Prompt Photon in PHP Analysis

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ZEUS Analysis Forum
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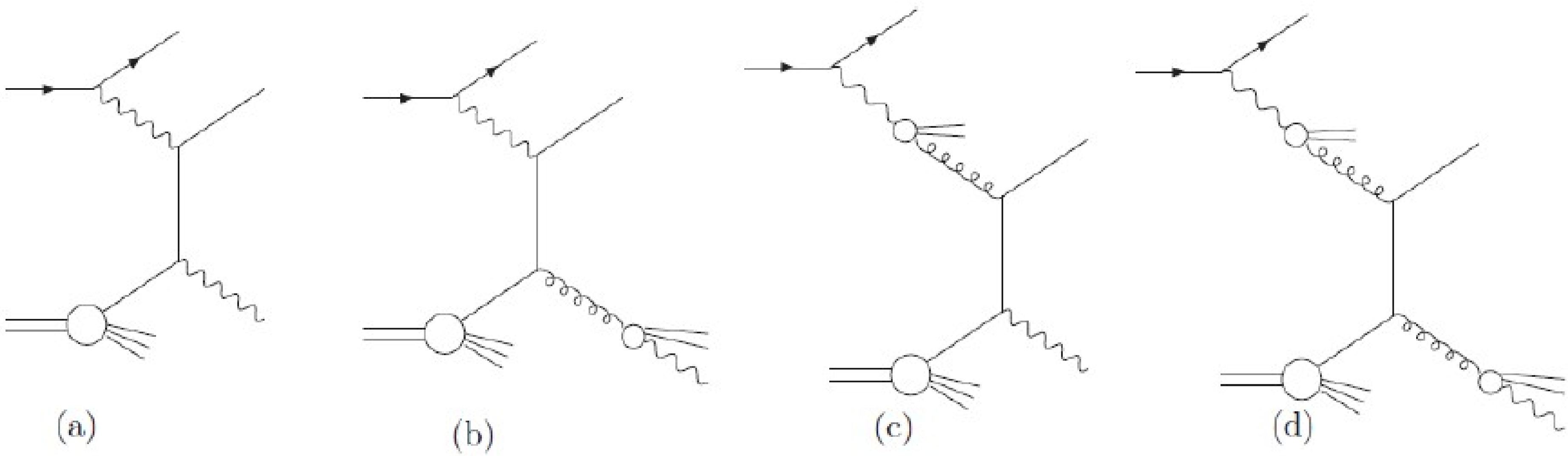
Introduction



A prompt photon is one that emerges directly from a perturbative QCD process. LO diagrams are illustrated above:
(a) direct, in which the entire incoming photon interacts,
(c) resolved, in which a parton from the photon interacts.
Higher order pQCD processes occur and also "fragmentation" processes (b, d).

Motivation

- Prompt (isolated, high pT) photons are a useful tool to study and test QCD.
- Their measurements are more precise than hadronic jets.
- Prompt photons can be used to measure and constrain the pdfs of proton and photon.

Differences from previous experiments

- Luminosity 370 pb^{-1}. First ZEUS prompt photons used 6.4 pb^{-1}, latest published – 77pb^{-1}.
- For jet building and photon finding ZUFO – ZEUS Unidentified Flying Object – are used, signal identification based on shower shapes. Previous analyses used calorimeter cells, BPRE signal.
- Phase space. Different sets of E_T and cuts η are used.
- For jet finding KTCLUS and Fastjet are used.
- More complex Monte-Carlo background sample (previously single-particle MC was used).

Theory

FGH – LO and NLO and the box diagram term are calculated explicitly. Fragmentation processes are calculated in terms of a fragmentation function in which quark or gluon jet gives rise to a photon.

LMZ – The k_T factorisation method makes use of unintegrated proton parton densities at NLO + box following the approach of KMR (Kimber-Martin-Ryskin). The procedure gives a quark-radiated contribution that is enhanced relative to the LO collinear approximations. The most recent values with larger errors than before are used. LMZ has no photon structure function in their model for resolved photons.

Analysis procedure

- Apply cleaning photoproduction cuts.
- Use Zufos as photon candidates.
- Find accompanying hadronic jet.
- Subtract the background using $\langle \delta Z \rangle$ quantity – it is broader for background than for signal. Perform a statistical subtraction. It is done for every bin of every measured variable.
- Calculate acceptance corrections, cross-sections.

Data Samples

- ***Data***: HERA II 04p, 04/05e, 06e, 06p, 07p (Common Ntuples v06d) 370 pb^{-1}
- ***MC Signal***: 04p, 05e, 06e, 06p, 07p (CN v06b PYTHIA v6.416, HERWIG v 6.510 – used for systematics) Direct, Resolved
- ***MC Background***: 04p, 04/05e, 06e, 06p, 07p (CN v06b PYTHIA - Heavy Flavour Group, Jet – Sebastian's + Filtered, HERWIG – Filtered – used for systematics) Direct, Resolved

Cuts

- **Event Selection**
- Trigger HPP16 on
- $0.2 < y_{JB} < 0.7$
- | Zvtx |<40 cm
- |BCAL time|<10 ns
- Cal p_T<10 GeV
- No SINISTRA electron with Prob > 0.9 and Yel < 0.7

- **Prompt Photon Selection**
- Tufo[0] =31
- $-0.7<\eta^{zufo}<0.9$
- $6<E_T^{zufo}<15$ GeV
- $E^{zufo}/E^{jet}>0.9$
- ZufoEemc/ZufoEcal>0.9
- track isolation in cone 0.2

- **Jet Selection**
- $-1.5<\eta^{jet}<1.8$
- $4<E_T^{jet}<35$ GeV

- **Truth level selection**
- $Q^2<1$ GeV^2
- $0.2<y_{JB}<0.7$
- Particle type 29
- $-0.7<\eta^{particle}<0.9$
- $6<E_T^{particle}<15$ GeV
- $E^{particle}/E^{jet}>0.9$

Phase space of previous measurements

H1 (DESY 09-135)

- $Q^2 < 1$ GeV^2
- $0.1 < y_{JB} < 0.7$
- $-1.0<\eta^{zufo}<2.4$
- $6<E_T^{zufo}<15$ GeV
- $-1.3<\eta^{jet}<2.3$
- $E_T^{\ jet} > 4$ GeV

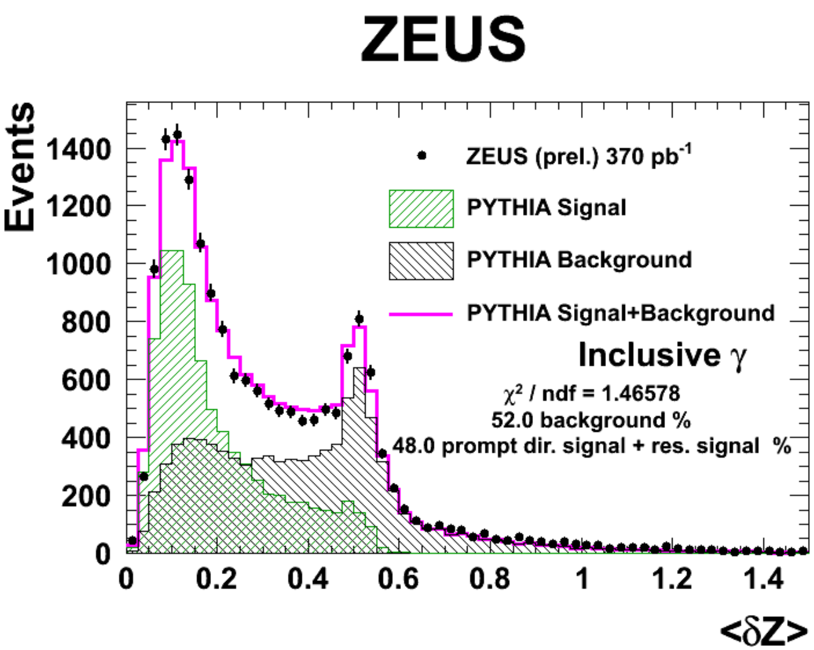
ZEUS (DESY 06-125)

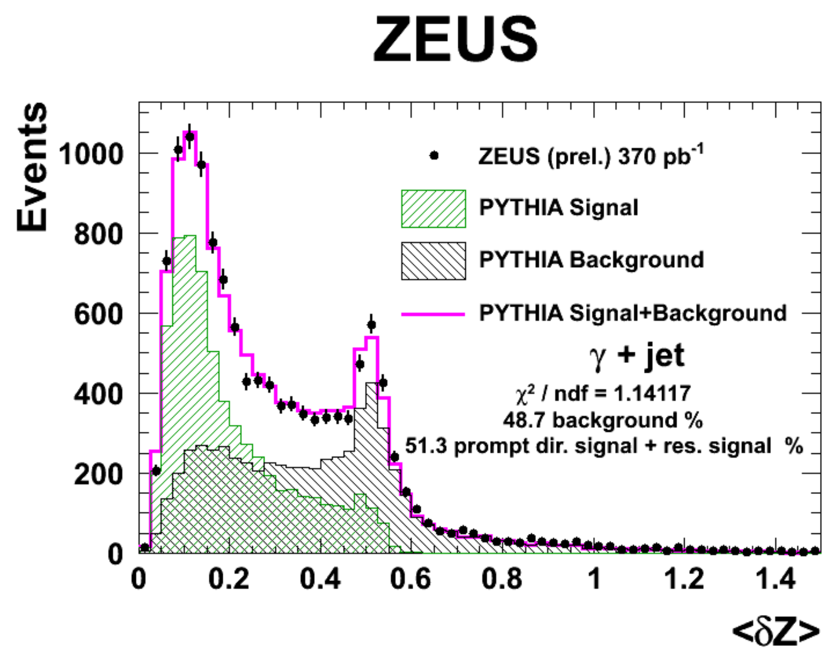
- $Q^2 < 1$ GeV^2
- $0.2 < y_{JB} < 0.8$
- $-0.74<\eta^{zufo}<1.1$
- $5<E_T^{zufo}<16$ GeV
- $-1.6<\eta^{jet}<2.4$
- $6 <E_T^{\ jet} < 17$ GeV

ZEUS (DESY 99-161)

- $0.2 < y_{JB} < 0.9$
- $-0.7<\eta^{zufo}<0.9$
- $5<E_T^{zufo}<10$ GeV

Signal extraction





<δZ> energy weighted mean width of the electromagnetic cluster in Z direction:

$$\langle \delta Z \rangle = \sum_i E_i |Z_i - Z_{\text{cluster}}| \Big/ (w_{\text{cell}} \sum_i E_i)$$

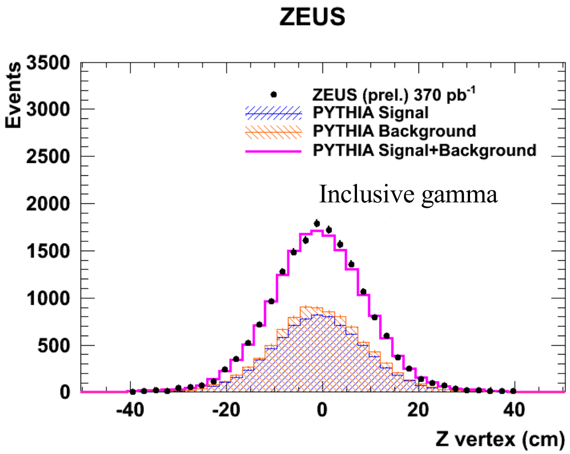
Distributions of <δZ> for (a) inclusive photon events, (b) events with a jet, showing the fitted signal and background components.
Chi**2 per degree of freedom in bins of examined variables is typically 1.1.

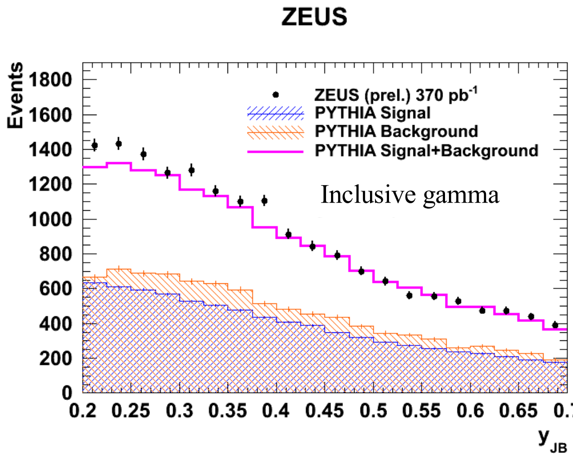
A model of
50% PYTHIA Direct,
40% Resolved,
5% each of resolved and direct radiative ("fragmentation").

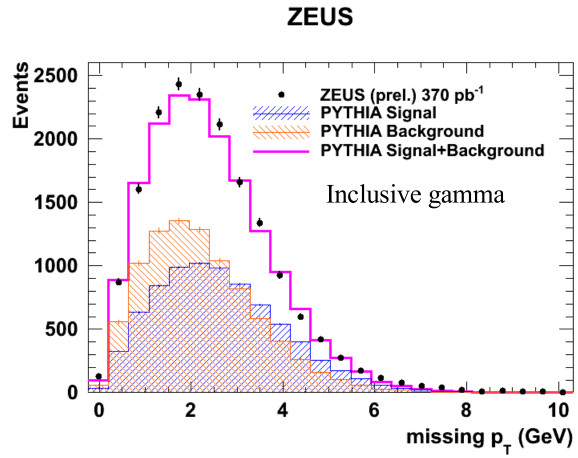
The radiative events are obtained from the background.
They are discarded from the background before it is
used in the fits.

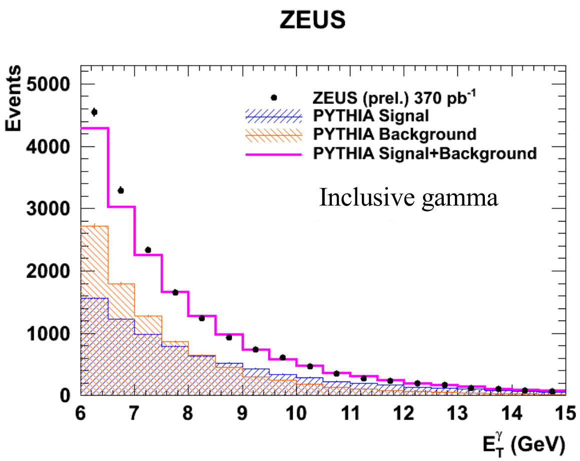
A systematic uncertainty allows for uncertainties in this model.

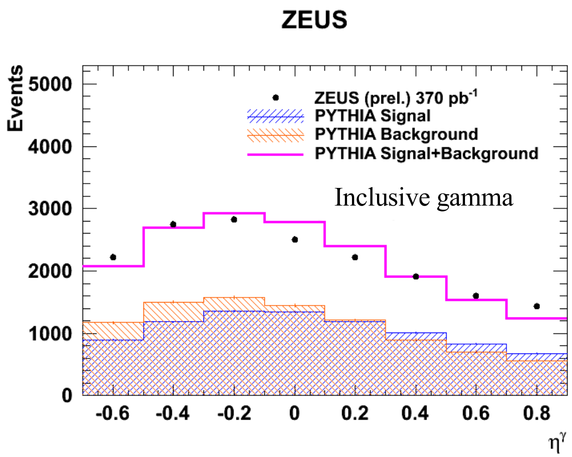
Control plots. Inclusive photon







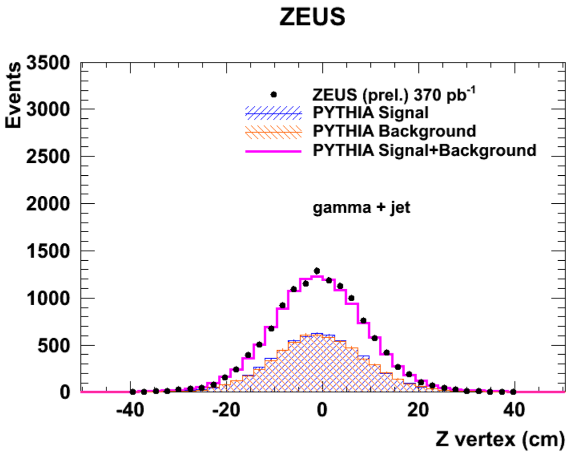


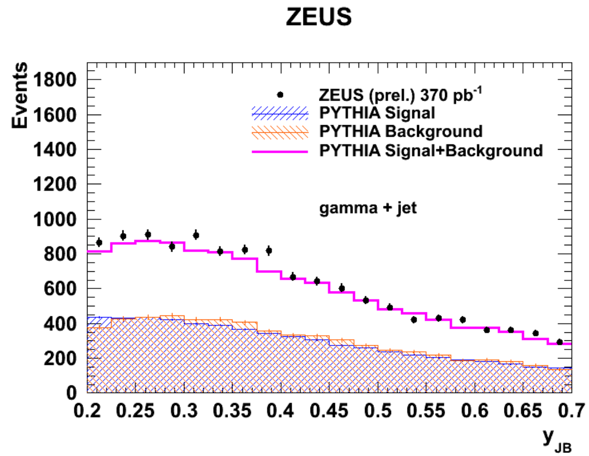


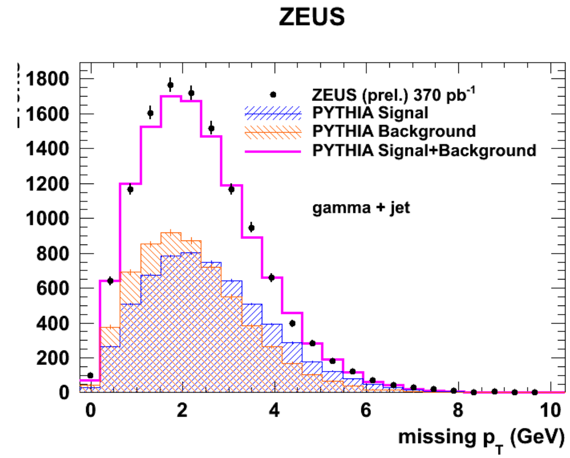
Shown are results of the deltaz fit to signal+background for Z vertex, y_{JB}, missing transverse momentum, E_T^{γ}, η^{γ}.

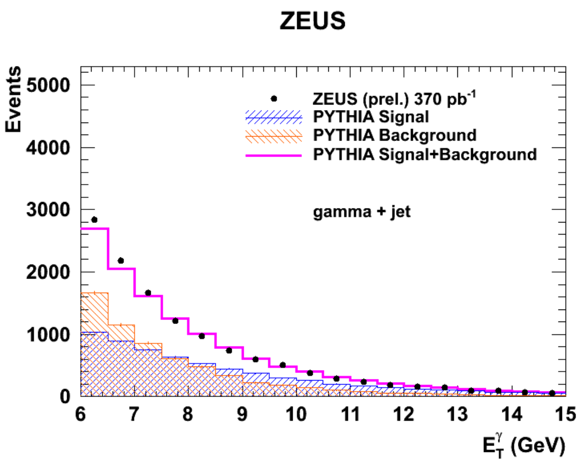
PYTHIA MC signal consists of 50% direct-prompt, 5% direct-fragmentation, 40% resolved-prompt, 5% resolved-fragmentation.

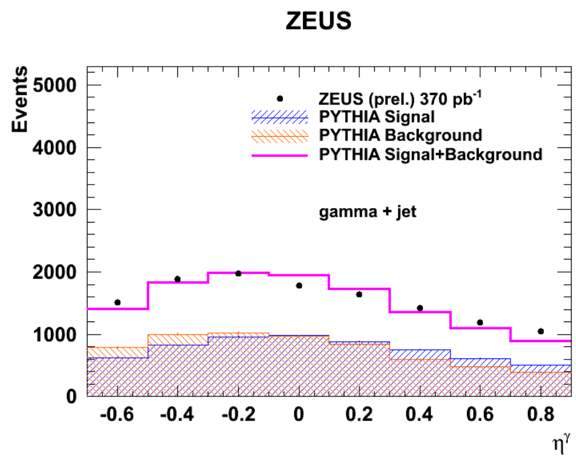
Control plots. Photon + jet





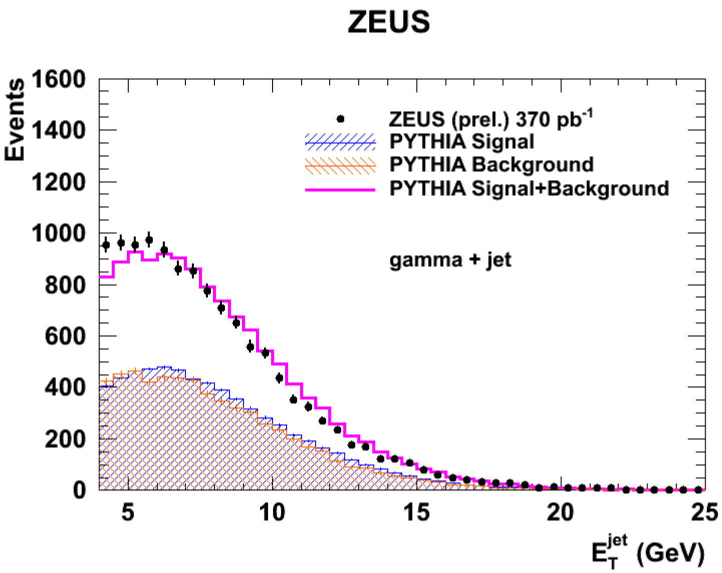


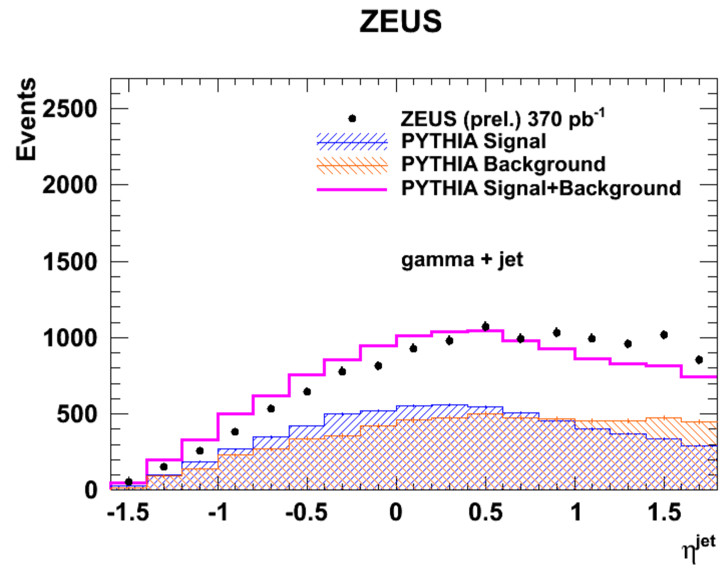


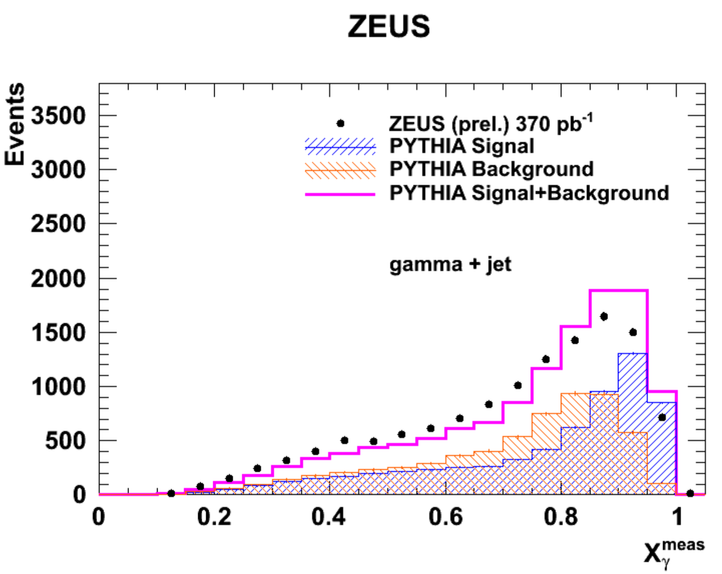


Description of data looks reasonable.

Control plots. Photon + jet



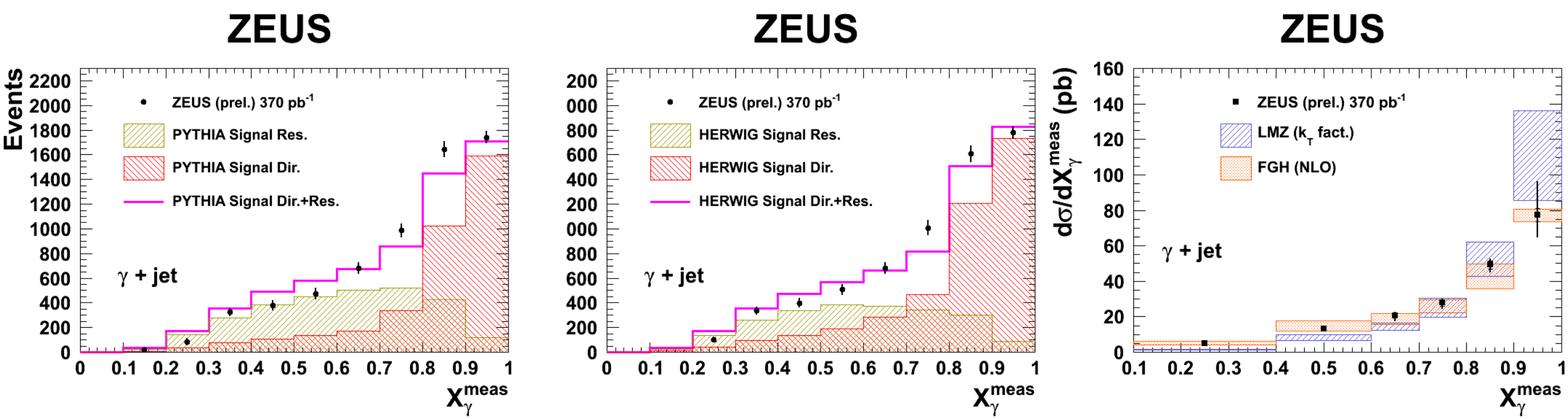




In view of the minor mismatch in the modelling of E_T^{jet}, a reweighting procedure was studied.
It made little difference to the results and is not used.
X_γ^{MEAS} – the fraction of the incoming photon energy given to the final state photon and jet, at a lowest-order approximation

$$x_\gamma^{\text{meas}} = \frac{E^\gamma + E^{\text{jet}} - p_Z^\gamma - p_Z^{\text{jet}}}{E^{\text{all}} - p_Z^{\text{all}}}$$

Definition of direct/resolved mix



a) b) c)

- Events detected for different values of X_γ^{MEAS}, compared to a mixture of 50% direct prompt, 40% resolved prompt, 5% dir frag and 5% res frag events generated using PYTHIA. No acceptance corrections have been applied at this point.

b) HERWIG events. Mix is 60% dir prompt, 30% res prompt, 5% dir frag and 5% res frag.

- Cross sections as s function of X_γ^{MEAS}, for events containing an inclusive photon and a jet, compared to predictions from FGH (uncertainty from varying all scales simultaneously, changing only one scale gives uncertainties +-10%) and LMZ.

Here and in following hadronization corrections are applied to theory.

Both PYTHIA and HERWIG are not perfect. Using PYTHIA as central value.

Trigger studies

Trigger studies

Investigations of FLT and SLT.

PJB.

9 Aug 2013

1) FLT studies

2) SLT studies

Trigger studies

Procedure:

Following Katsuo's advice, take DIS events which contain high-ET photons (our DIS sample, thank you Oleg).

Select events with an inclusive isolated prompt photon satisfying broadened cuts in ET, but otherwise as in the analysis.
No jet requirement. Normal trigger requirement is not applied.
In the DIS, select events having an FLT that just takes RCAL information.

See what fraction of selected events fire the relevant photon FLT.

1) The DIS FLT triggers selected were 30, 36 and 46.

2) The HPP FLT uses triggers 28, 30, 39. 30 is a DIS trigger, and so look for 28 or 39. 28 seems included in 39 **so just look for 39**

Compare the DIS data to the php direct MC.

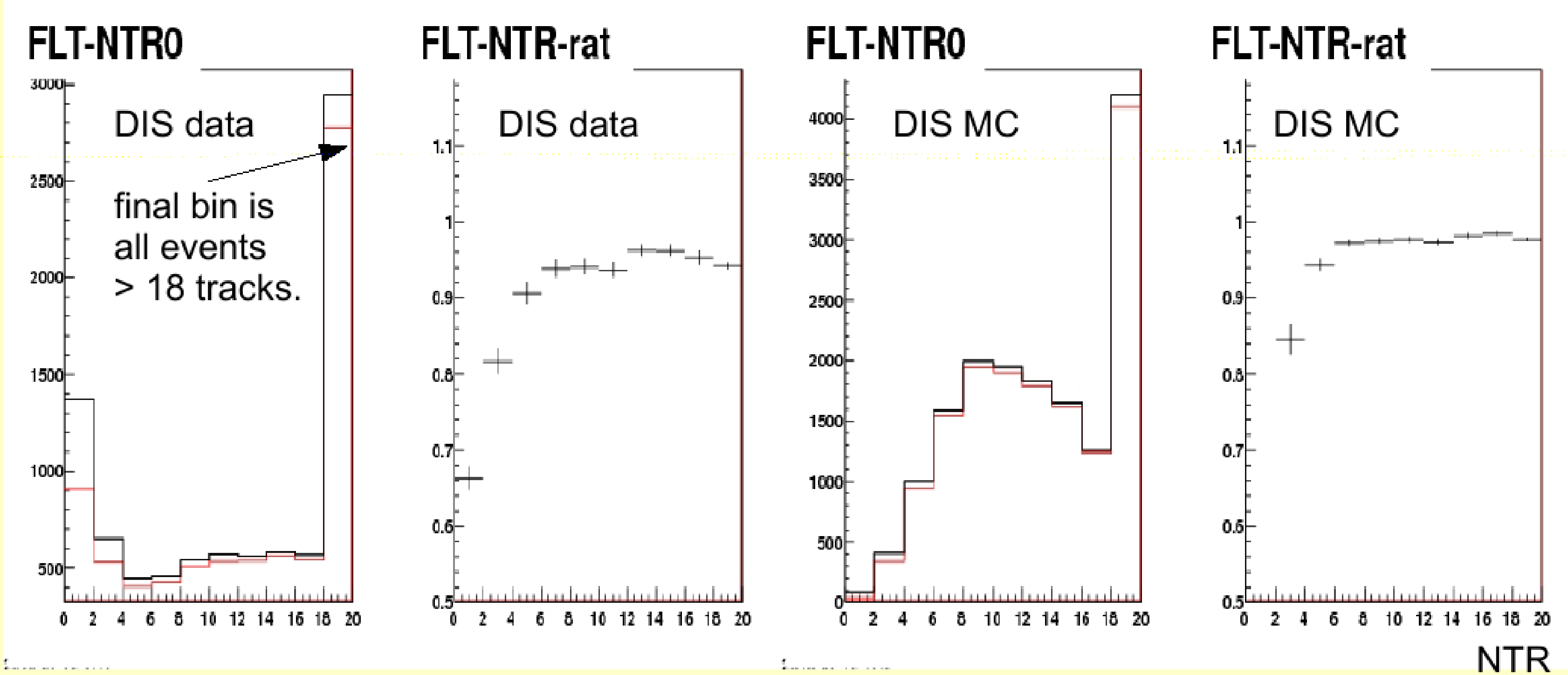
We first look at track multiplicity and add a track multiplicity requirement to the MC events.

Trigger studies

DIS Plot the DIS flt39 efficiency as a function of number of tracks, i.e. **Trk_ntracks**

Black=all selected, red = selected+flt39   Ratio red/black = flt eff.

Events   FLT eff.   Events   FLT eff.



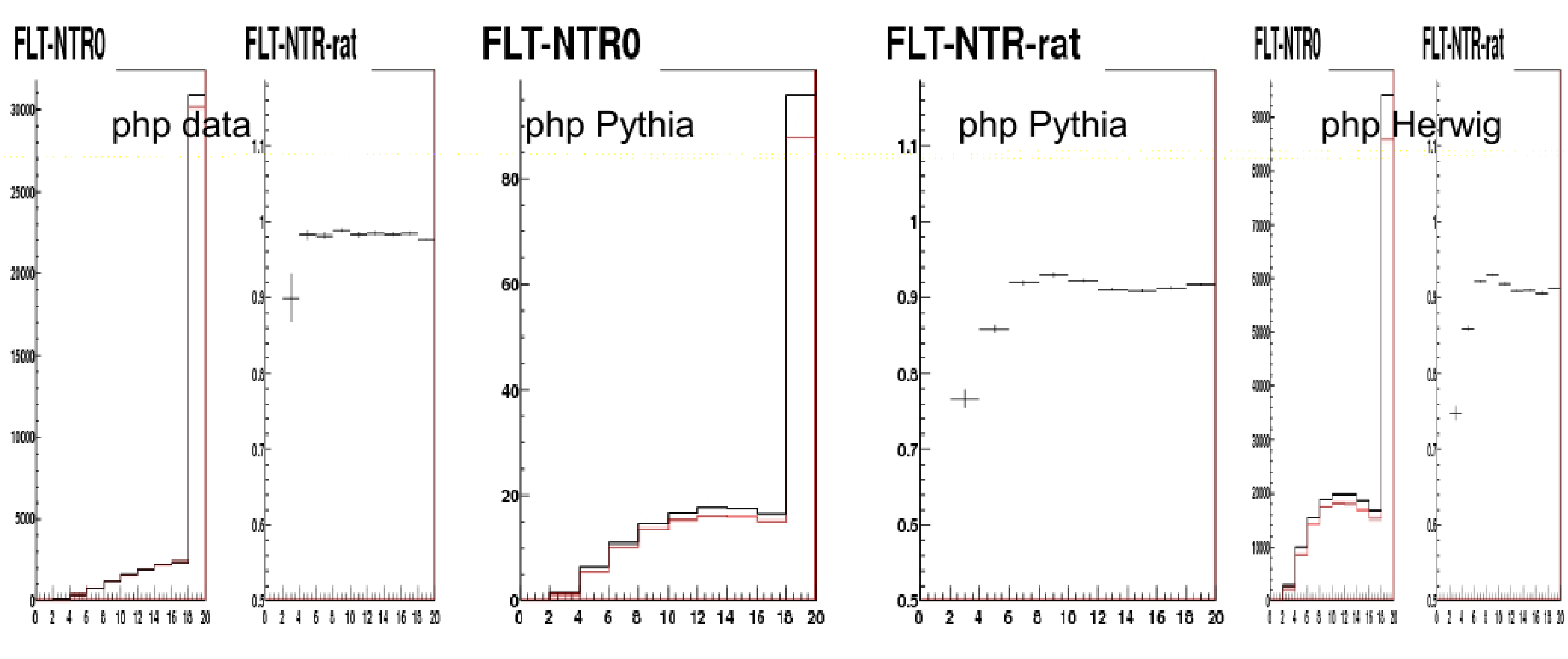
Conclusion: There is a low-multiplicity component to the DIS data (DVCS??) which has very different properties from the rest. Otherwise the two distributions are similar but the MC at 98% is a bit higher than the data at 95%.

Trigger studies

Php plot the php flt39 efficiency as a function of number of tracks, i.e. **Trk_ntracks**

Black=all tagged, red = +flt39 Event numbers, ratio red/black = flt eff.

Events Events FLT eff FLT Eff

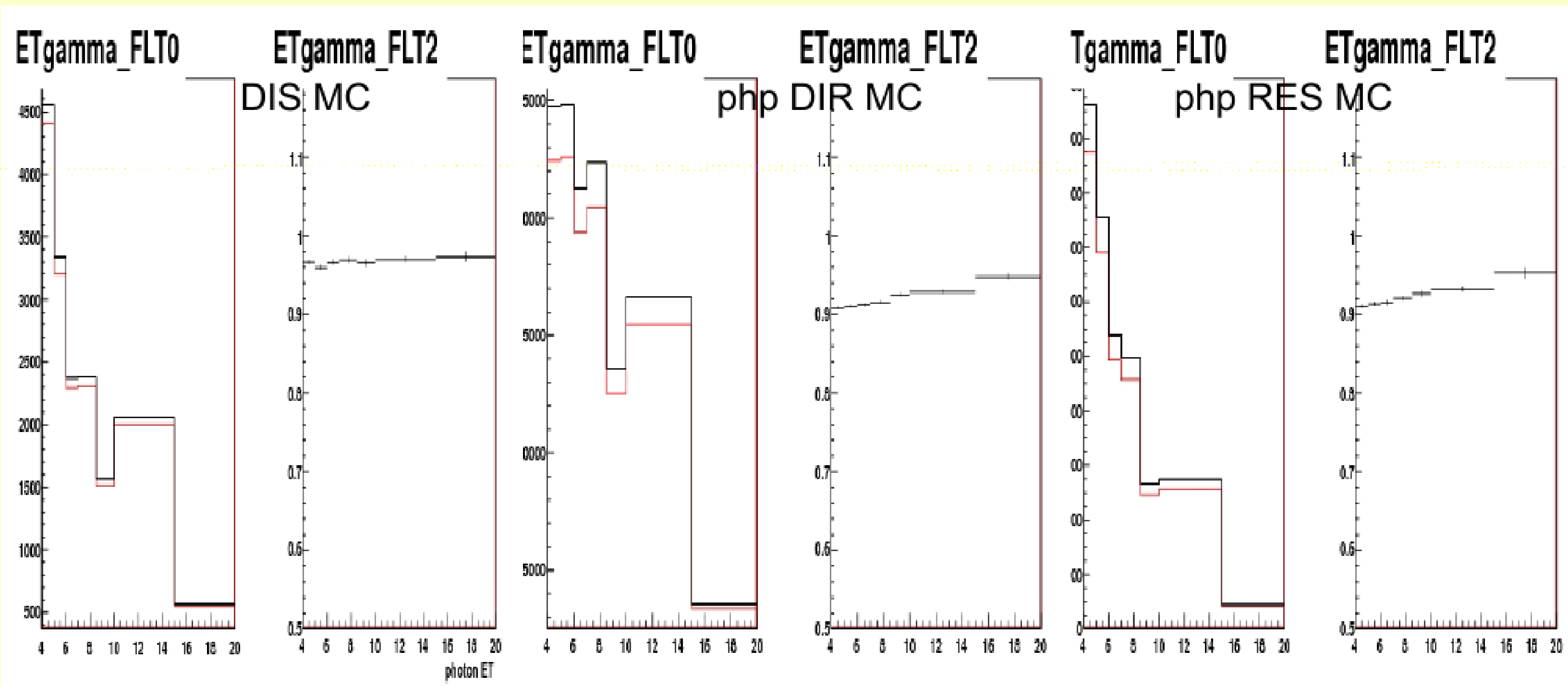


Conclusion: The php data have high track multiplicity and so we can ignore the low-multiplicity effect. Enough statistics in both MCs to show php is somewhat similar to DIS. The MC are a mixture of resolved and direct.

Trigger studies

New: now compare the different **MCs** imposing the condition that Trk_ntracks ≥ 5

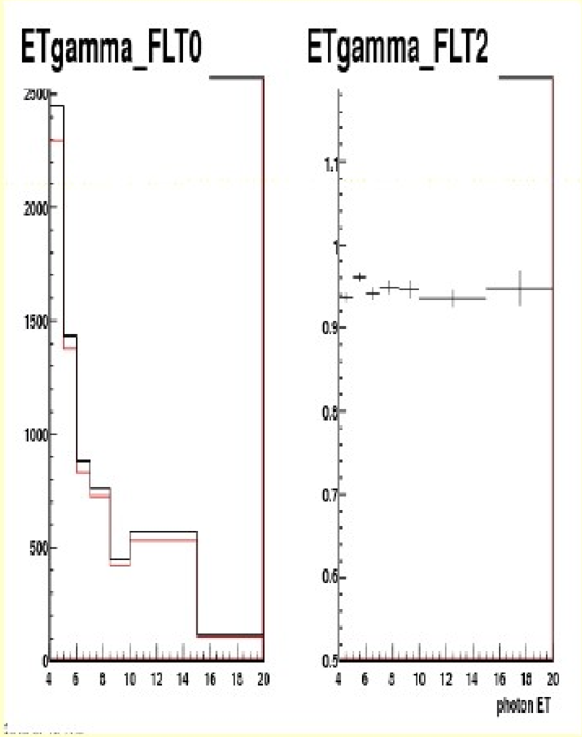
flt39 efficiency as before. Plot as function of photon ET.



Conclusion: the distributions are fairly flat and DIS is different from photoproduction.

Trigger studies

Compare with **DIS data** with ntracks ge 5:



Between 6 and 15 GeV we have the following flt39 efficiencies:

DIS data: 94-95%

DIS MC: 97%

php MC: 91-93%

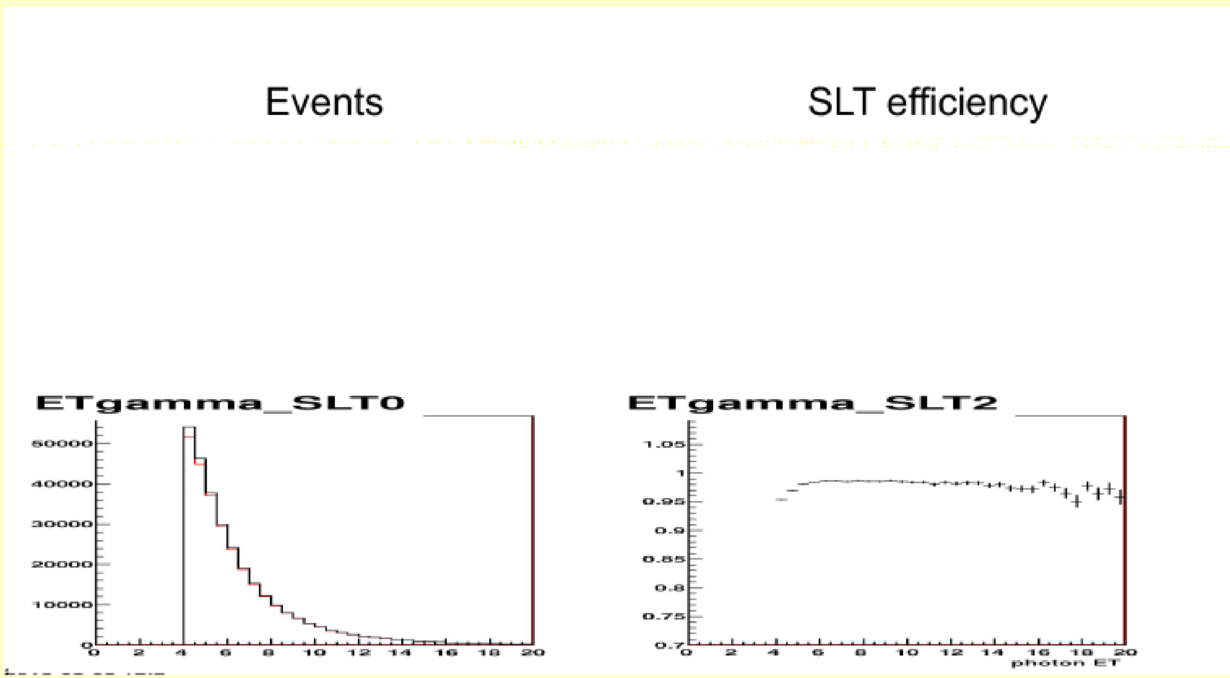
Advice from Katsuo:
the present php MC efficiency should be corrected down by 2-3% to match the effect seen in the DIS samples.

Selecting between 6-15 GeV the correction is 2.64%

Trigger studies

Study of SLT efficiencies

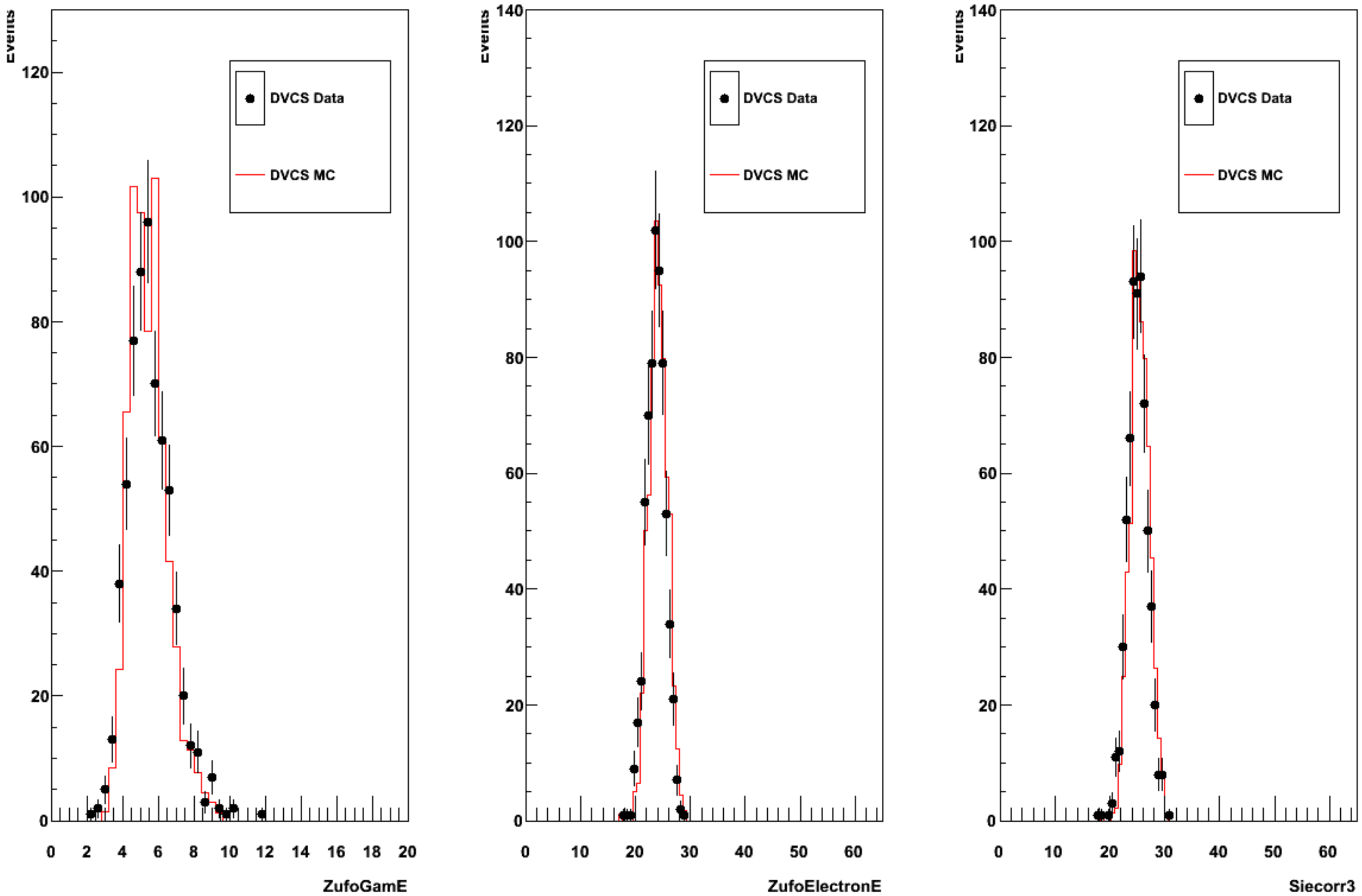
Take php MC events that pass the FLT trigger, and ask what fraction also pass the SLT trigger. Inclusive photons are selected with normal event requirements apart from the ET and trigger.



Conclusion: The SLT efficiency is rather flat at ~98% within our normal accepted range. Above 8 GeV the "cone requirement" efficiency should be 100%. So the inefficiency seen must come from event cleaning requirements. We are well clear of the fall off at lower ET values, though the efficiency is quite high everywhere.

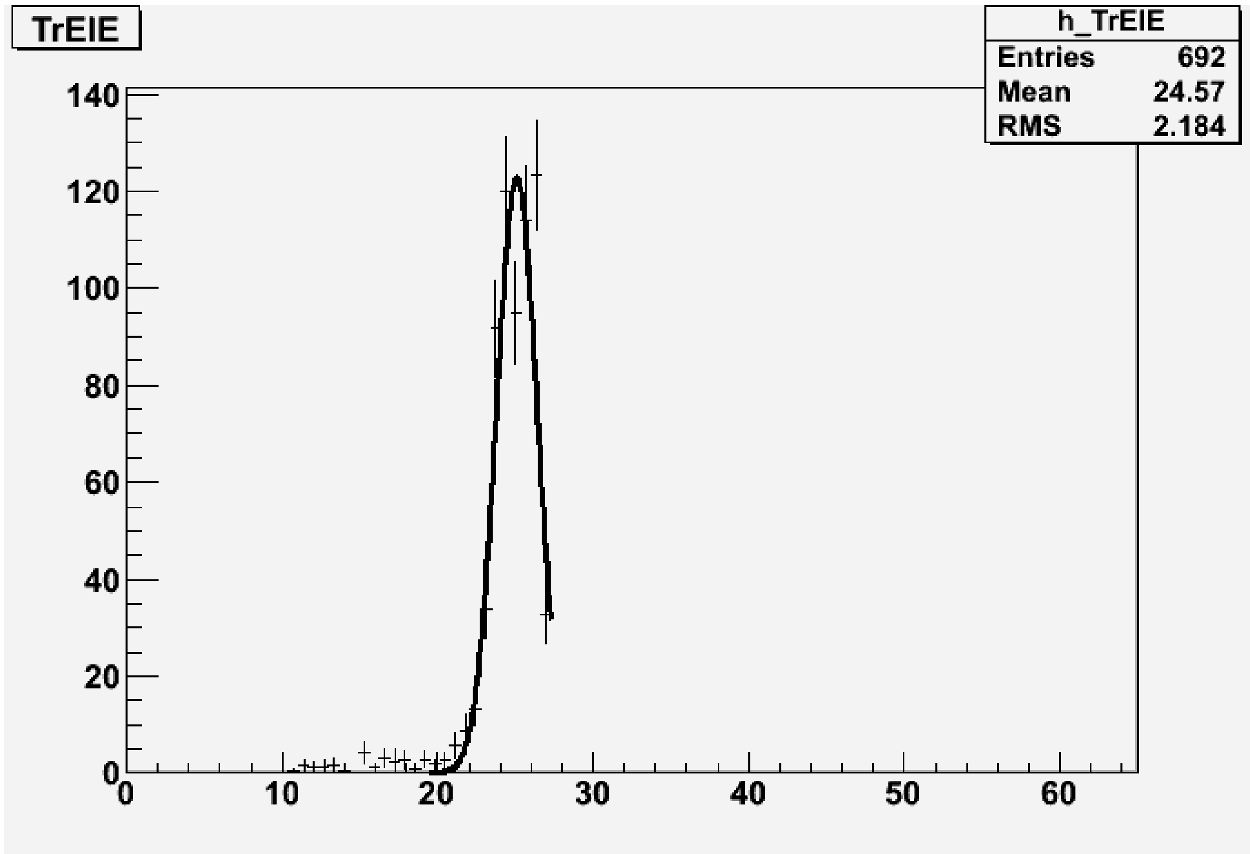
Energy scale studies

DVCS. Control plots after reweighting



Electron peaks agree within 2% for both Zufo and Sira electrons.

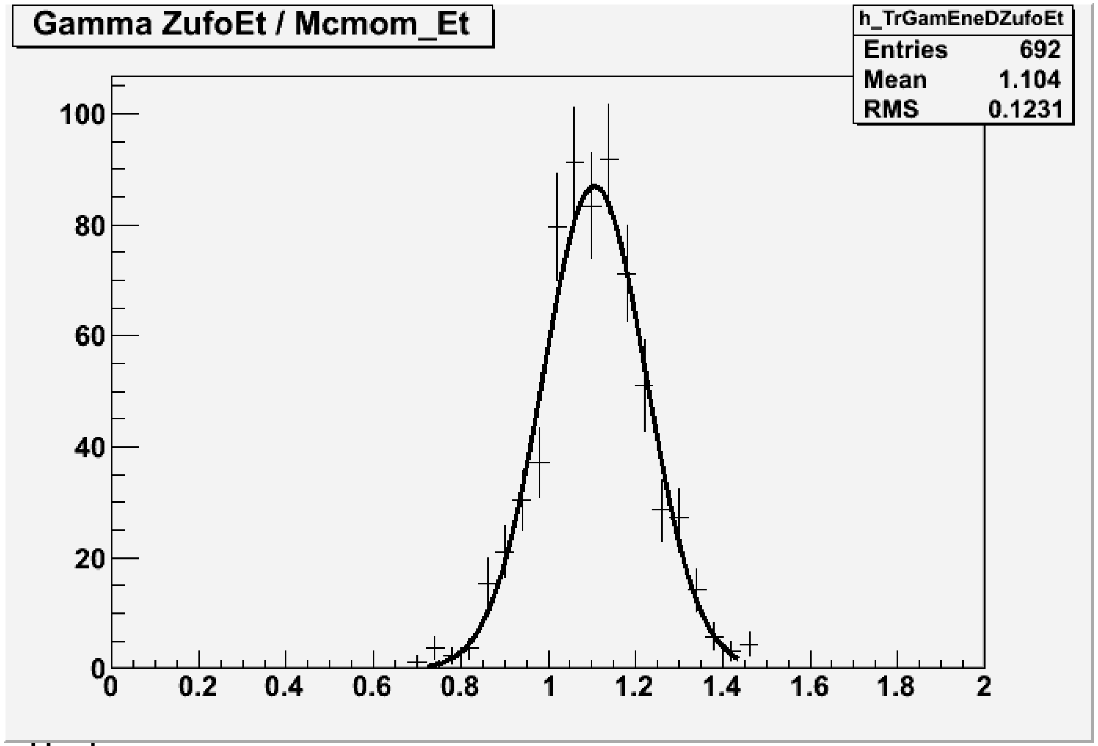
DVCS Hadron level electron E



Hadron level electron energy

EXT PARAMETER				STEP	FIRST
NO.	NAME	VALUE	ERROR	SIZE	DERIVATIVE
1	Constant	1.22490e+02	6.70833e+00	1.65887e-02	1.84283e-06
2	Mean	2.50732e+01	6.41946e-02	1.94258e-04	-8.07657e-04 - within 2% of Sinistra in Data and detector level MC
3	Sigma	1.32999e+00	5.58002e-02	3.35839e-05	8.78500e-03

DVCS MC Gamma DetEt/HadEt



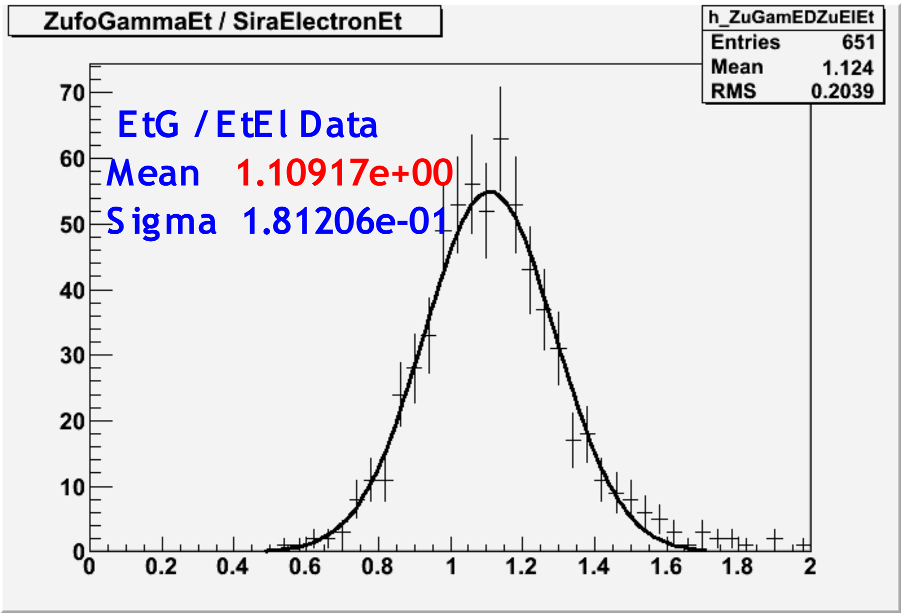
MC EtGamDet/EtGamHad

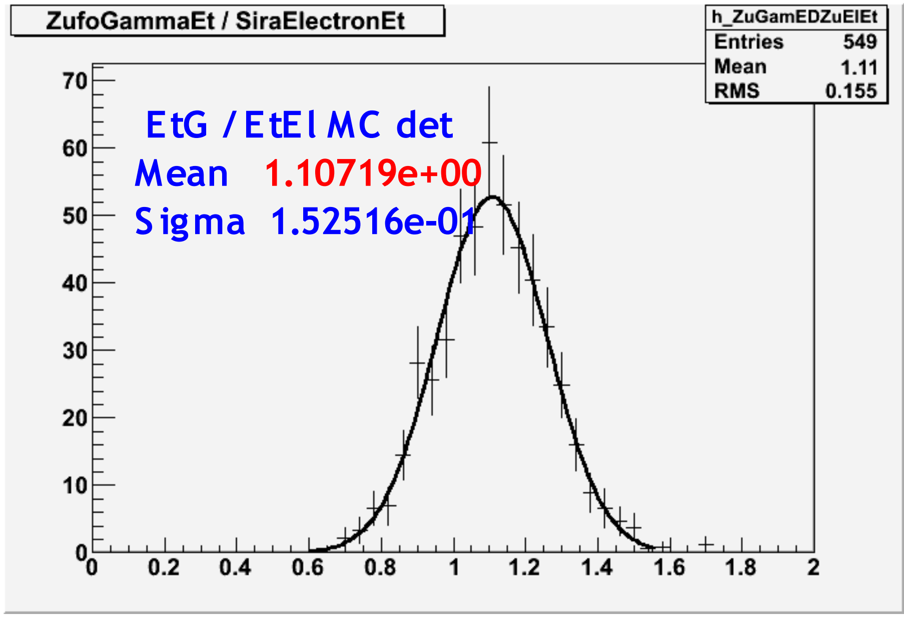
EXT NO.	PARAMETER NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	Constant	8.69706e+01	4.58659e+00	7.14497e-03	7.45215e-08
2	Mean	**1.10550e+00**	4.83577e-03	9.73969e-06	3.26266e-05
3	Sigma	1.18495e-01	3.96685e-03	1.72827e-05	-2.52587e-05

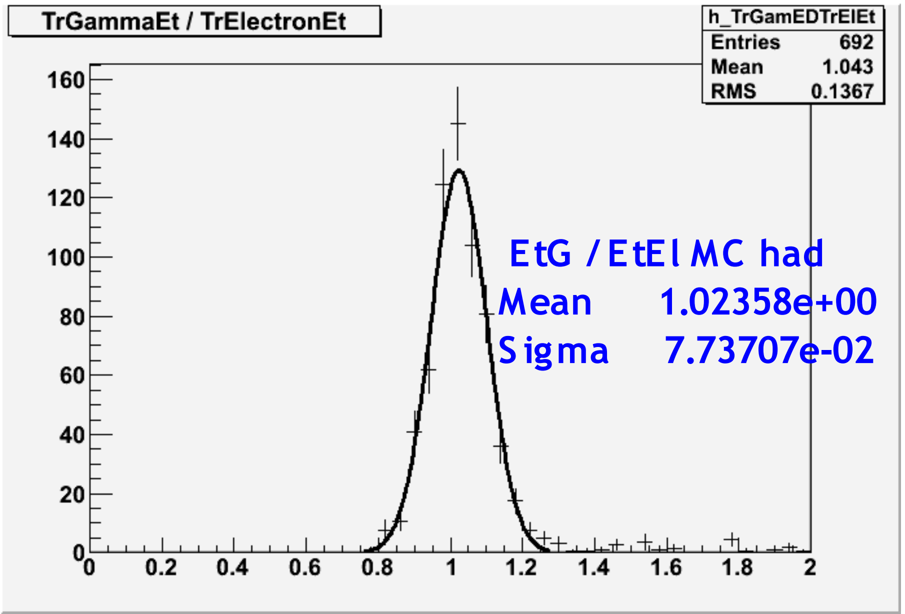
Reweighting applied.

A 10% effect similar to PHP.

DVCS Zufo Gamma Et/Ele Et





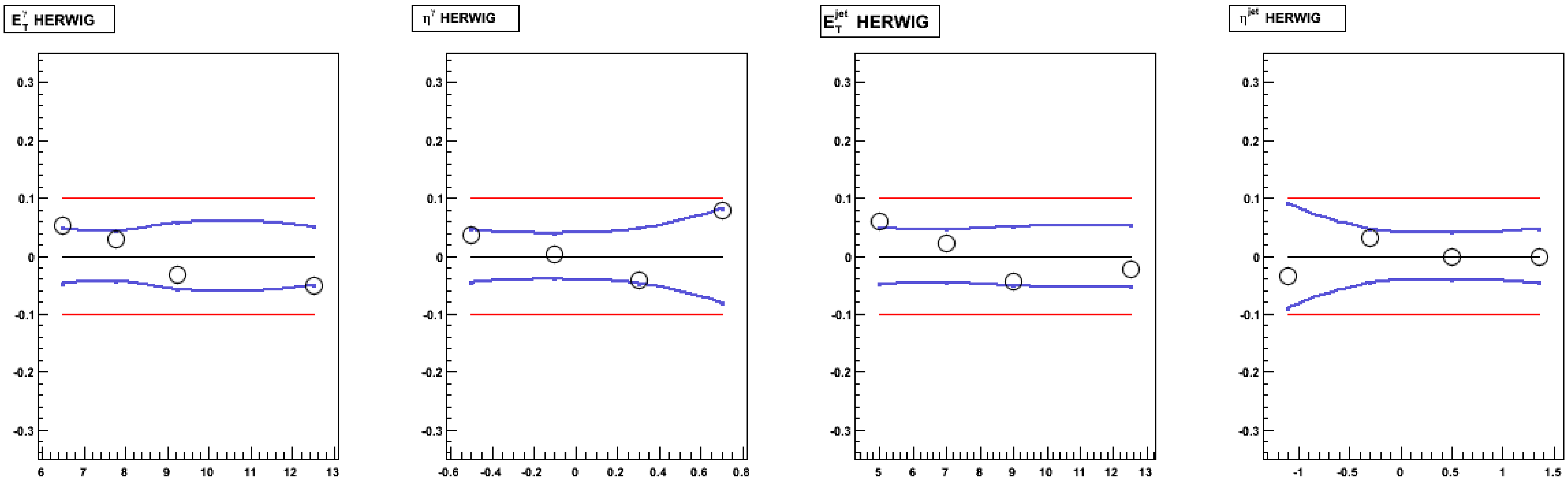


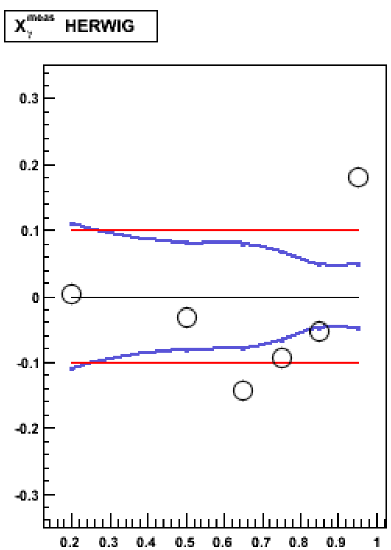
Reweighting applied.

Gamma and electron Et difference in Data is close to MC detector level value.

Factor 1.1 is applicable to MC and Data.

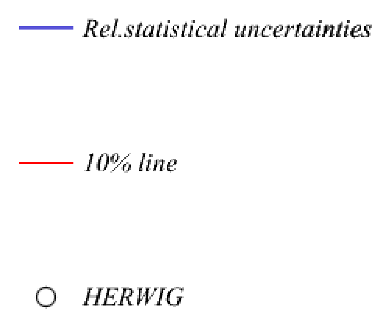
Systematic uncertainties: HERWIG



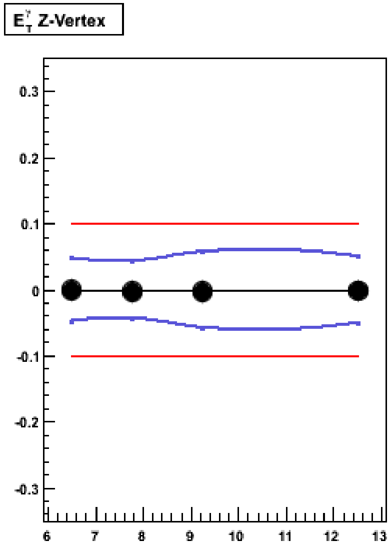


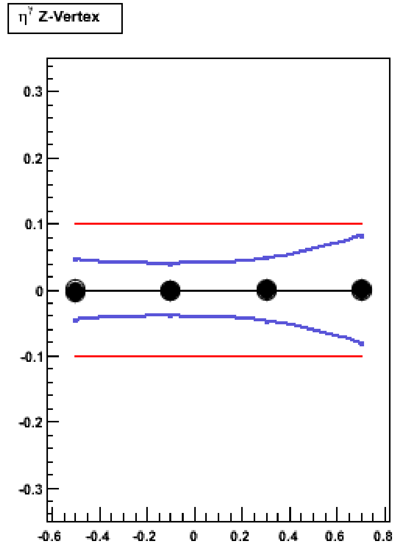
Use HERWIG signal and background instead of PYTHIA

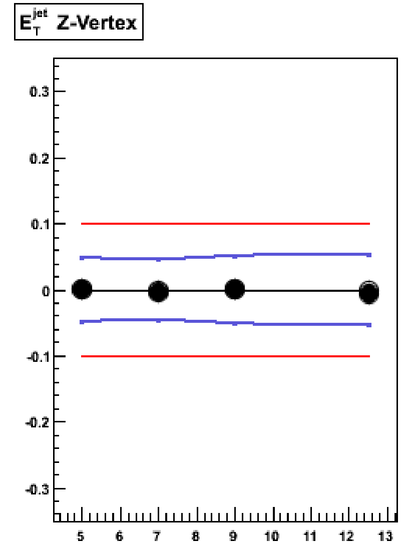
γ+jet

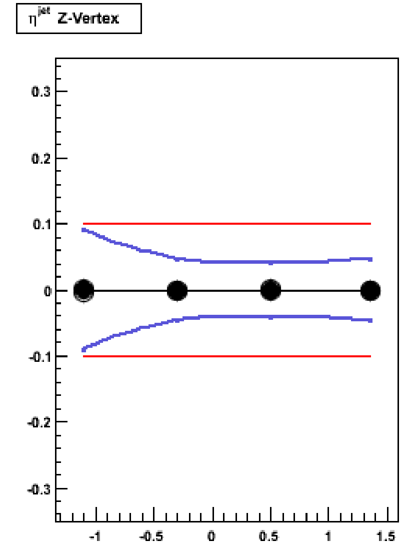


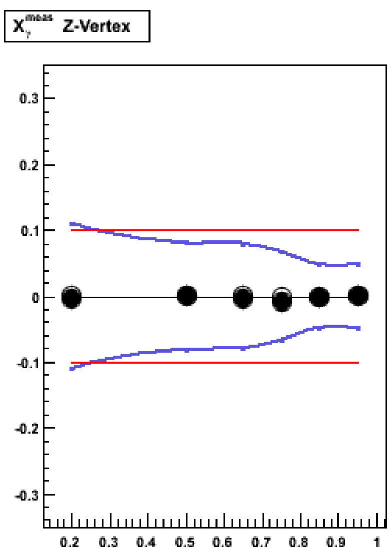
Systematic uncertainties: Zvtx











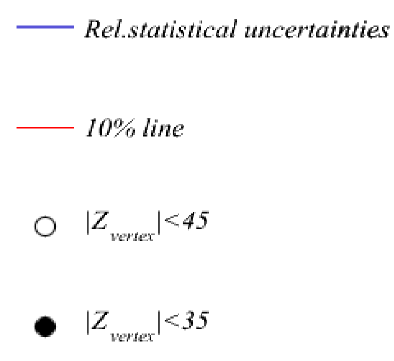
Standard cut:

- | Zvtx |<40 cm

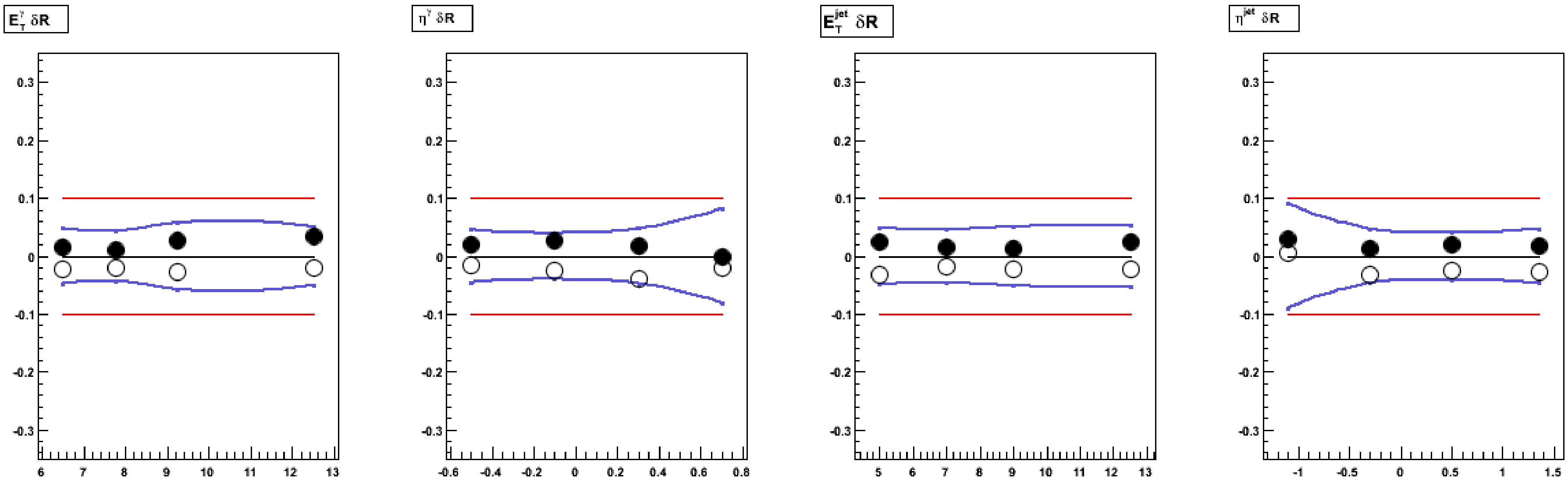
Vary z-vertex cut by +-5 cm

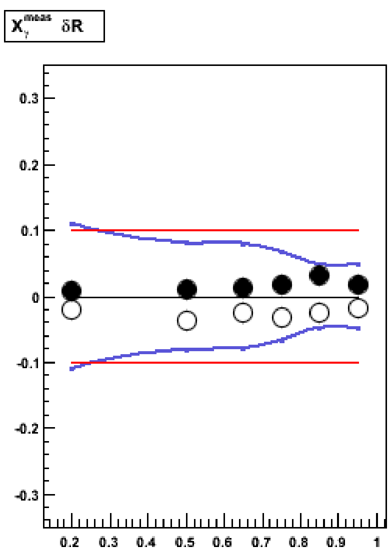
From now on systematics are averaged in every bin independently, without the shift of the central value.

γ+jet



Systematic uncertainties: deltaR





Standard cut:

•deltaR track isolation in cone 0.2

Vary cone radius by +-0.1

γ+jet

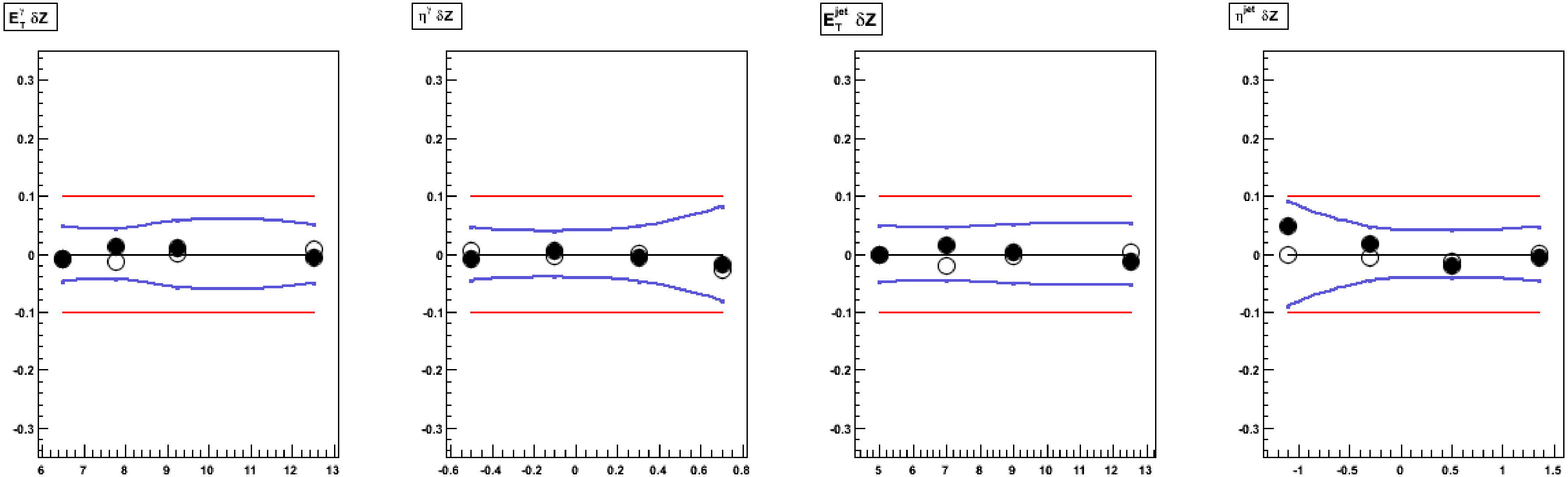
Rel.statistical uncertainties

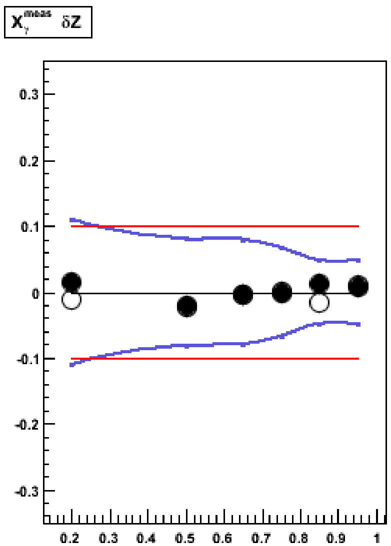
10% line

○ *δR 0.3*

● *δR 0.1*

Systematic uncertainties: deltaZ fit range





Standard range:

0.05 – 0.8

deltaZ upper limit variation between 0.6 and 1.0

γ+jet

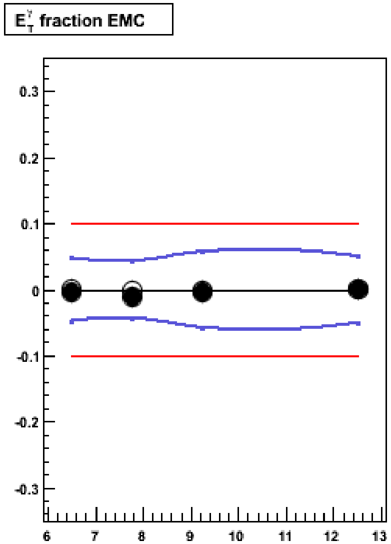
Rel.statistical uncertainties δZ

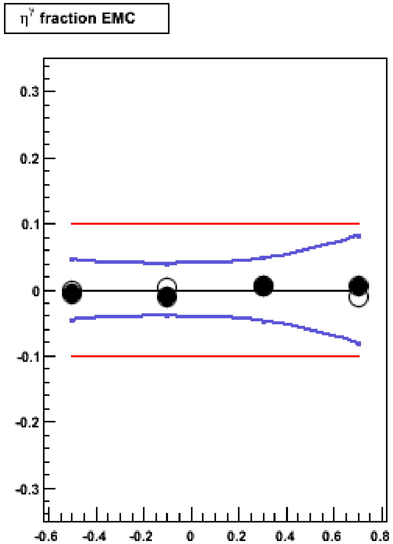
10% line

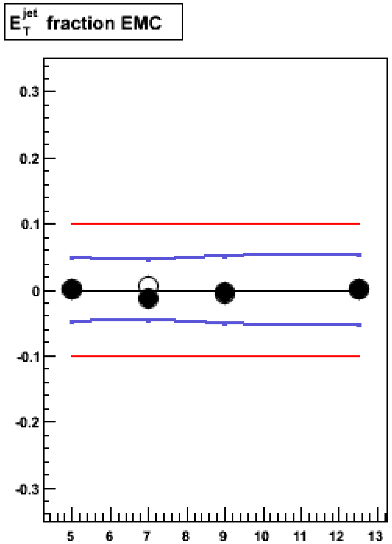
○ *δZ fit range 1.0*

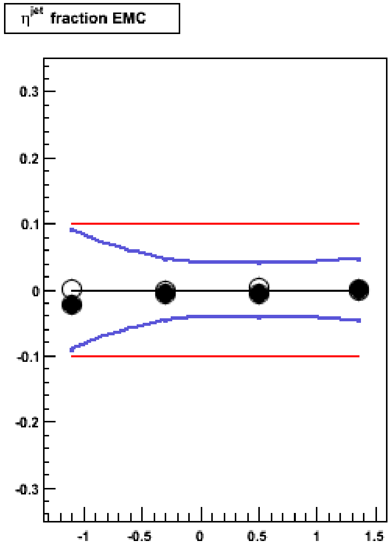
● *δZ fit range 0.6*

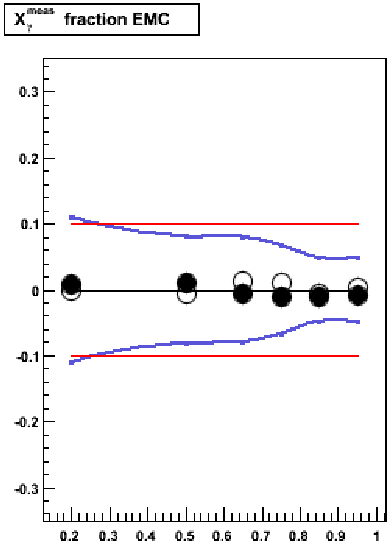
Systematic uncertainties: Fraction EMC











Standard cut:

•ZufoEemc/ZufoEcal>0.9

Vary the em fraction in the photon zufo by +-2.5%

γ+jet

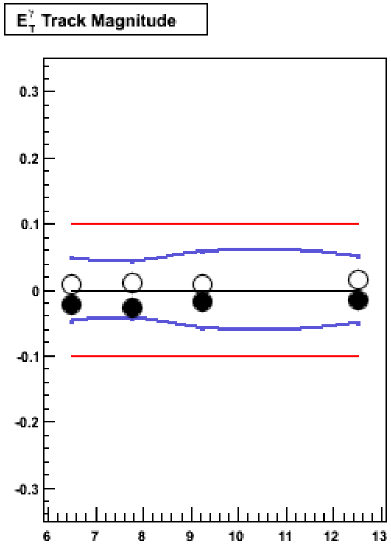
Rel.statistical uncertainties

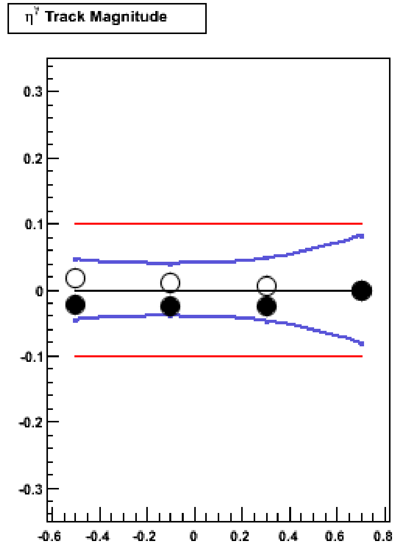
10% line

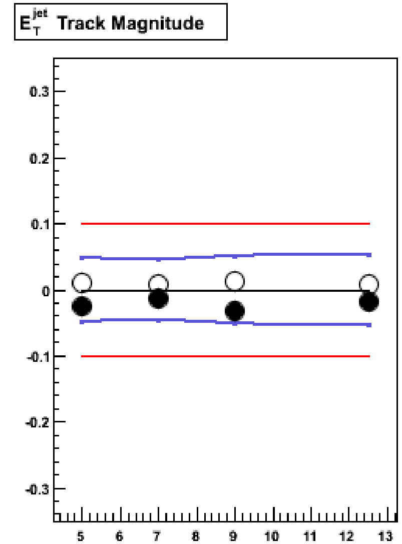
Fraction EMC +0.025

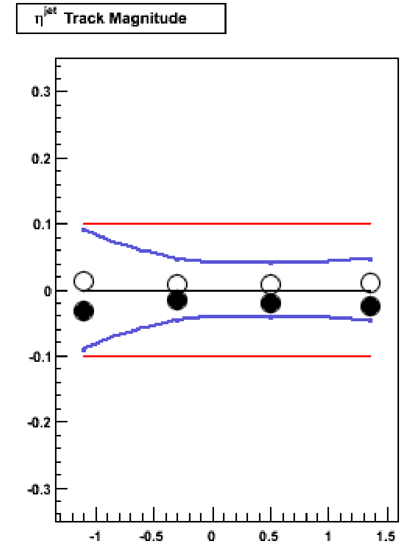
Fraction EMC -0.025

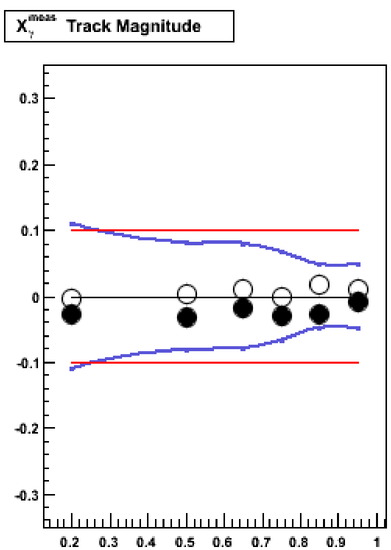
Systematic uncertainties: Track momentum









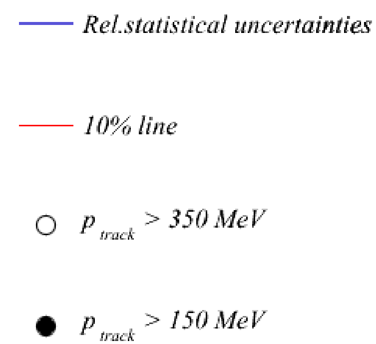


Standard cut:

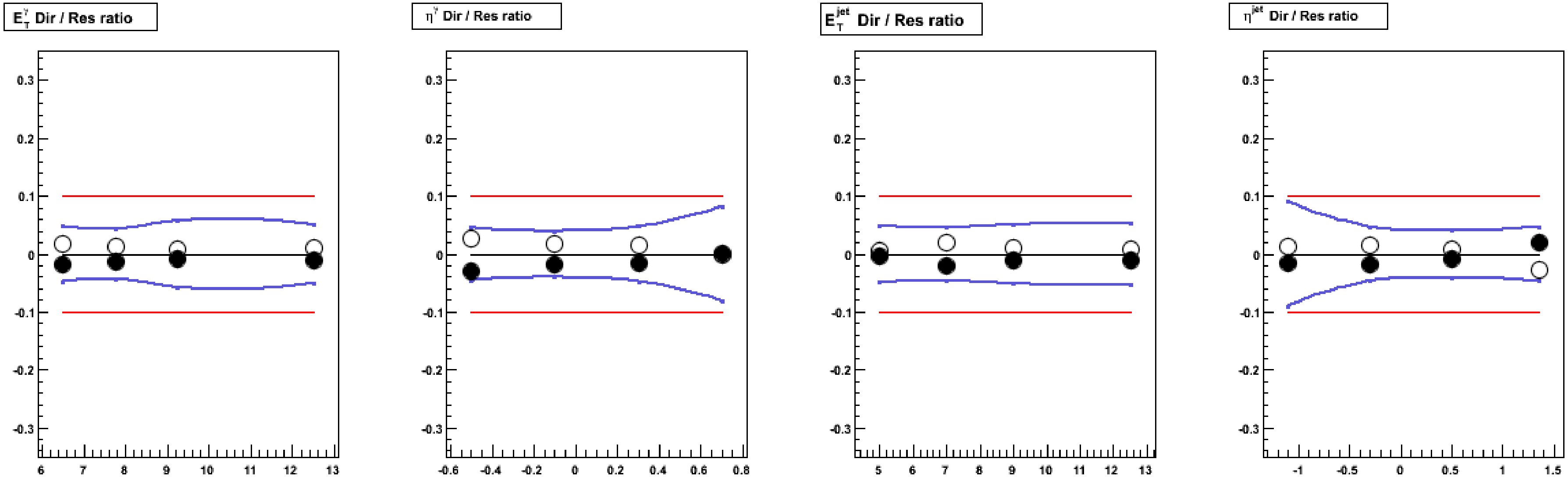
•Track momentum>250 MeV

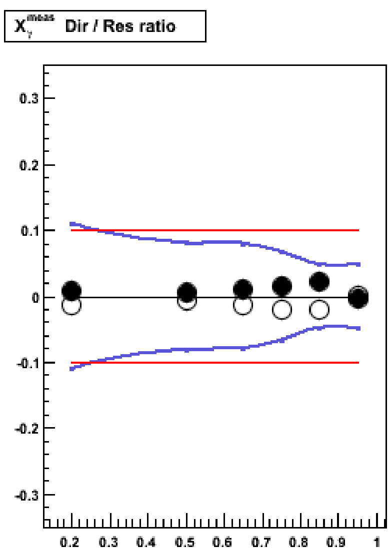
Vary track momentum by 100 MeV

γ+jet



Systematic uncertainties: PYTHIA dir / res





Standard direct/ resolved ratio:
50% / 40%

γ+jet

Vary fraction of resolved by +-15%:

35% / 55%
65% / 25%

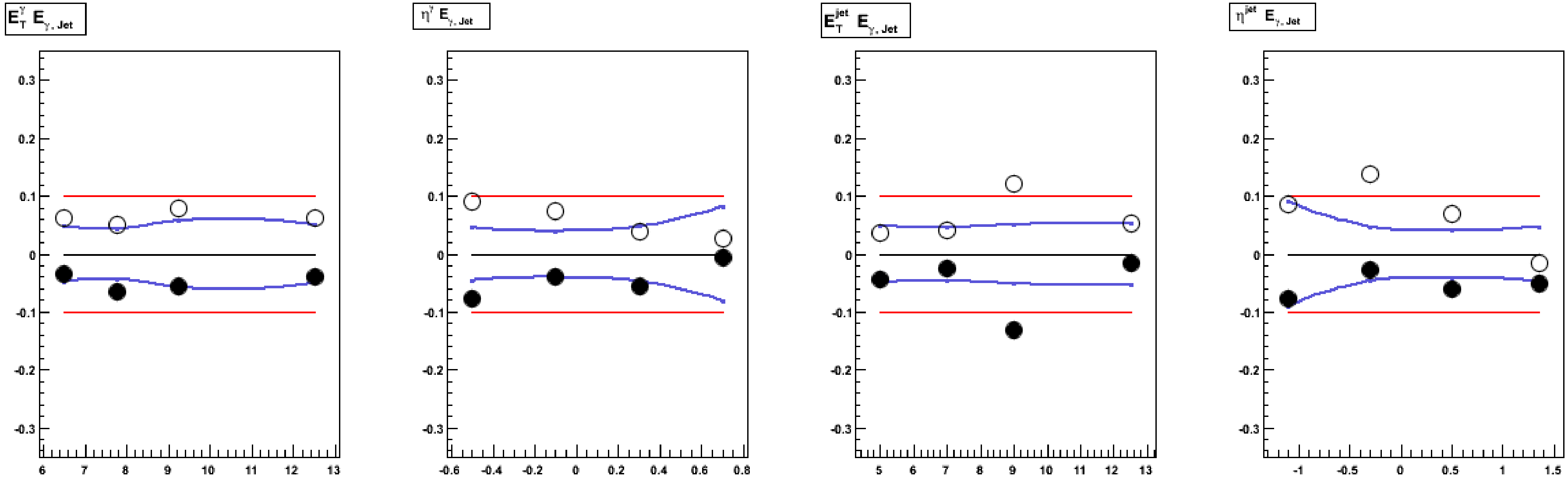
Rel.statistical uncertainties

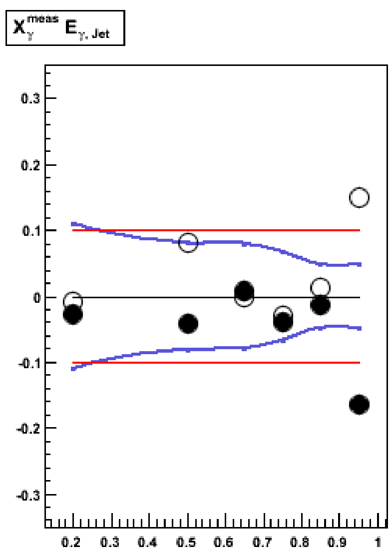
10% line

○ *-15% resolved*

● *+15% resolved*

Systematic uncertainties: E-γ, E-jet variation

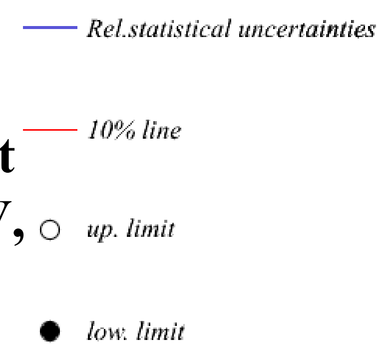




Standard cuts:

- $6<E_T^{zufo}<15$ GeV
- $4<E_T^{jet}<35$ GeV

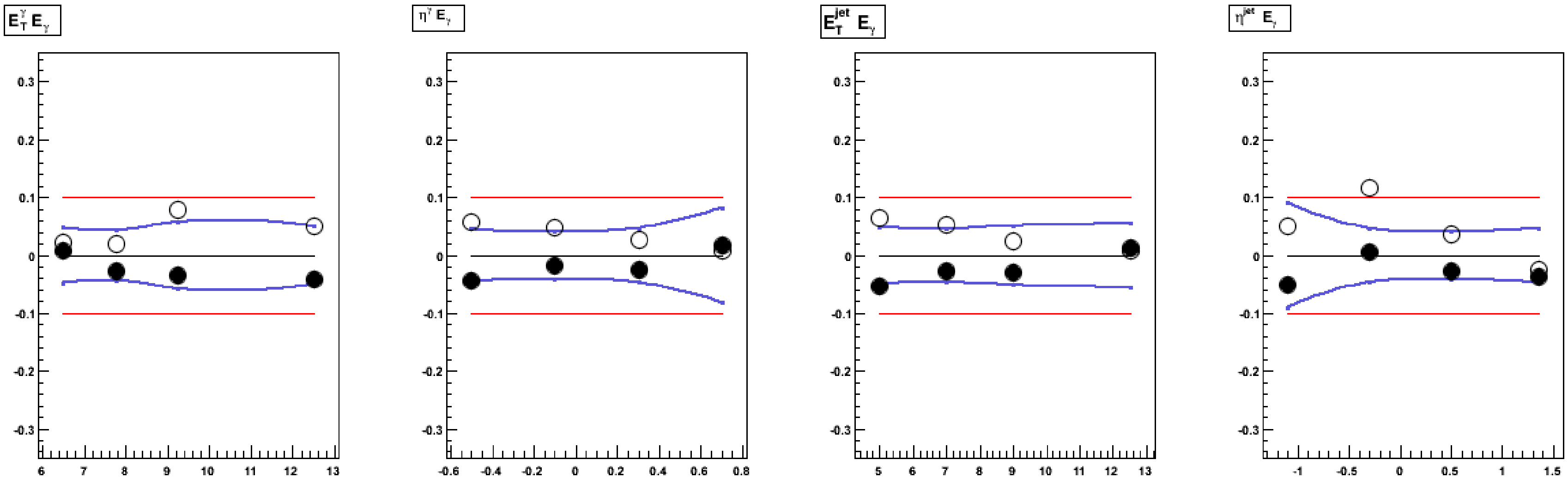
γ+jet

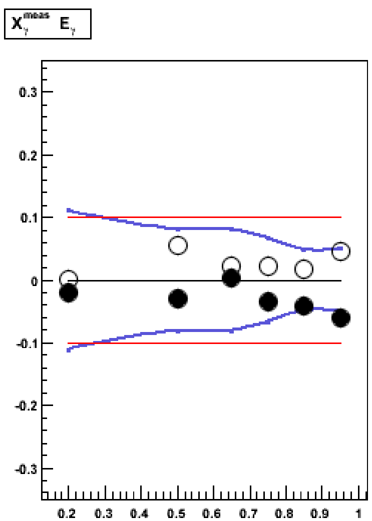


Vary Eγ by +-2% simultaneously with E-jet depending on its value: +-4% if $E_T^{jet}<6$ GeV, +-2.5% if $6<E_T^{jet}<10$ GeV +-1.5% if $E_T^{jet}>10$ GeV

Dominating systematic

Systematic uncertainties: indepentent E-γ variation





Standard cuts:

•6<E_T^{zufo}<15 GeV

Vary Eγ by +-2%

Rel.statistical uncertainties

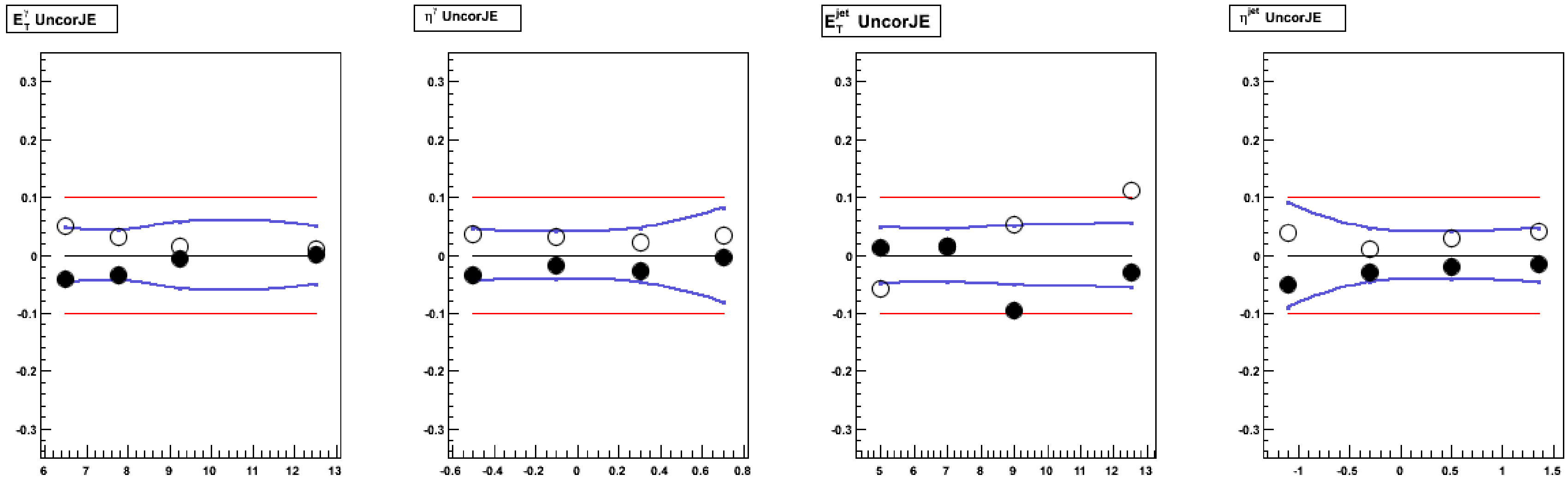
10% line

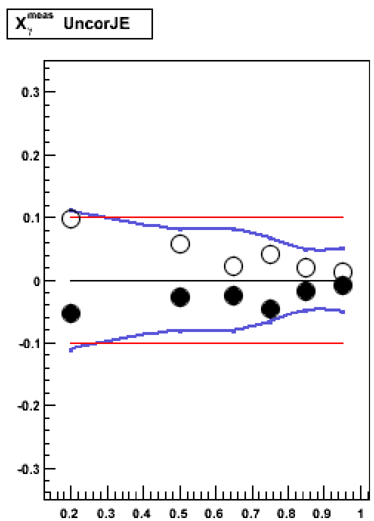
E_γ +2%

E_γ -2%

Not used for current cross-section pictures

Systematic uncertainties: indepentent E-jet variation





Standard cuts:

•$4<E_T^{jet}<35$ GeV

Rel.statistical uncertainties

10% line

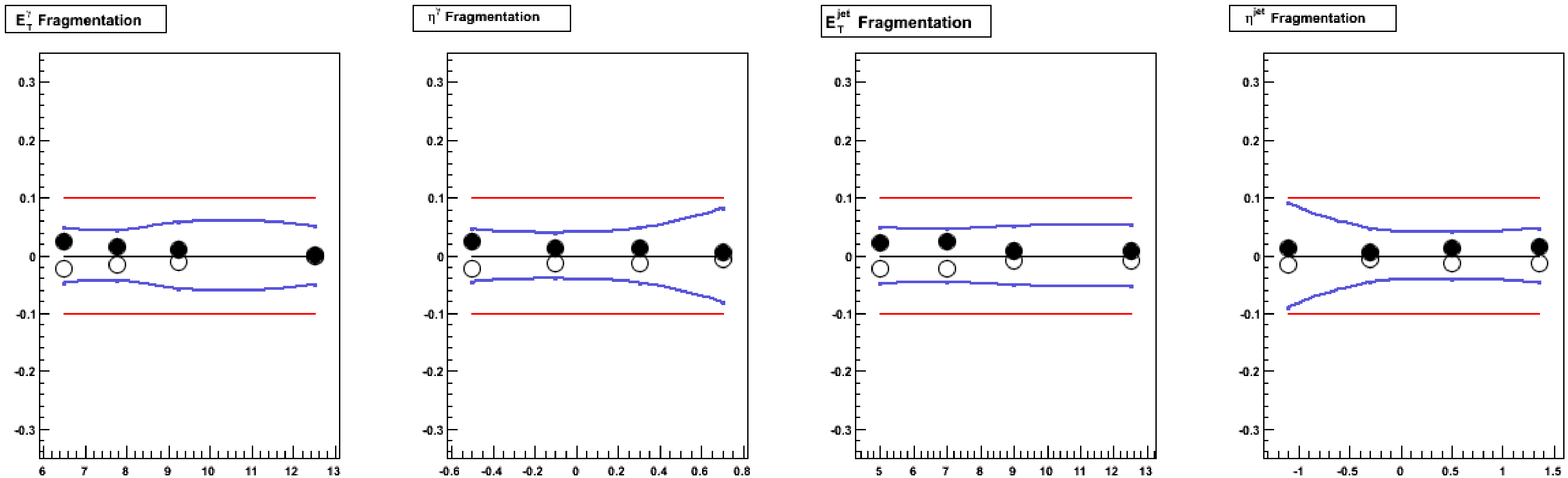
variation up

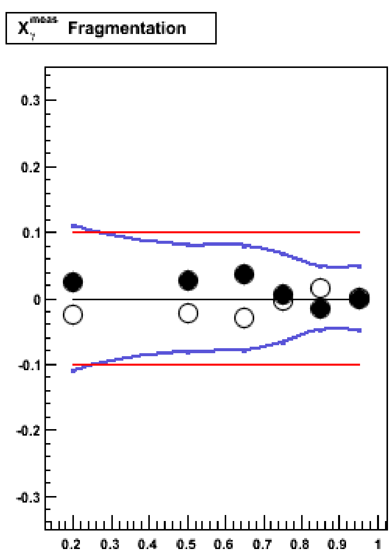
variation down

Vary Et-jet depending on its value:
+-4% if $E_T^{jet}<6$ GeV, +-2.5% if $6<E_T^{jet}<10$ GeV
+-1.5% if $E_T^{jet}>10$ GeV
AND add 2% electron uncertainty i.e.
+-6% if $E_T^{jet}<6$ GeV

Not used for current cross-section pictures

Systematic uncertainties: PYTHIA fragmentation

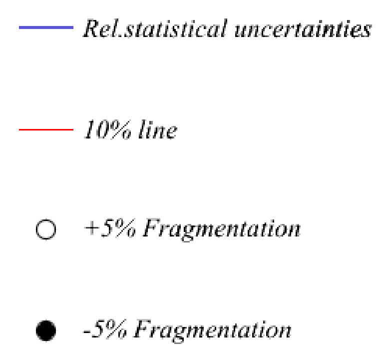




Standard value:

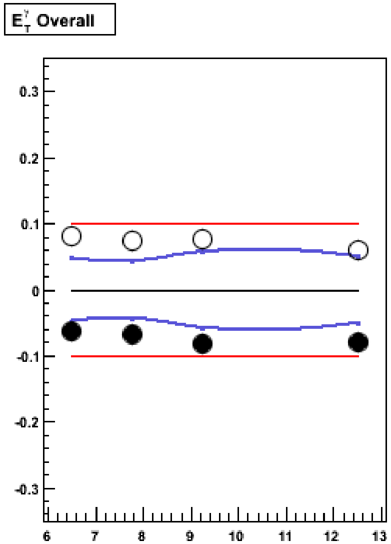
- 10%

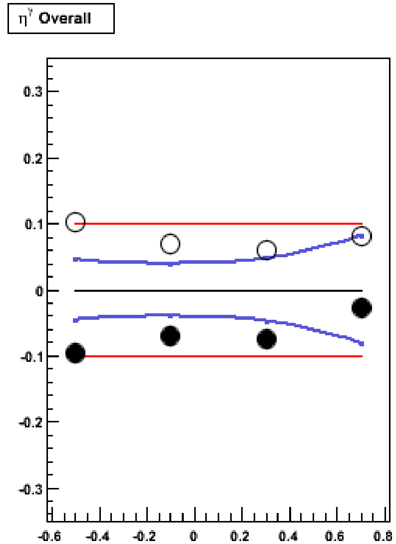
γ+jet

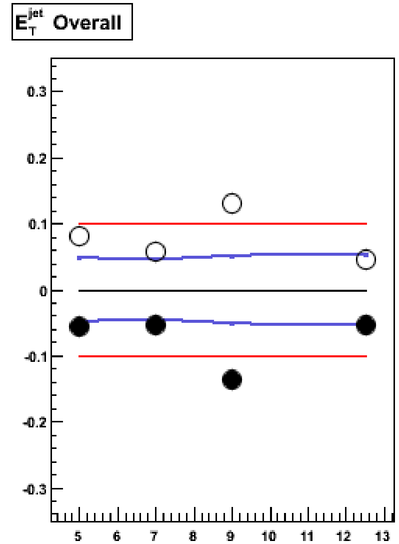


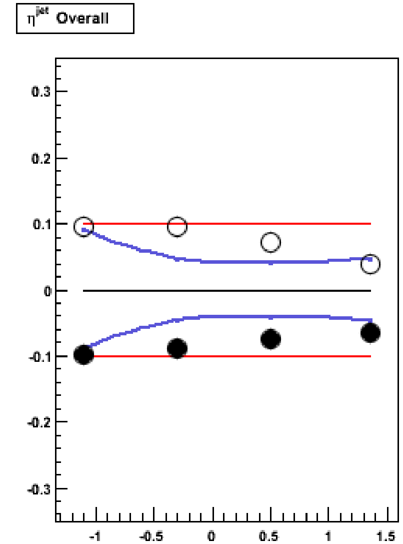
Vary fraction of fragmentation direct and resolved simultaneously by +-5%

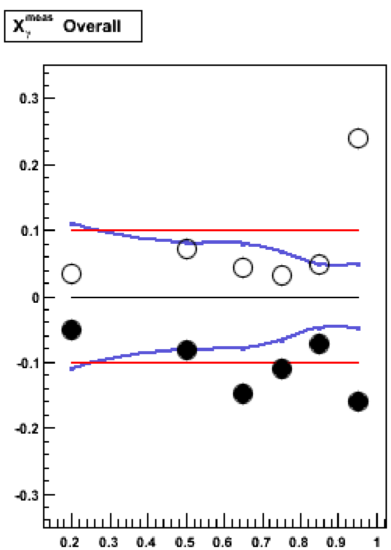
Overall Systematic uncertainties





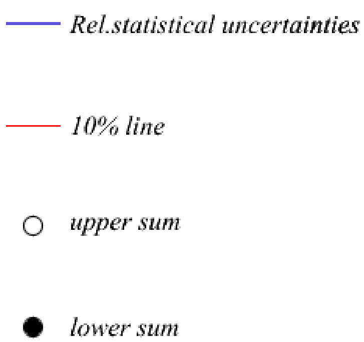




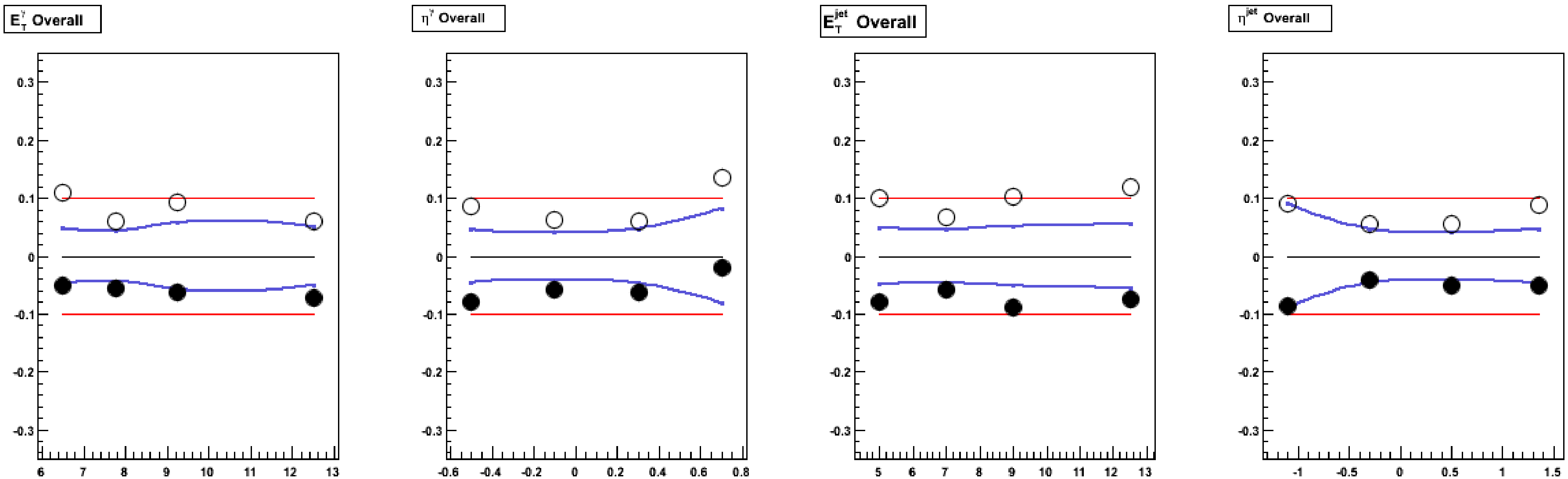


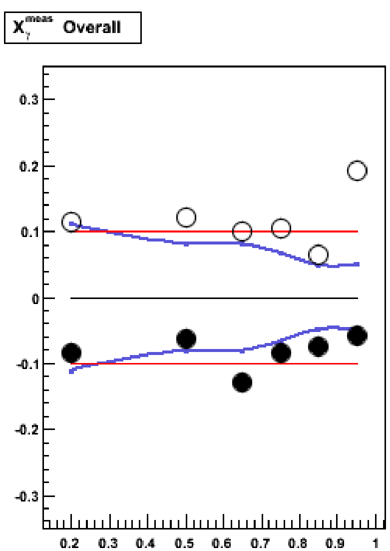
γ+jet

Systematics are close to statistical errors.
Largest contributions: from E variation overall and from HERWIG to X-gamma.

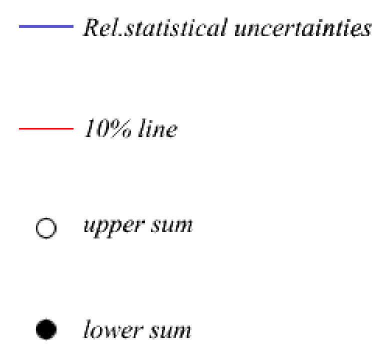


Overall Systematic uncertainties with independent E variations

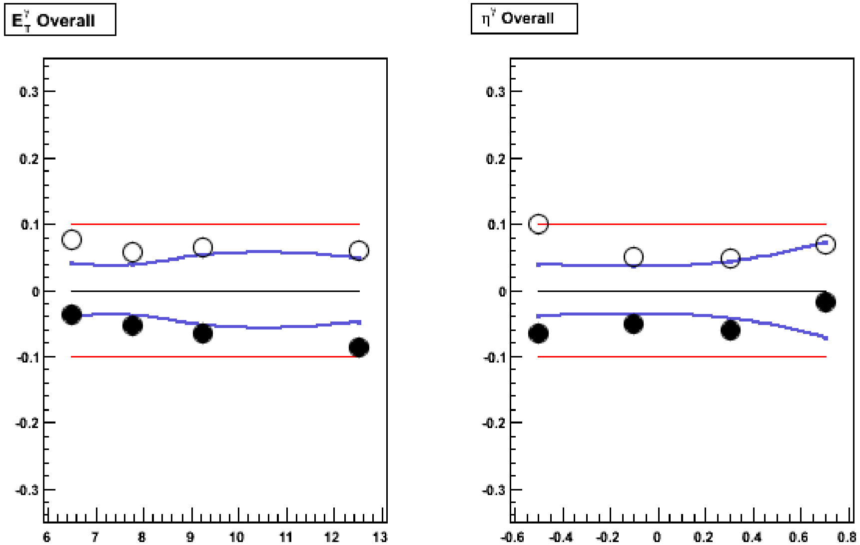




Not used for current cross-section pictures



Overall Systematic uncertainties: Inclusive γ



Rel.statistical uncertainties

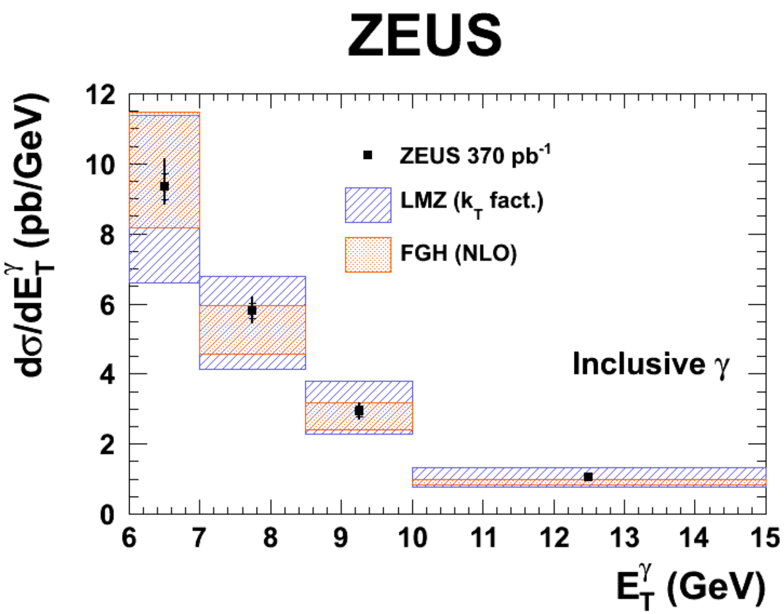
10% line

upper sum

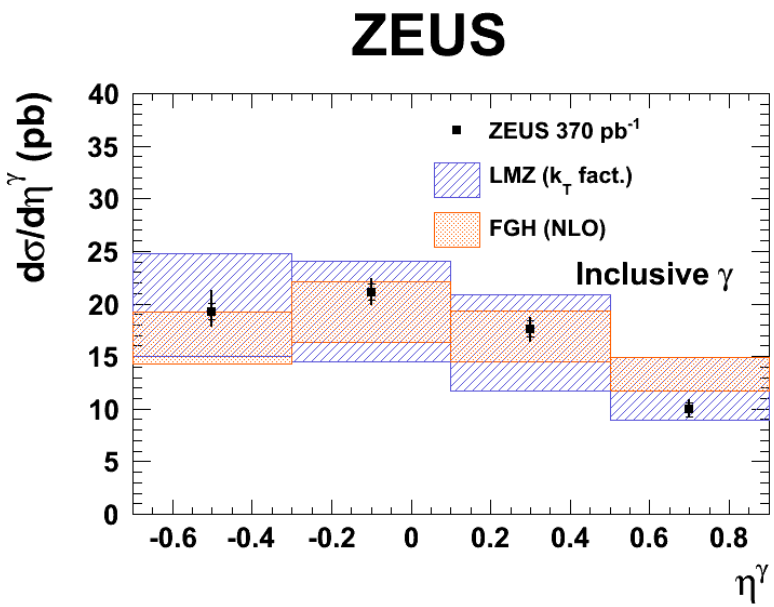
lower sum

Systematics are comparable with the statistical errors.

Inclusive cross-sections



(a)



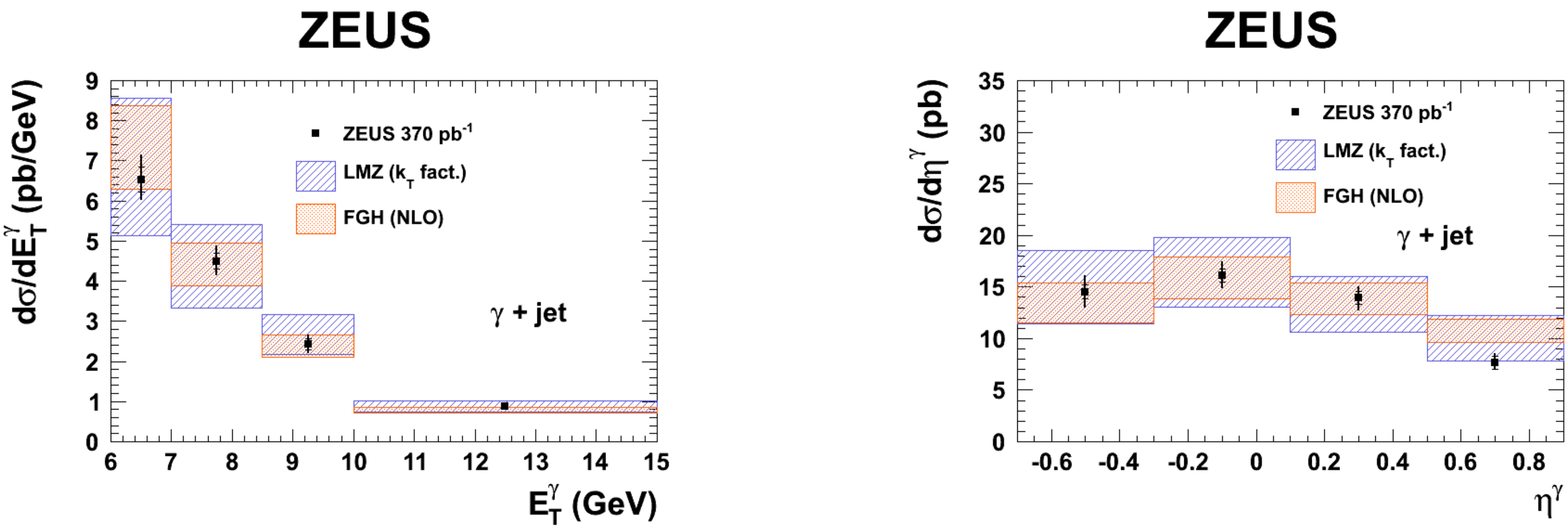
(b)

Cross sections as a function of (a) E_T^{γ} and (b) η^{γ}, for events containing an isolated photon compared to predictions from FGH and LMZ.

$$\frac{d\sigma}{dY} = \frac{\mathcal{A}\, N(\gamma)}{\mathcal{L}\, \Delta Y}$$

N(γ) is the number of photons extracted from the fit, ΔY is the bin width, L is the total integrated luminosity, and A is the acceptance correction and was calculated using Monte Carlo from the ratio of the number of events generated to those reconstructed in a given bin. Its value was typically around 1.2.

Cross sections for photon plus jet

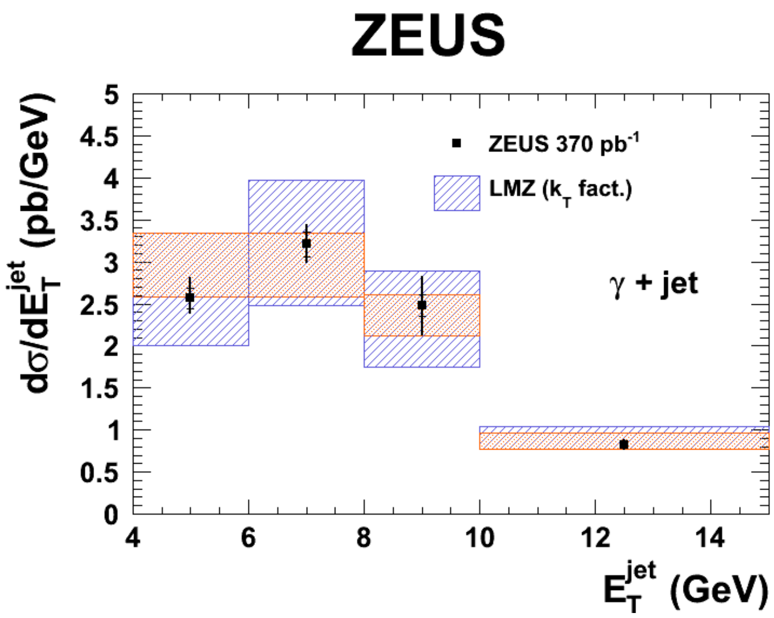


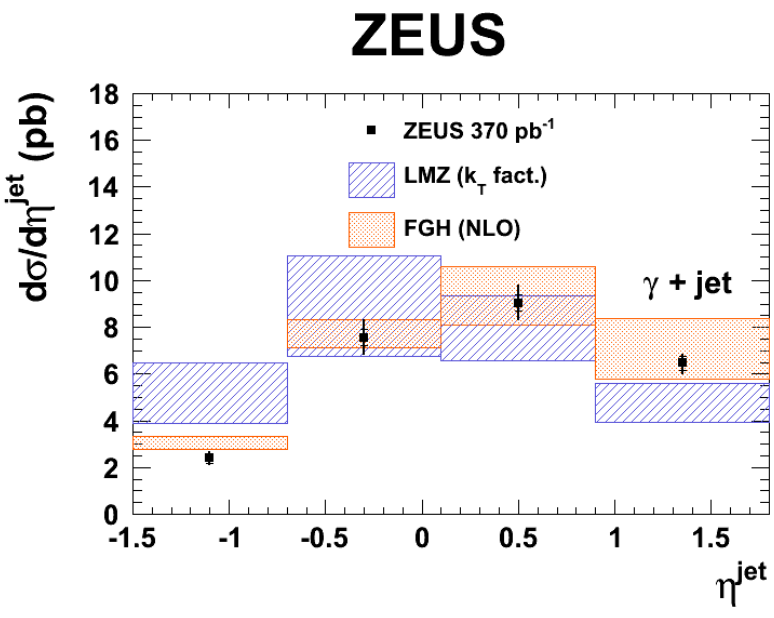
(a) (b)

Cross sections as a function of (a) E_T^{γ} and (b) η^{γ}, for events containing an isolated photon accompanied by jet compared to predictions from FGH and LMZ.

All acceptance factors were calculated using a model containing equal numbers of direct and resolved PYTHIA events and a 10% admixture of fragmentation events.

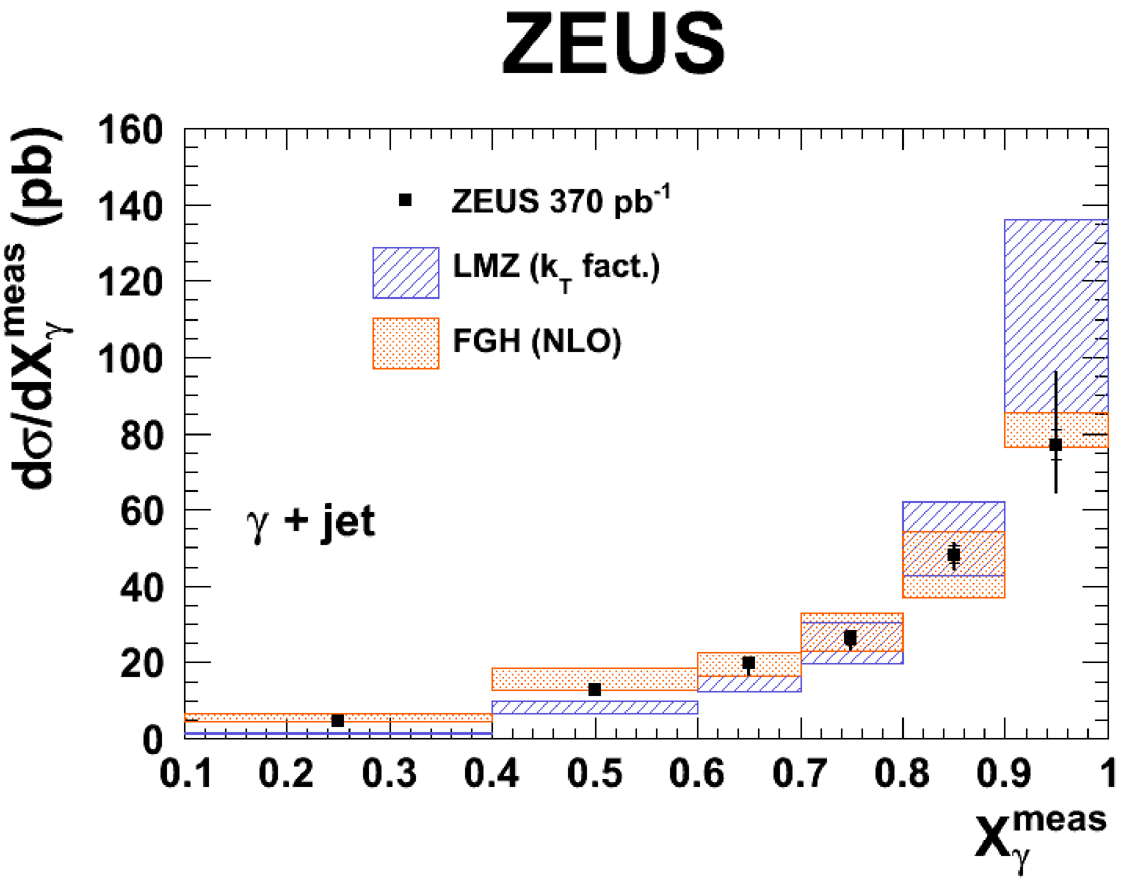
Cross sections for photon plus jet





Cross sections as a function of (a) E_T^{jet} and (b) η^{jet}, for events containing an isolated photon accompanied by jet compared to predictions from FGH and LMZ.

Cross sections for photon plus jet



Cross sections as a function of X_γ^{MEAS}, for events containing an isolated photon accompanied by jet compared to predictions from FGH and LMZ.

Summary

A complete set of photoproduction cross sections has been calculated, for inclusive prompt photons and prompt photons plus a jet.

Inclusive: Good description within errors by both theories.

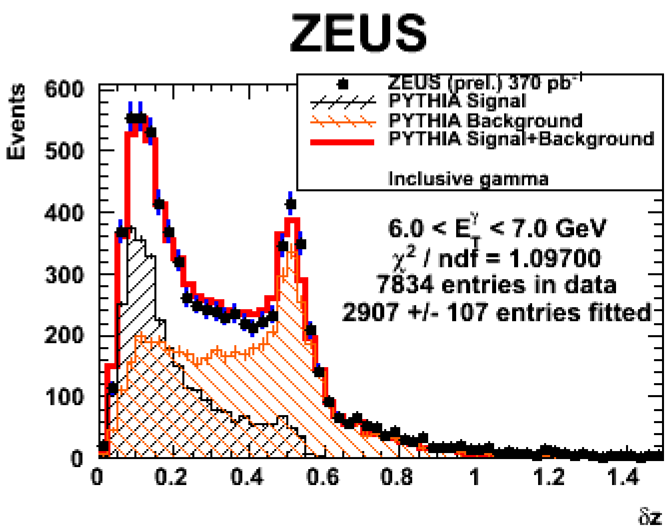
Photon+jet: LMZ is systematically low at small x-gamma and the central value is high for the x-gamma 0.9-1.0 bin.
The trend for η^{jet} is better described by FGH than LMZ.

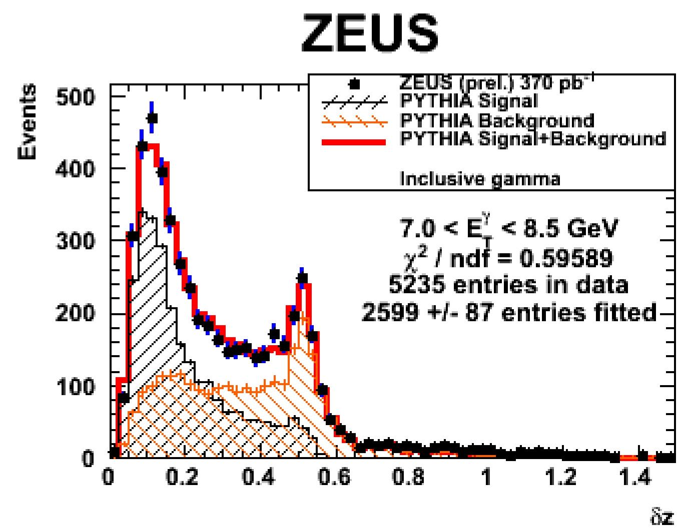
Backups

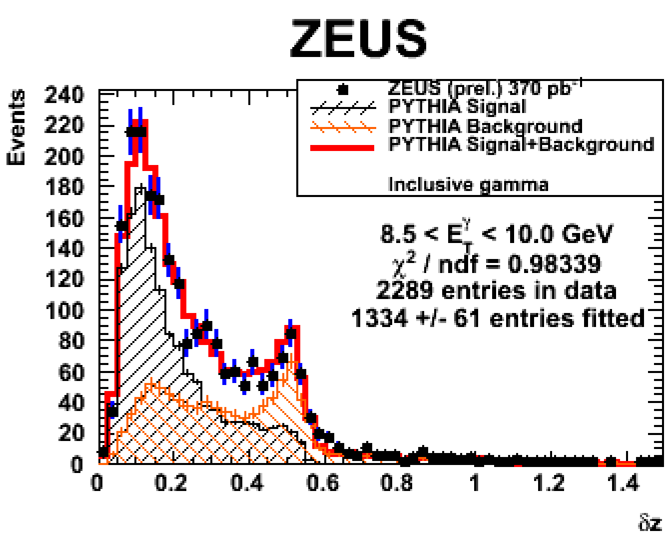
- Fits in bins of studied variables
- Inclusive systematics
- Hadronisation correction factors
- Acceptance
- E scale systematic
- Post-fitting comparison with the PYTHIA model
- PYTHIA and HERWIG X-gamma
- Comparison between analyses

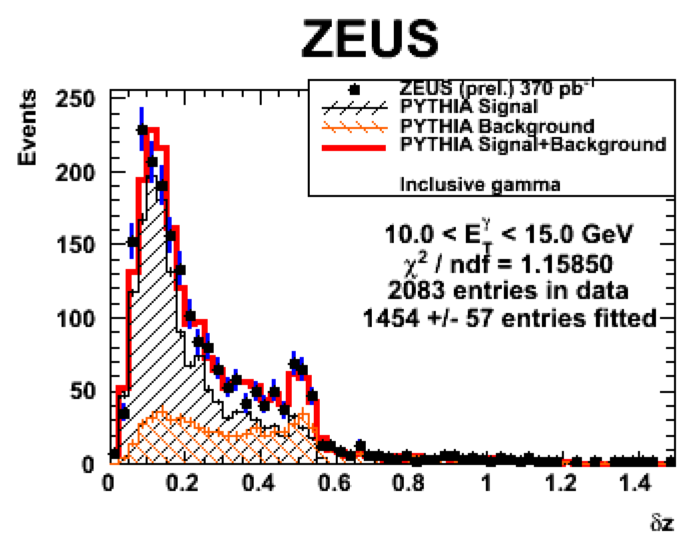
Fits in bins of studied variables

Fits in bins (Inclusive)

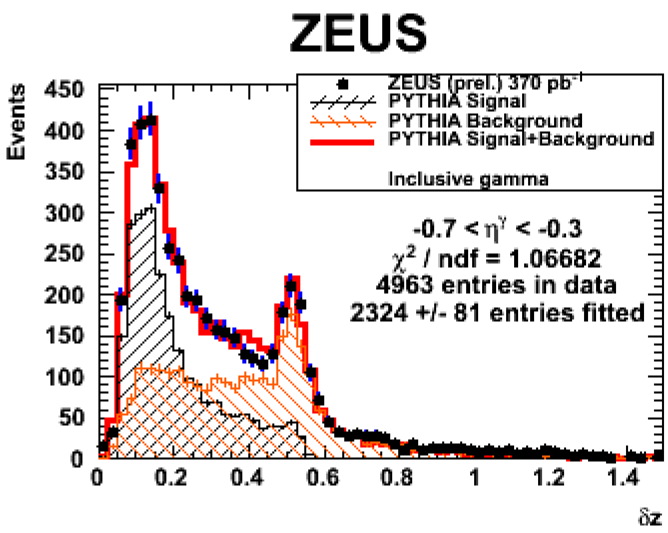


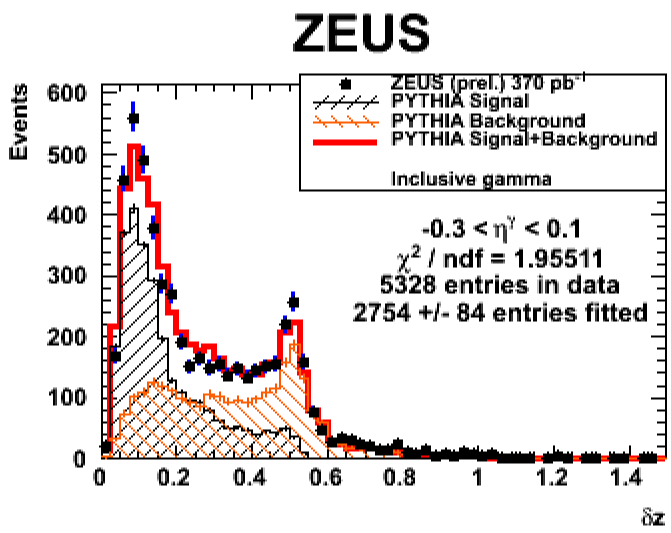


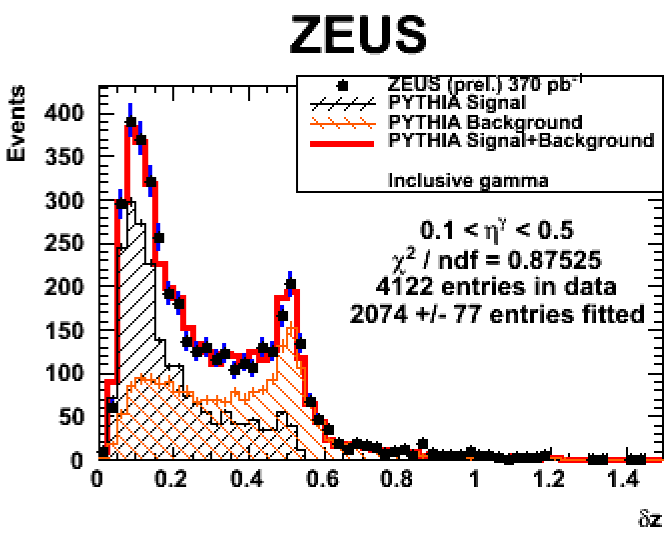


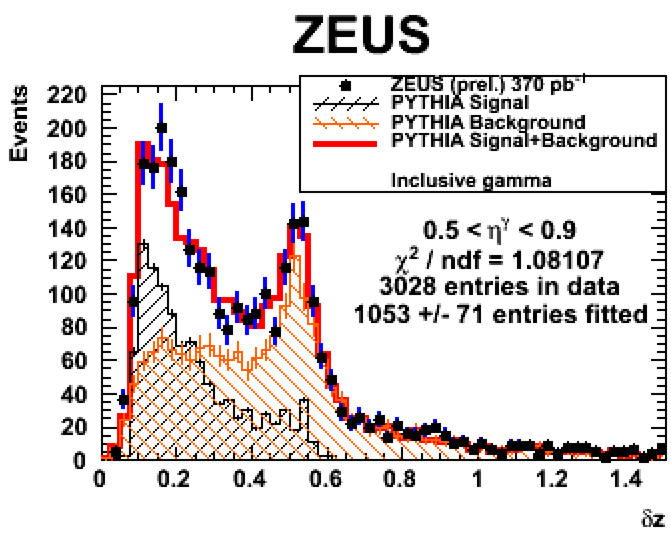


Fits in bins (Inclusive)

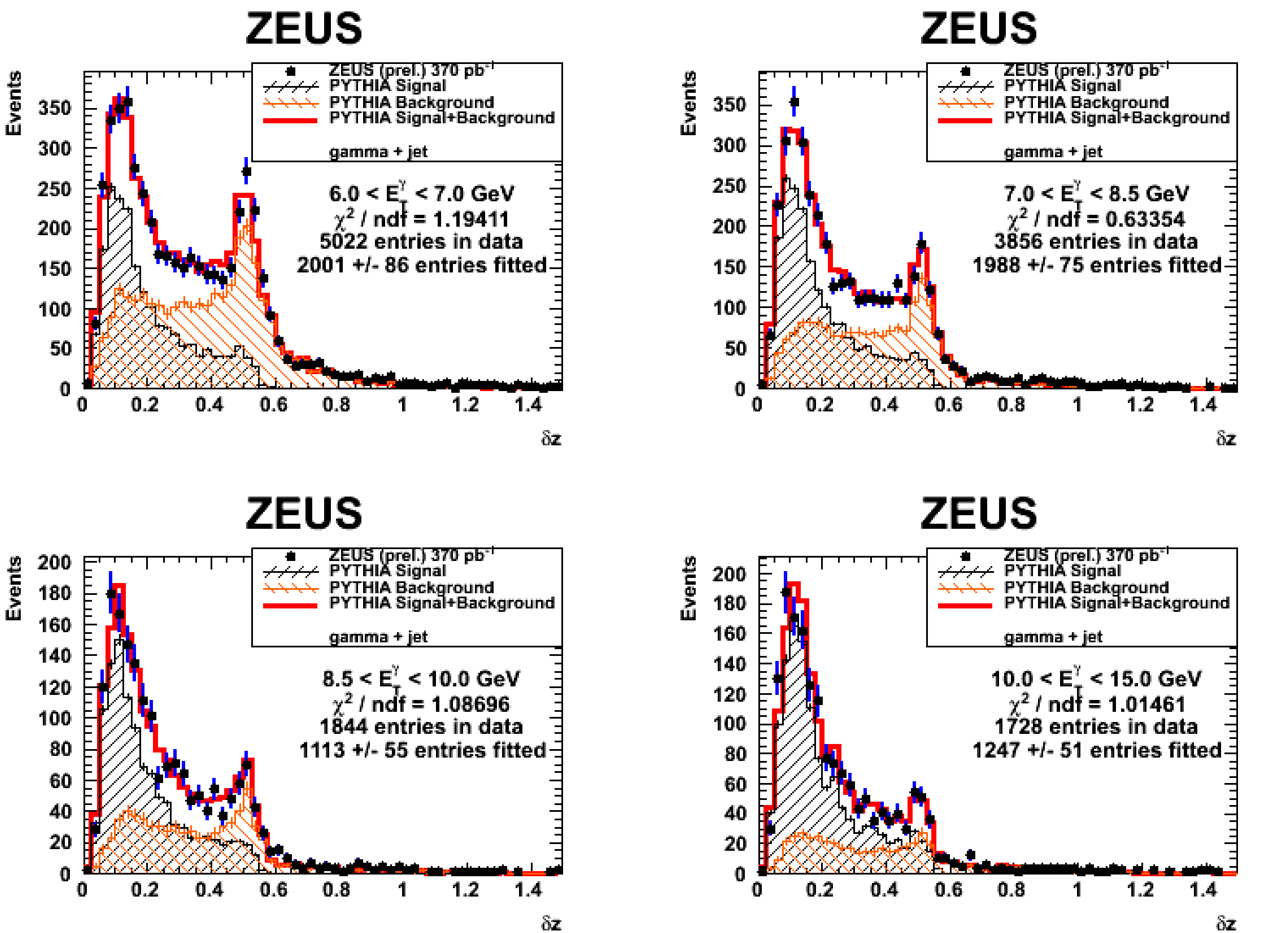




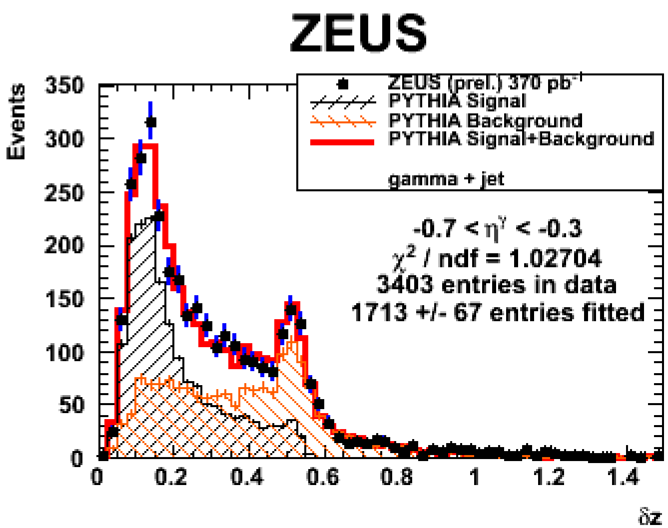


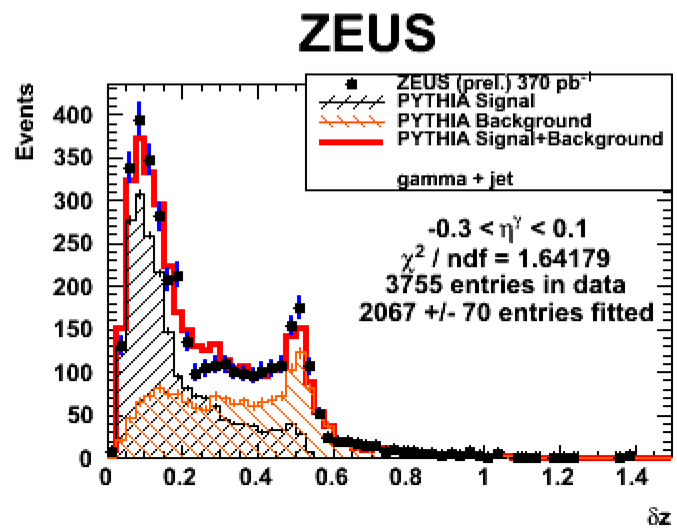


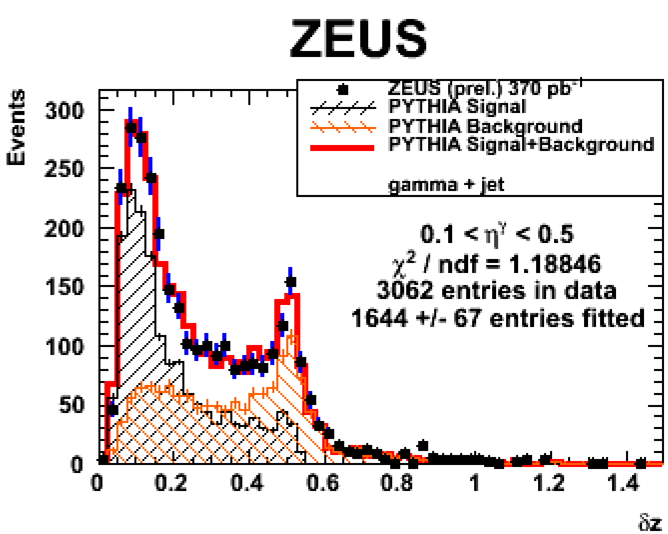
Fits in bins (photon+jet)

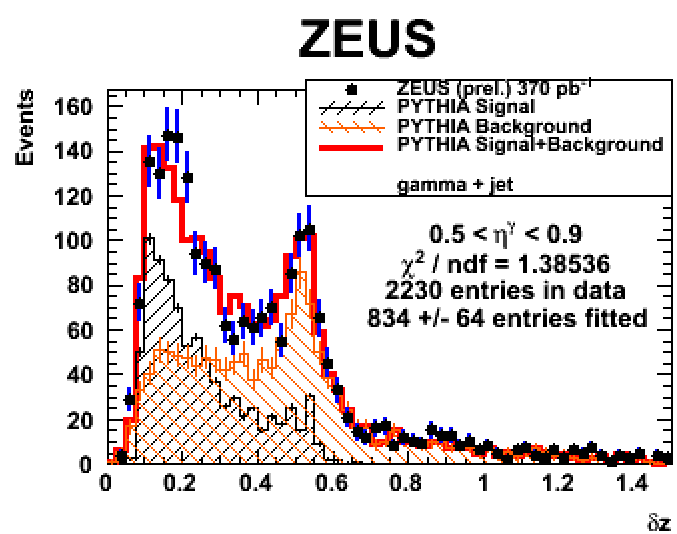


Fits in bins (photon+jet)

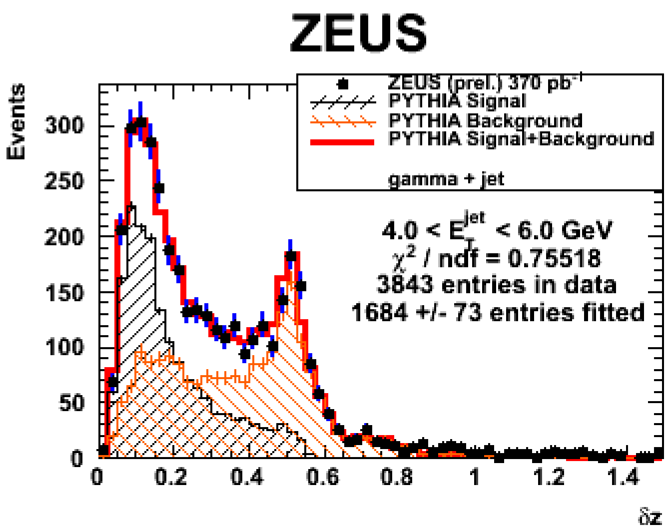


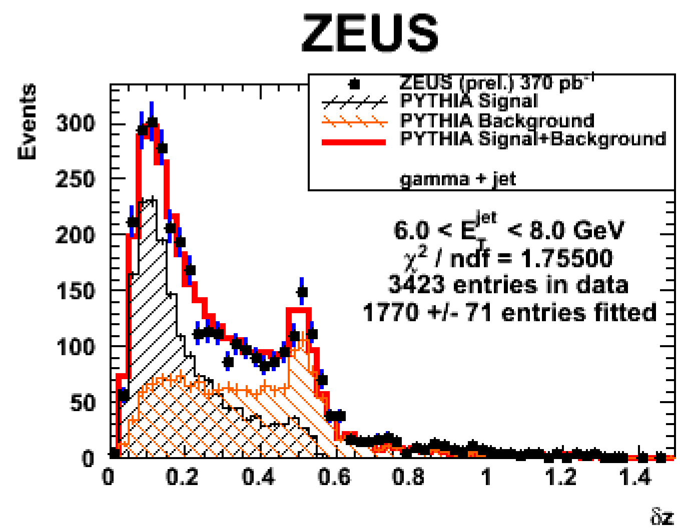


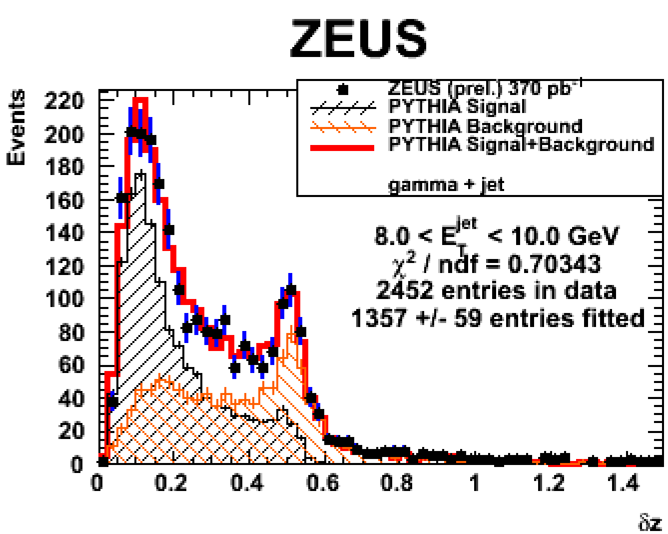


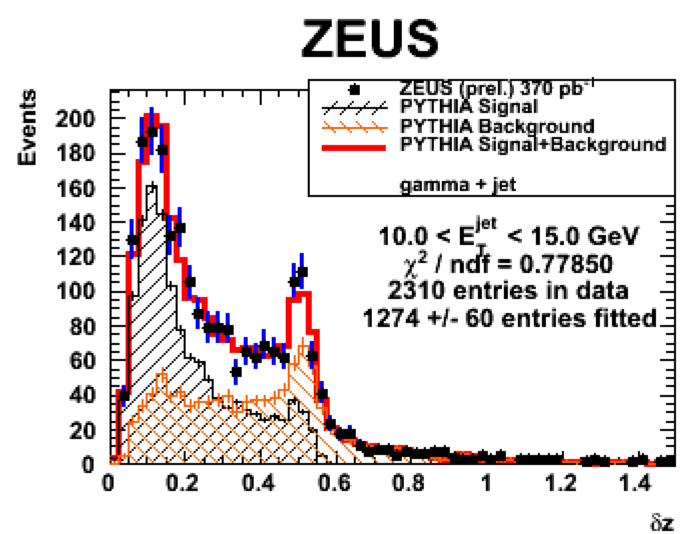


Fits in bins (photon+jet)

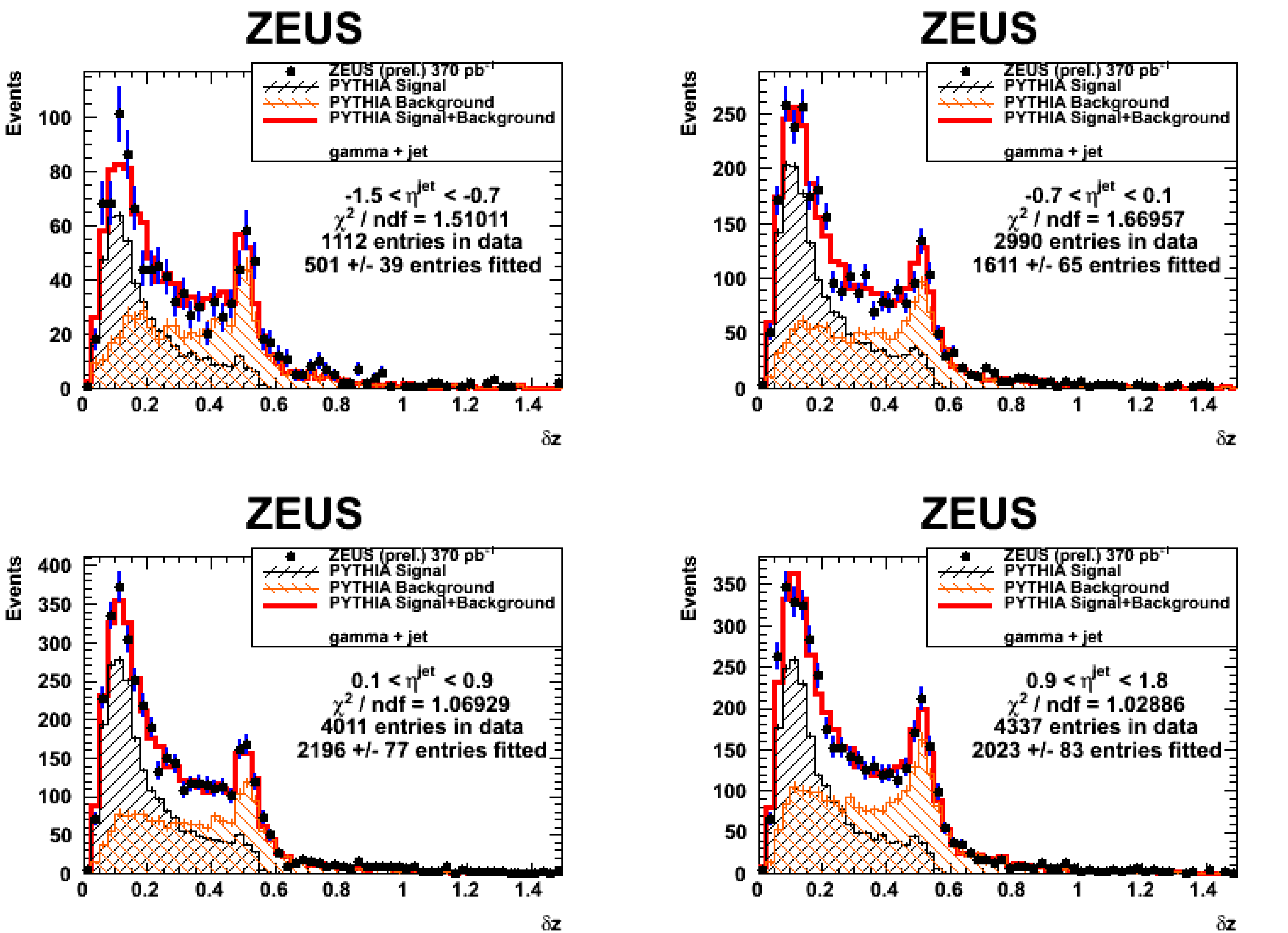




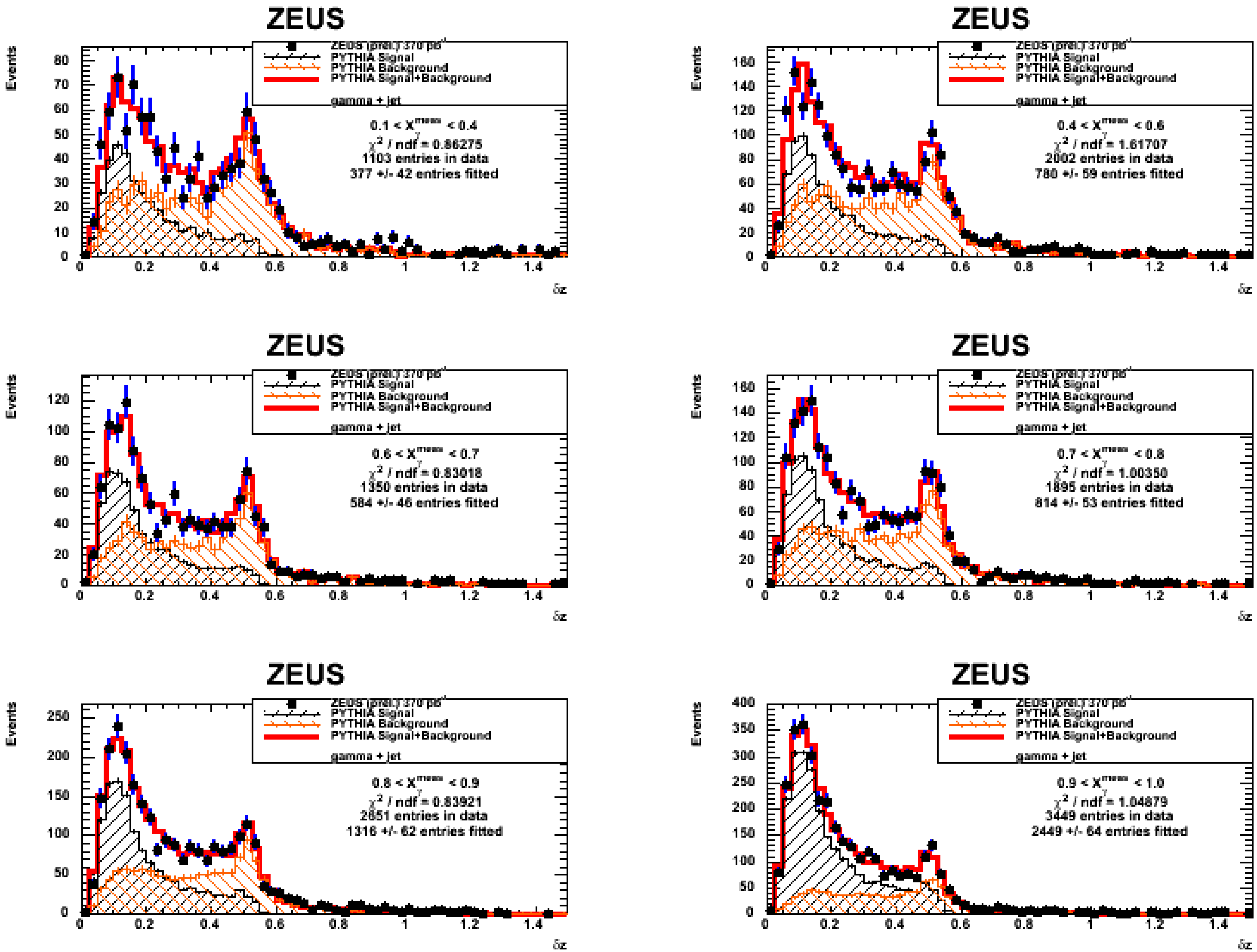




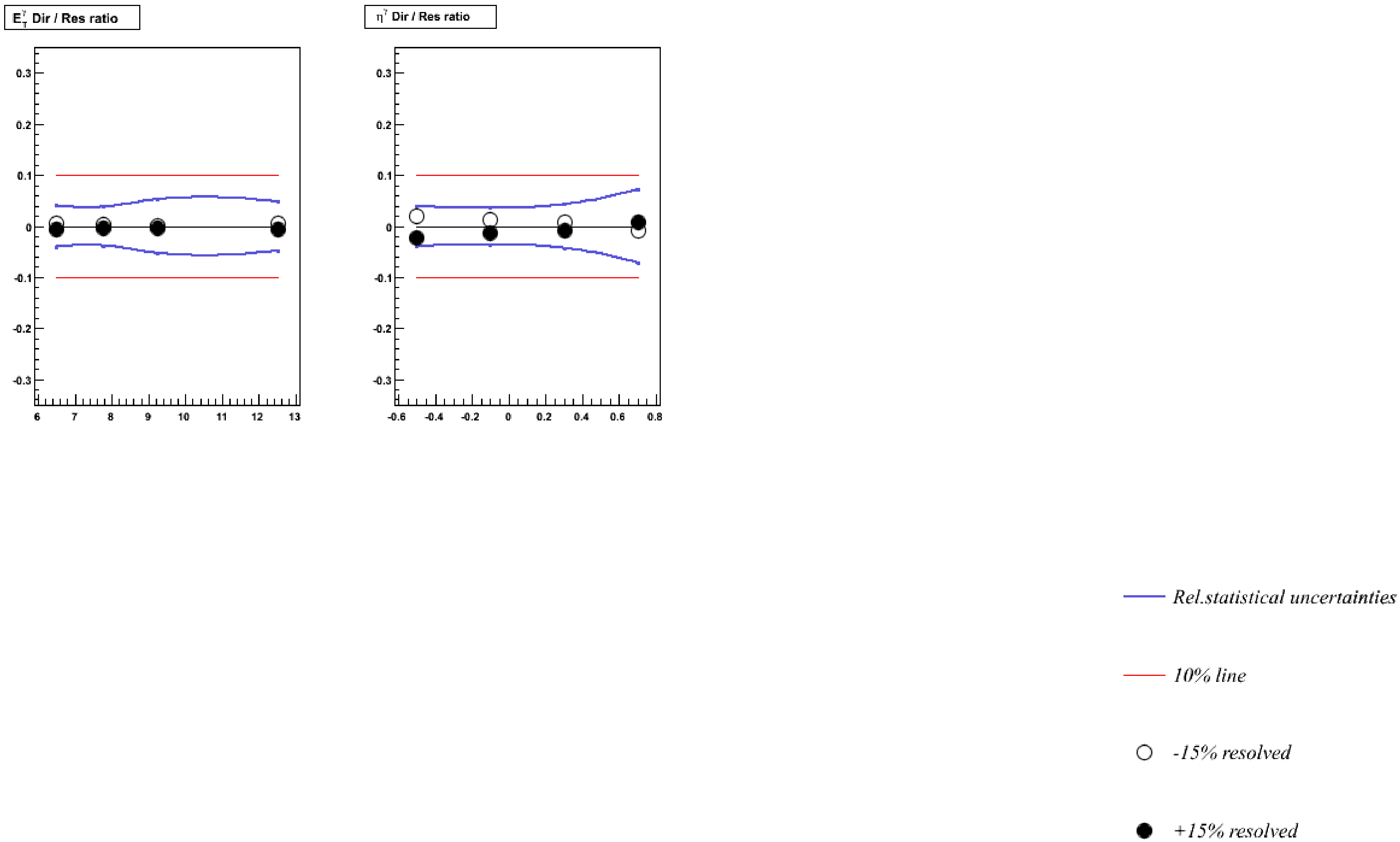
Fits in bins (photon+jet)

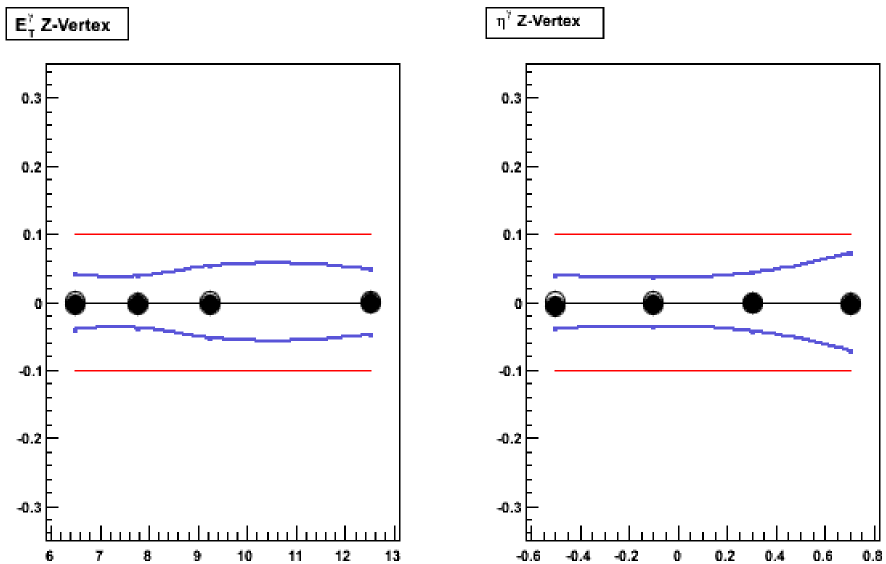


Fits in bins (photon+jet)



Inclusive systematics


E_T^γ Dir / Res ratio
η^γ Dir / Res ratio
Rel.statistical uncertainties
10% line
-15% resolved
+15% resolved

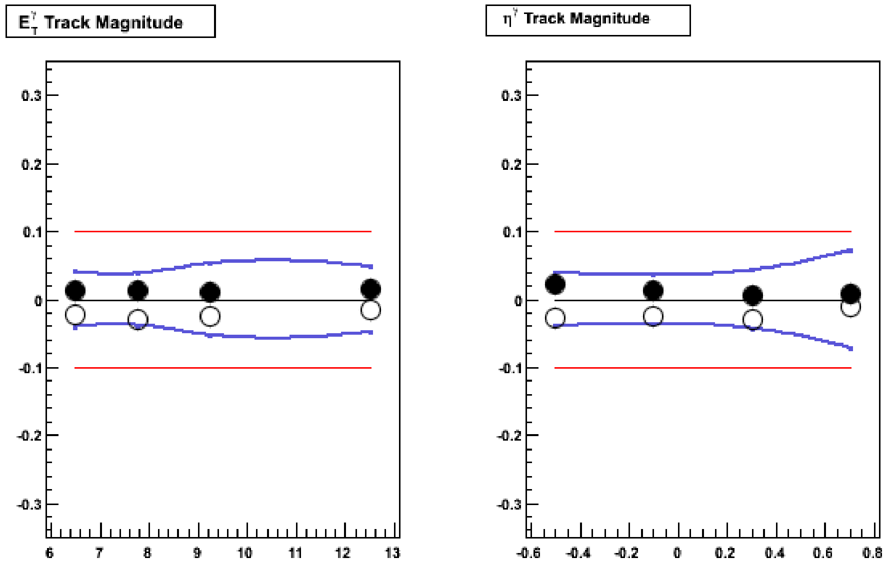


Rel.statistical uncertainties

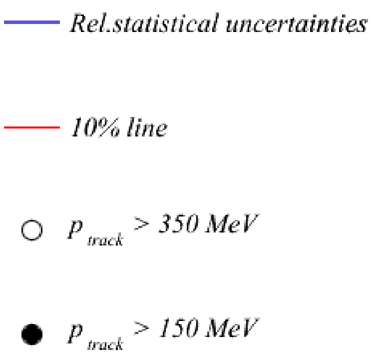
10% line

○ $|Z_{vertex}|<45$

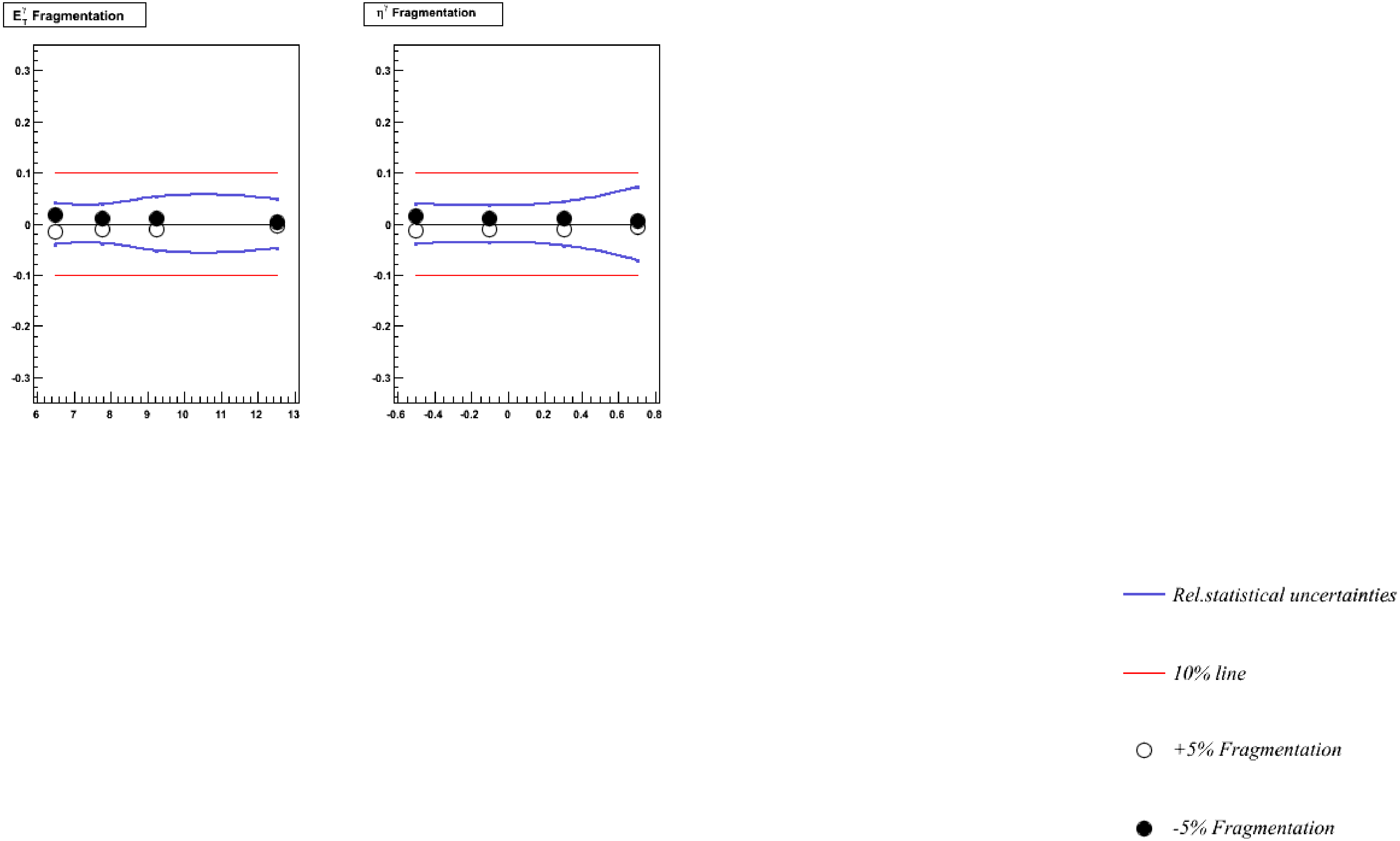
● $|Z_{vertex}|<35$

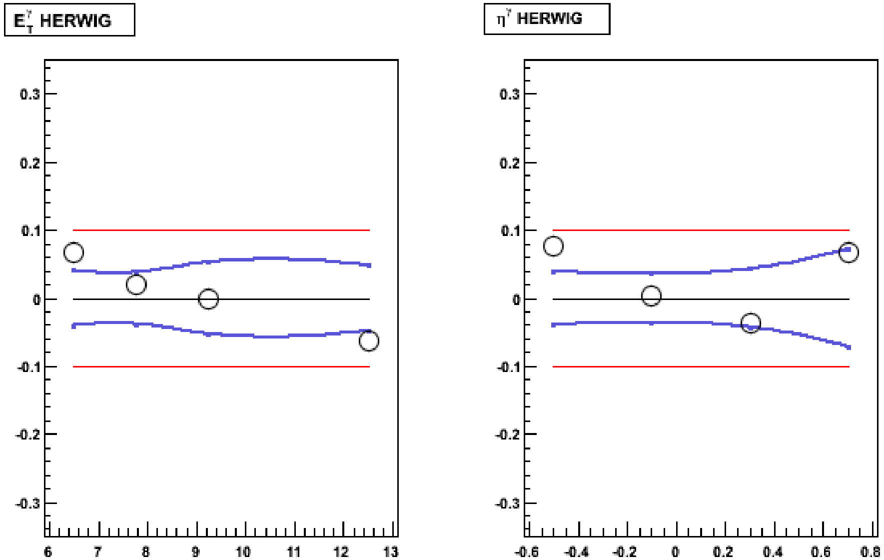


E_T^γ Track Magnitude
η^γ Track Magnitude
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
6 7 8 9 10 11 12 13
-0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8



Rel.statistical uncertainties
10% line
p_{track} > 350 MeV
p_{track} > 150 MeV

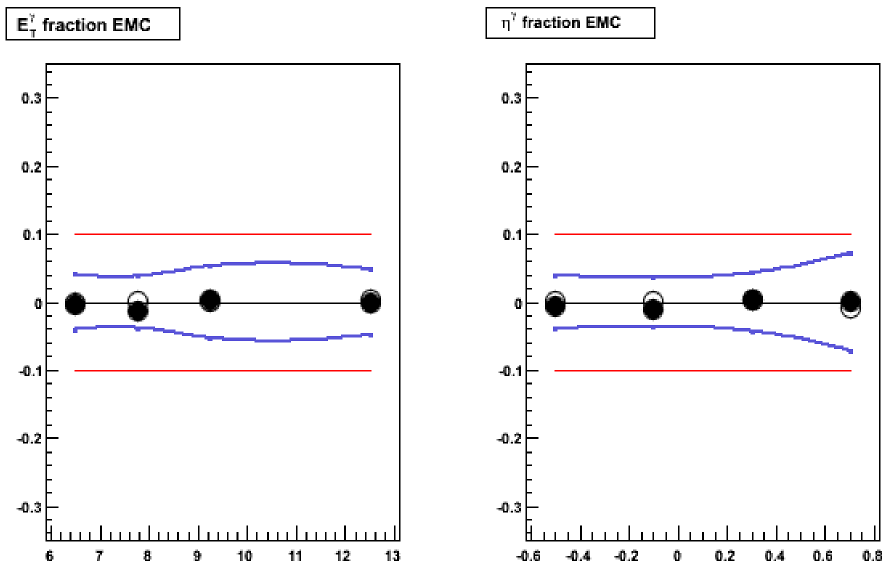

E_T^{γ} Fragmentation
η^{γ} Fragmentation
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
6
7
8
9
10
11
12
13
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
Rel.statistical uncertainties
10% line
+5% Fragmentation
-5% Fragmentation



Rel.statistical uncertainties

10% line

○ *HERWIG*

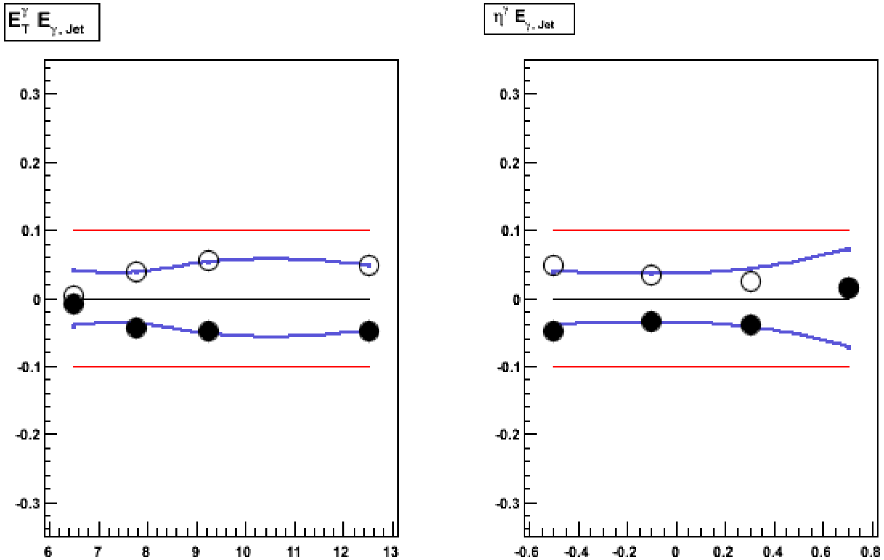


Rel.statistical uncertainties

10% line

Fraction EMC +0.025

Fraction EMC -0.025

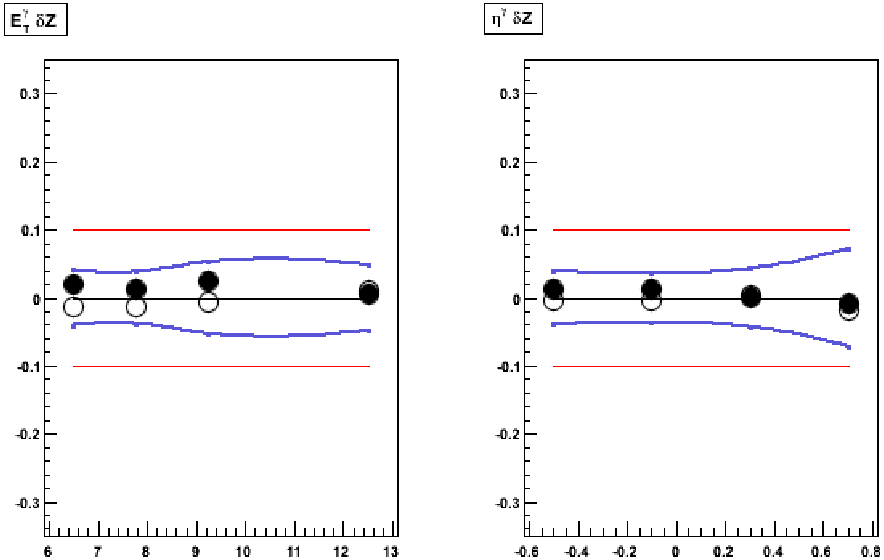


Rel.statistical uncertainties

10% line

up. limit

low. limit

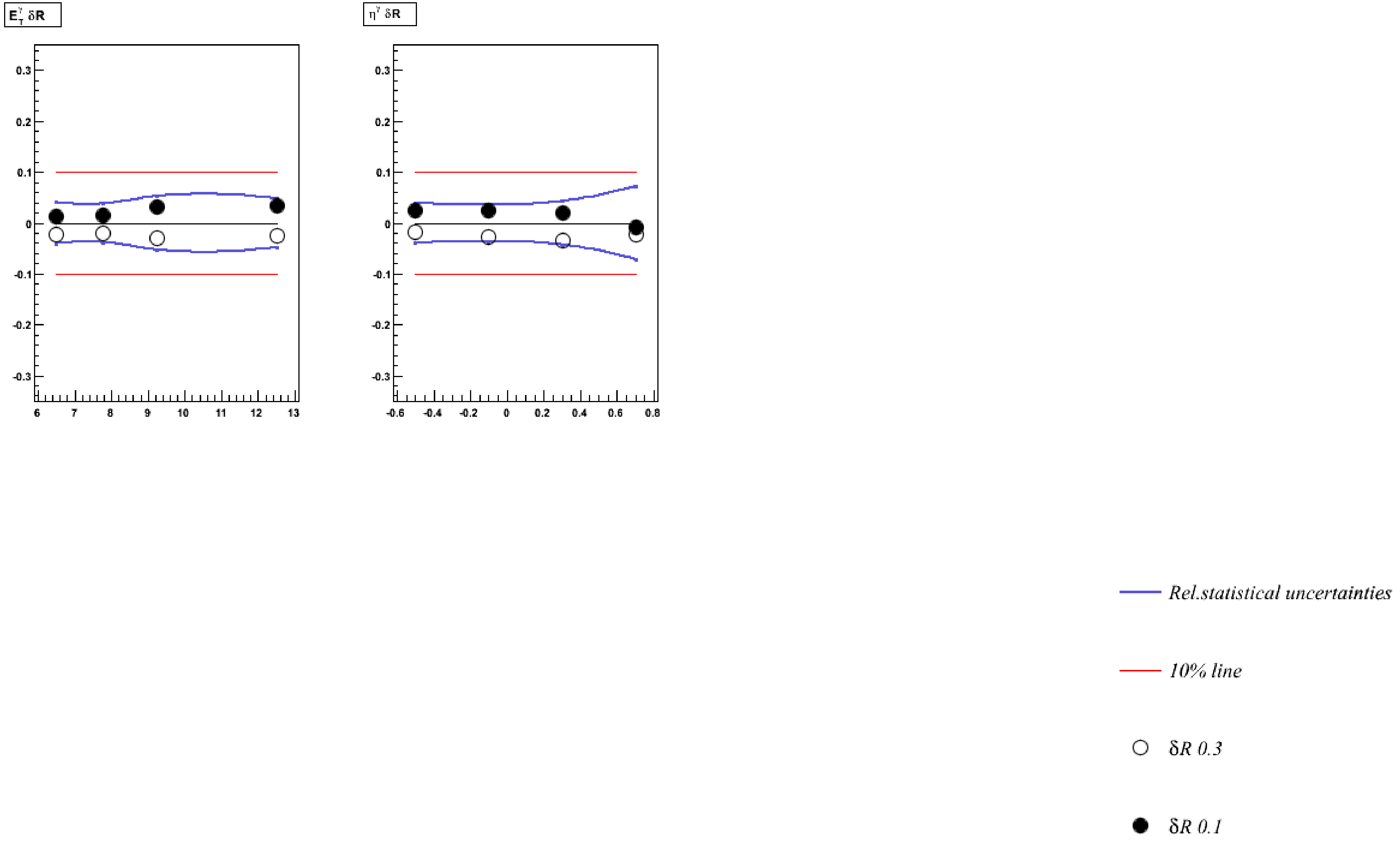


Rel.statistical uncertainties δZ

10% line

○ *δZ fit range 1.0*

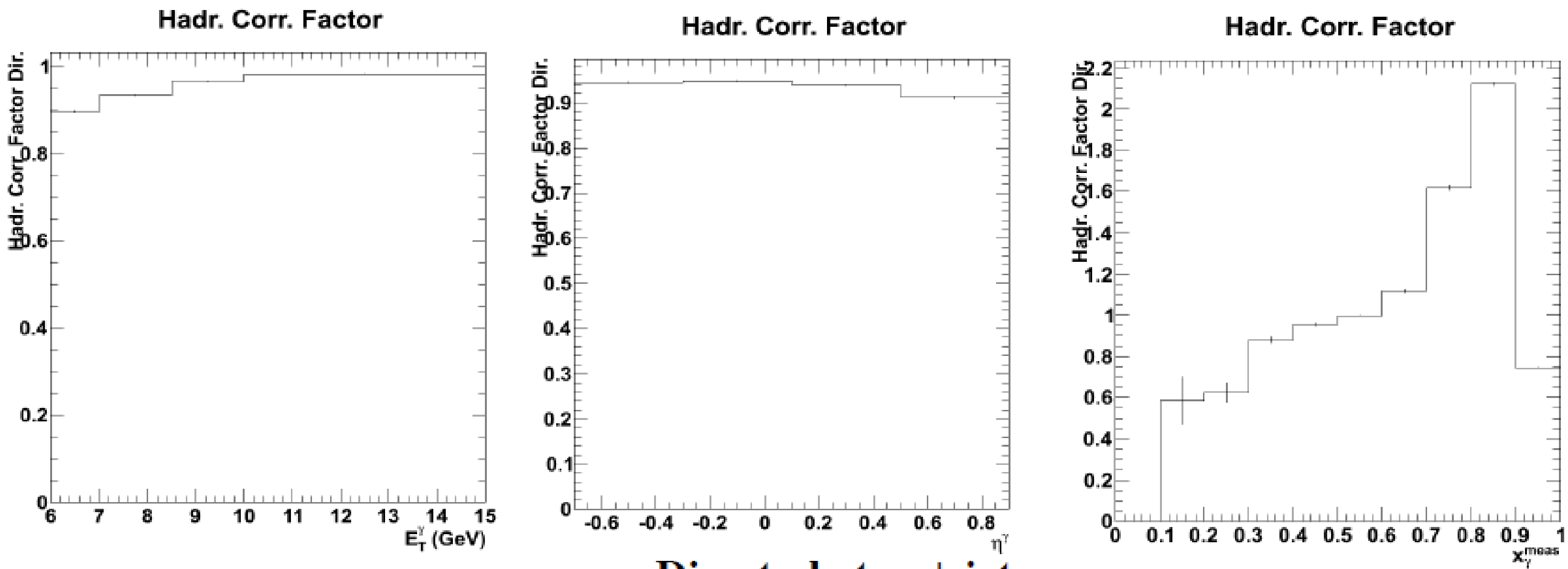
● *δZ fit range 0.6*



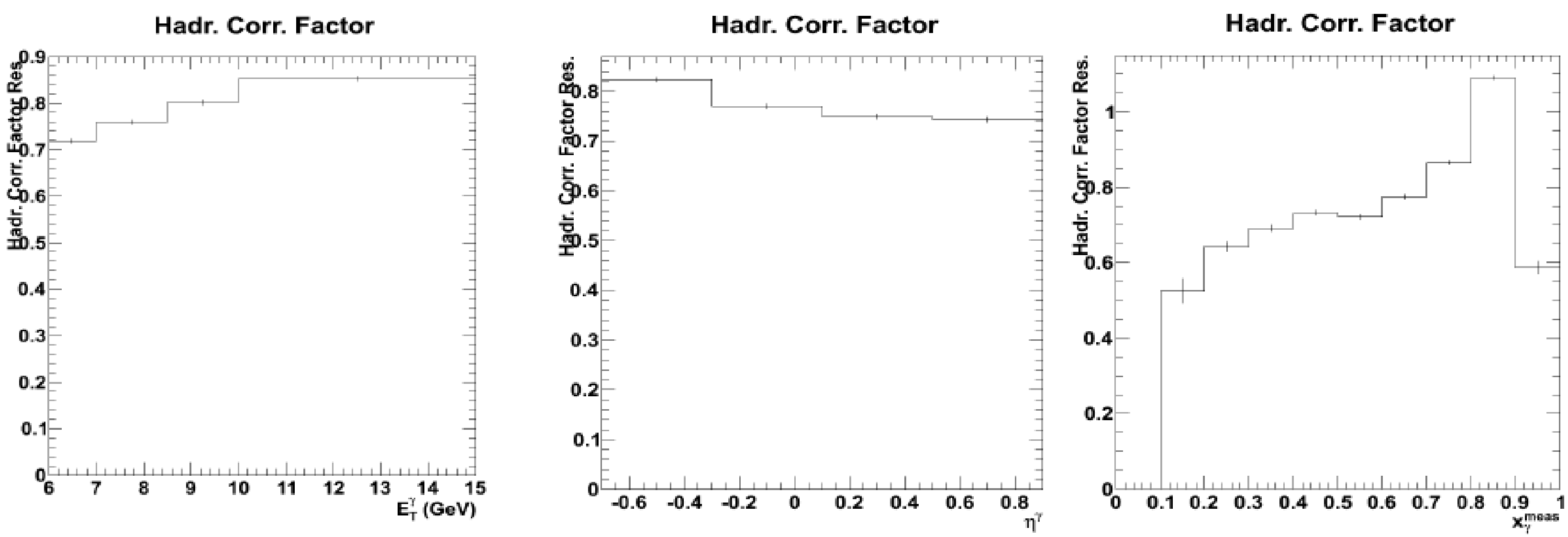
E$_T^\gamma$ δR
η$^\gamma$ δR
Rel.statistical uncertainties
10% line
δR 0.3
δR 0.1

Hadronisation correction factors

PYTHIA Correction factors

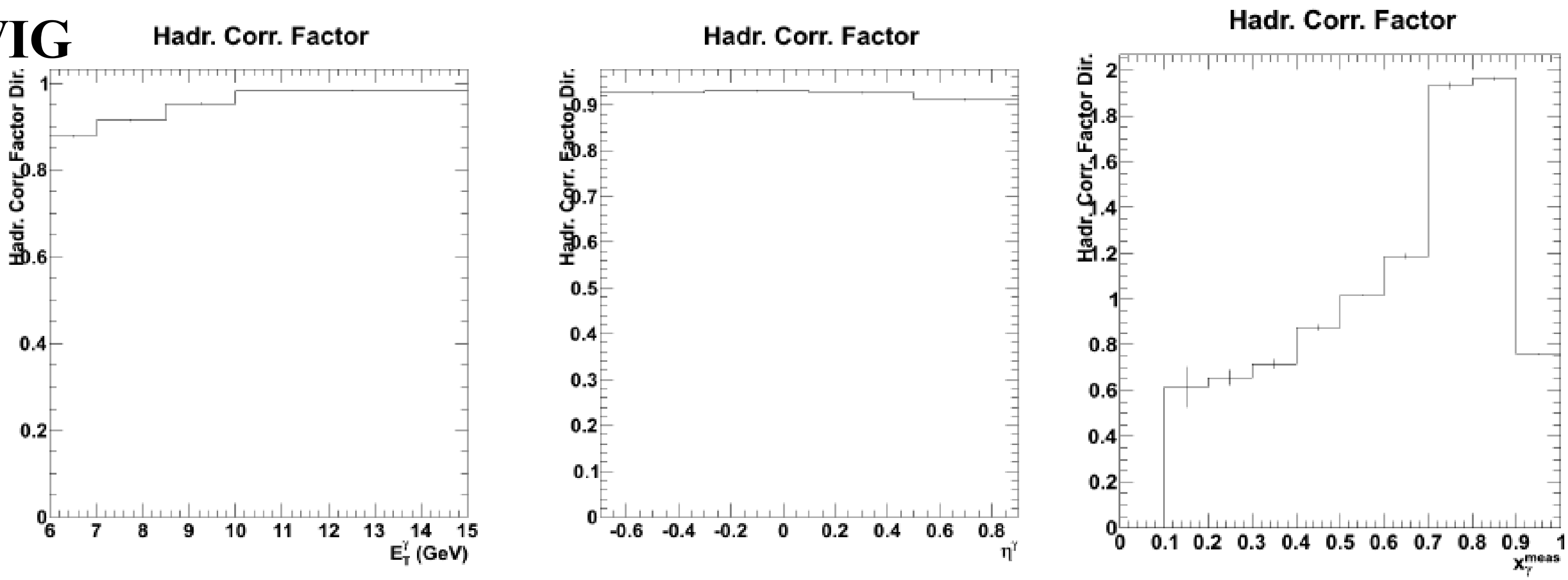


Direct photon + jet

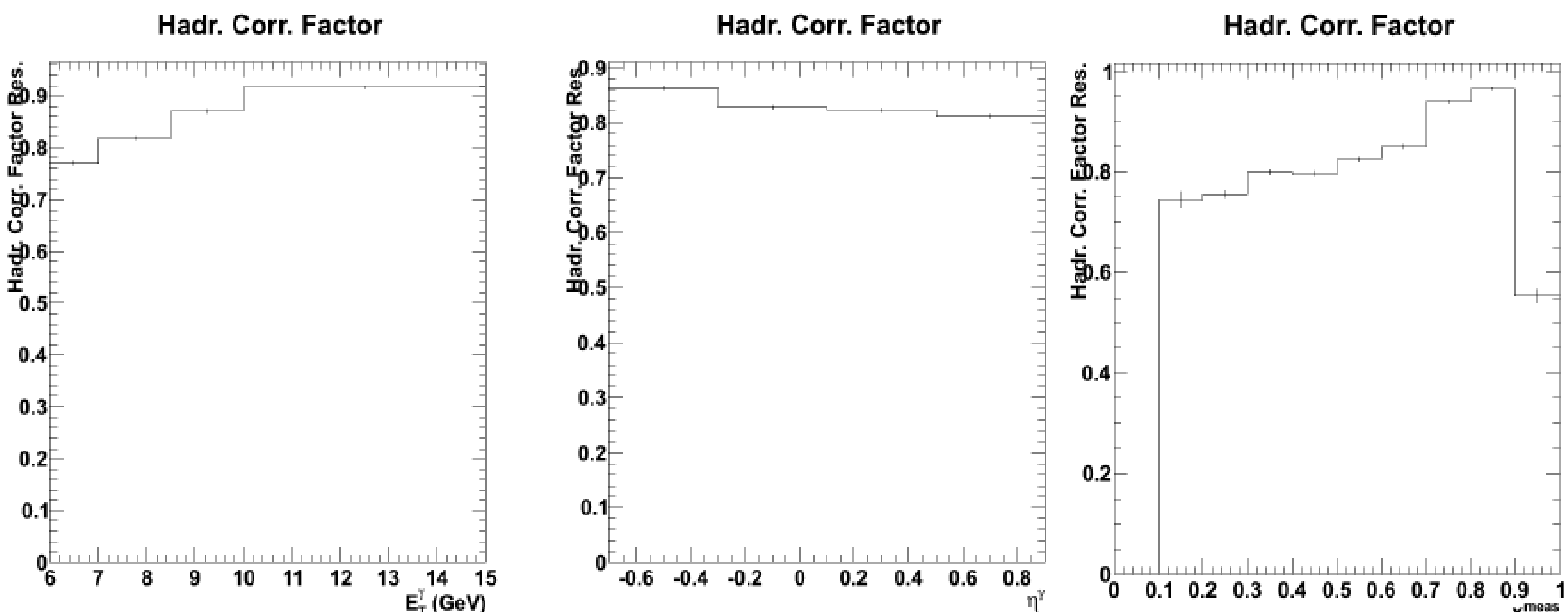


Resolved photon + jet

HERWIG



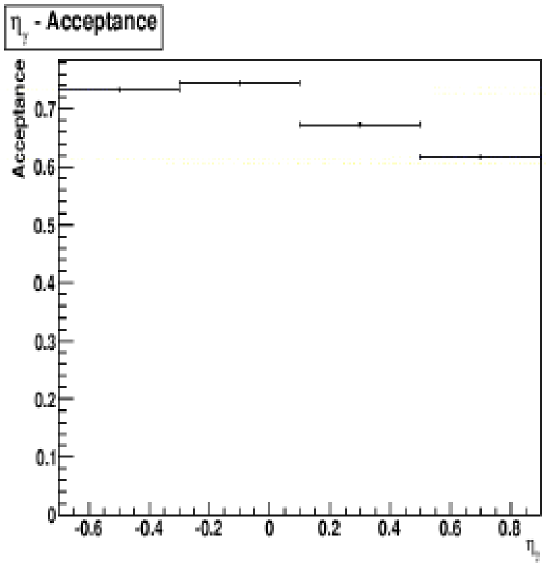
Direct photon + jet

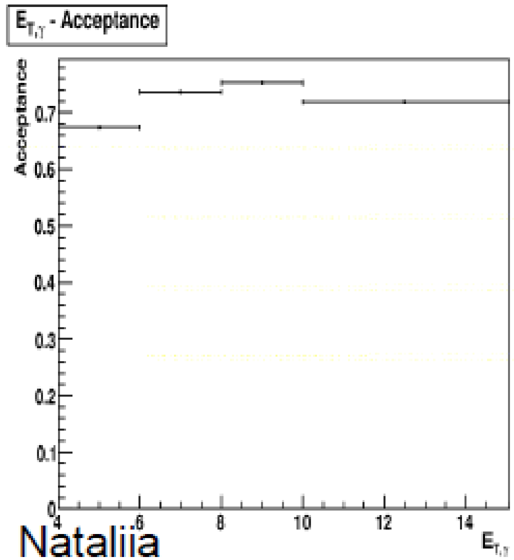


Resolved photon + jet

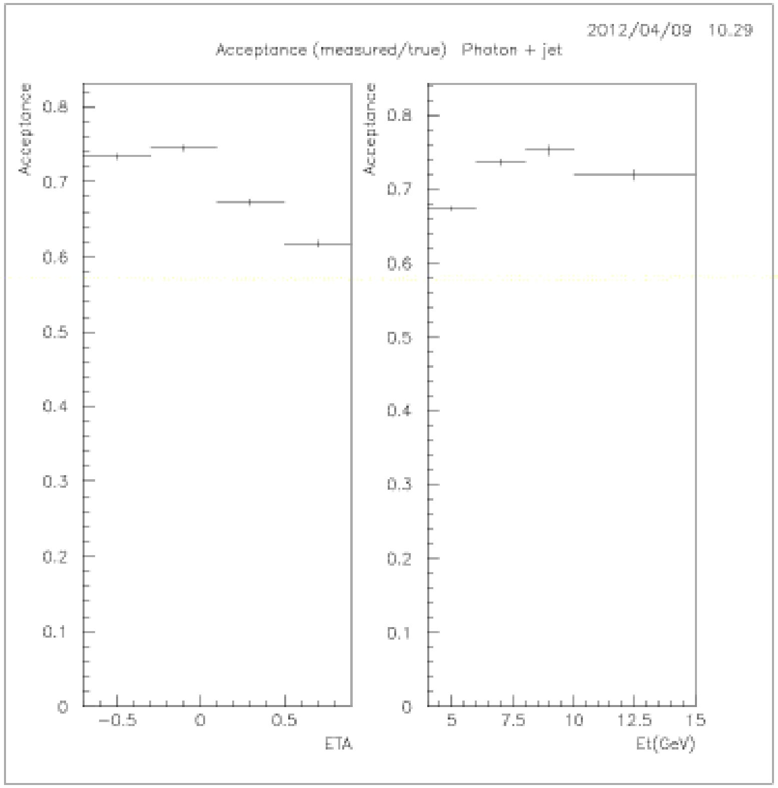
Acceptance

MC signal direct acceptance (photon + jet)

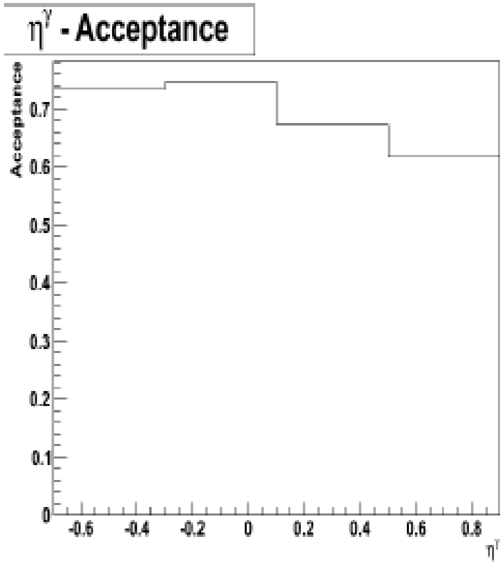


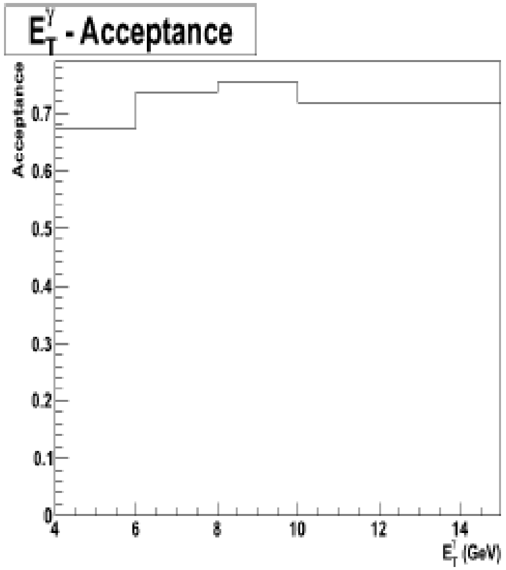


Nataliia



Ian

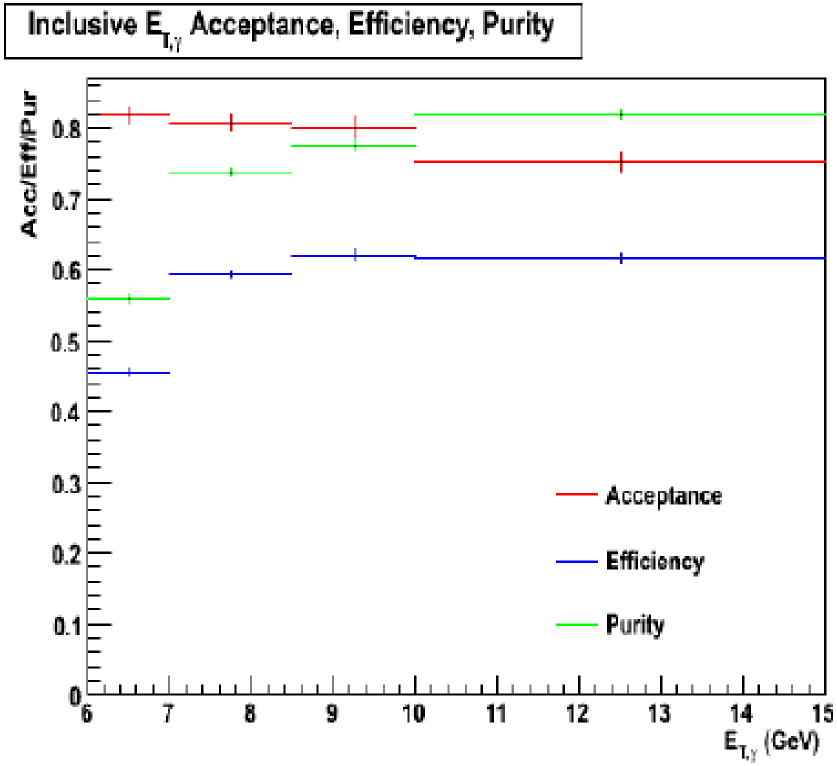


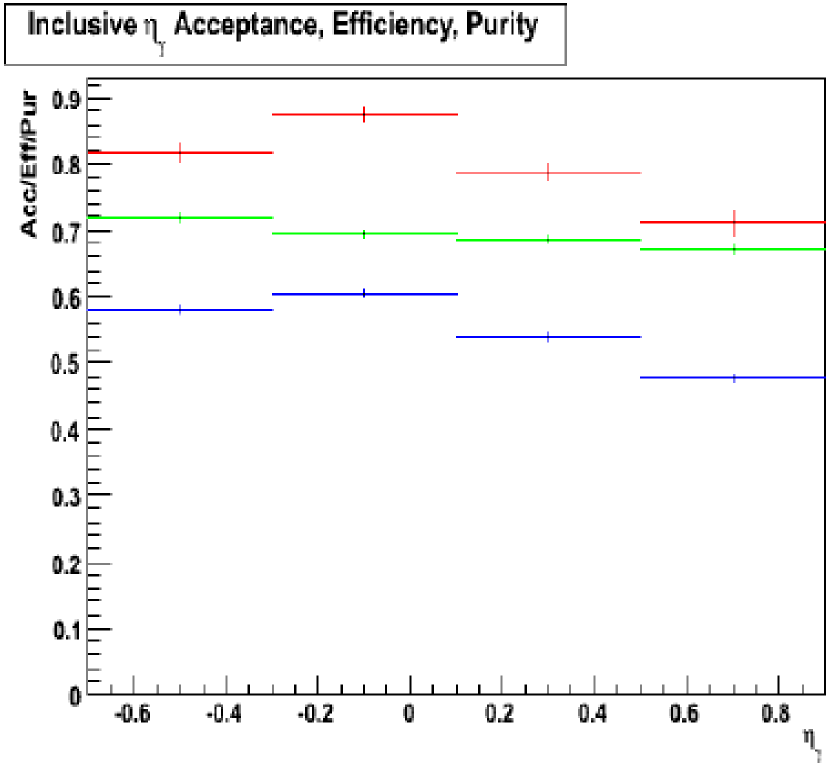


Andrii

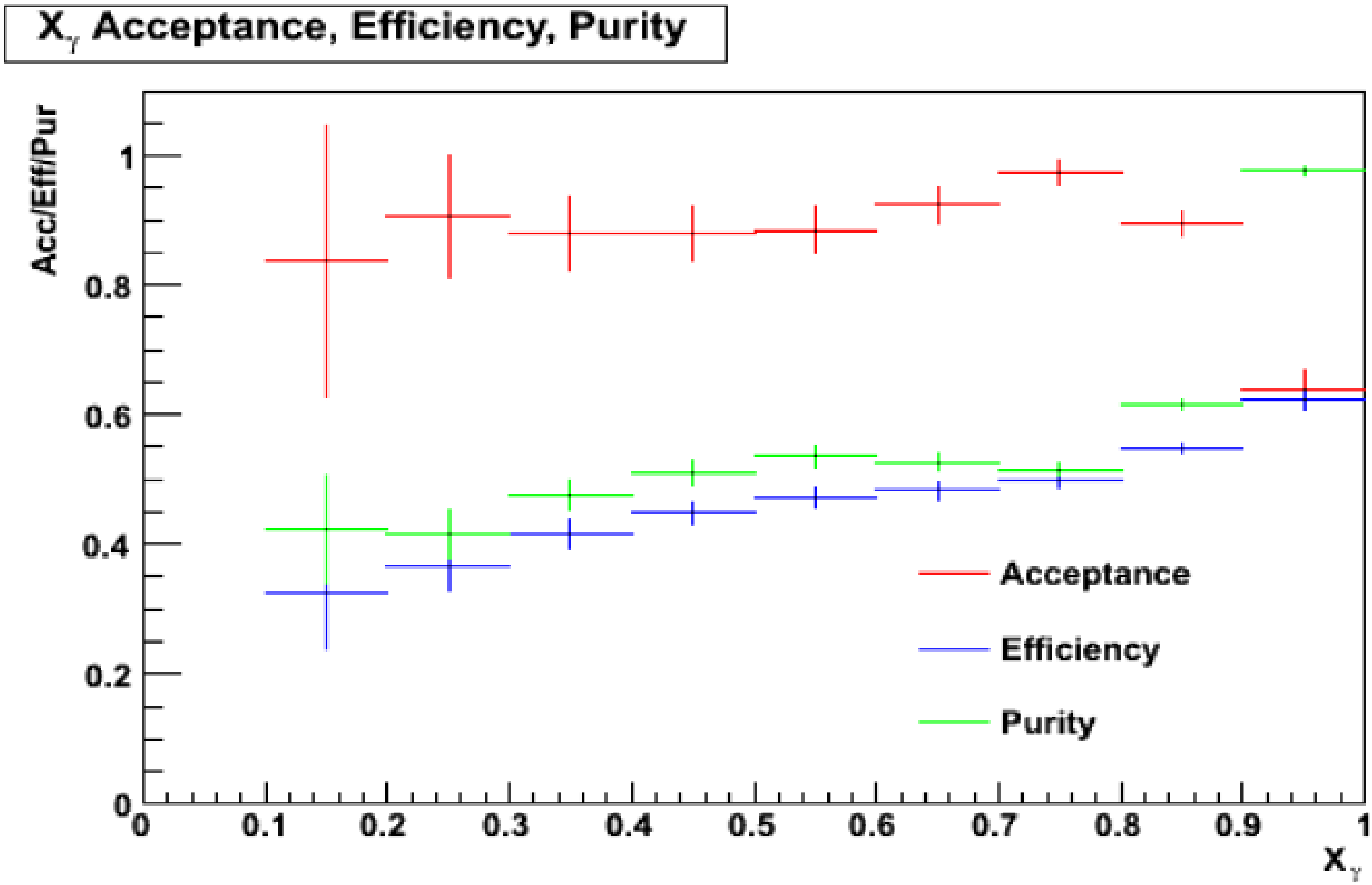
Truth level difference has no significant effect

Inclusive Acceptance, Efficiency, Purity

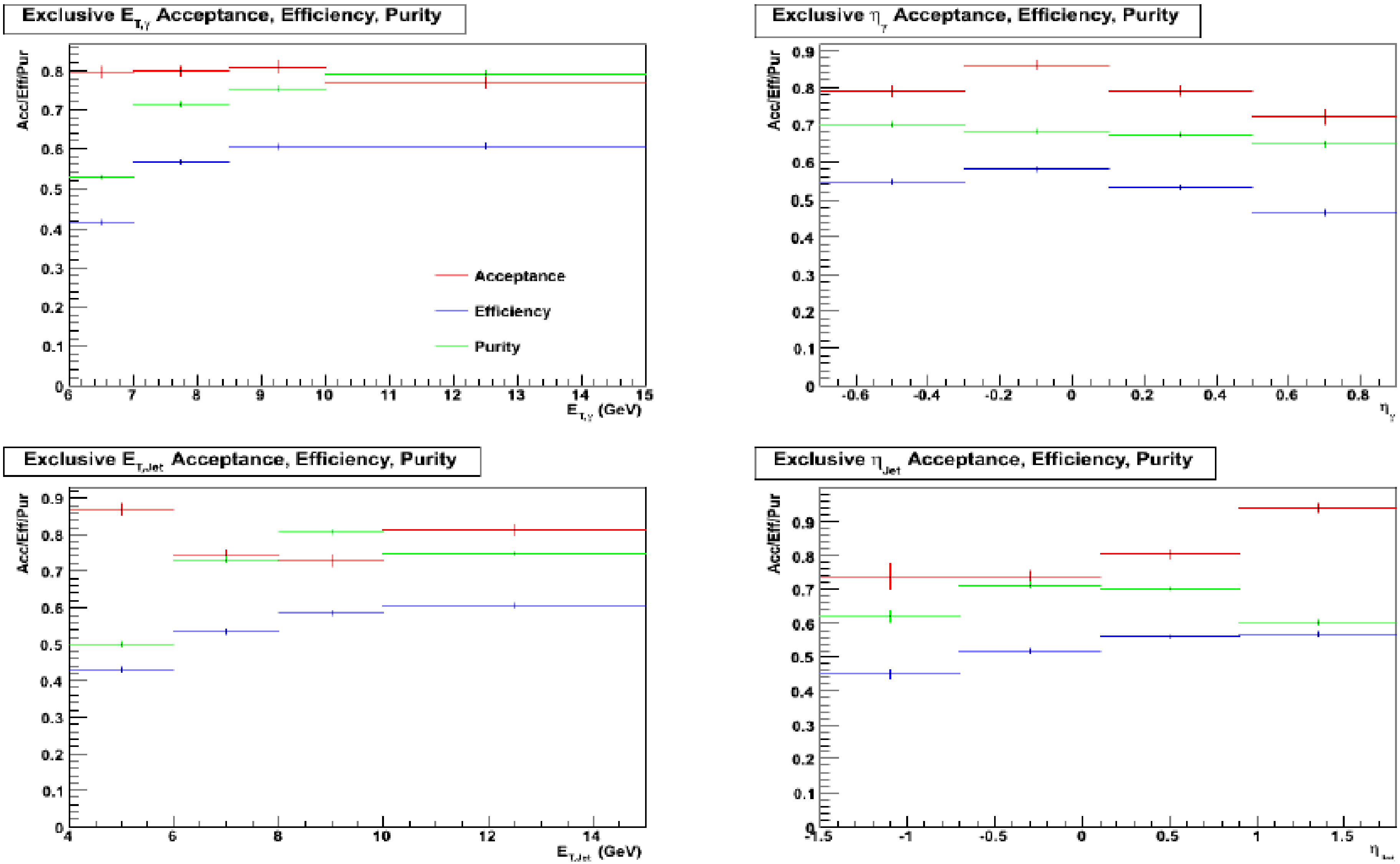




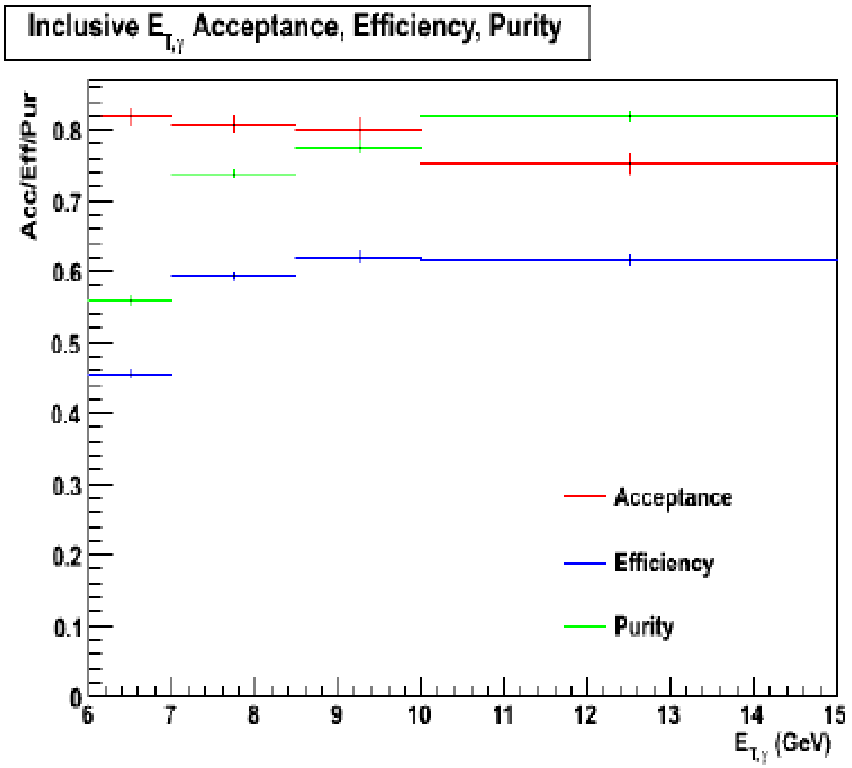
Exclusive Acceptance, Efficiency, Purity

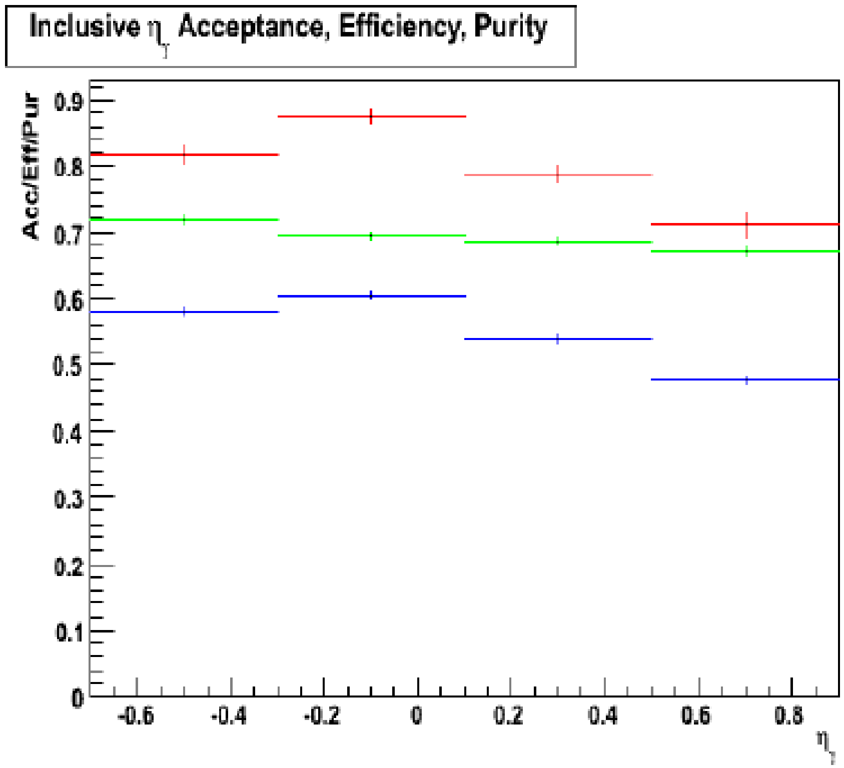


Exclusive Acceptance, Efficiency, Purity



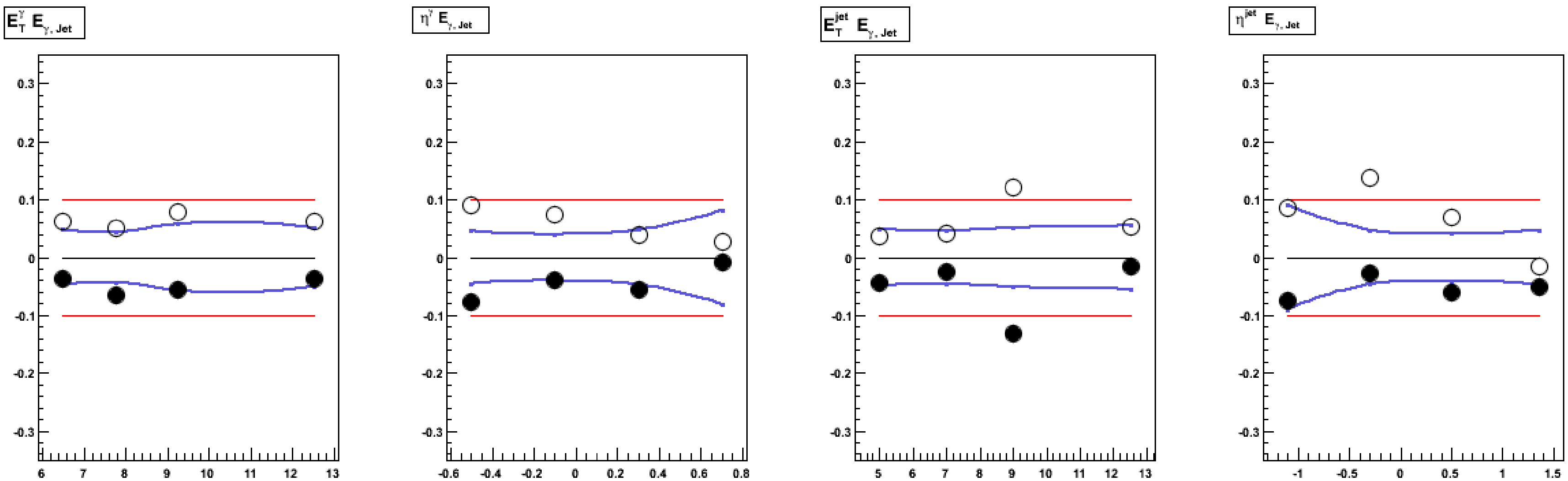
Inclusive Acceptance, Efficiency, Purity

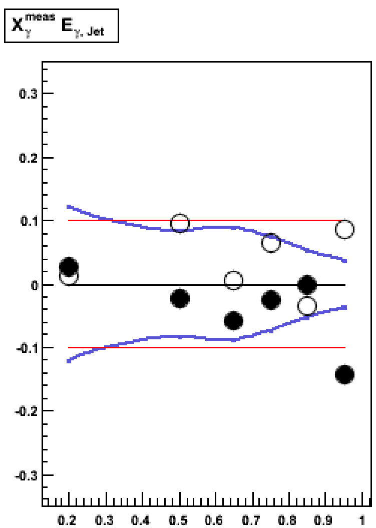




E scale systematic

Energy scale systematics





Change photon E by 2% and

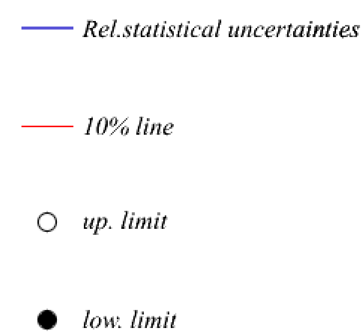
if JetEt > 10 GeV - jet E by 1.5 %.

if JetEt < 10 GeV - jet E by 2 %.

In addition:

JetEt < 6 GeV - jet E by sqrt(4*4-2*2) %.

6< JetEt <10 GeV - jet E by sqrt(2.5*2.5-2*2) %.



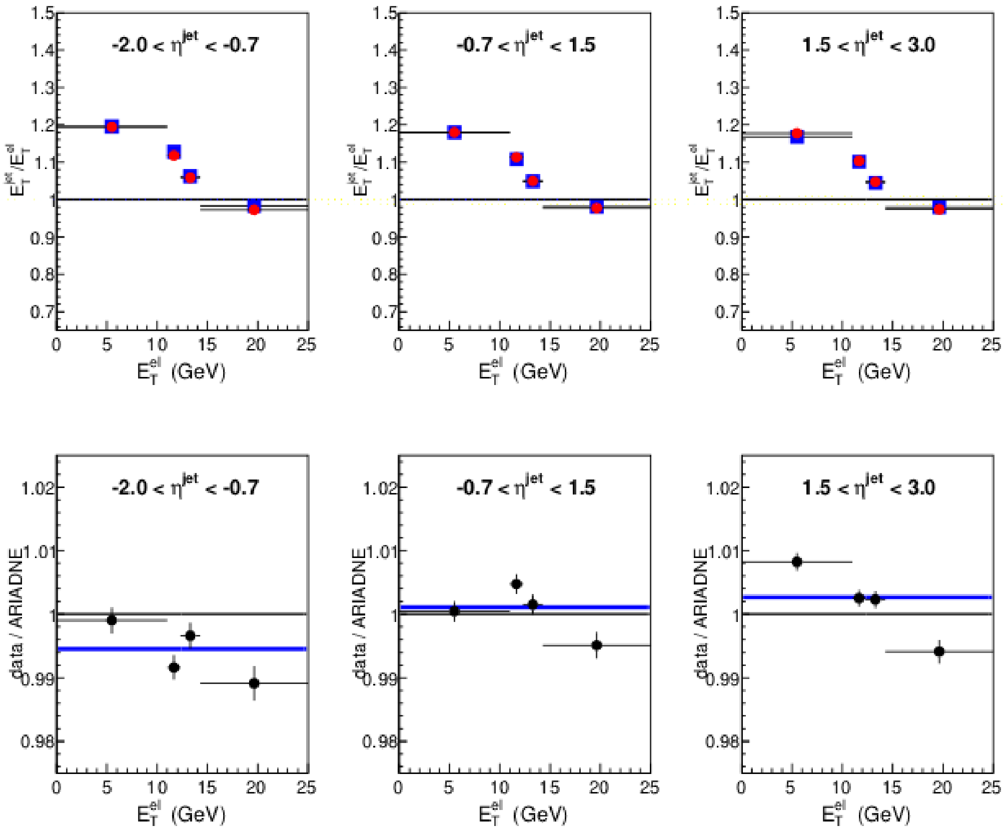
These systematics are to be symmetrised when calculating total systematics

Estimation of jet energy uncertainty: jets with $E_T^{jet} > 10$ GeV

- 04-05e, 06e, 06-07p
- inclusive DIS events
- $E_T^{e'} > 10$ GeV

- We consider:
- strictly one jet with $E_T^{jet} > 10$ GeV;
- $-1.5 < \eta_{jet} < 1.8$ (our usual phase space);
- no further jets in $2.5 < E_T^{jet} < 10$ GeV range.
- Build the ratio of E_T^{jet} to $E_T^{e'}$ in bins of $E_T^{e'}$ (4 bins) and η^{jet} (3 bins) for data and Ariadne.

Jets with $E_T^{jet} > 10$ GeV. $E_T^{\rm jet}/E_T^{e'}$ ratio.



Circles are data, squares are ARIADNE

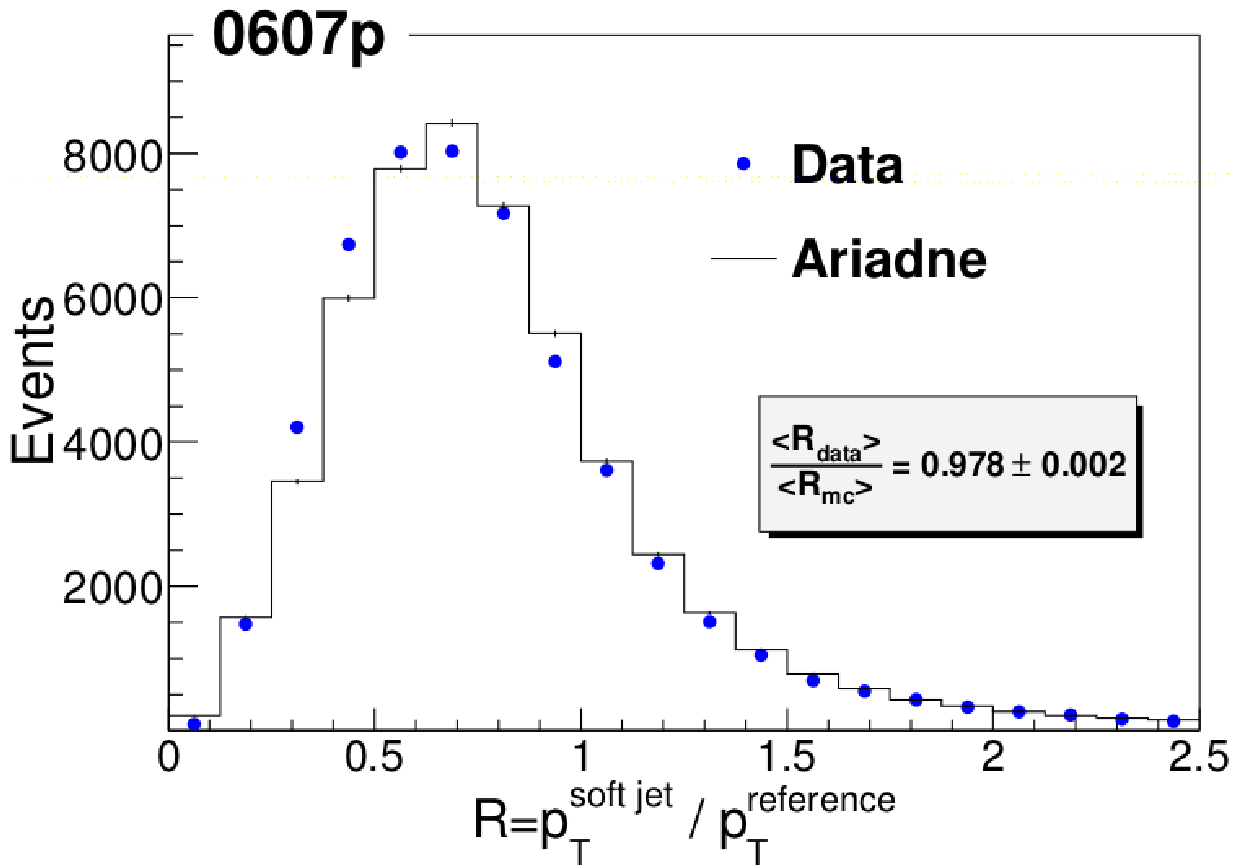
Difference between ratios in data and Monte Carlo is smaller than $\pm 1.5\%$

Estimation of jet energy uncertainty: jets with $2.5 < E_T < 10$ GeV

- 04-05e, 06e, 06-07p
- inclusive DIS events

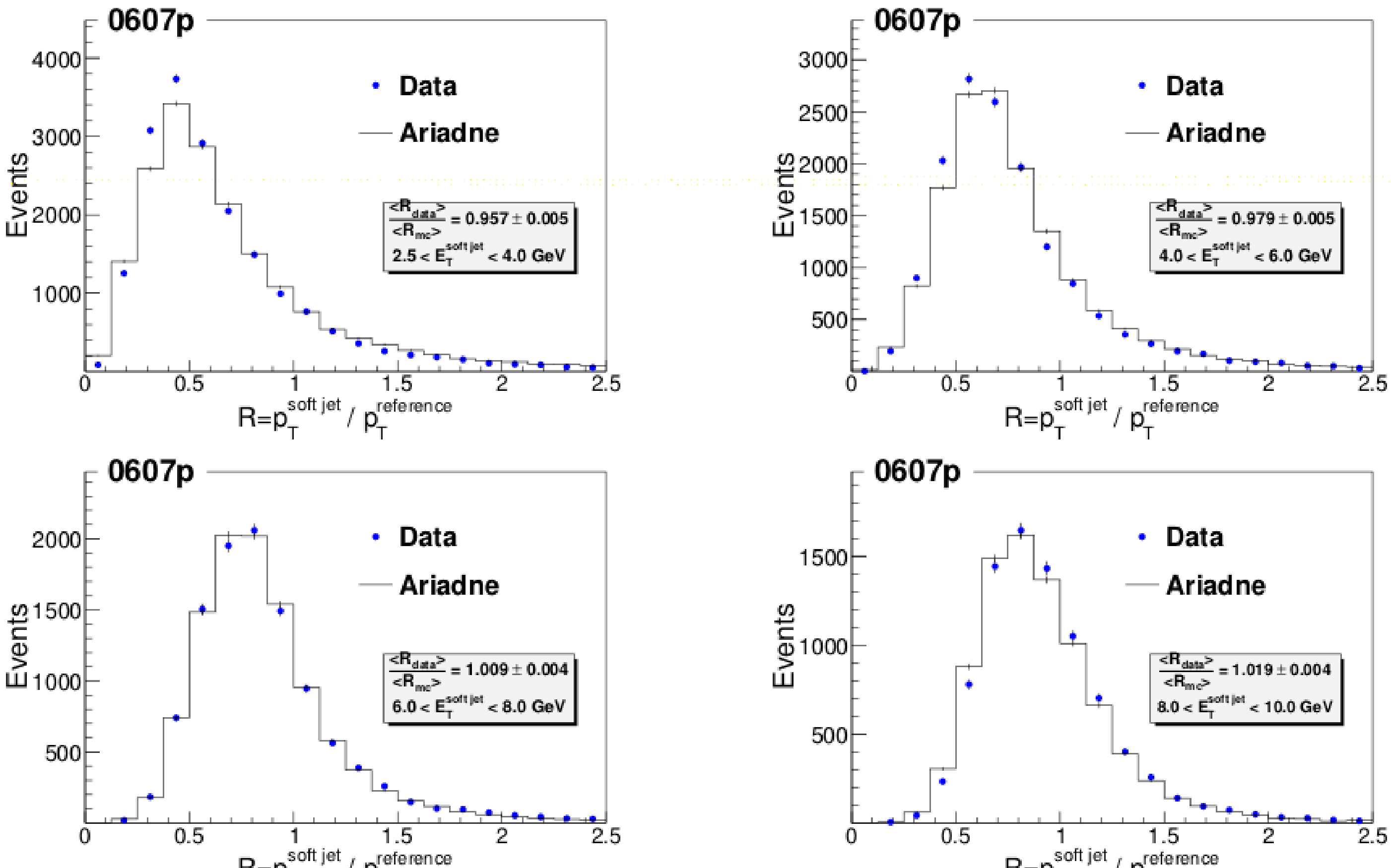
- We consider:
- strictly one jet with $E_T^{jet} > 10$ GeV;
- and strictly one jet with $2.5 < E_T < 10$ GeV;
- $-1.5 < \eta_{jet} < 1.8$ (our usual phase space).
- Combine the 4-vectors of the high-energetic jet and of the scattered electron into reference 4-vector;
- look into the ratio $\frac{E_T^{\text{softjet}}}{E_T^{\text{reference}}}$ for data and Ariadne.

Jets with $2.5 < E_T < 10$ GeV. Ratio $\frac{E_T^{\rm softjet}}{E_T^{\rm reference}}$.



Agreement within 2%

Jets with $2.5 < E_T < 10$ GeV. Ratio $\frac{E_T^{\text{softjet}}}{E_T^{\text{reference}}}$.

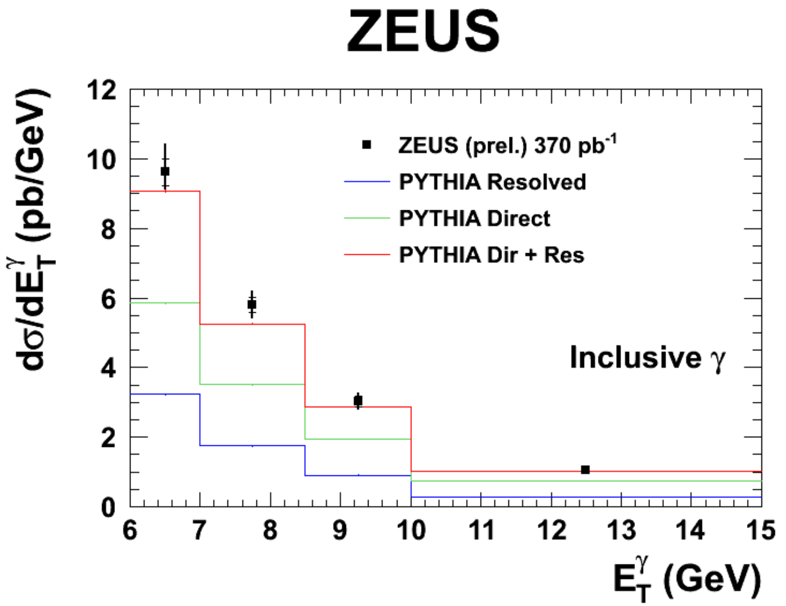


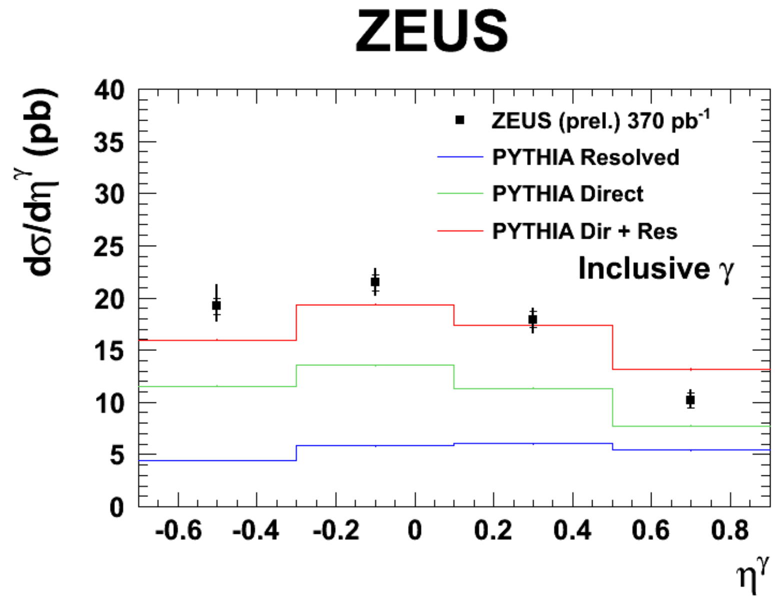
The biggest difference between ratios of the mean values in data and Monte Carlo is about 4% (for lowest E_T^{jet}).

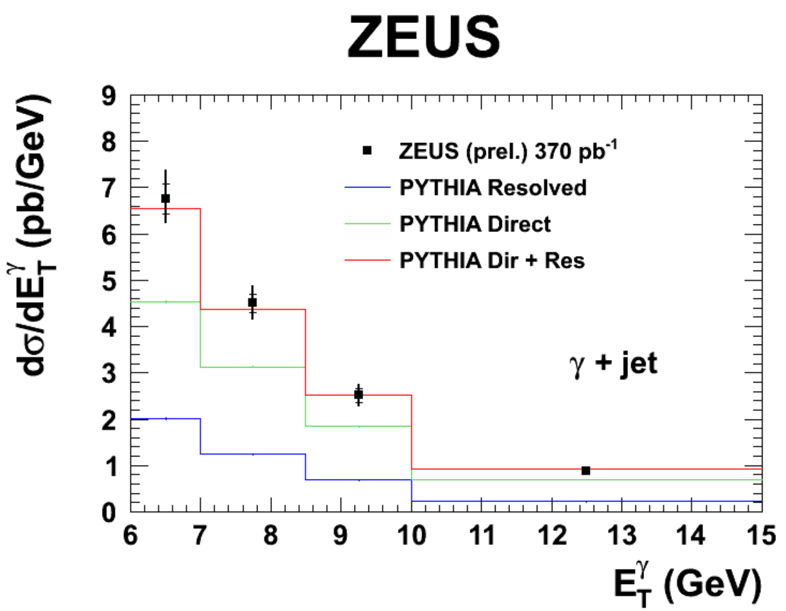
We conclude that the jets are well understood at this level.

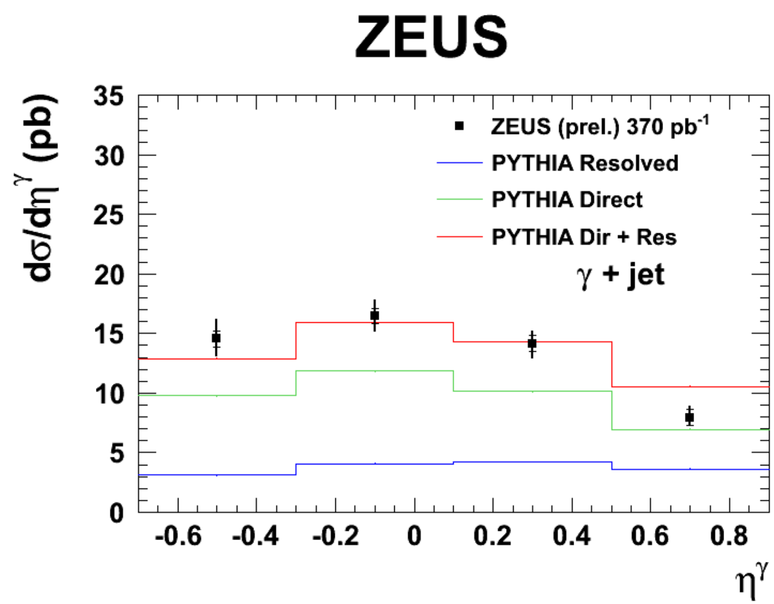
Post-fitting comparison with the PYTHIA model

Post-fitting comparison with the PYTHIA model



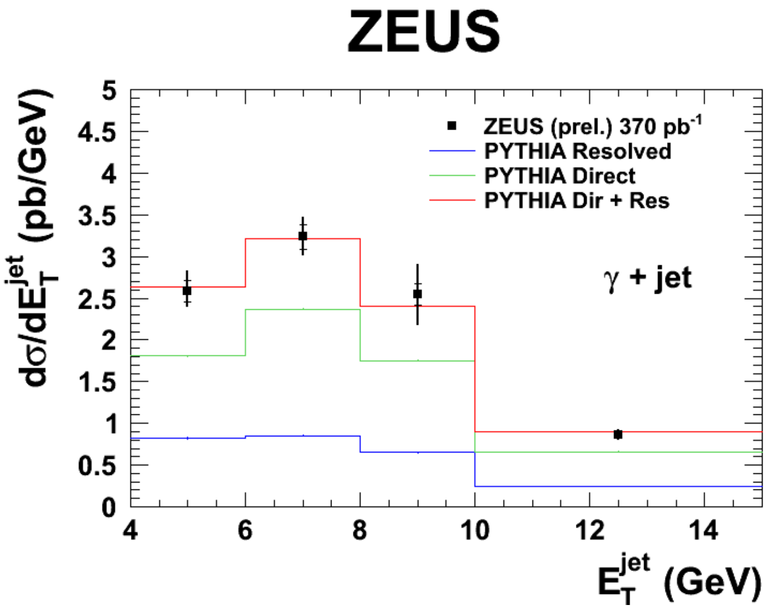


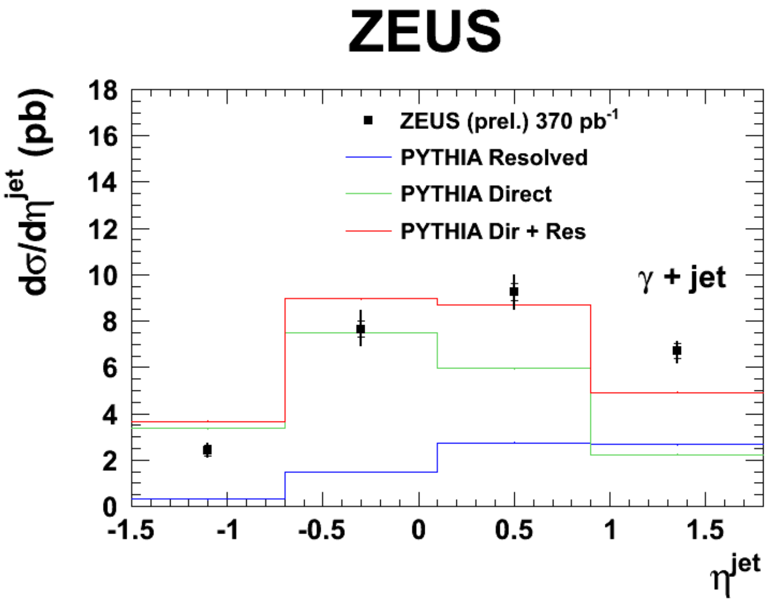


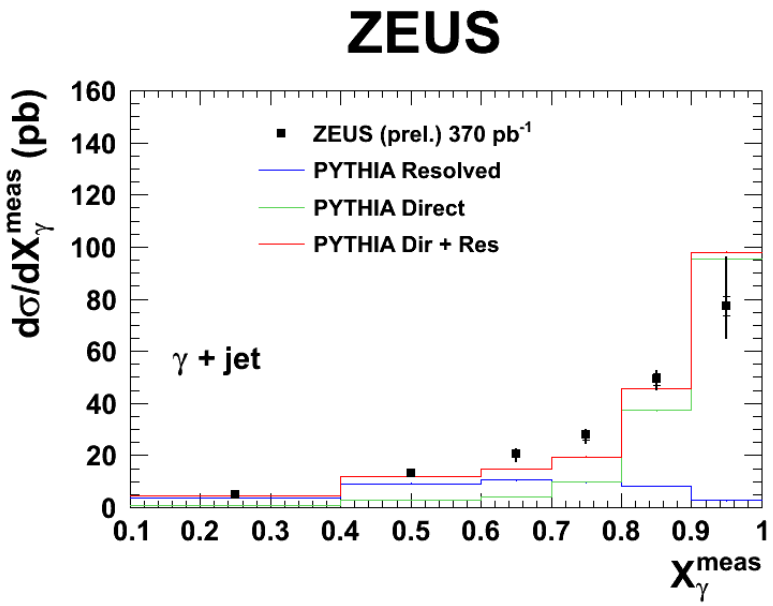


Reasonable description of data by MC model

Post-fitting comparison with the PYTHIA model



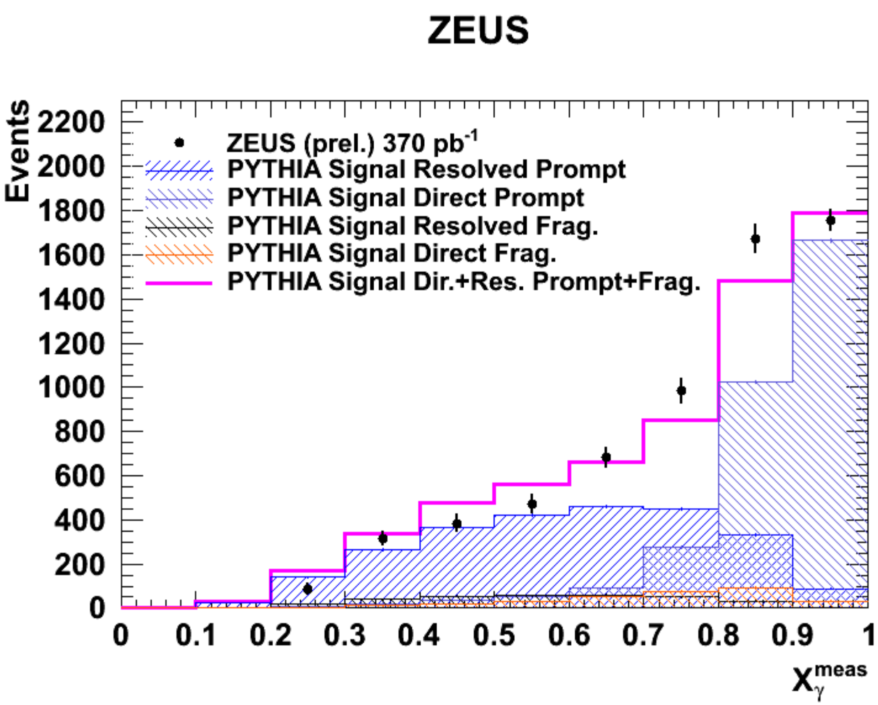


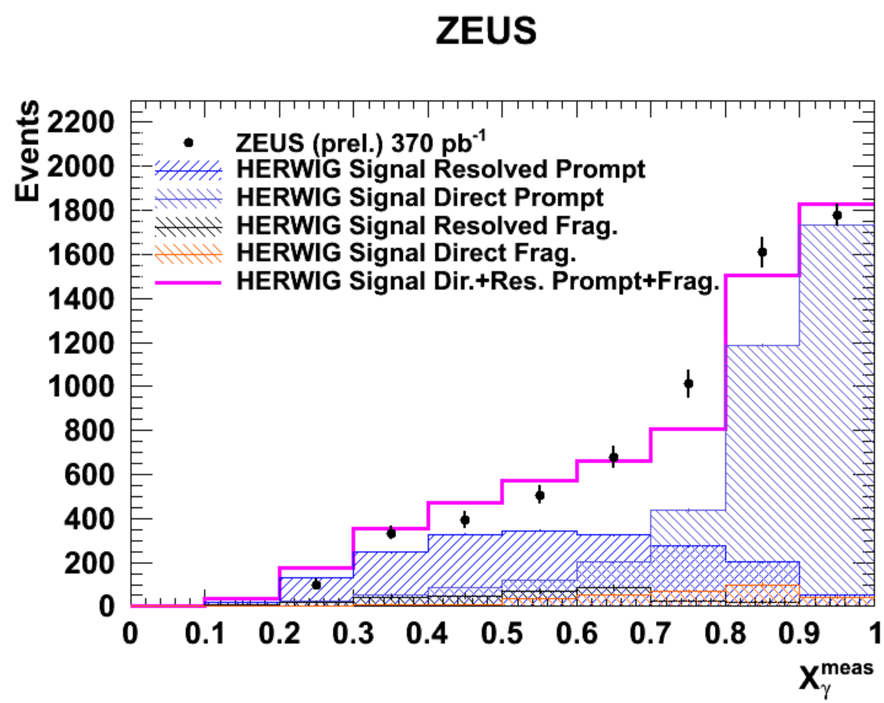


Reasonable description of data by MC model

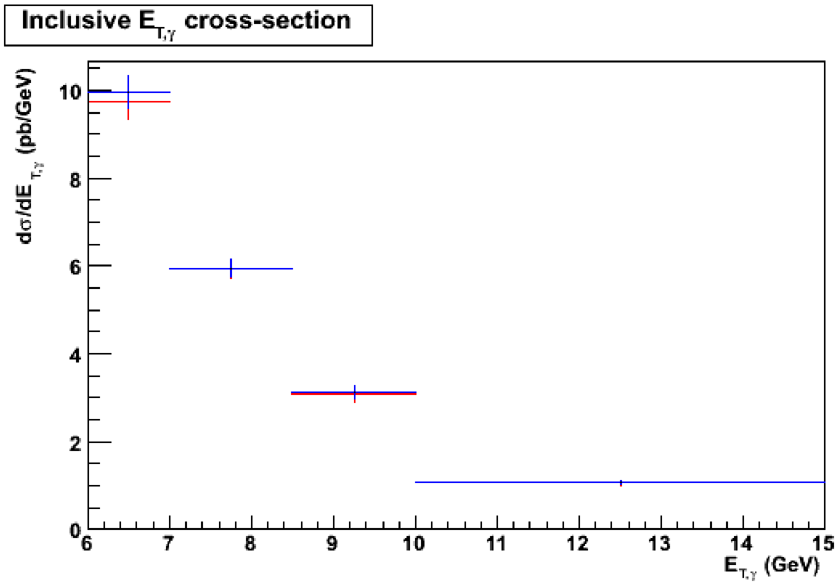
Additional plots

PYTHIA and HERWIG x-gamma



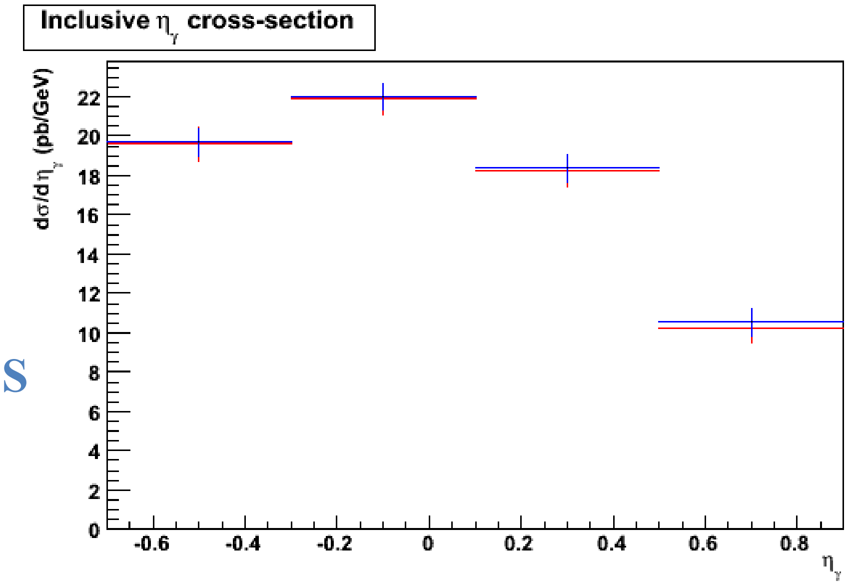


Comparison between analyses. Inclusive photon



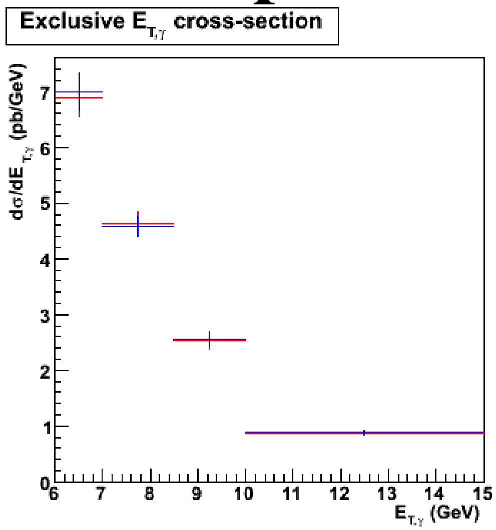
AI

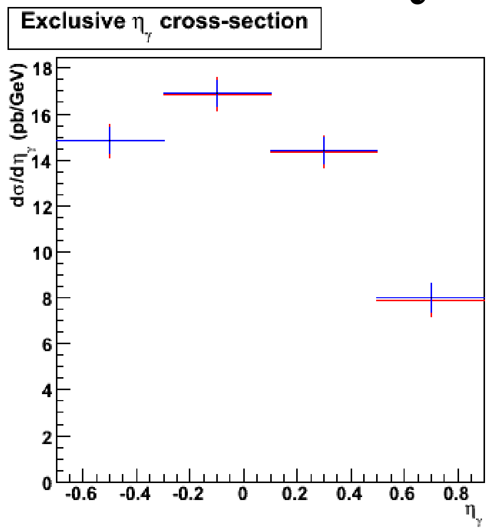
IOS

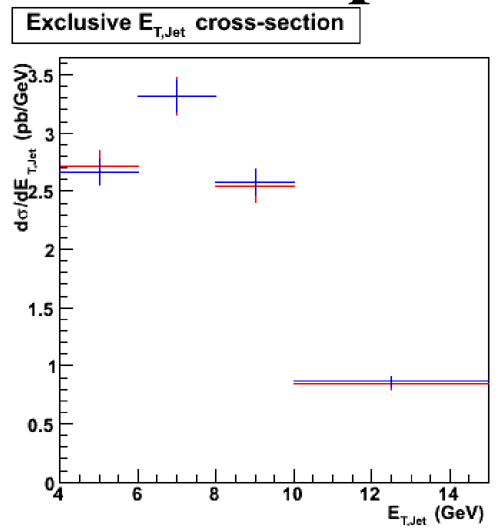


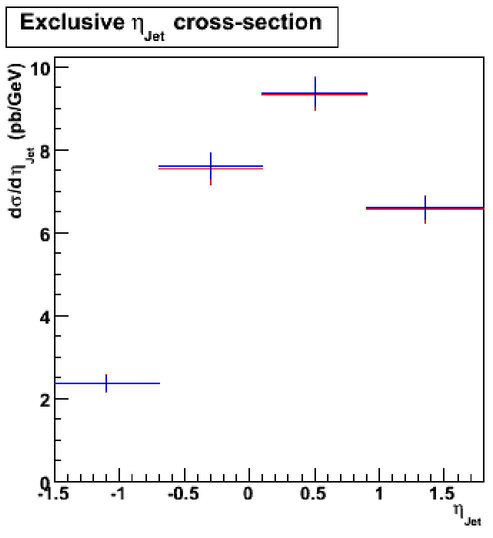
Shown are cross-section numbers with statistical uncertainties only.
Plots provided by Volodymyr. Comparison with his results is ongoing.

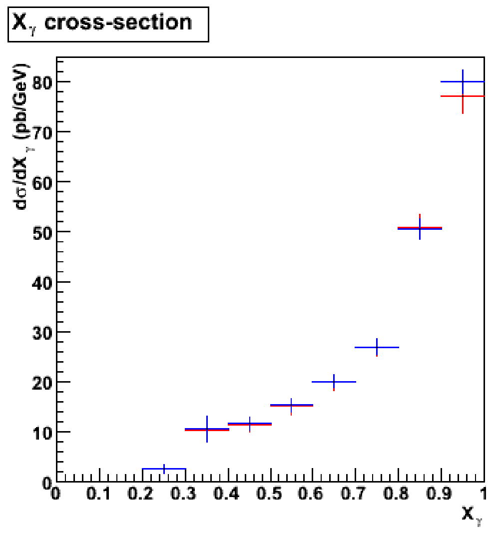
Comparison between analyses. Inclusive photon







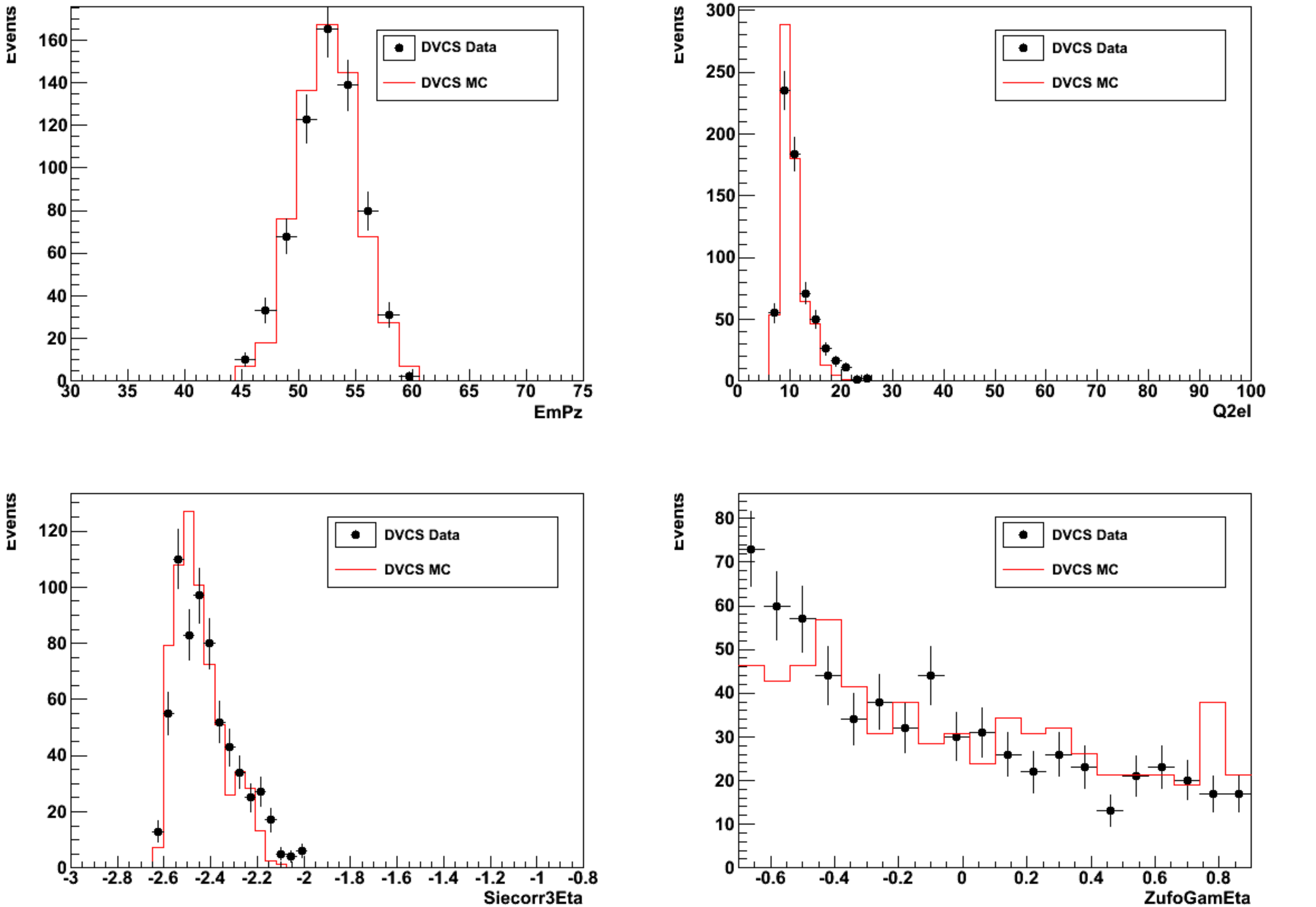




Excellent agreement between analyses considering that IOS is based on a 50-50 mix and no change in cone factor.

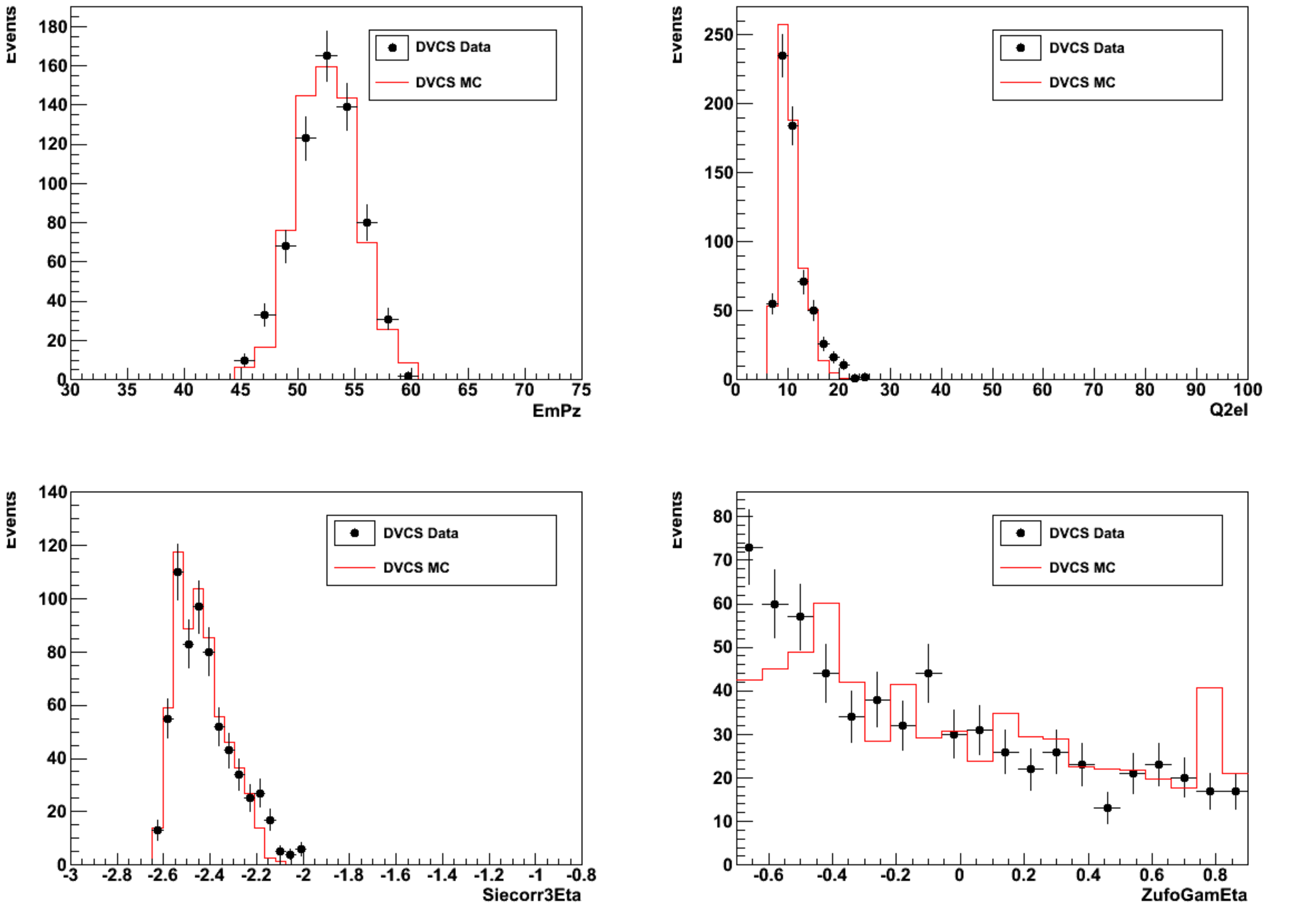
Last X-gamma bin might be caused by different implementation of selection on true level, hence different acceptance correction factor.

DVCS. Control plots without reweighting



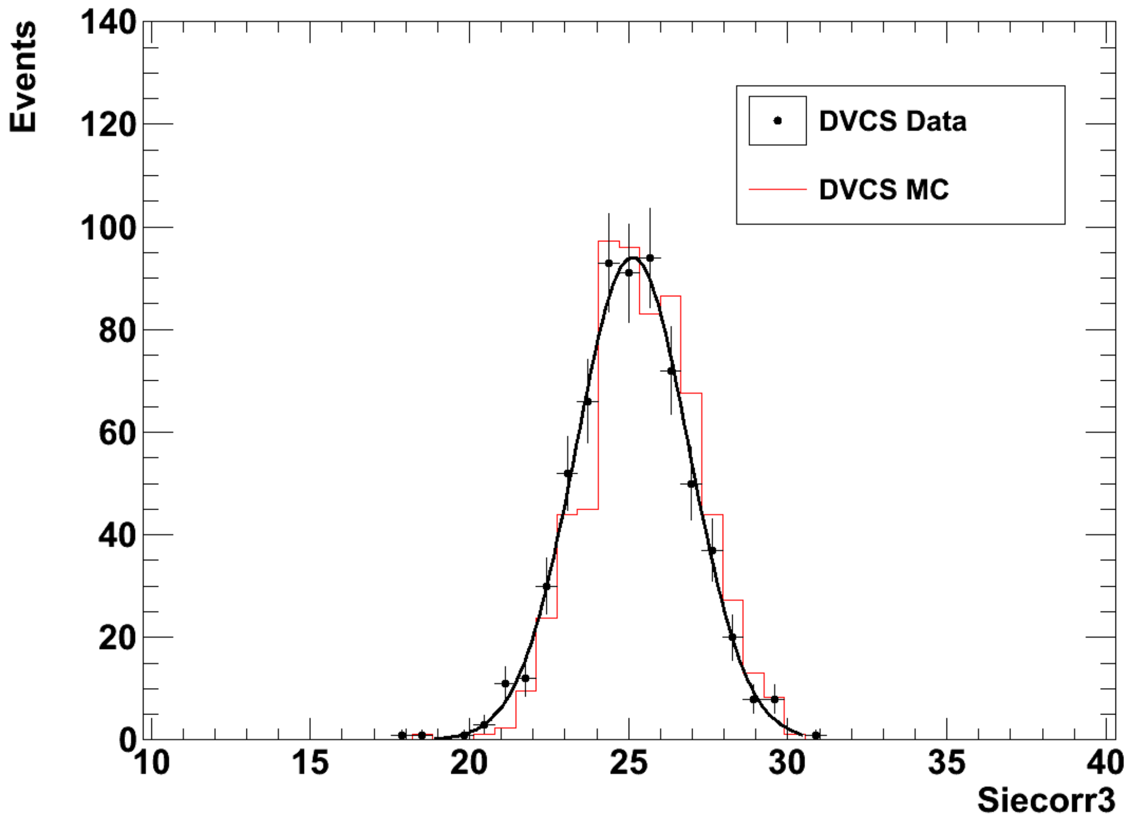
Not so good description of data by MC.

DVCS. Control plots after reweighting



Small improvement in Q2 description can be noticed

Fit of Siecorr3



Siecorr3 Data 18.25-31.55 Siecorr3 MC 18.25-31.20

Fit **2.51213e+01** Fit **2.54787e+01**

Agreement within 2%