Prompt Photons + Jets in DIS

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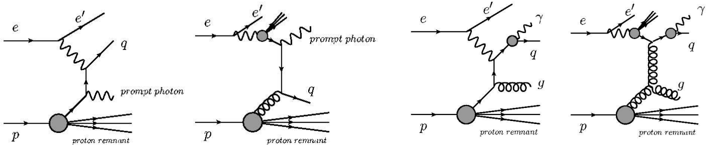
PCOOR meeting

Outline

- Data and MC samples
- Event selection cuts
- Q^2 reweighting procedure redone !
- Control plot
- f_{max}, δz fits
- Differential cross sections
- 1st and 2nd analysis comparison
- Summary

DIS ep collision



- Prompt photons are high transverse energy final state photons which are emitted directly during the hard scattering process
- Prompt photons do not undergo the hadronization process, therefore theoretical calculations can be done with better precision
- The final state photon is a particle which arrives in the detector after participating in the actual hard scattering process and so it can provide direct information of the process and the proton structure
- Must take account of ISR reffered as LL-diagrams

Used Data and MC samples

Data

- 040506e, 0607p
- $\int Ldt = 332 \text{ pb}^{-1}$

MC

- PYTHIA (signal)
- ARIADNE (background)

Notations

- LL = photons from leptons
- QQ = photons from quarks

Event Selection Cuts

Phase Space

- $10 < Q^2 < 350\text{GeV}^2$

Cleaning Cuts

- $-40 < Z_{\text{vtx}}/cm < 40$
- $35 \text{ GeV} < \text{E} - \text{p}_\text{z} < 65 \text{ GeV}$

Electron Cuts

- $\text{Siecorr} > 10 \text{ GeV}$
- $140^\circ < \theta_{el} < 180^\circ$
- $-14.8 < e_x/\text{cm} < 14.8$
- $-14.6 < e_y/\text{cm} < 12.5$

Triggers

- SPP02 trigger for 0405e
- SPP09 trigger for 06e, 0607p

Prompt Photon Phase Space

- $4 < E_{T,\gamma}/\text{GeV} < 15$
- $-0.7 < \eta_\gamma < 0.9$

Prompt Photon Cleaning Cuts

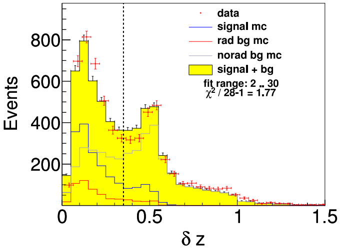
- $\Delta r < 0.2$
- $\frac{\text{E}_{\text{EMC}}}{\text{E}_{\text{HAC}}+\text{E}_{\text{EMC}}} > 0.9$
- $\frac{\text{E}_\gamma}{\text{E}_{\text{jet containing }\gamma}} > 0.9$
- $f_{max} > 0.05$

Jet Selection

- based on zufos
- $E^{corr}_{T,jet} > 2.5\text{GeV}$
- $-1.5 < \eta_{jet} < 1.8$
- take highest $E_{T,jet}$ jet within η range in the event

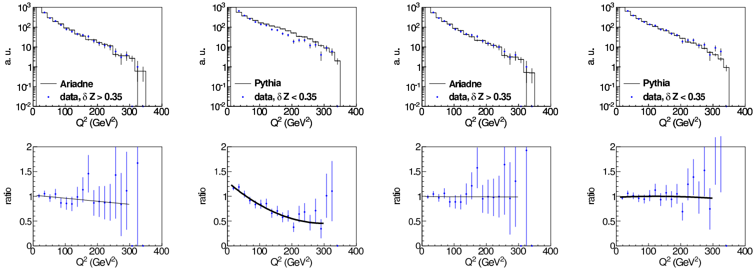
Q^2-reweighting

- Q^2-reweighting procedure has been improved since last meeting. Instead of reweighting MC after inclusive DIS selection to inclusive DIS Data:
- Split data events after full event selection into two parts: with $\delta Z > 0.35$ (more background events) and with $\delta Z < 0.35$ (more signal events)



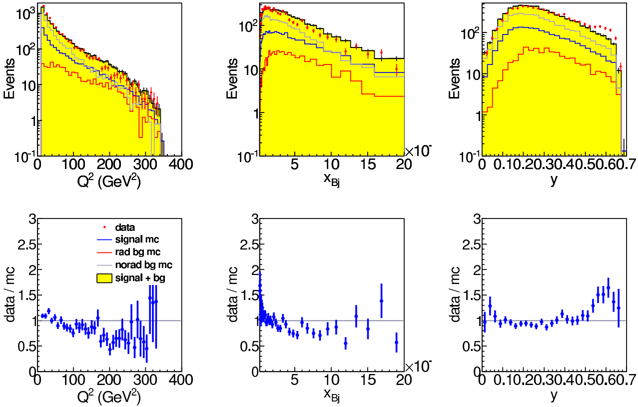
- reweight non-radiative Ariadne background to the part of data with $\delta Z > 0.35$
- reweight signal Pythia MC to the part with $\delta Z < 0.35$
- do not reweight LL Ariadne at all, since it is well theoretically understood

Q^2-reweighting



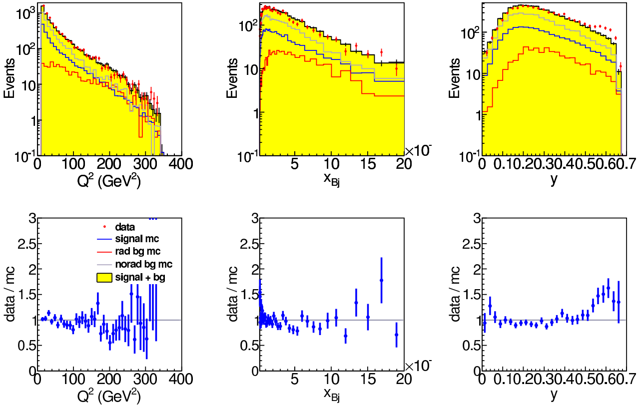
- Left four plots are before reweighting
- Right four plots are after reweighting
- Linear fit for Pythia and polynomial of order two for Ariadne
- Compared hadronic level of MC with Data corrected for acceptance effects
- Data and MC summed over periods

Q^2-reweighting



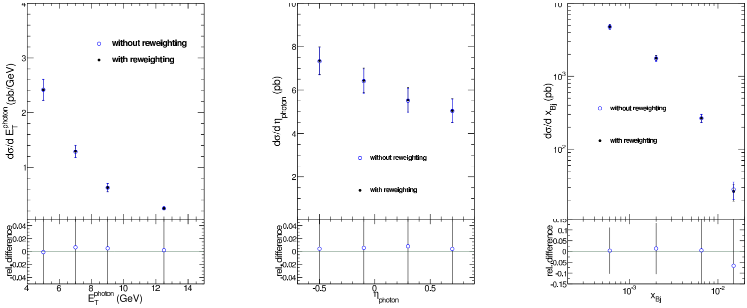
- Control plots before Q^2-reweighting

Q^2-reweighting



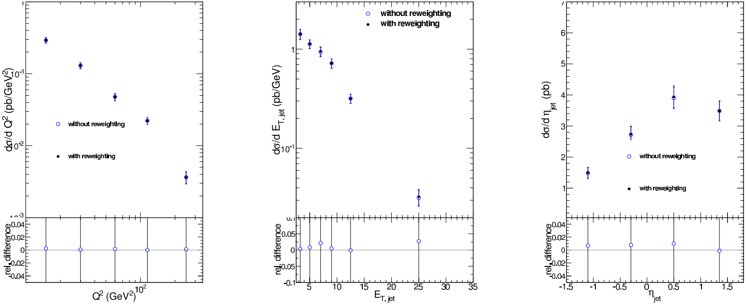
• Control plots after Q^2-reweighting: better description of Data by MC for Q^2 and x

Cross-section comparison with/without Q^2 reweighting (1/2)



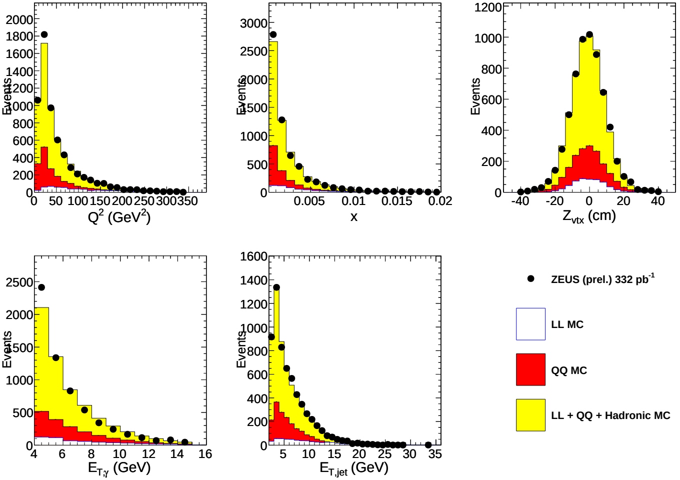
- Discrepancy is typically less then 1%

Cross-section comparison with/without Q^2 reweighting (1/2)



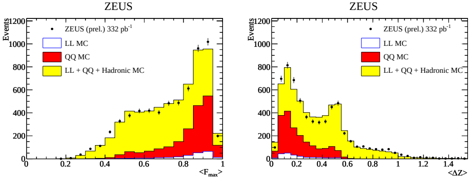
- Influence on Q^2 cross-section is tiny

Control Plot



- Q^2-reweighting has been applied here and on the further plots

f_{max}, δz definition



• f_{max} - ratio of the energy in the highest energy cell of a cluster to the total energy of a cluster

• δz - energy weighted mean width of the electromagnetic cluster in Z direction:

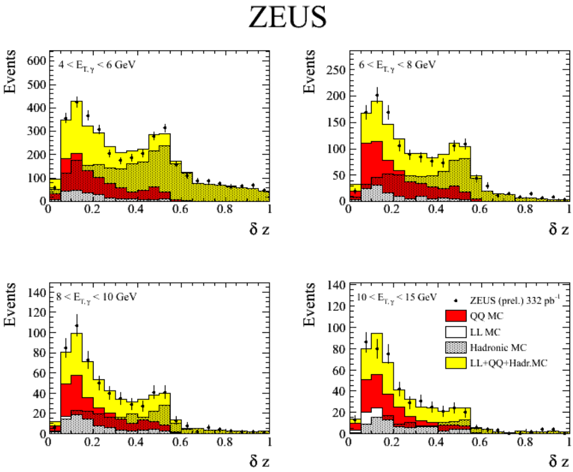
$$\delta z = \frac{\sum_i |Z_i - Z_{cluster}| * E_i}{W_{cell} \sum_i E_i}$$

• The δz distribution has the more detailed structure and was chosen to define the prompt photon fraction in Data, as in the previous analysis

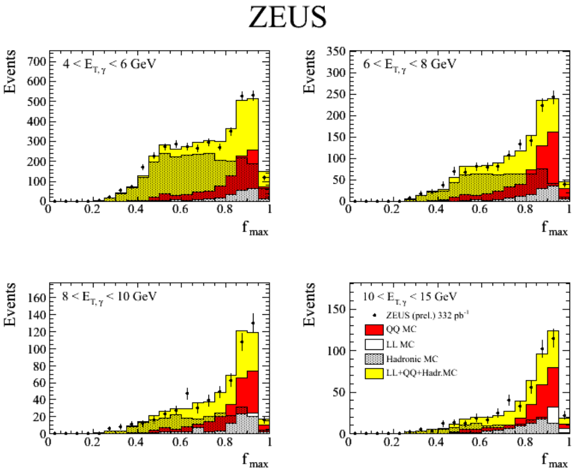
• LL = predicted value of lepton high-energy radiation

• QQ = predicted value of prompt photons

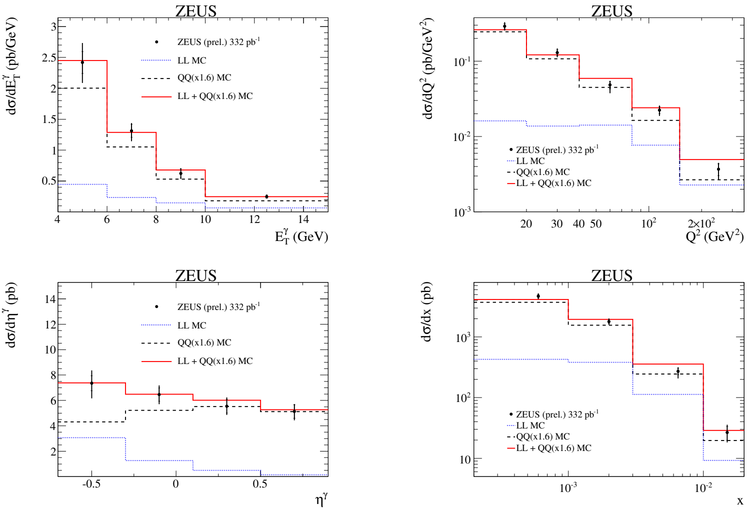
fits: δz/Et



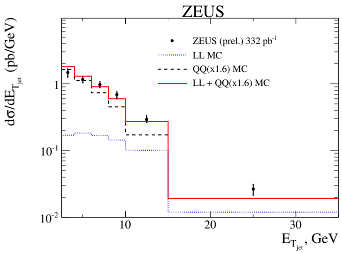
fits: f_{max}/Et

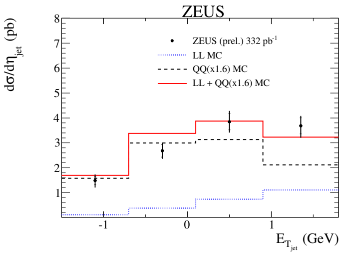

ZEUS
Events
4 < E_T,γ < 6 GeV
6 < E_T,γ < 8 GeV
8 < E_T,γ < 10 GeV
10 < E_T,γ < 15 GeV
ZEUS (prel.) 332 pb^-1
QQ MC
LL MC
Hadronic MC
LL+QQ+Hadr.MC
f_max

Differential cross sections

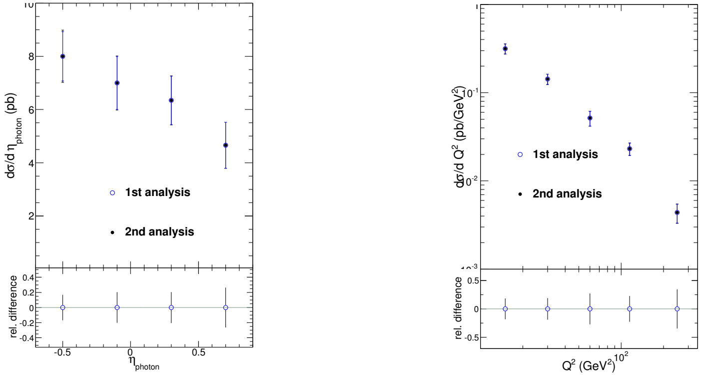


Cross sections as functions of jet variables



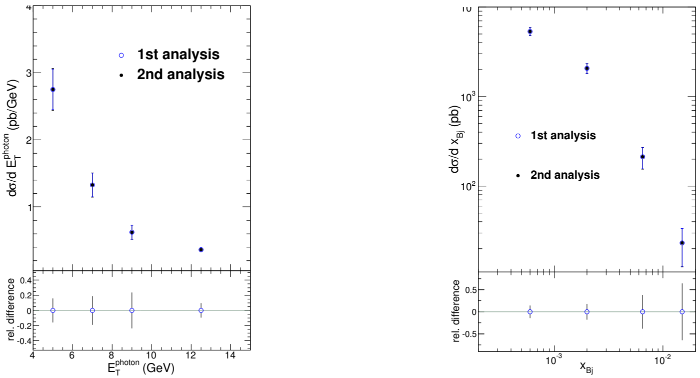


Comparison of 1st and 2nd analysis, 0405e (1/3)



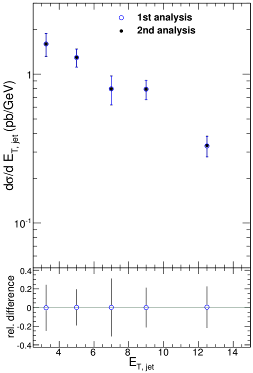
- Distributions of selected events with photon + jet are compared
- Agreement in 1st and 2nd analysis is excellent

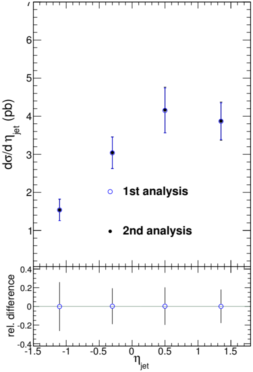
Comparison of 1st and 2nd analysis, 0405e (2/3)



- Distributions of selected events with photon + jet are compared
- Perfect agreement of 1st and 2nd analysis

Comparison of 1st and 2nd analysis, 0405e (3/3)



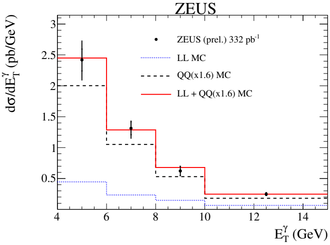


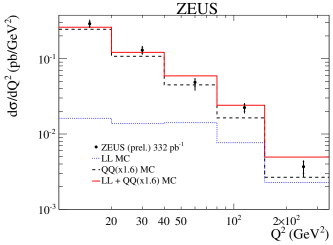
- Distributions of selected events with photon + jet are compared
- Agreement in 1st and 2nd analysis is excellent

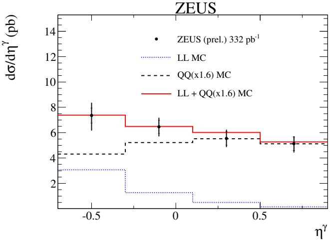
Summary

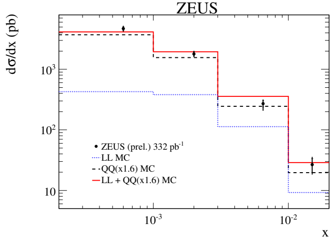
- Differential cross sections for prompt photon + jets production have been measured.
- We are waiting for promised theoretical predictions.

These plots to be made preliminary









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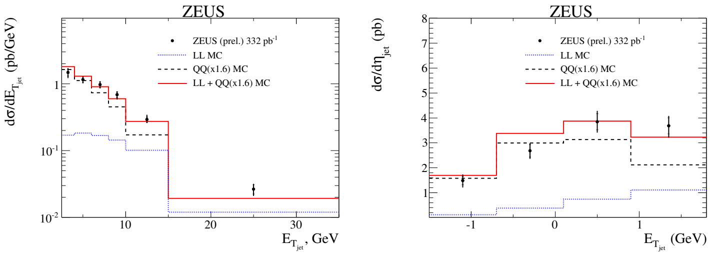

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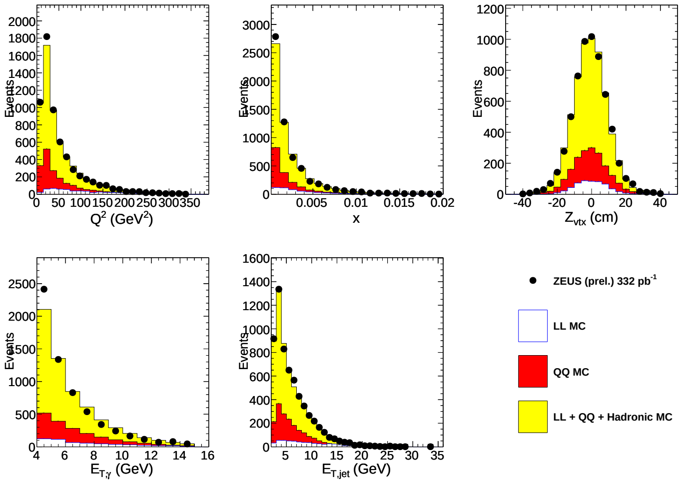

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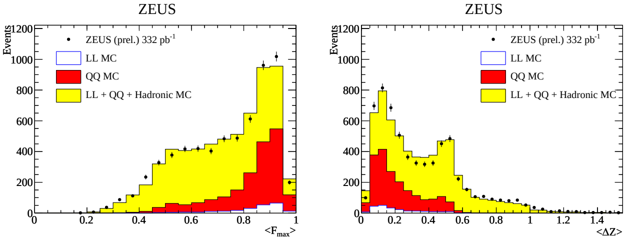
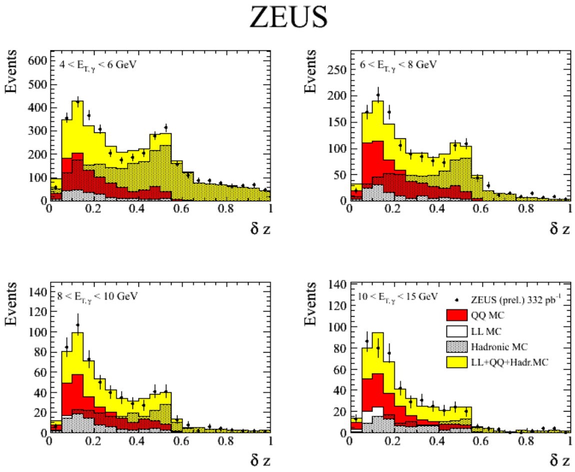
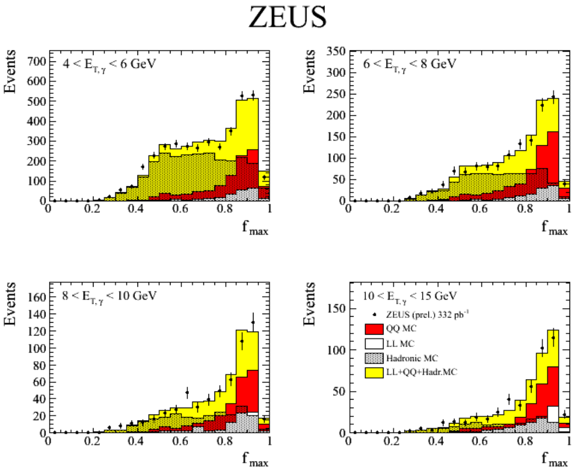


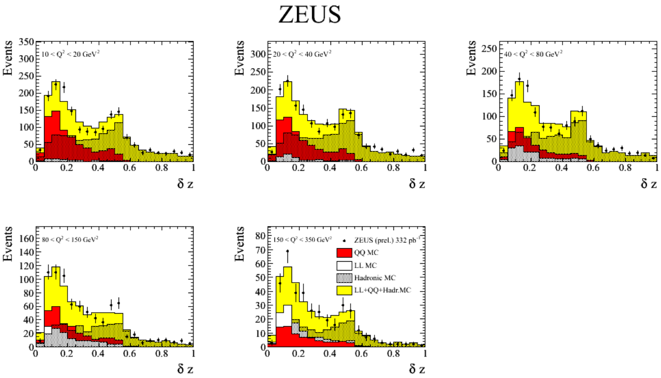
These plots to be made preliminary, fits: δz/Et



These plots to be made preliminary, fits: f_{max}/Et



These plots to be made preliminary, fits: δz/Q^2



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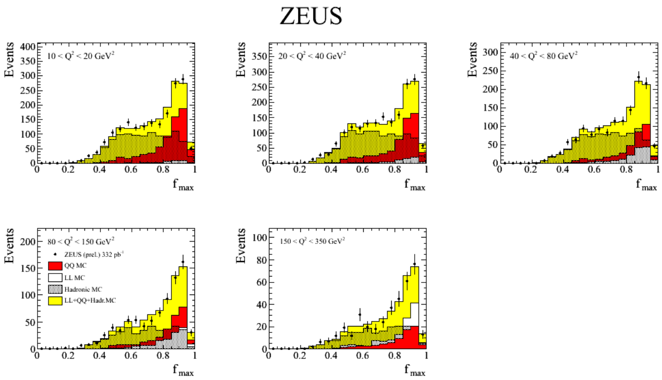
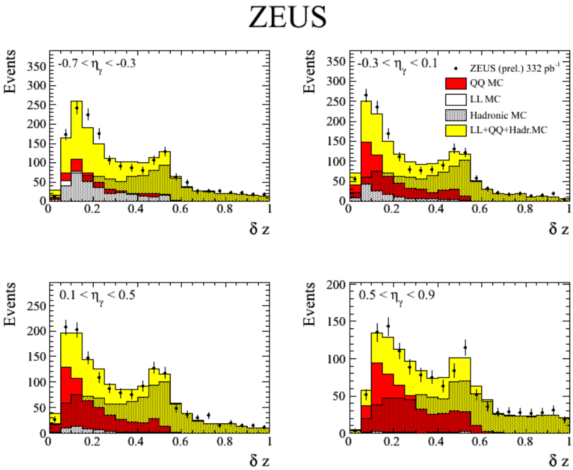


These plots to be made preliminary, fits: δz/η



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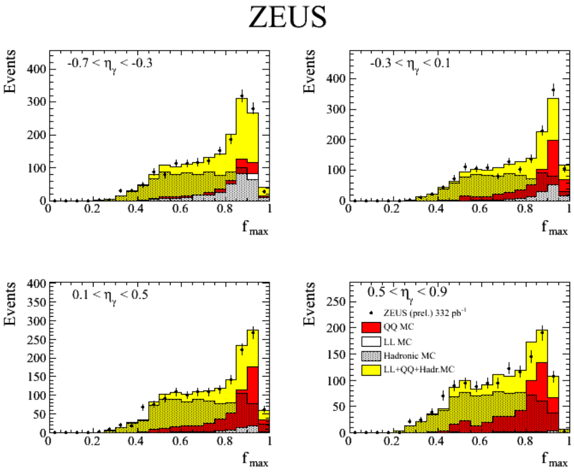
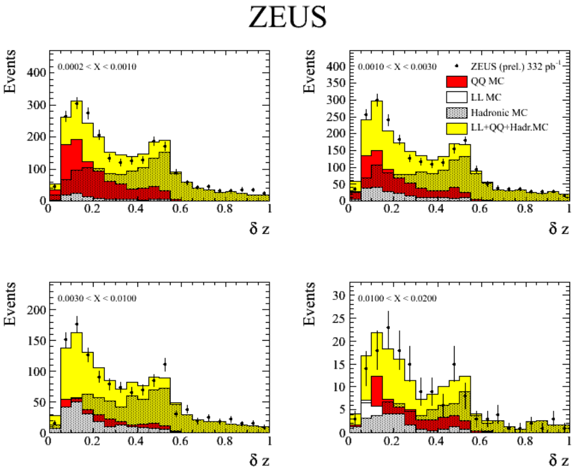
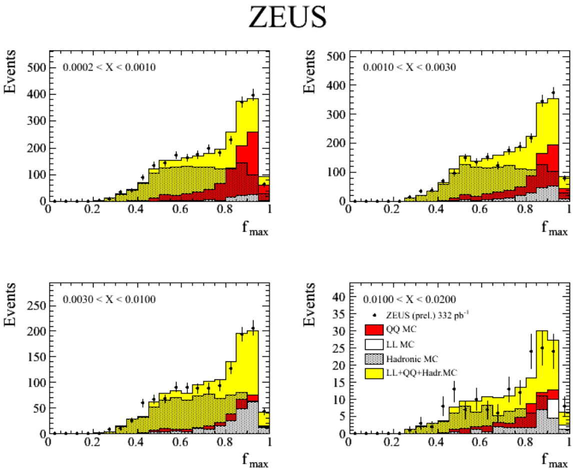


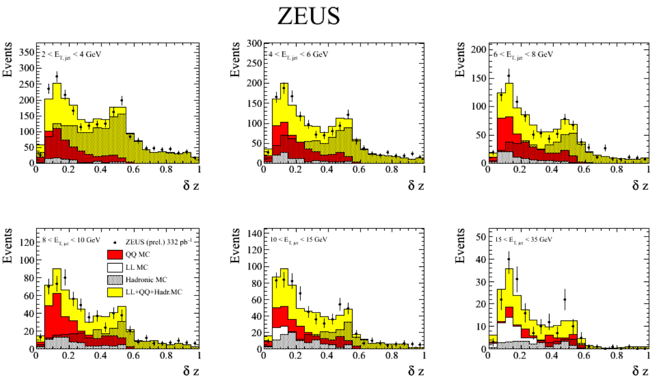
These plots to be made preliminary, fits: δz/x



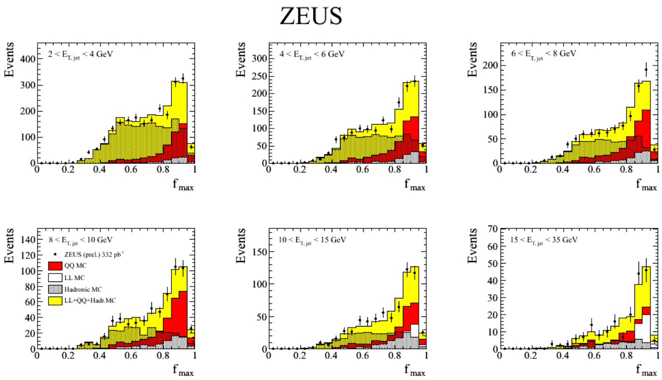
These plots to be made preliminary, fits: f_{max}/x



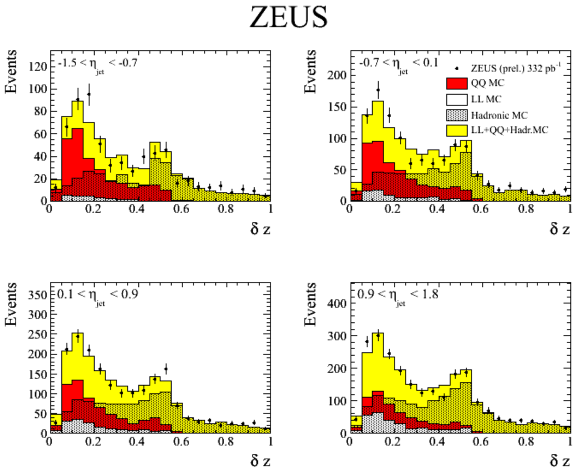
These plots to be made preliminary, fits: δz/$E_{T,jet}$



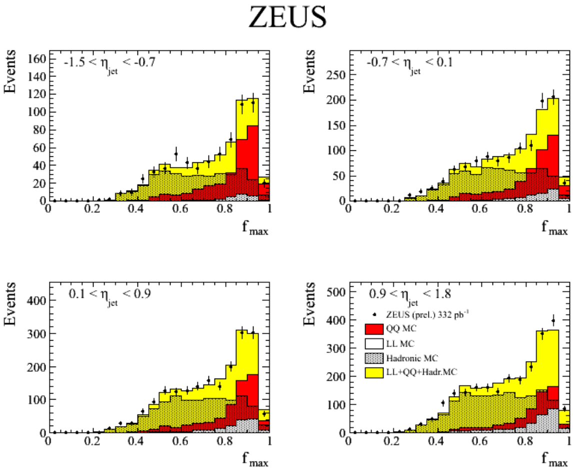
These plots to be made preliminary, fits: $f_{max}/E_{T,jet}$



These plots to be made preliminary, fits: δz/η_{jet}



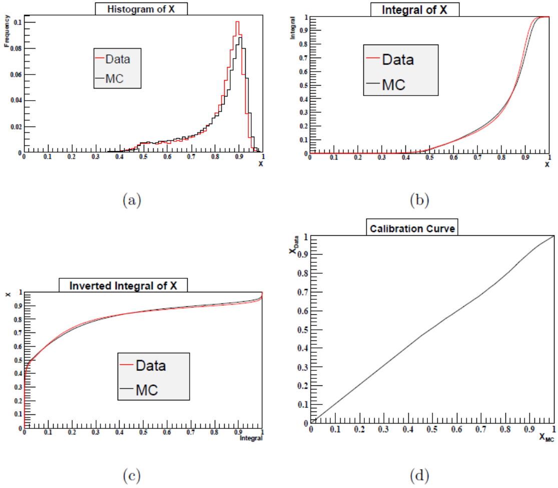
These plots to be made preliminary, fits: f_{max}/η_{jet}



Stretch calibration: description (from M.Forrest's PHD thesis)

1. Area normalise the data and MC histograms to unity.
2. Form the cumulative integral distribution of X for both data and MC, see Figure 6.14(b).
3. Invert the cumulative distribution so that X is on the y-axis and the integral is on the x-axis, see Figure 6.14(c).
4. Read off the value of X for data and MC ($X_{\rm data}$ and $X_{\rm MC}$ respectively) at finely spaced intervals and tabulate them as illustrated in Table 6.1.
5. Plot $X_{\rm data}$ against $X_{\rm MC}$ at each point and interpolate to produce a calibration curve as seen in Figure 6.14(d).
6. To correct a given value of $X_{\rm MC}$, simply read off the corresponding value of $X_{\rm data}$ from the calibration curve.

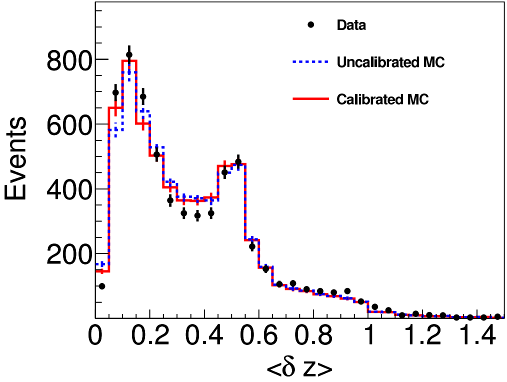
Stretch calibration (from M.Forrest's PHD thesis)



Percentile	X_{data}	X_{MC}
0.0%	0.0	0.0
1.25%	0.449633	0.459171
2.5%	0.484134	0.492759
3.75%	0.506804	0.512258
5.0%	0.528282	0.531042
6.25%	0.549042	0.552366
.	.	.
.	.	.
.	.	.
100%	1.0	1.0

Table 6.1: Example of tabulated X_{data} and X_{MC} for stretch calibration procedure.

Stretch calibration: result



- Better fit of Data distributions after applying stretch calibration