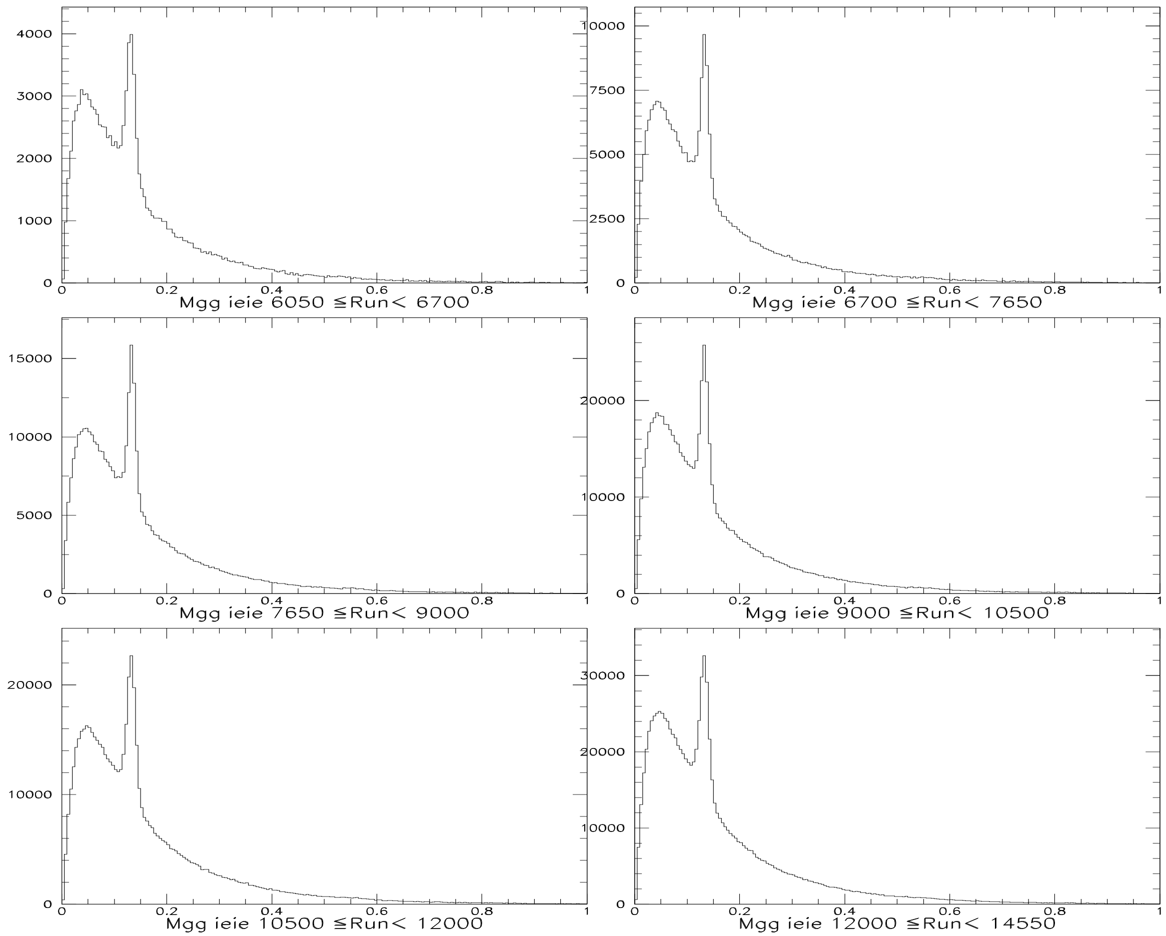
Run Number

- Run Number (6 Periods)



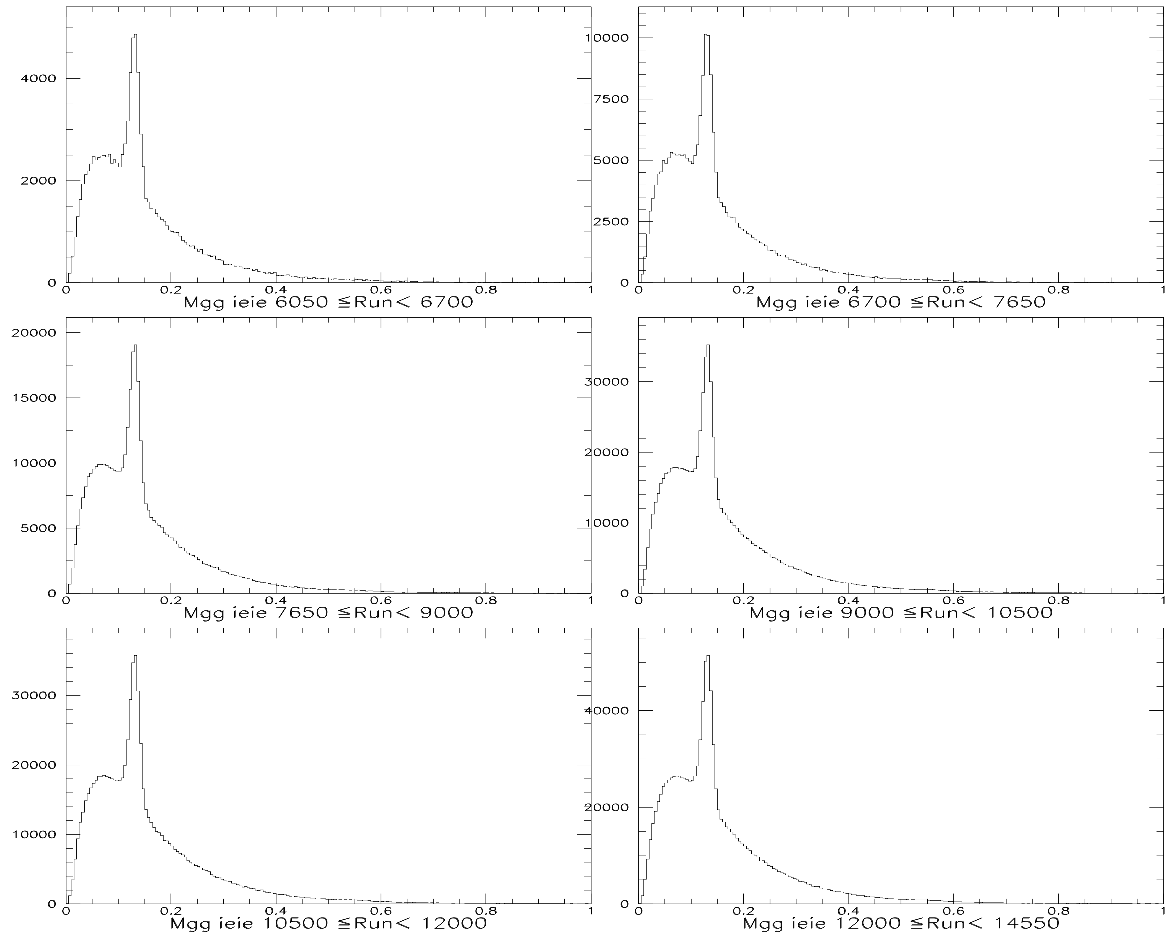


RAW $M_{\gamma\gamma}$ as a Function of Run Number



- (you want to see here how the shape of the background change)

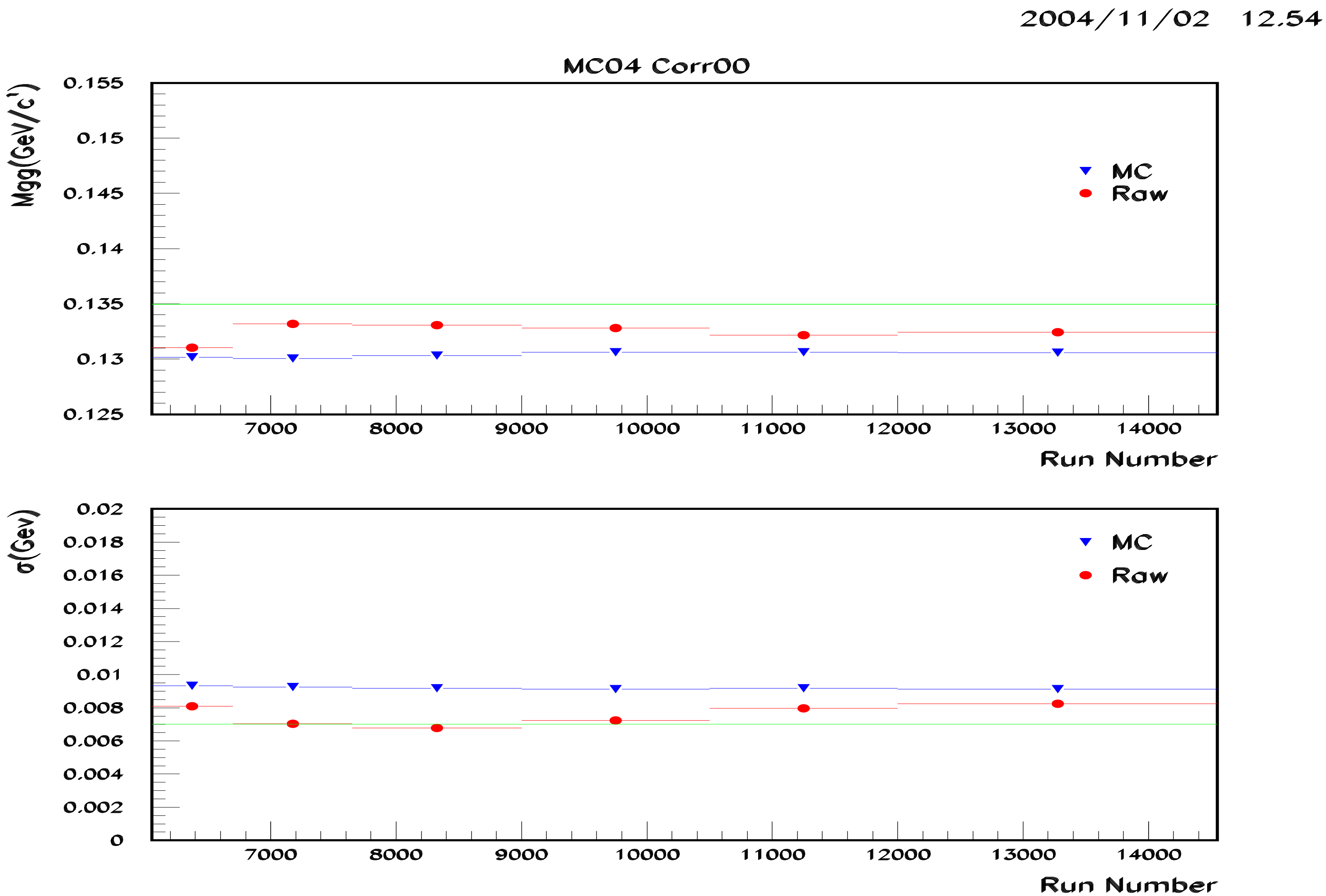
MC $M_{\gamma\gamma}$ as a Function of Run Number



- (you want to see here how the shape of the background change)

Corr 0

$M\gamma\gamma$ and σ_{π^0} as a function of Run Number for MC and RAW Data



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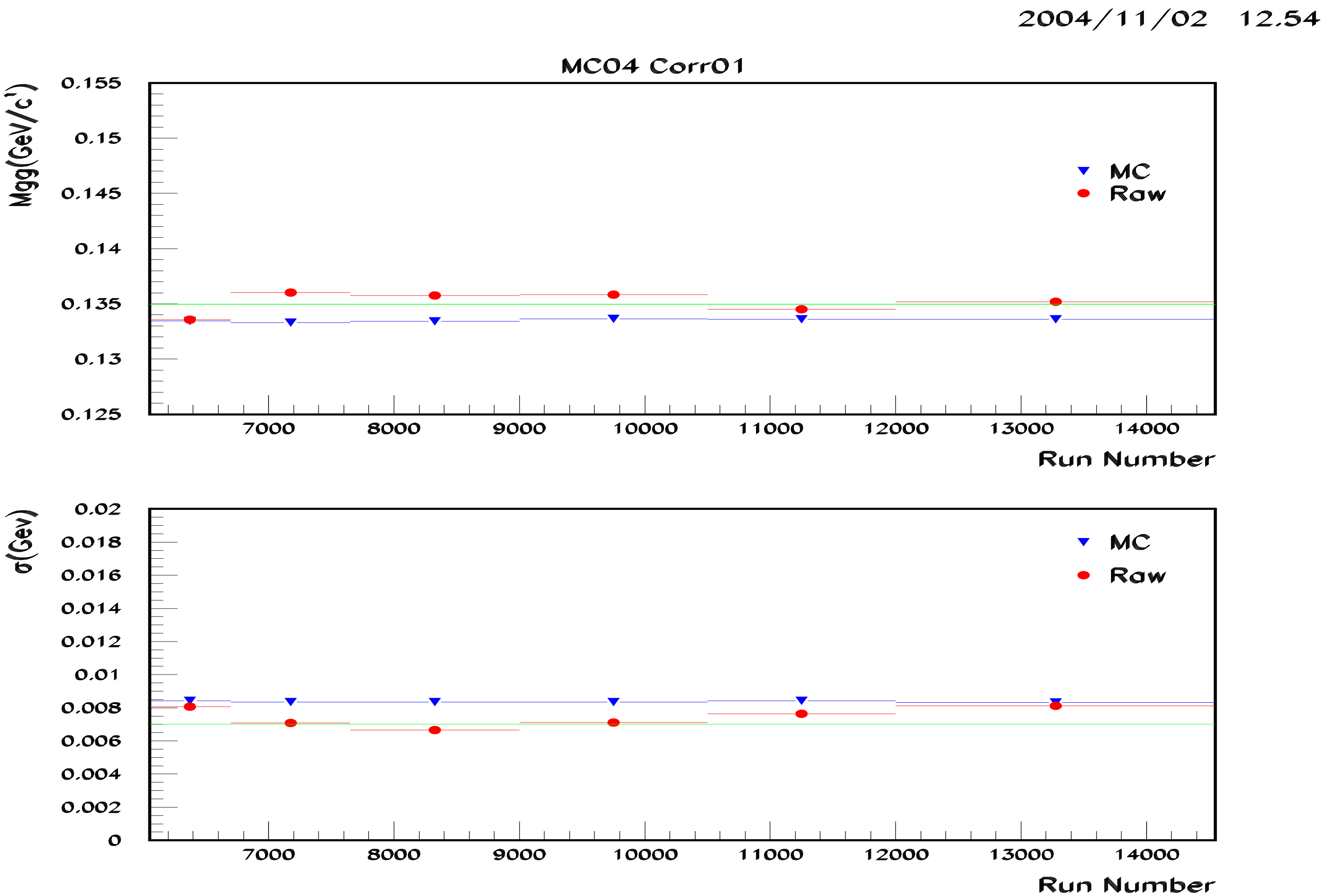
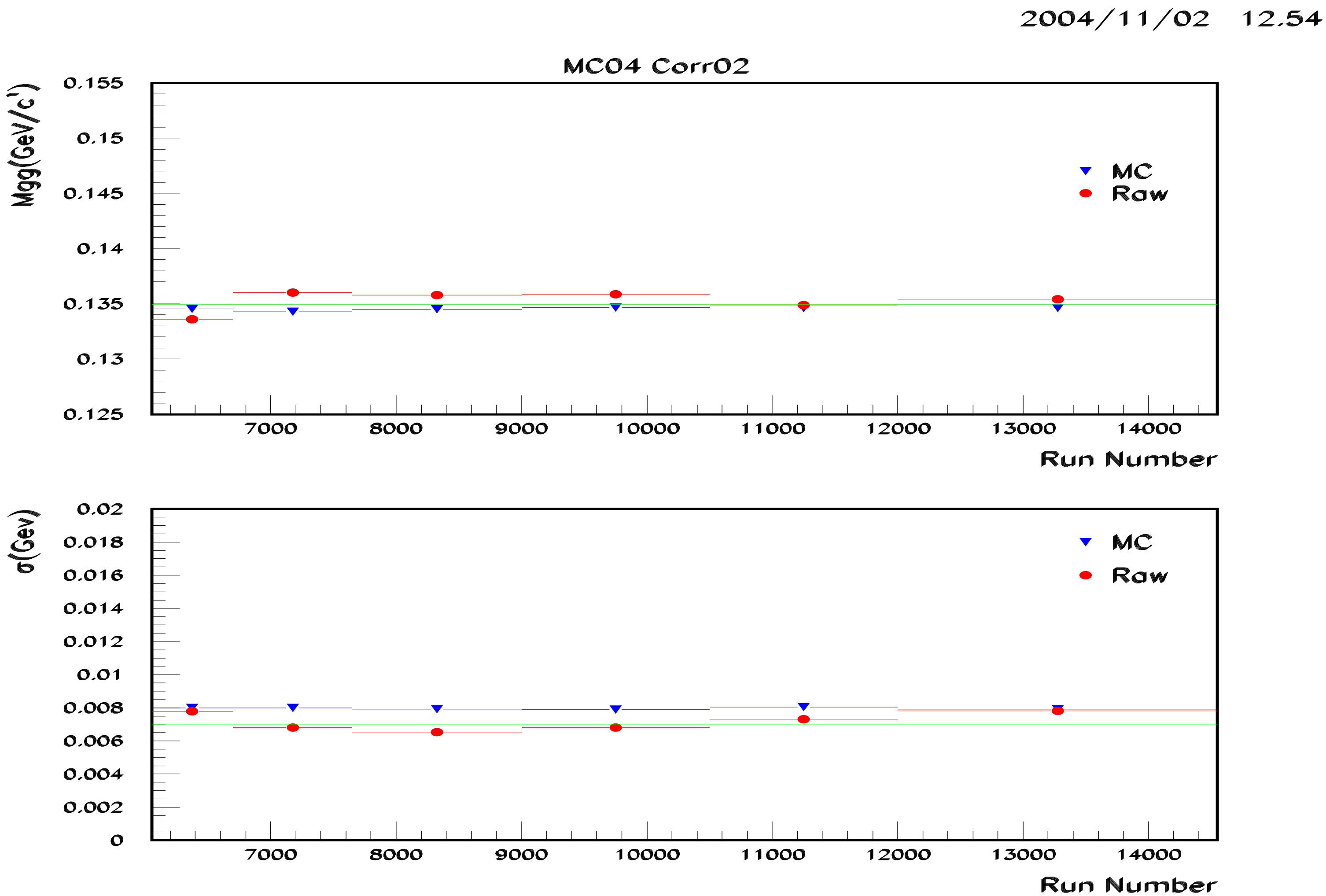
Corr 1

$M\gamma\gamma$ and σ_{π^0} as a function of Run Number for MC and RAW Data



Corr 2

$M\gamma\gamma$ and σ_{π^0} as a function of Run Number for MC and RAW Data



Summary

- ✔ ⋆ π^0's here are very Stable and MC match the RAW Data
- ✔ ⋆ $M_{\gamma\gamma}$ Distributions for MC and RAW are very similar
- ✔ ⋆ Reconstructed π^0 varies as much as 4% of Nominal Mass
- ✔ ⋆ MC reproduce the RAW Data very well
- ✔ ⋆ Don't know about Low Energy Photon ($\leq$ 1 GeV)
- ✔ ⋆ $E_\gamma \geq 2$ GeV remove small dependence
- ✔ ⋆ Try some Physics Measurements involving π^0 and single photons
- ✔ **Coming soon .....** $D^* \rightarrow D + \pi^0$ / $D + \gamma$

rgb0.5812,0.0665,0.0659 rgb0.2116,0.0104,0.7716 RGB85,66, 200 rgb0,1,0 rgb1,1,0 RGB 250,250,210 RGB 224,255,255 RGB 255,240,245 RGB 253,245,230 RGB 240, 240, 240 RGB 179, 179, 179 RGB 133, 133, 133 RGB 139, 102, 139 RGB 205, 50 , 120 RGB 255, 255, 224 RGB 240, 255, 255 RGB 224, 238, 238 RGB 255, 240, 245 RGB 255, 248, 220 RGB 255, 245, 238 RGB 153, 50 ,204 RGB 255, 250, 250 RGB 245, 245, 220 RGB 46 , 139, 87 RGB 95 , 158, 160 RGB 255, 245, 238 RGB 255, 255, 240 RGB 255, 250, 205 RGB 255, 255, 240 RGB 250, 240, 230 RGB 248, 248, 255 RGB 173, 255, 47

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