

# *In-situ JES validation with photon+jet events*

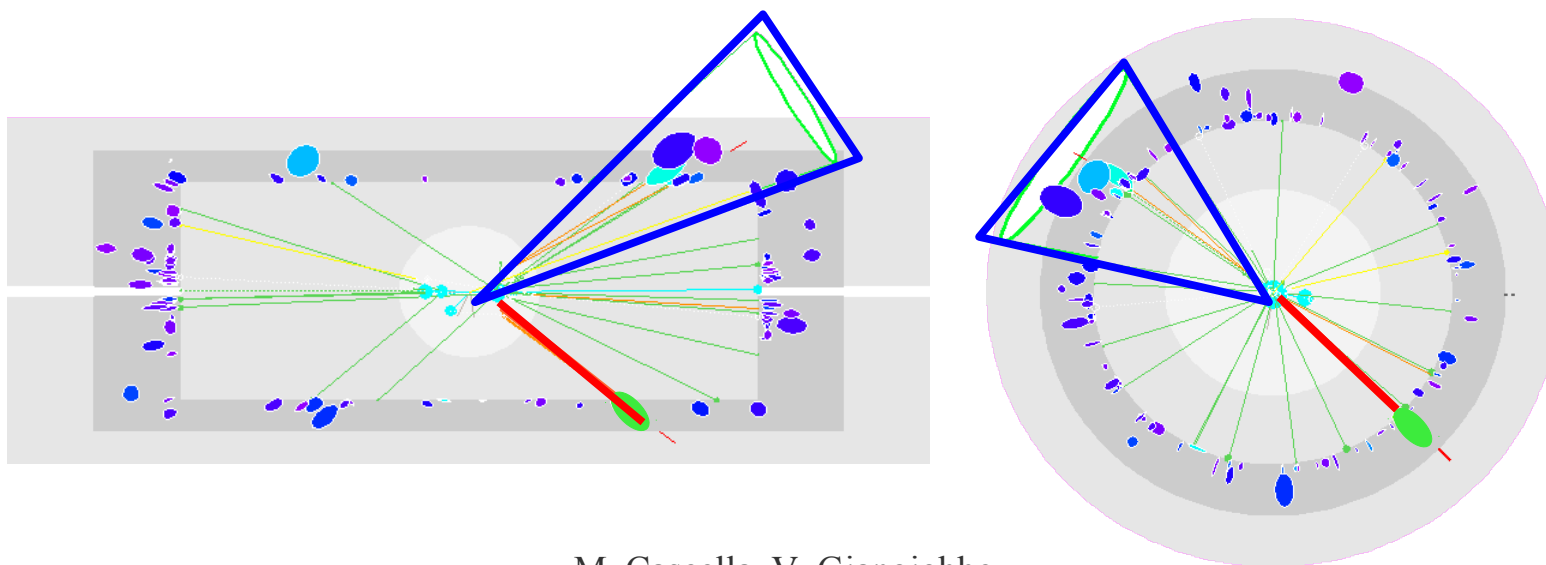
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# Introduction

- Events with one prompt photon and (at least) one jet
- Use the balancing in the transverse plane to check the Jet Energy calibration



# *The $E'$ method*

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■  $E' = E_T^\gamma \cosh(\eta^{\text{jet}})$

■ Using  $E'$  to estimate the jet energy

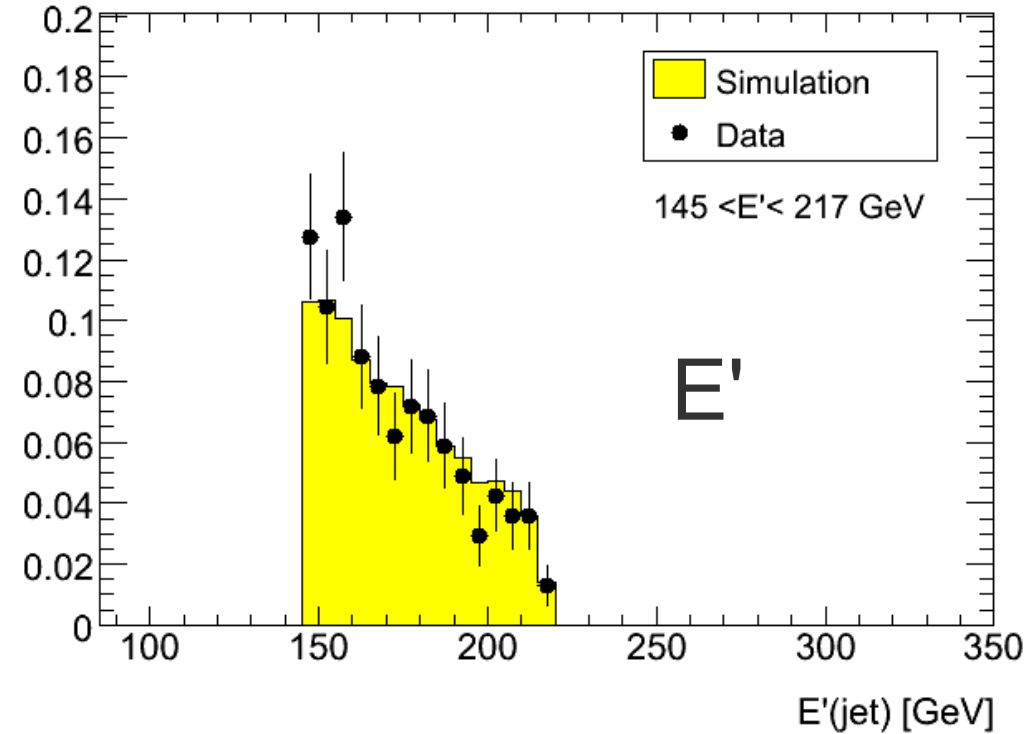
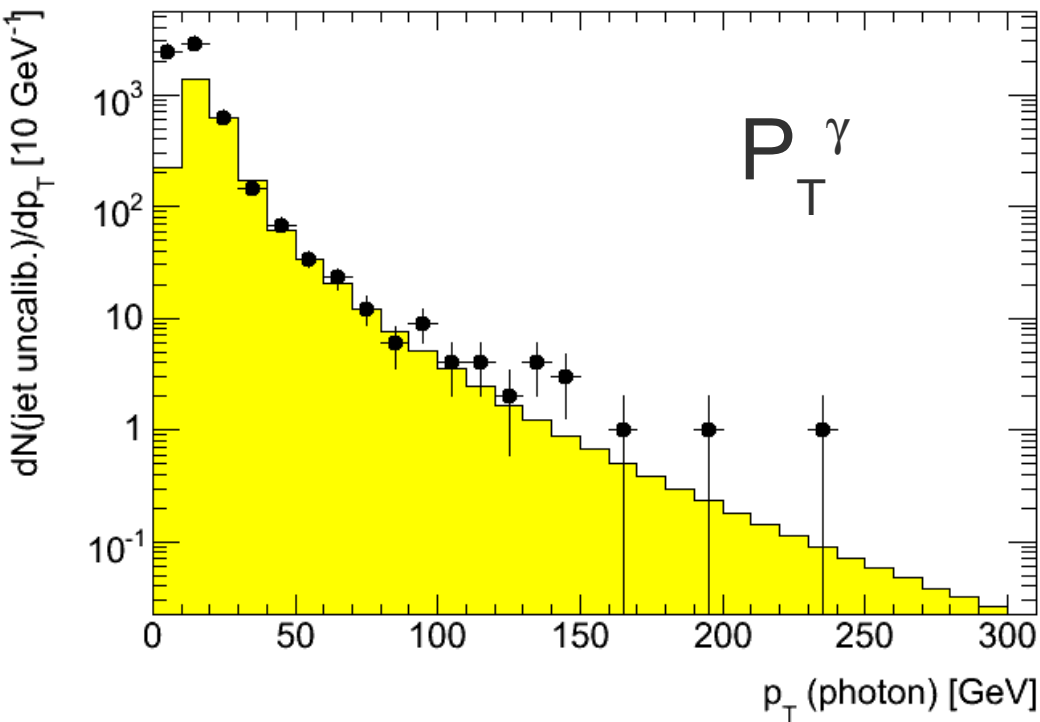
■  $R = E^{\text{jet}} / E'$

■ We compute both  $\langle R \rangle$  and  $\langle E^{\text{jet}} \rangle$  in bins of  $E'$

# *Experimental data*

- Periods A to E ( $L = 1 \text{ pb}^{-1}$ )
- GRL: the one provided for QCD analysis (CONF notes)
- Event selection
  - Event cleaning ( $nV\text{tracks} > 4$ )
  - L1 trigger: EM14
  - one good photon (TightIso), at least one central good jet (IsGood,  $|\eta| < 2.8$ )
  - jet and photon back-to-back ( $|\Delta\phi - \pi| < 0.2$ )
  - no 2<sup>nd</sup> jet ( $P_{\text{T}}^{2\text{nd}} < 10\% P_{\text{T}}^{1\text{st}}$ )

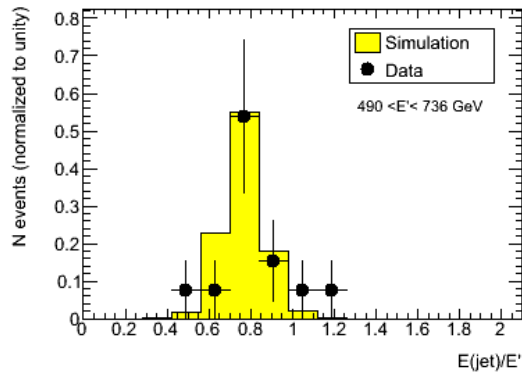
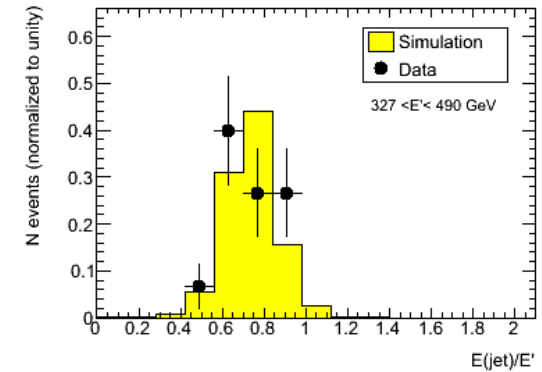
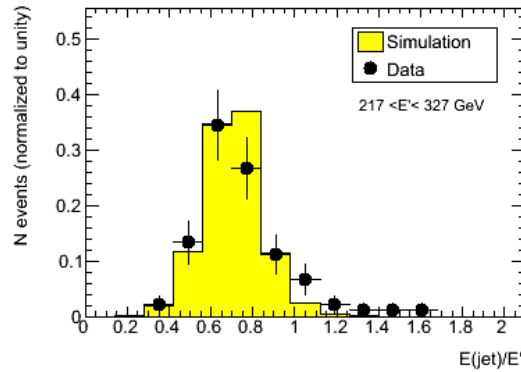
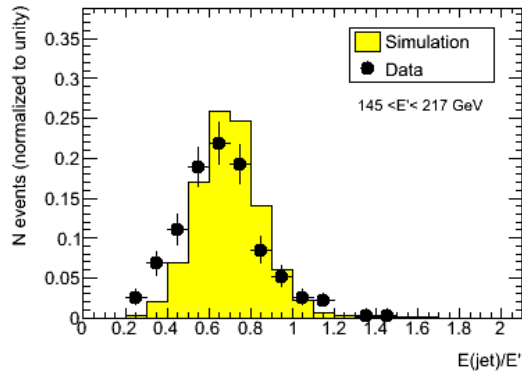
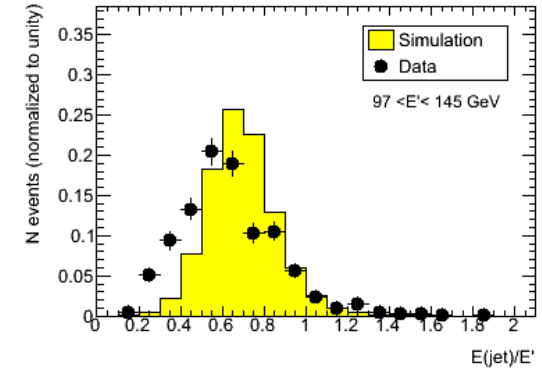
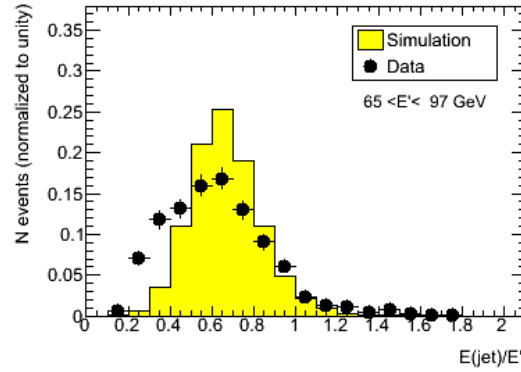
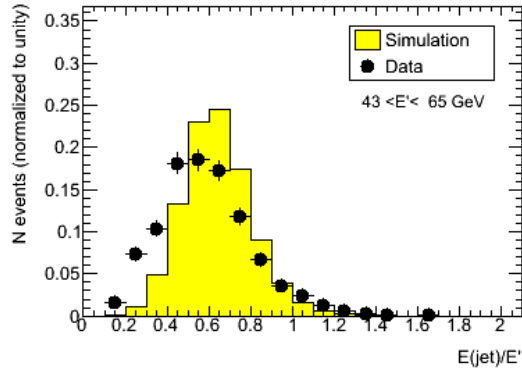
# Comparison with data: $P_T^\gamma$ , $E'$



$0 < \eta < 2.8$

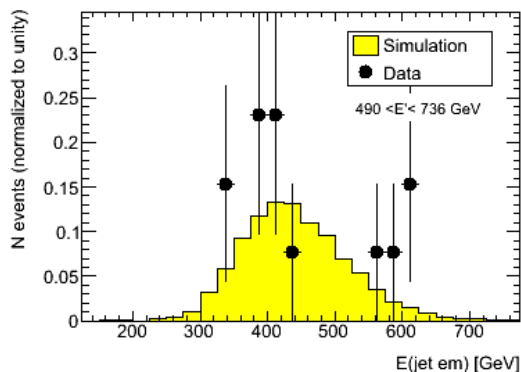
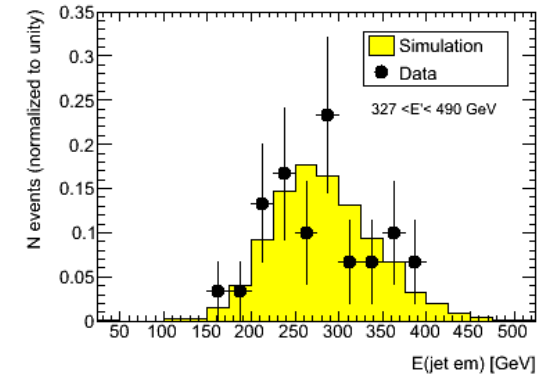
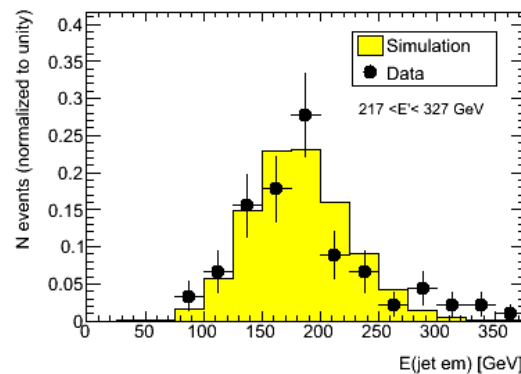
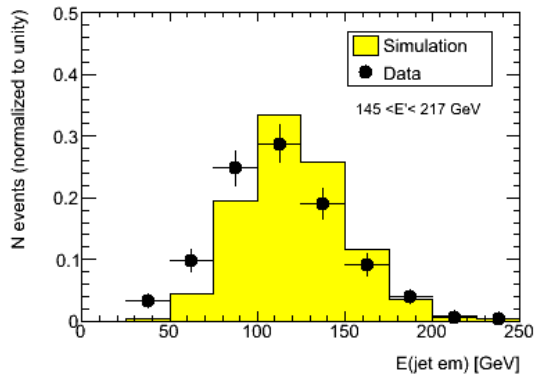
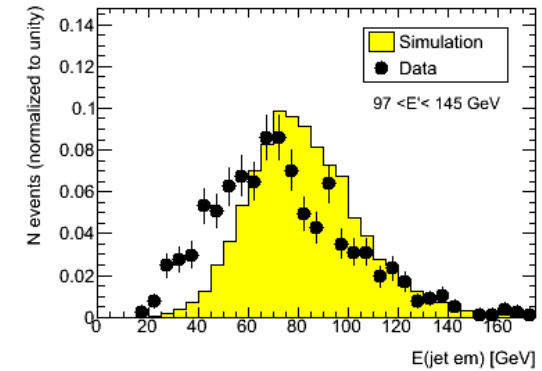
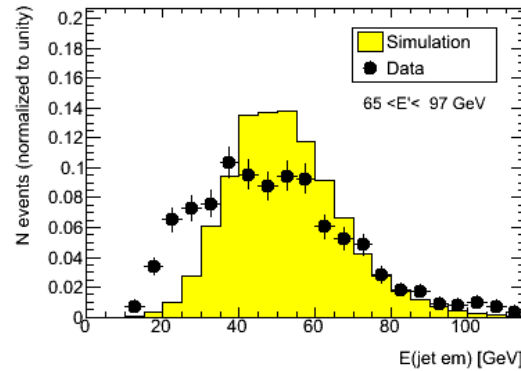
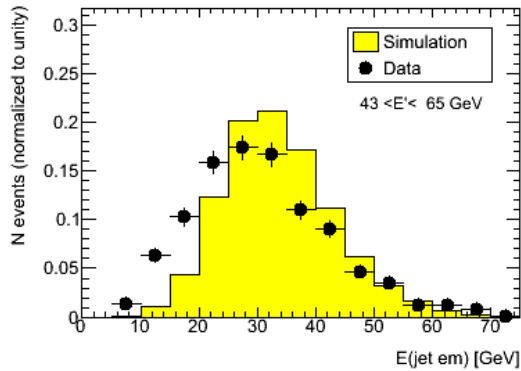
$E'$  spectrum still preliminary

# Comparison with data (EM scale)



R in bins of  $E'$

# Comparison with data (EM scale)

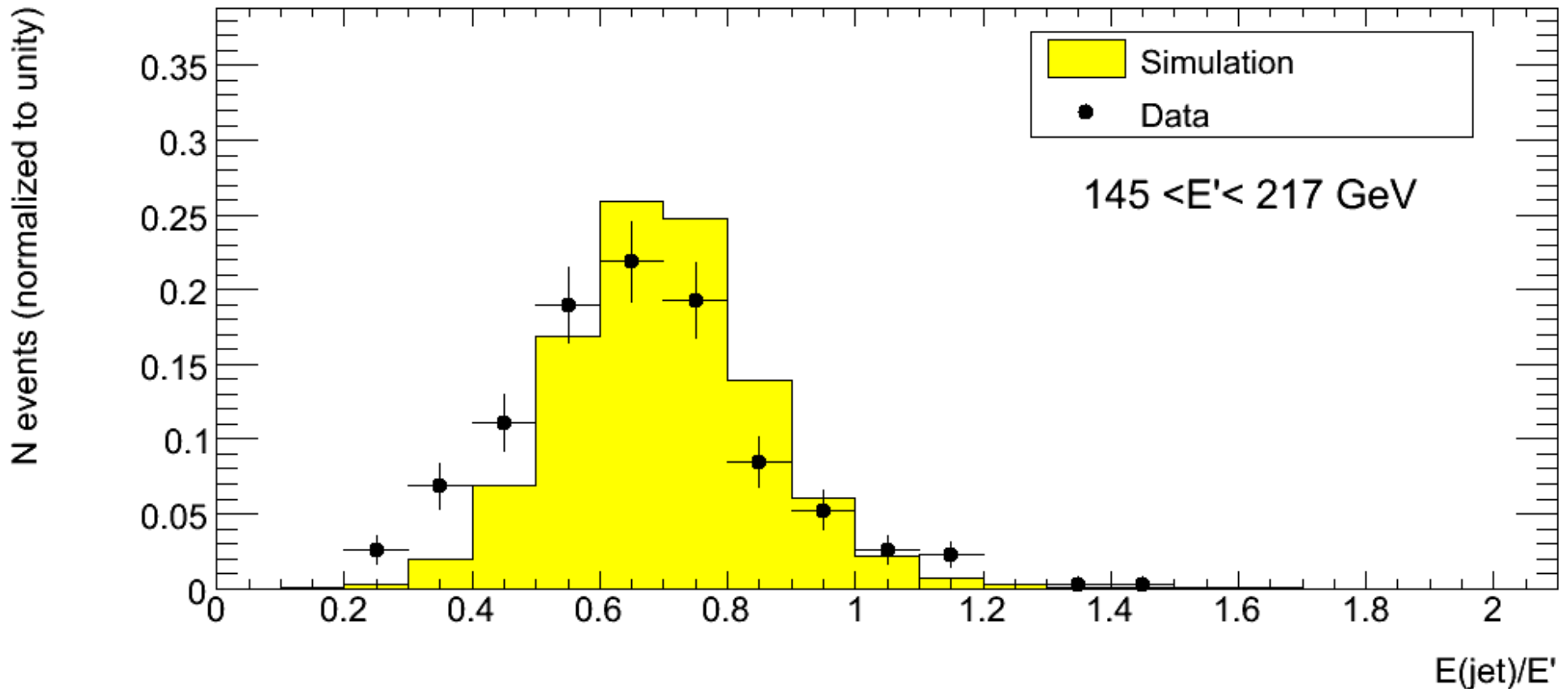


$E_{jet}$  in bins of  $E'$

NB

if  $E' < 140$  GeV MC suffer from a generation cut

# Comparison with data (EM scale)

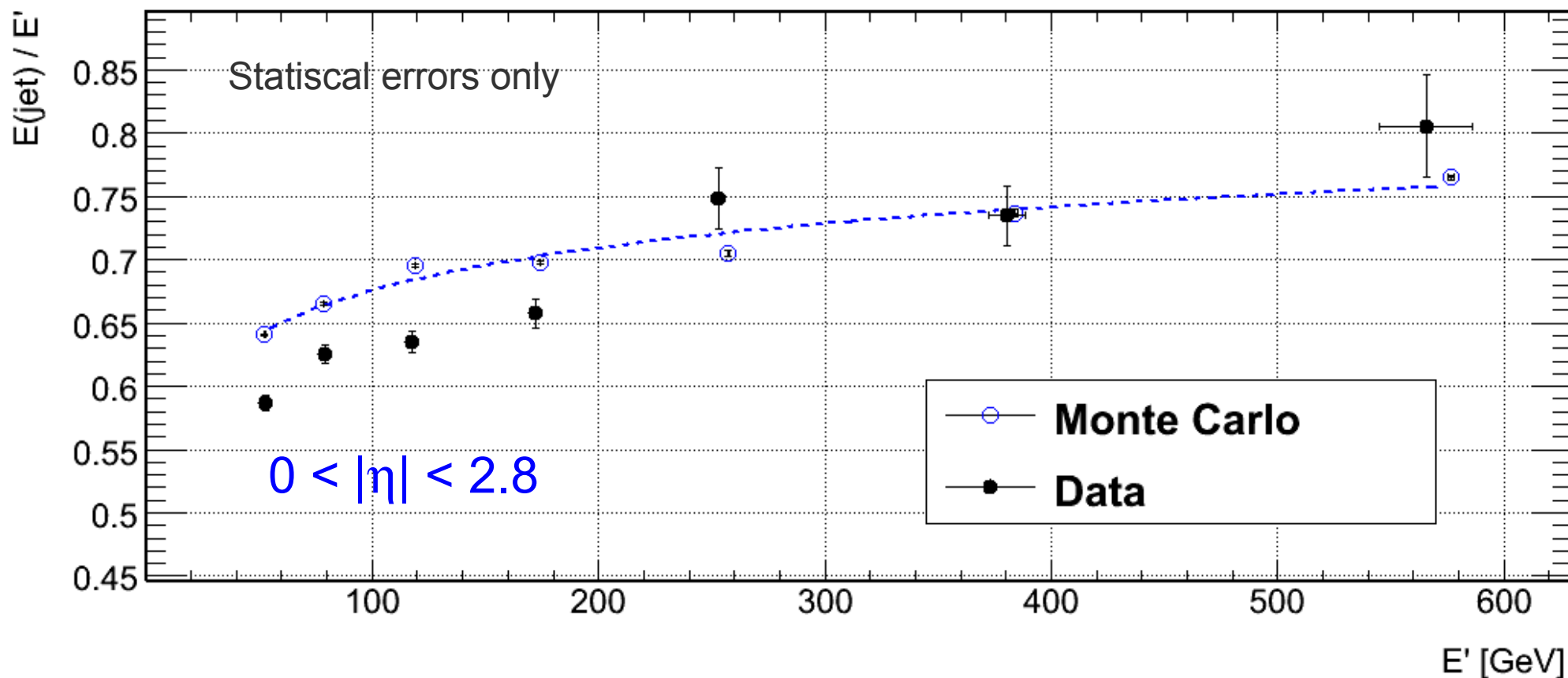


## Photon jet balancing

- $0 < |\eta| < 2.8$ ; Em scale

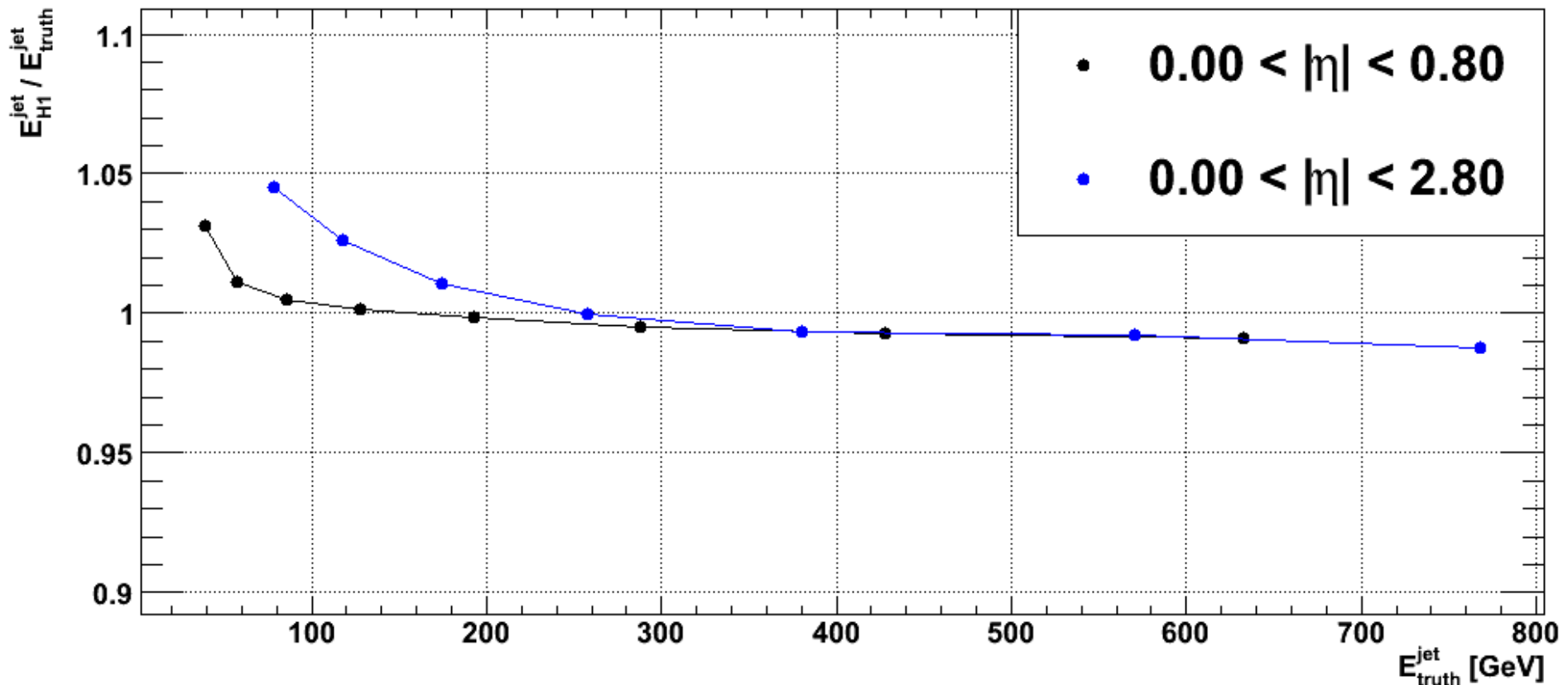


# Jets at EM scale



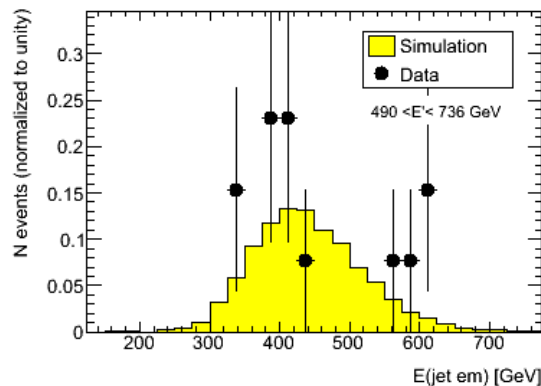
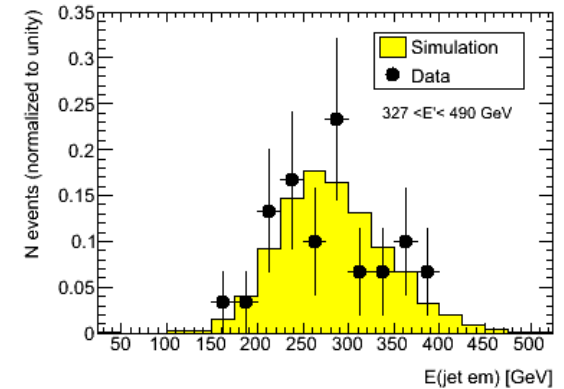
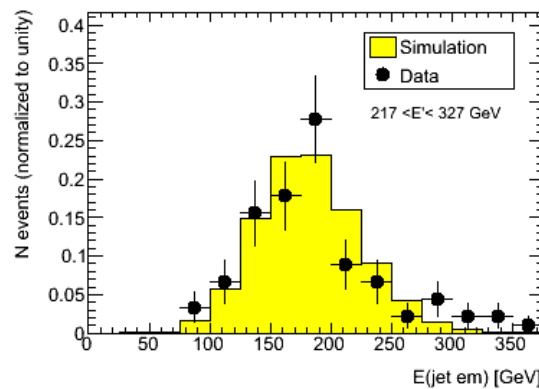
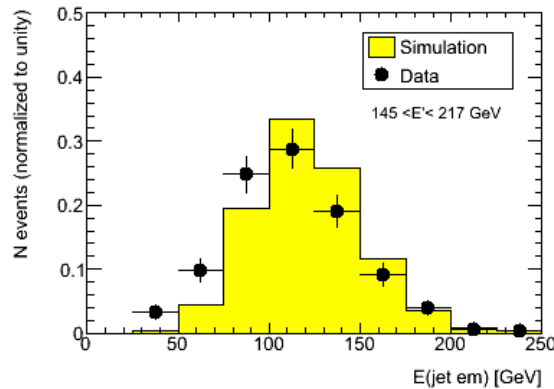
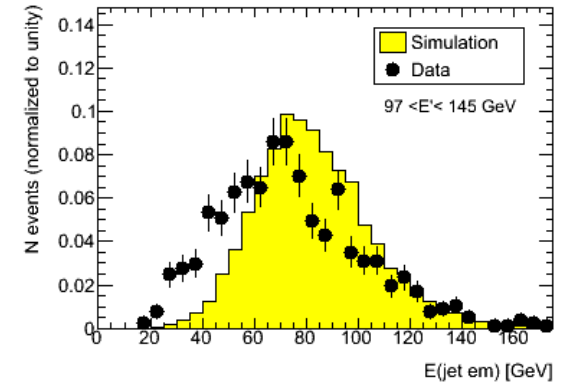
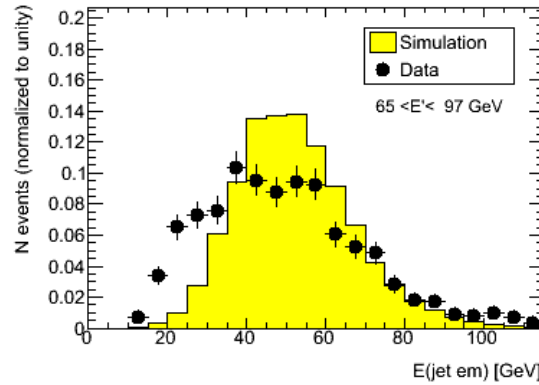
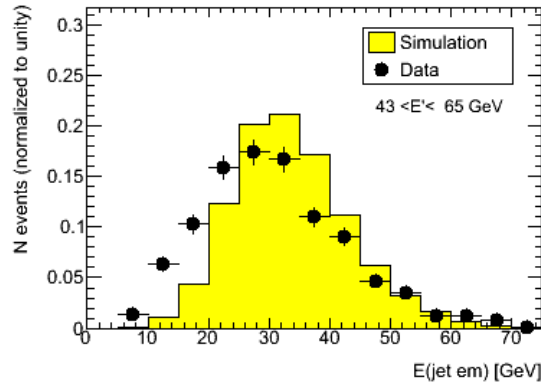
This is a data driven measurement of the calorimeter response to jets

# The global calibration on $\gamma$ +jet events



On  $\gamma$ +jet events the global weight calibration has a small bias

# Comparison with data (global calibration)

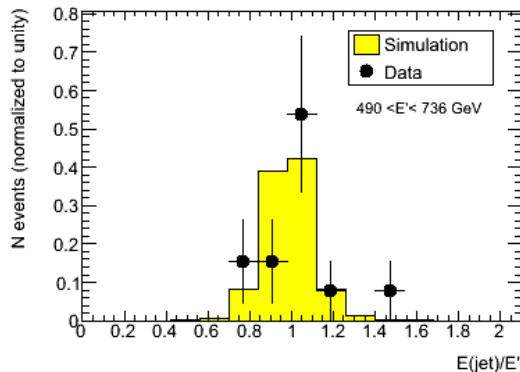
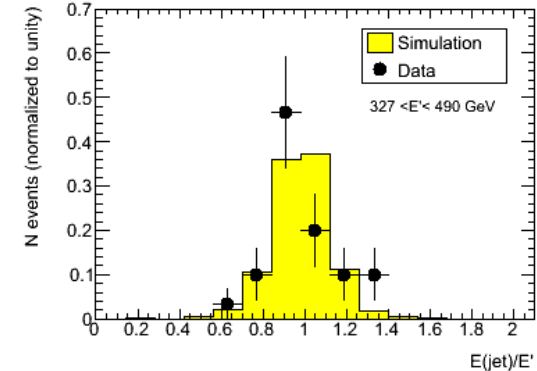
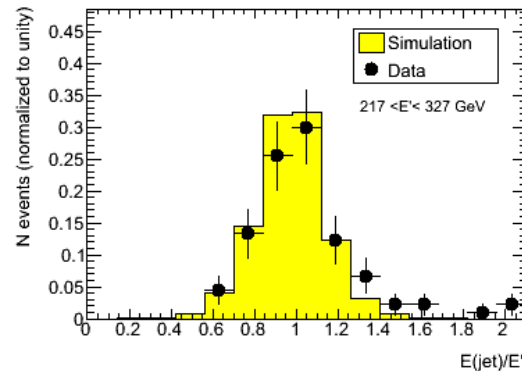
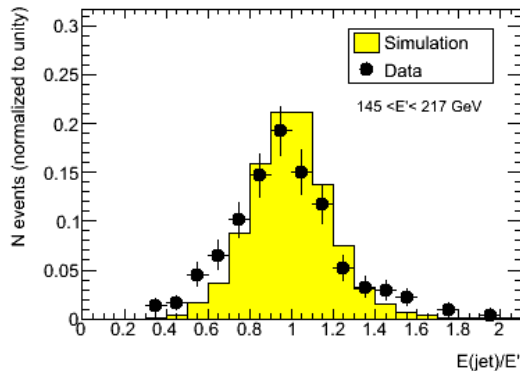
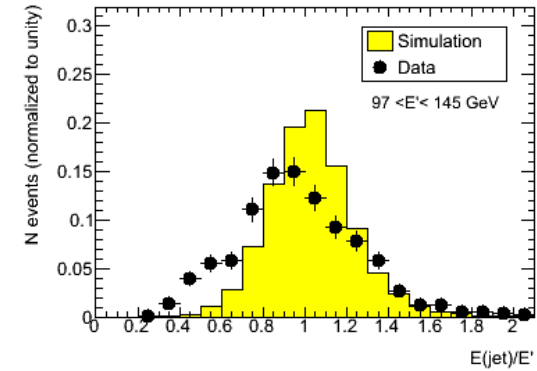
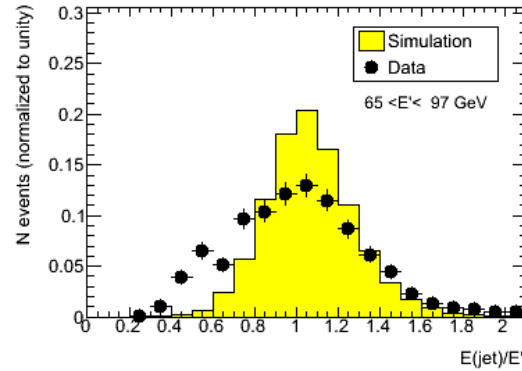
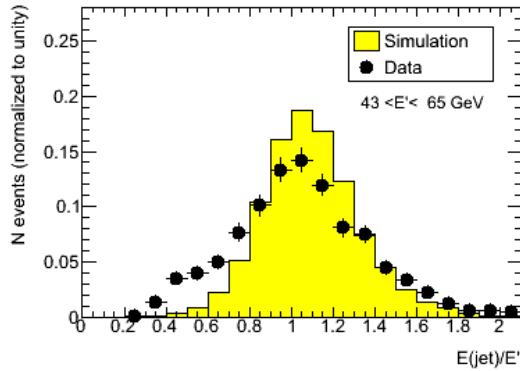


$E_{jet}$  in bins of  $E'$

NB

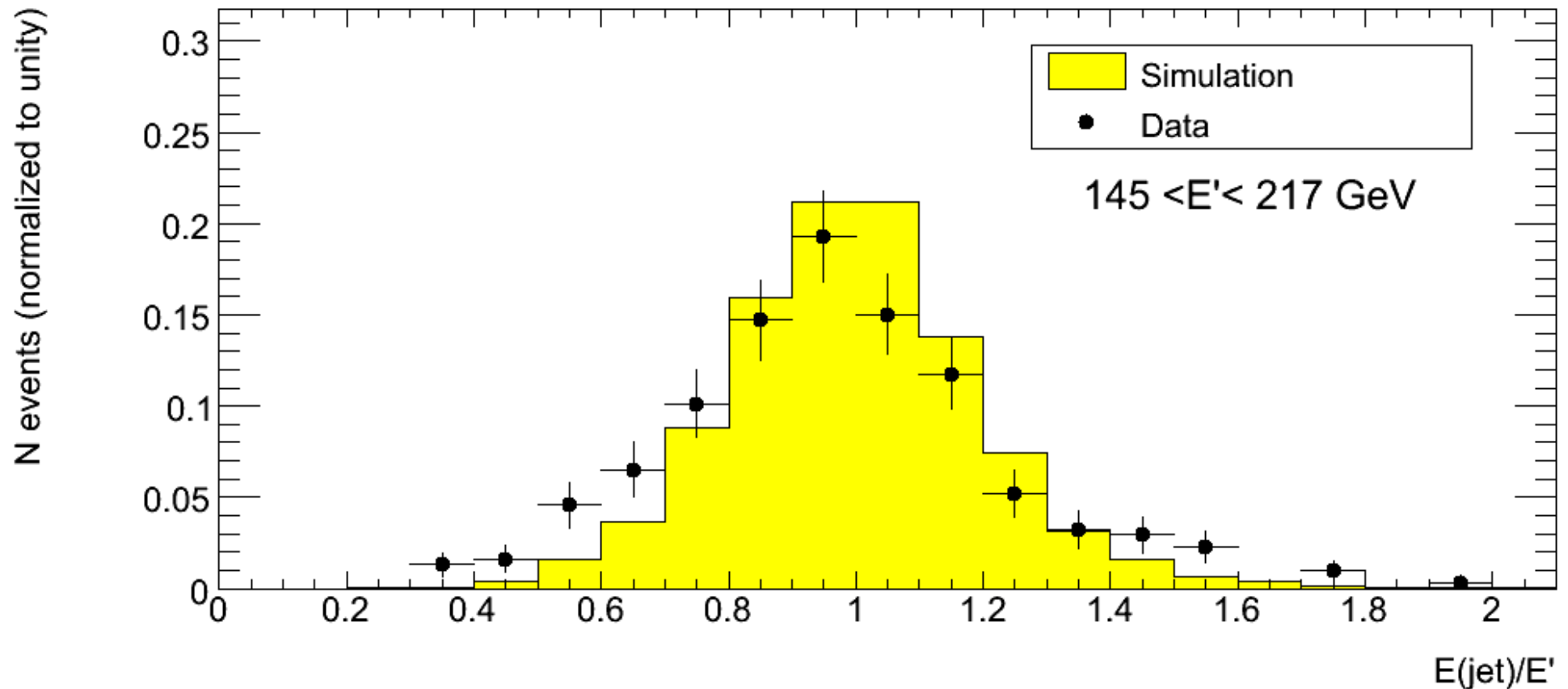
if  $E' < 140$  GeV MC suffer from a generation cut

# Comparison with data (global calibration)



R in bins of  $E'$

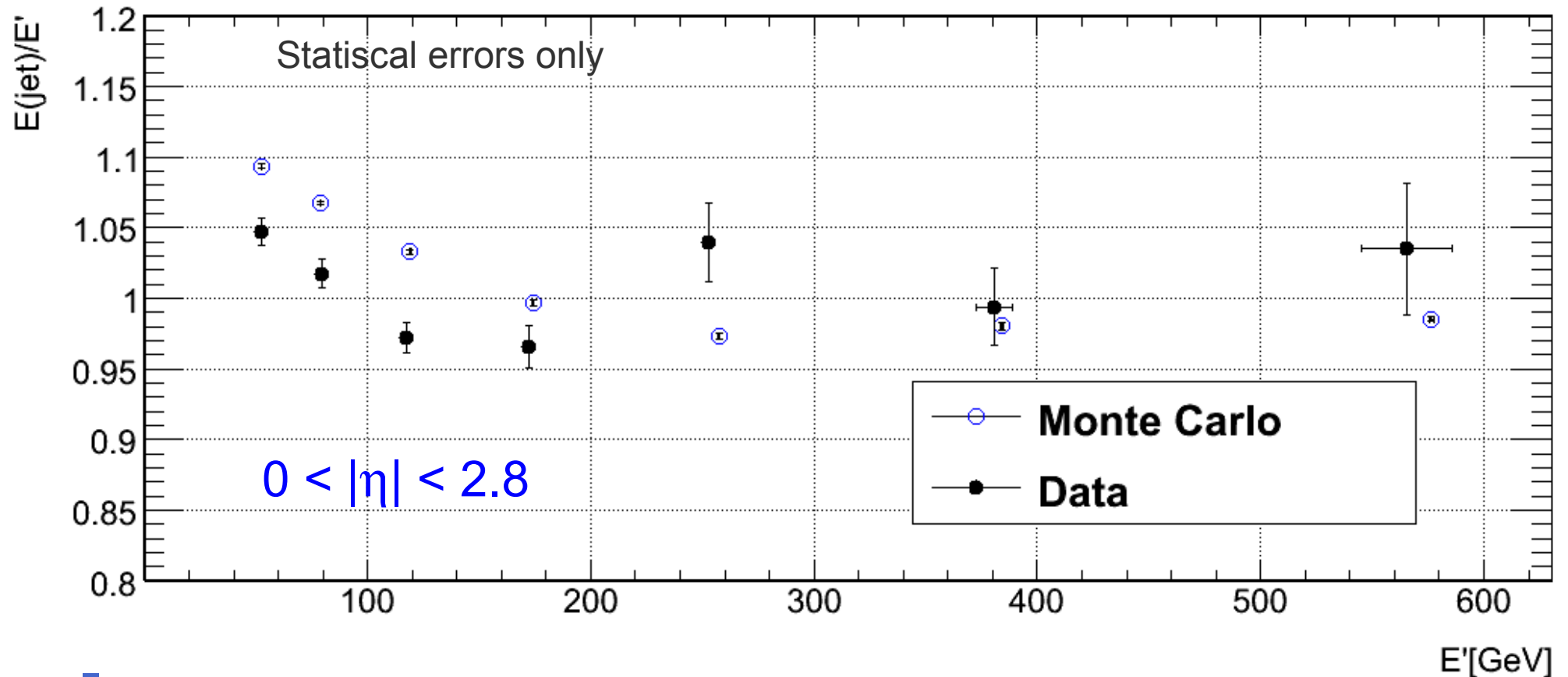
# Comparison with the data (H1)



## Photon jet balancing

- $0 < |\eta| < 2.8$ ; H1 applied

# *Jets calibrated with H1*



Comparison of the  $\gamma$  - jet balancing for data and Monte Carlo (H1)

■  $\gamma$ +jet balancing as a tool to cross check jet energy scale

■ Work in progress

- Short term: consistent cuts between MC and data, more data/MC comparison, better understanding
- Long term: JES uncertainty, errors and systematics, effect of background

■ Hadron Calibration Workshop

***The End***

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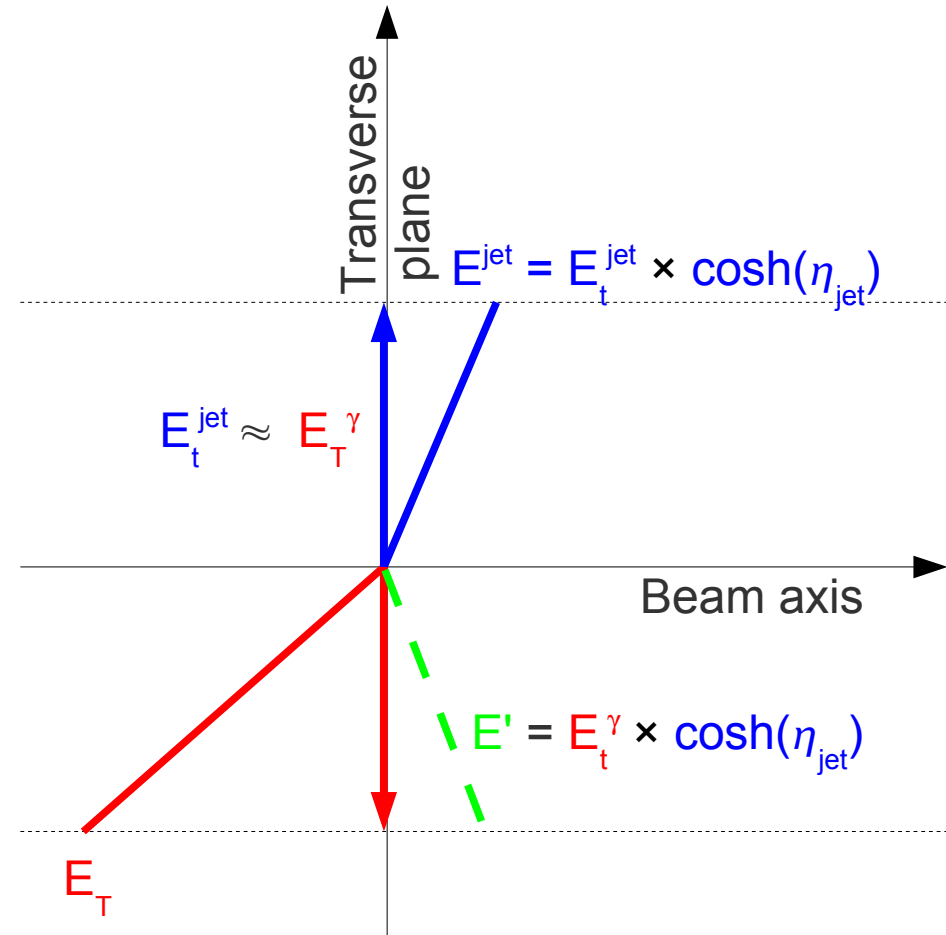


# Definition of $E'$

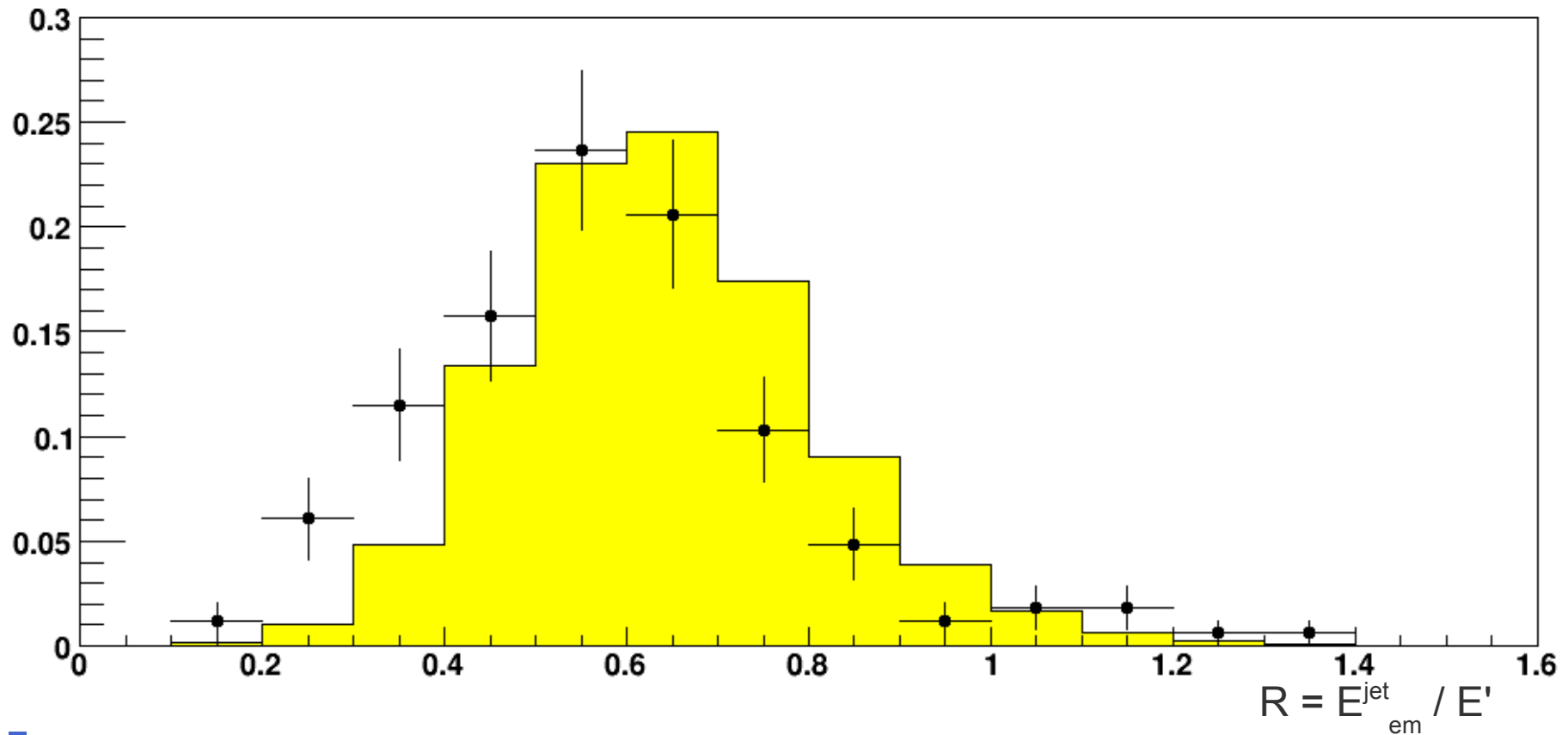
Best estimate of the jet energy given by the photon:

$$E' = E_T^\gamma \cos(\eta_t^{je})$$

On average  $E_T^\gamma = E_T^{jet}$  and  $\eta_t^{jet}$  is measured well



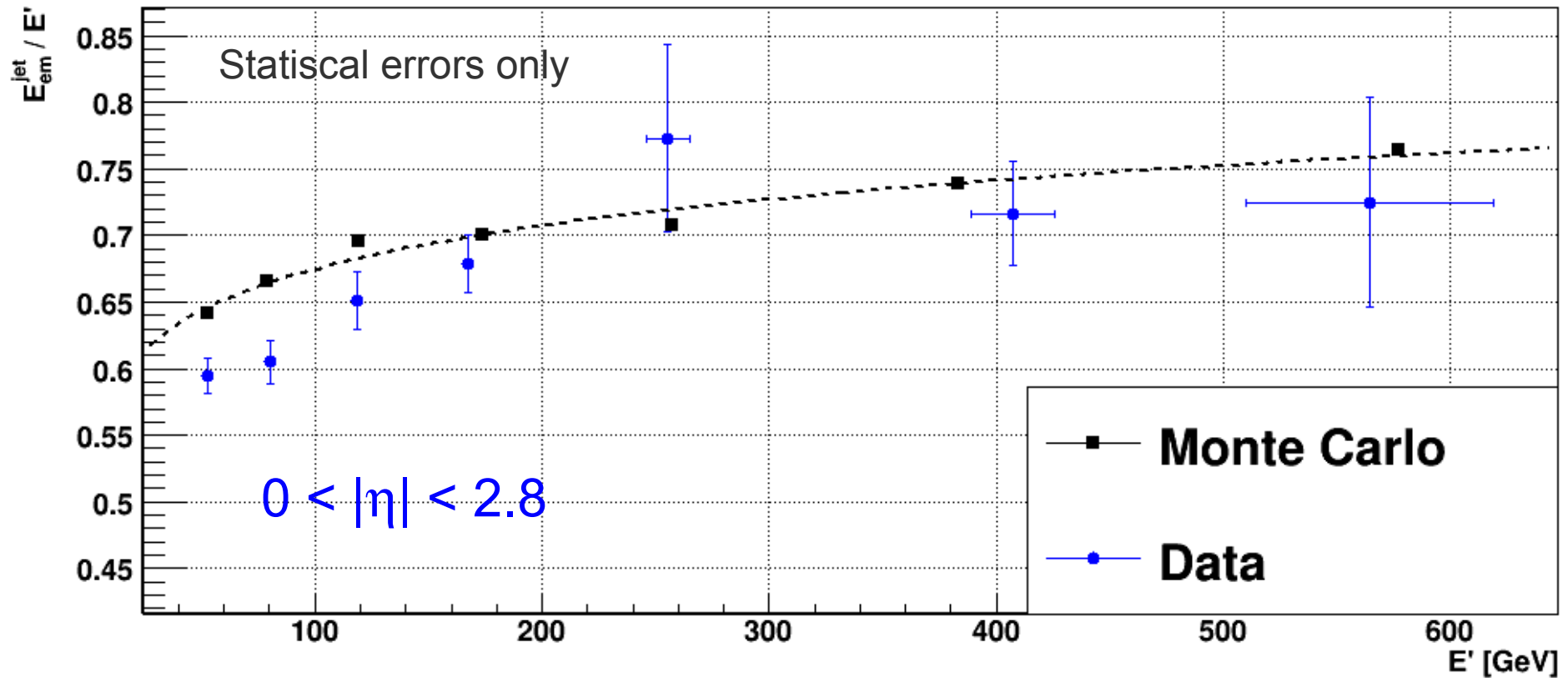
# Comparison with the data (EM scale)



## Photon jet balancing

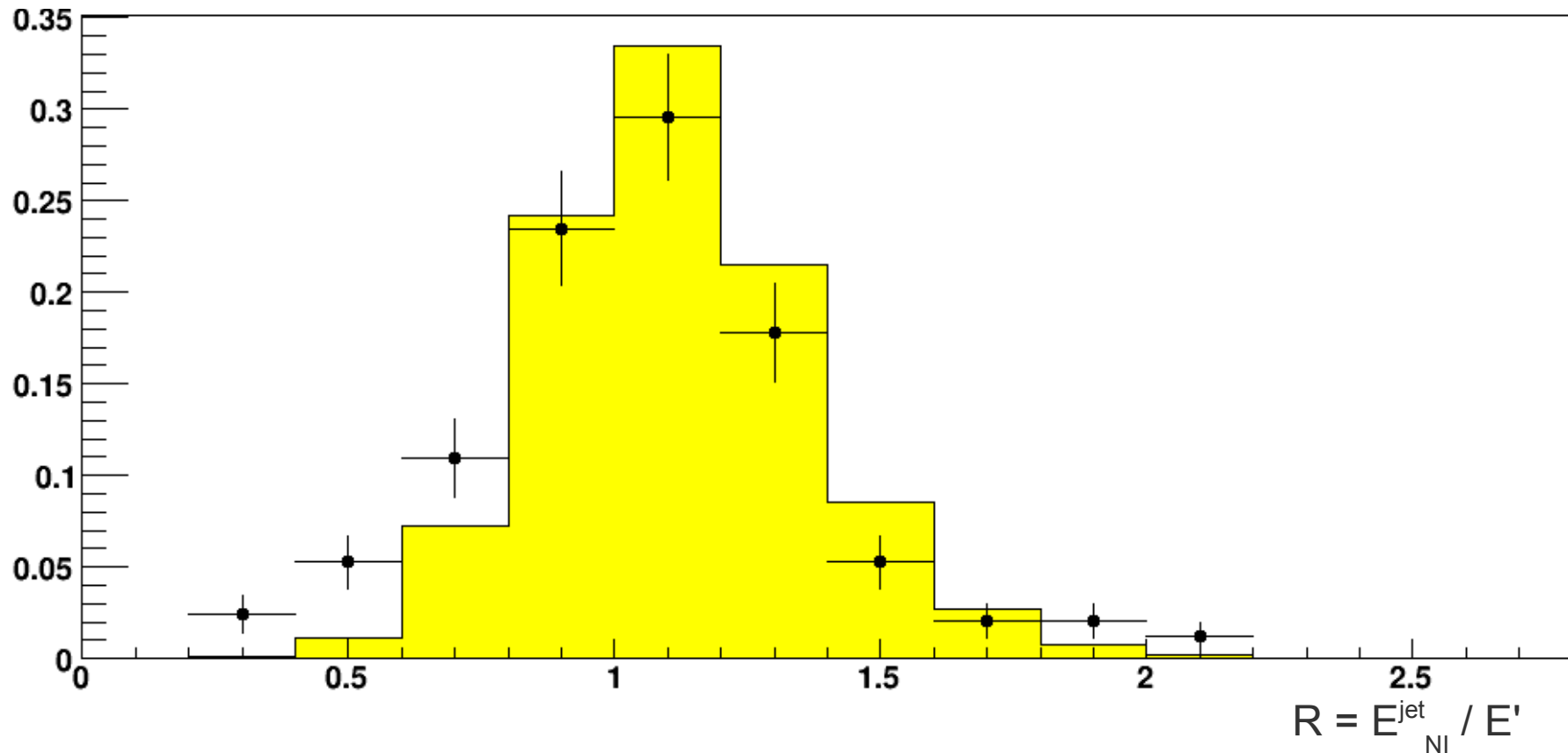
- $20 < E' < 30$  GeV;  $0 < |\eta| < 2.8$ ; Em scale

# Jets at EM scale



This is a data driven measurement of the calorimeter response to jets

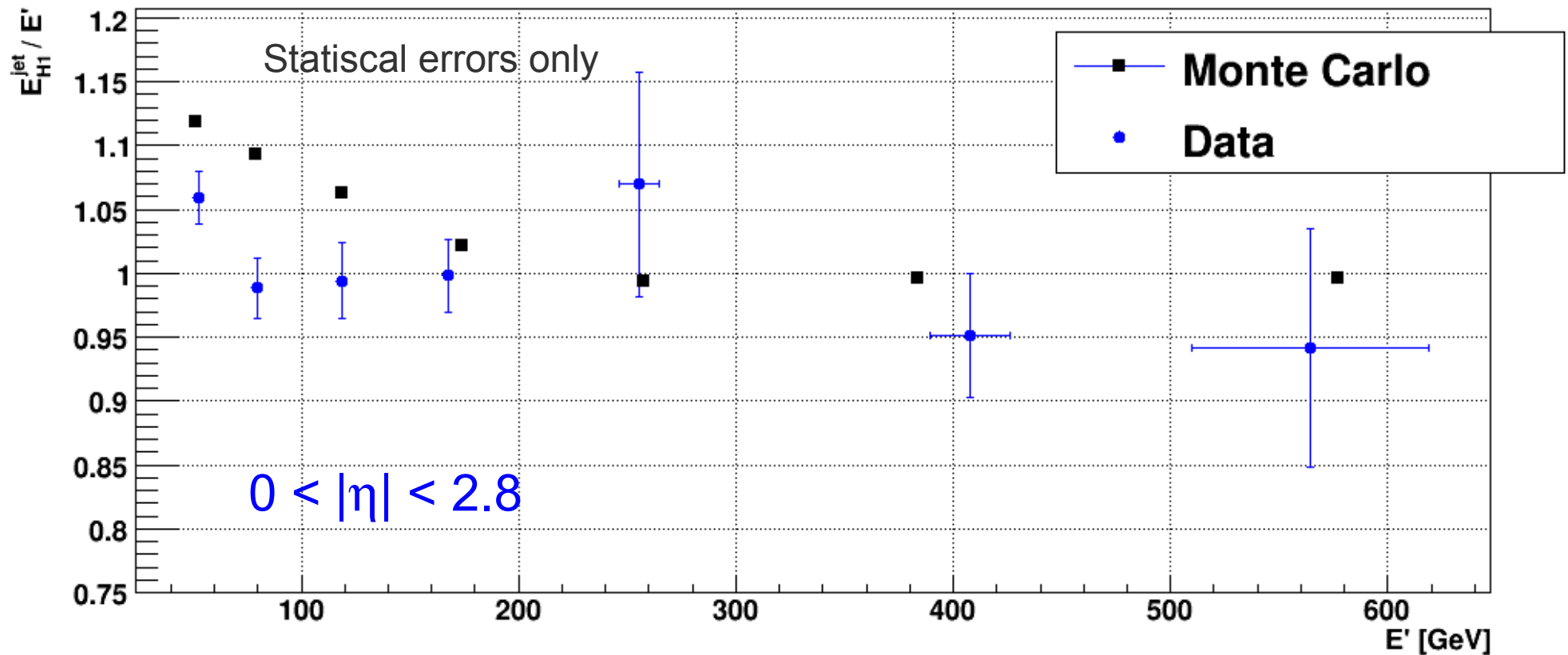
# Comparison with the data (Numerical Inversion)



## Photon jet balancing

- $20 < E' < 30$  GeV;  $0 < |\eta| < 2.8$ ; NI applied

# *Jets calibrated with NI*



Comparison of the  $\gamma$  - jet balancing for data and Monte Carlo (Numerical Inversion)

# Expected statistics

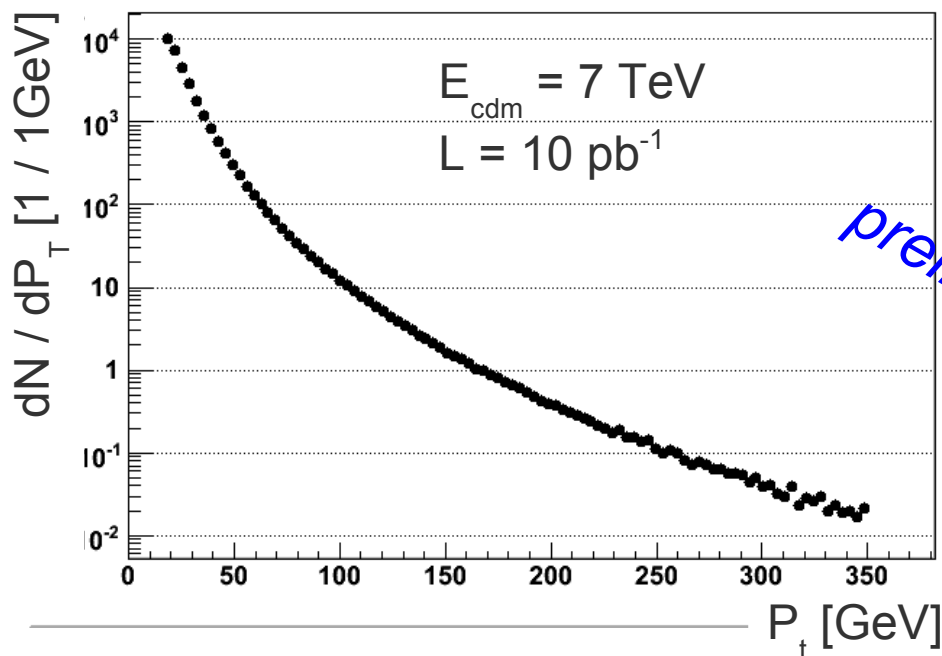
pT(photon) [GeV]	Gamma+Jet Before selection			Gamma+Jet After selection			QCD After selection		
	Count	±	Count	Count	±	Count	Count	±	Count
20 - 50	37023	±	192	1876	±	43	479	±	22
50 -100	3931	±	63	275	±	17	23	±	5
100-200	327	±	18	31	±	6	2.7	±	1.6
200-300	16	±	4.1	1.4	±	1.4	0.09	±	0.31

√s=7 TeV

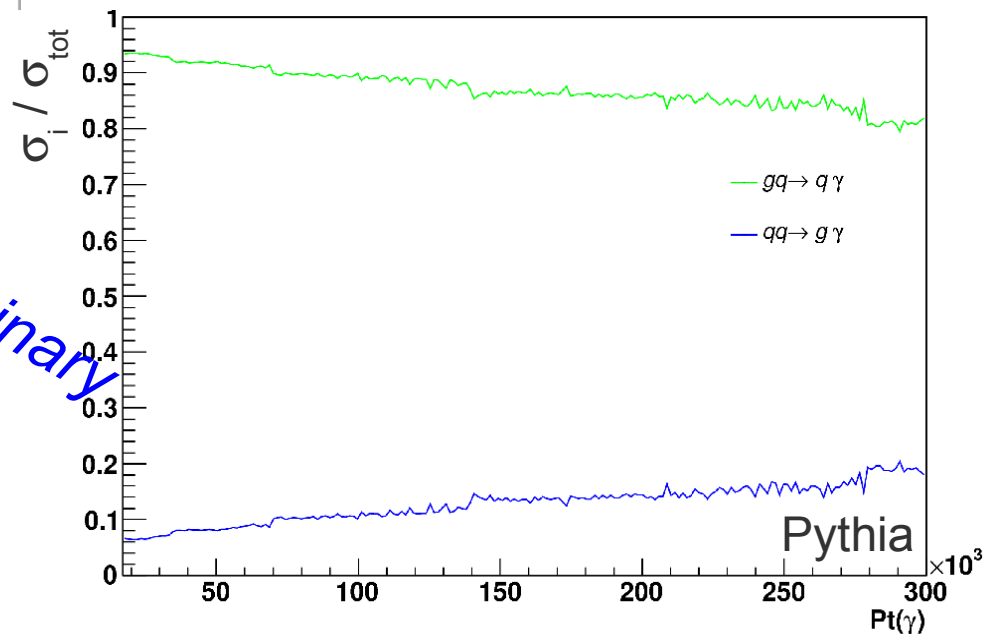
L=1pb<sup>-1</sup>

# The photon cross section

Cross section

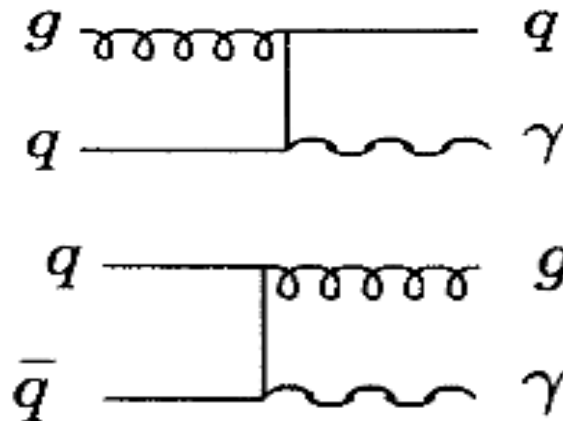


Cross section ratio



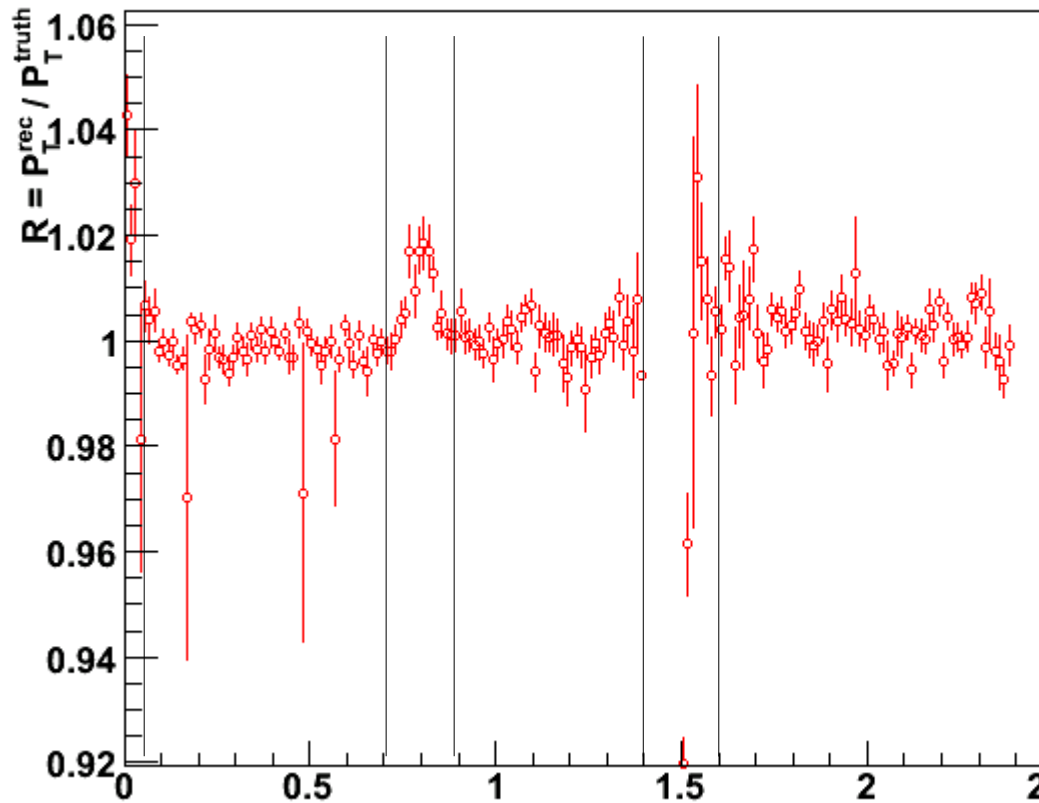
largest cross section after QCD

Dominated by  $qg \rightarrow q\gamma$



# Uniformity of photon response

Response vs.  $\eta$



Photons in gap regions are rejected

