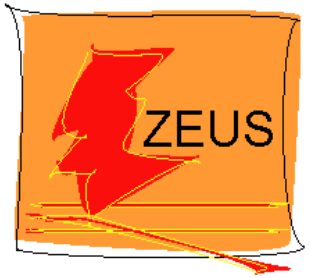


Prompt photons + jet in DIS

P. Bussey, O. Hlushchenko, O. Kuprash,

D. Saxon, I. Shyrma,

I. Skillicorn, N. Zhmak

November 2015
ZAF meeting

Outline :

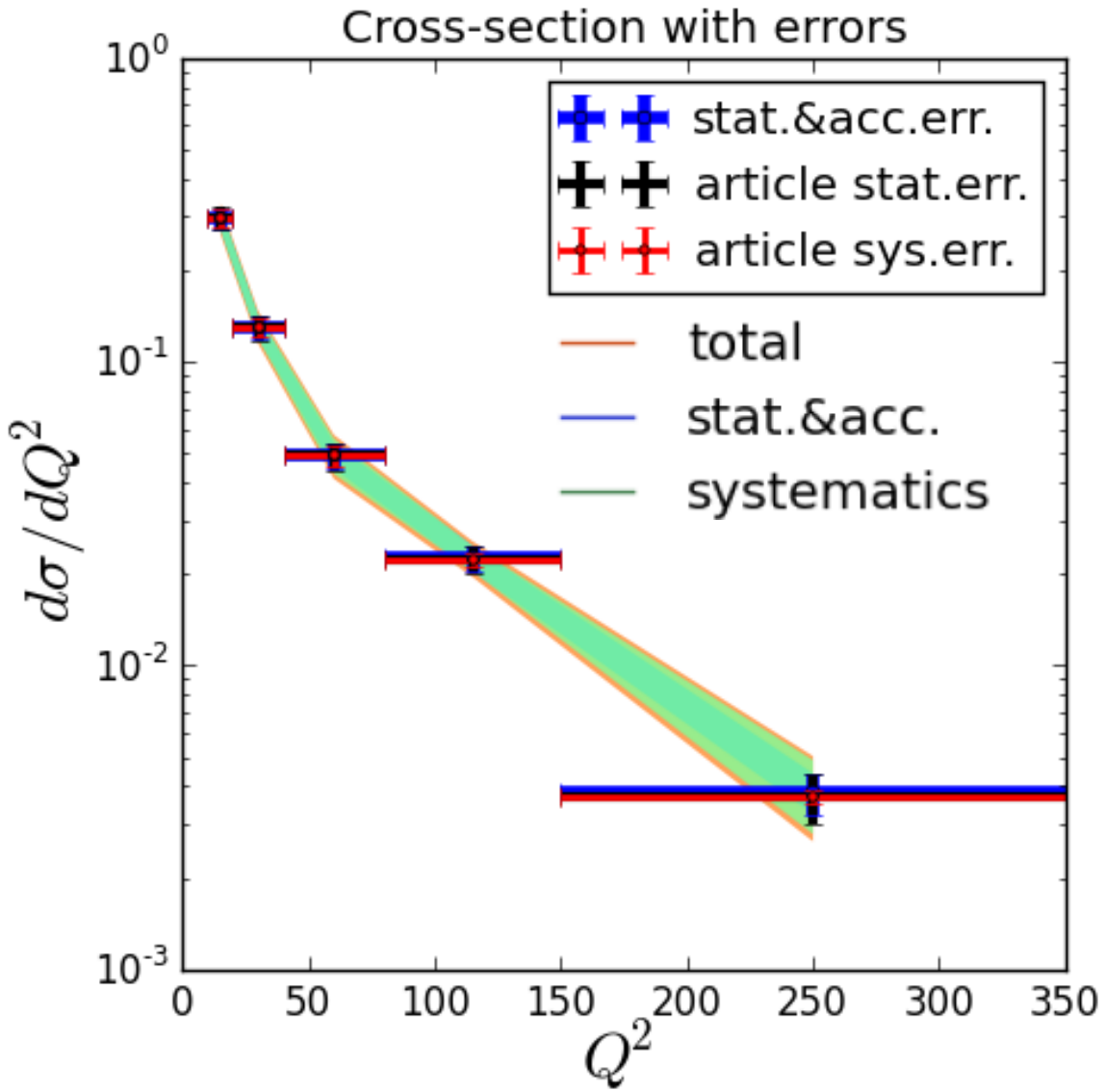
- Observables to study
- Control plots
- Purity
- Acceptance
- Cross sections
- Conclusion

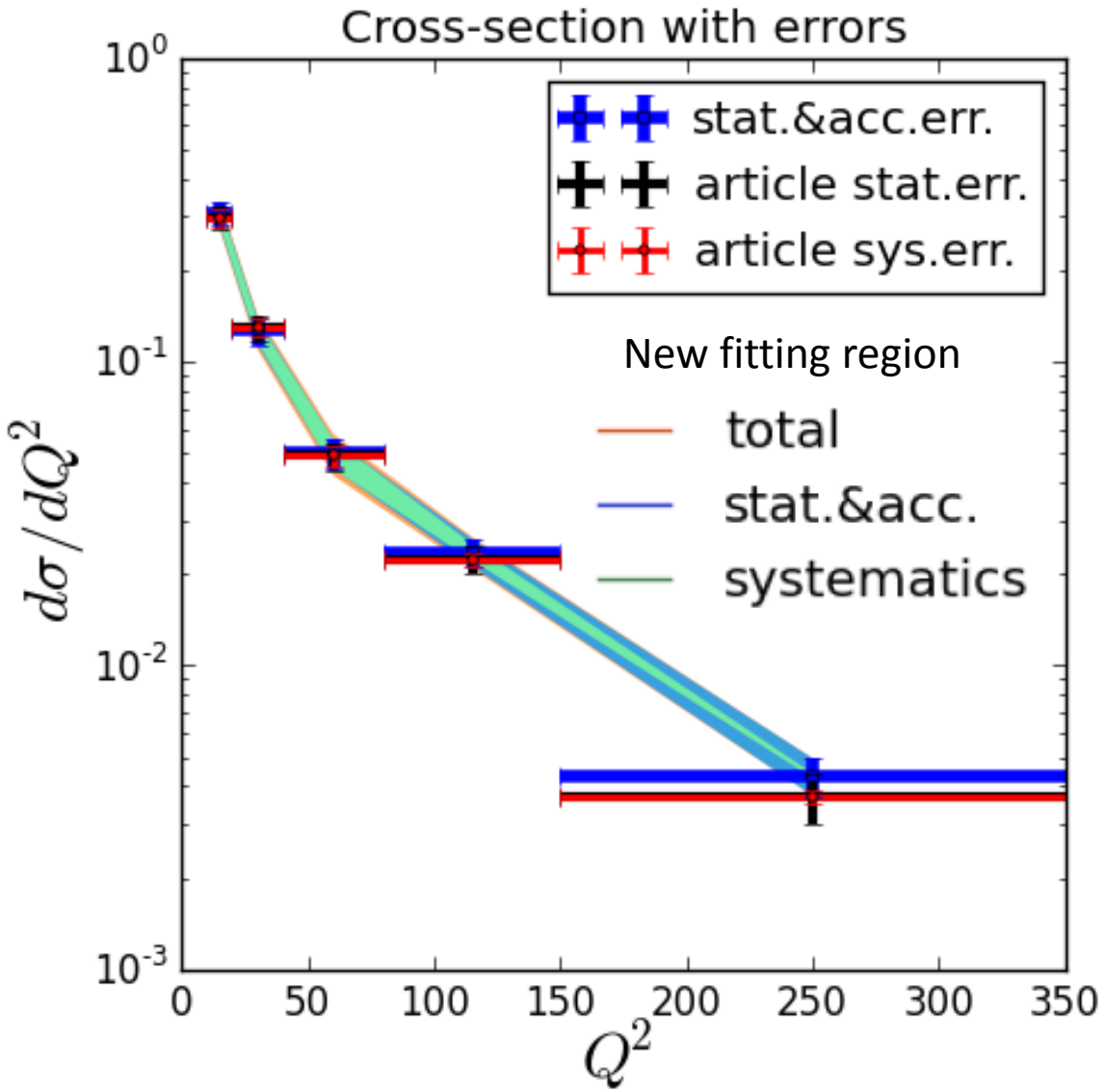
Observables to study

- $x_\gamma = \frac{\sum_{jet,\gamma}(E - p_z)}{2 y_{Bj} E_e}$
- $x_p = \frac{\sum_{jet,\gamma}(E + p_z)}{2 E_p}$
- $\Delta\eta_{\gamma,jet} = \eta_{jet} - \eta_\gamma$
- $\Delta\varphi_{\gamma,jet} = \varphi_{jet} - \varphi_\gamma$
- $\Delta\eta_{\gamma,e} = \eta_e - \eta_\gamma$
- $\Delta\varphi_{e,\gamma} = \varphi_e - \varphi_\gamma$

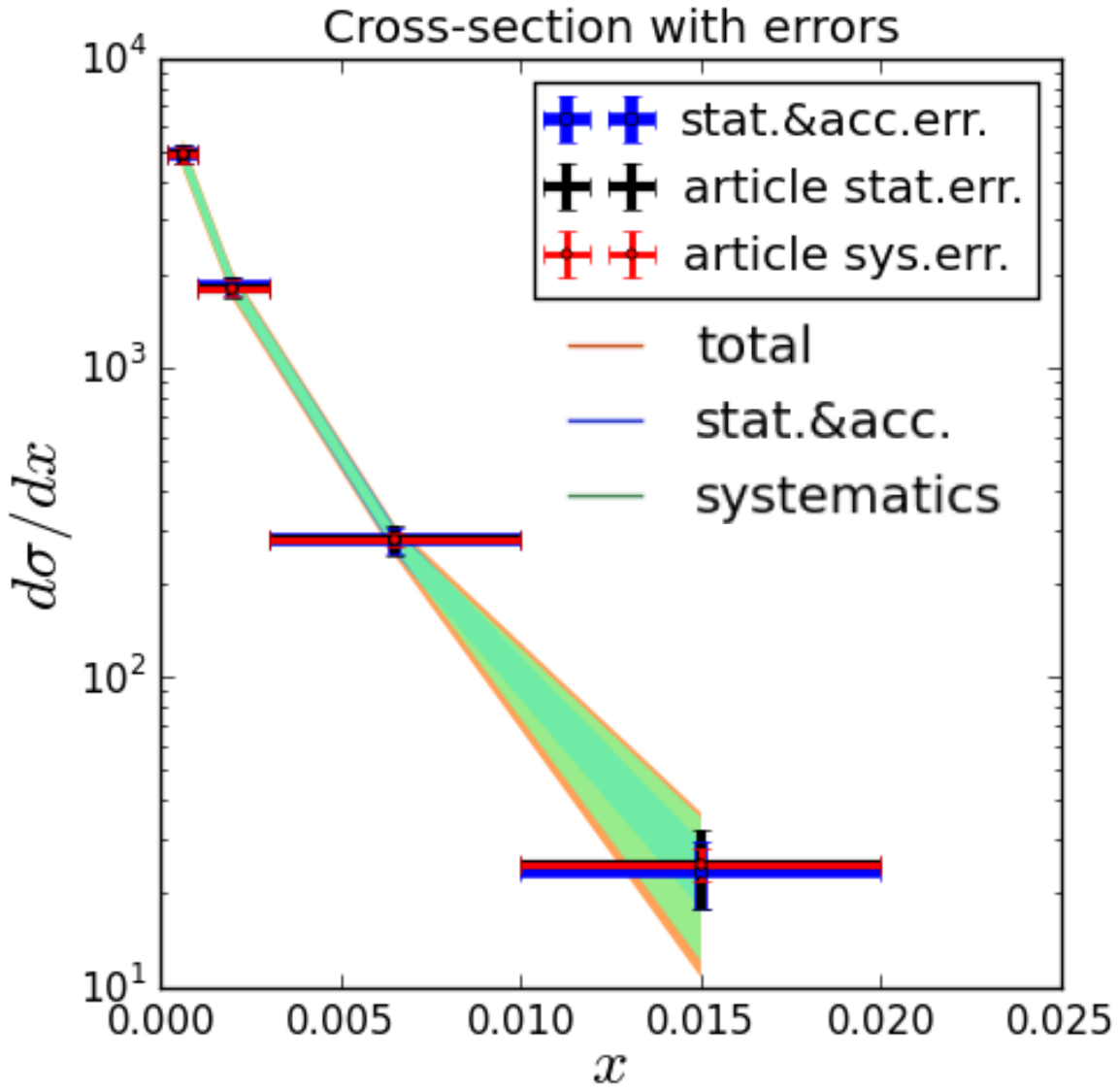
Similar kind of analysis was previously done for photoproduction (Q^2<1).

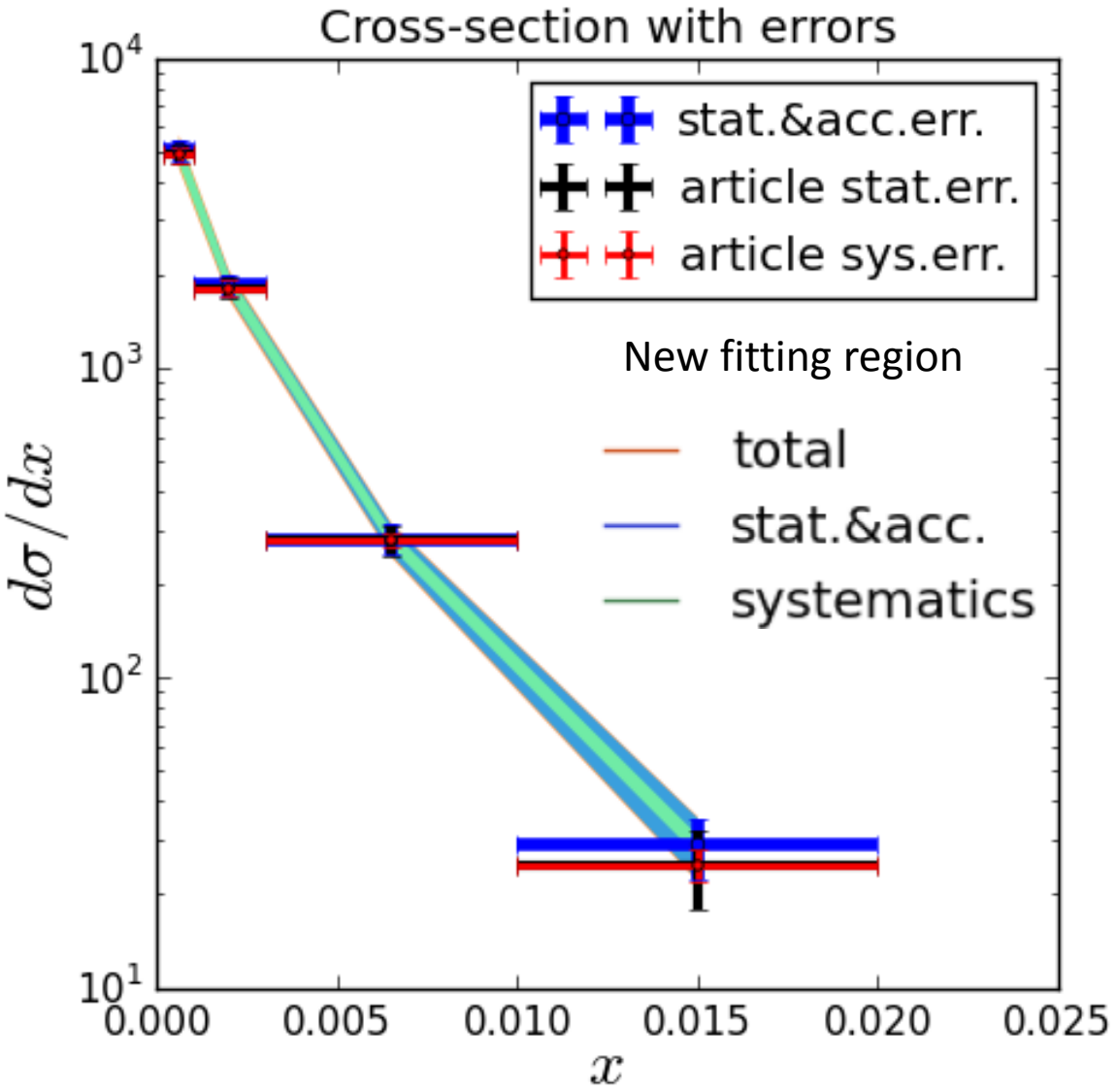
Comparison to previous analysis



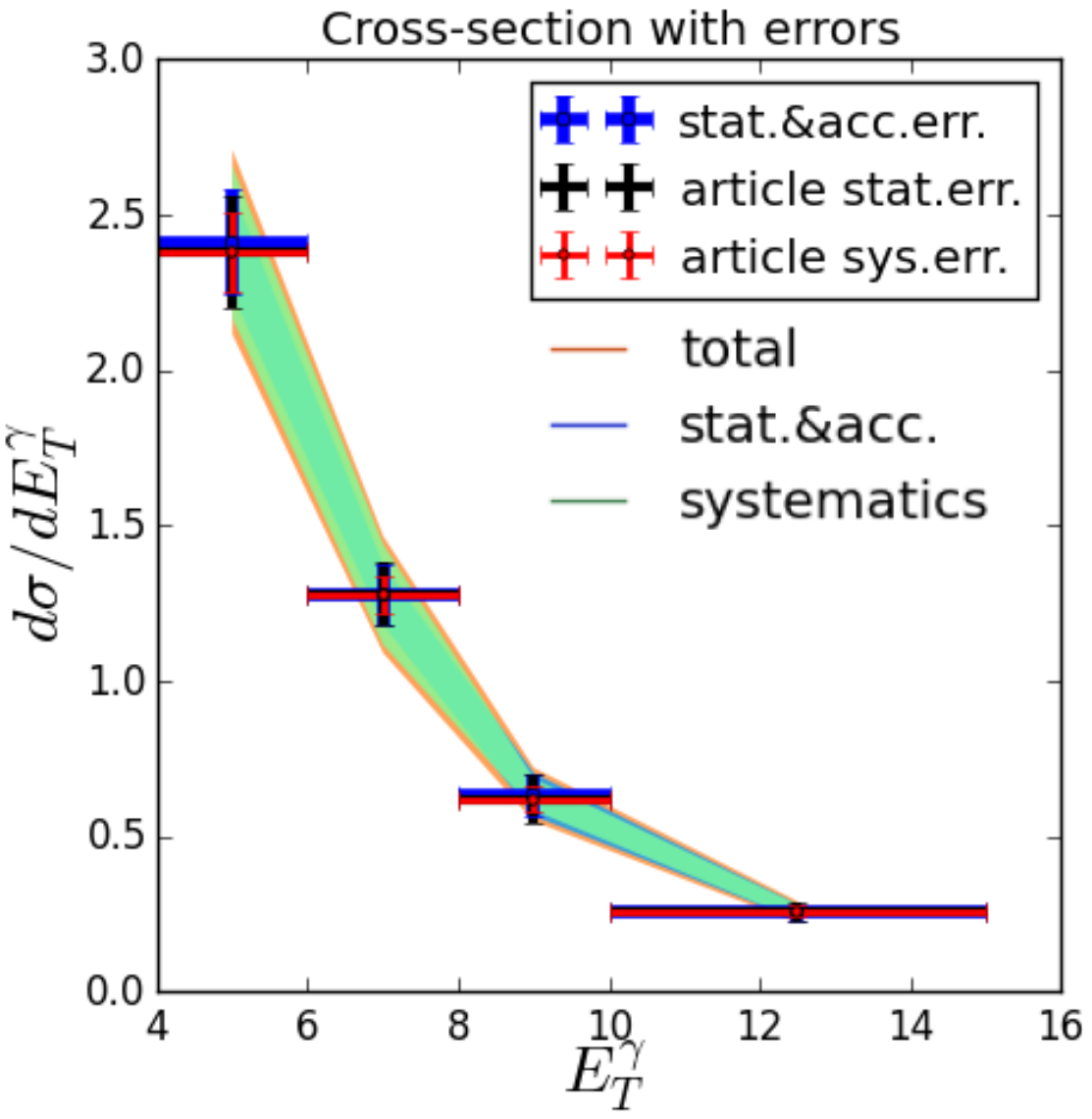


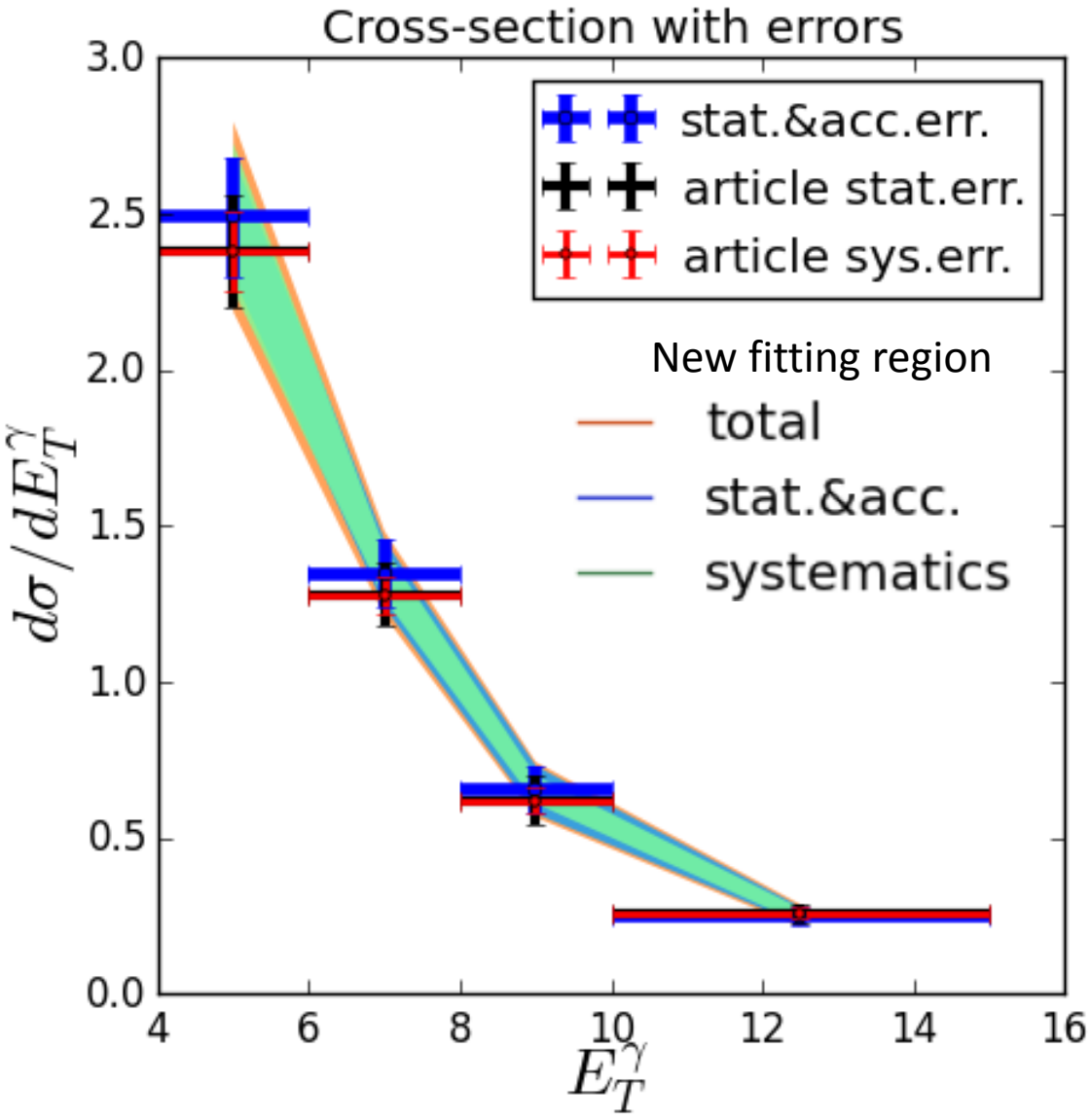
Comparison to previous analysis



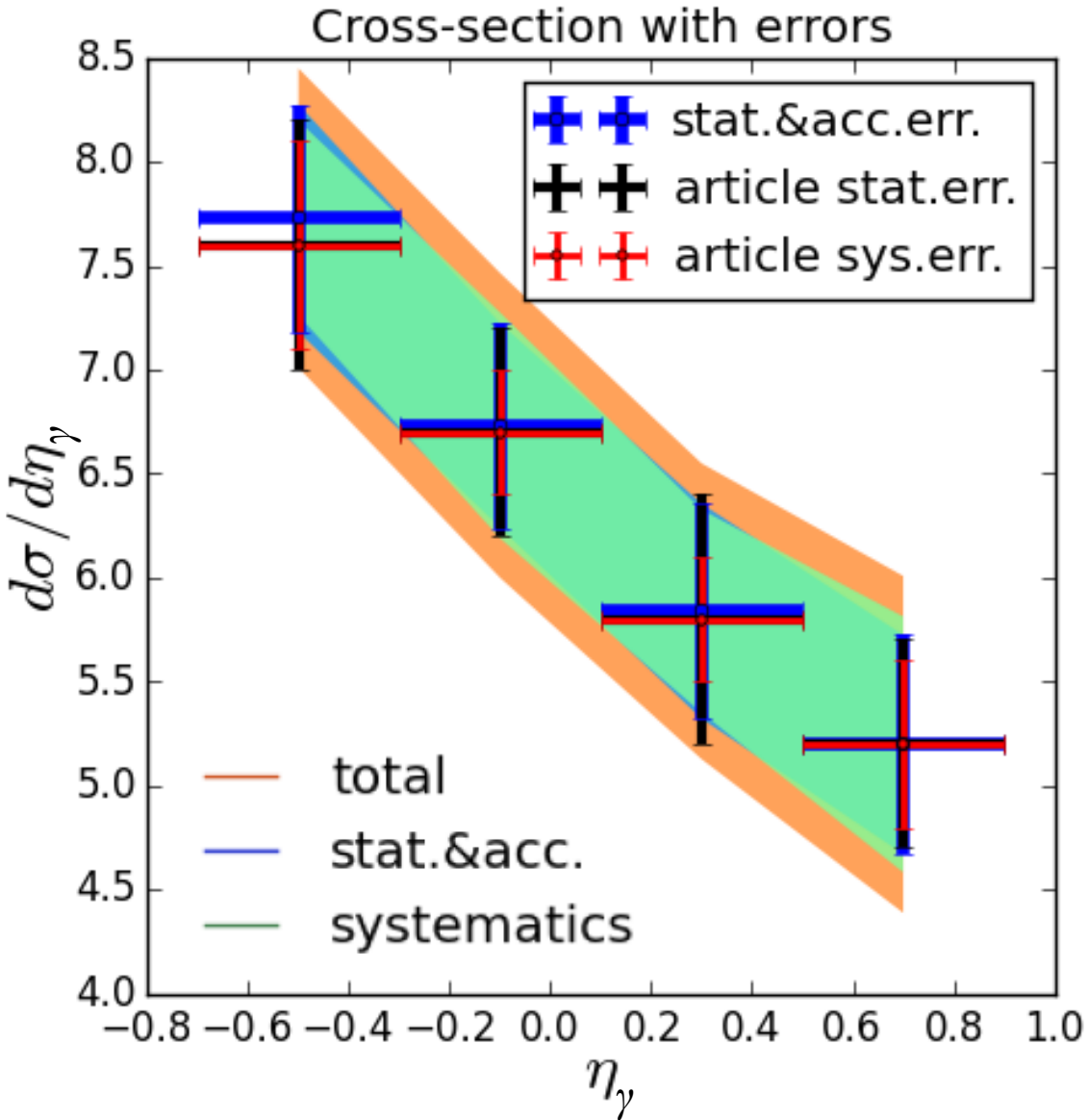


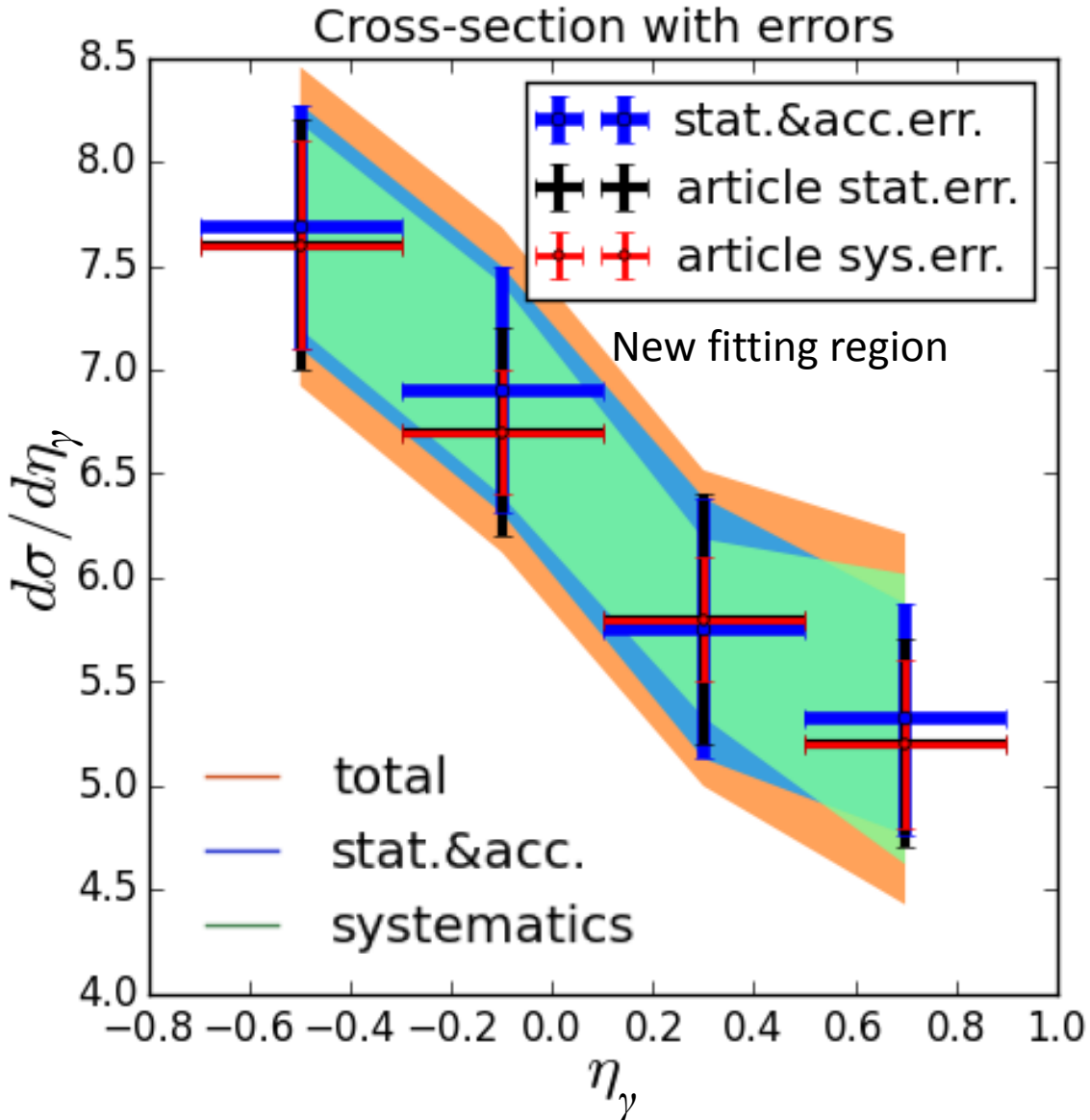
Comparison to previous analysis



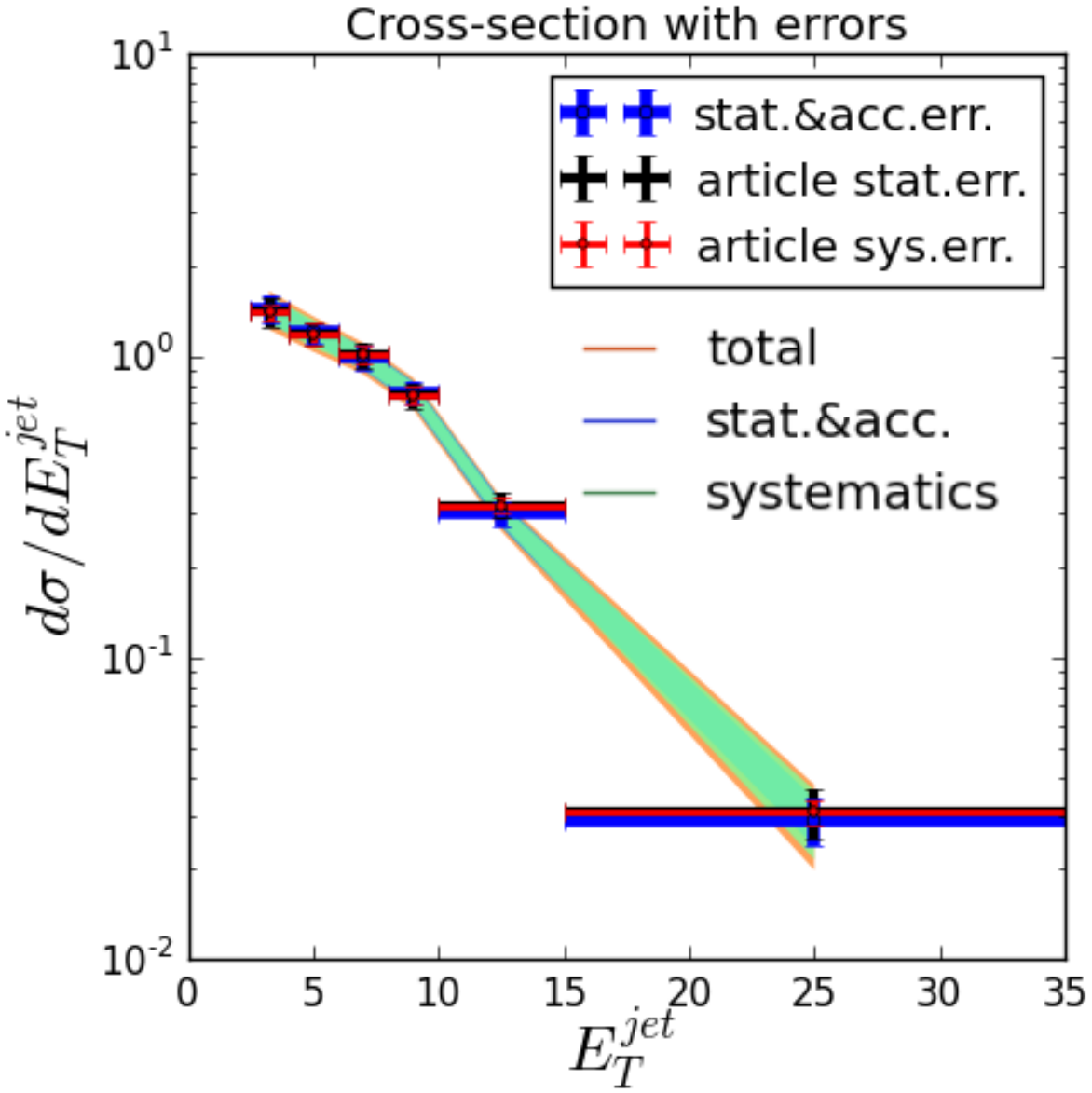


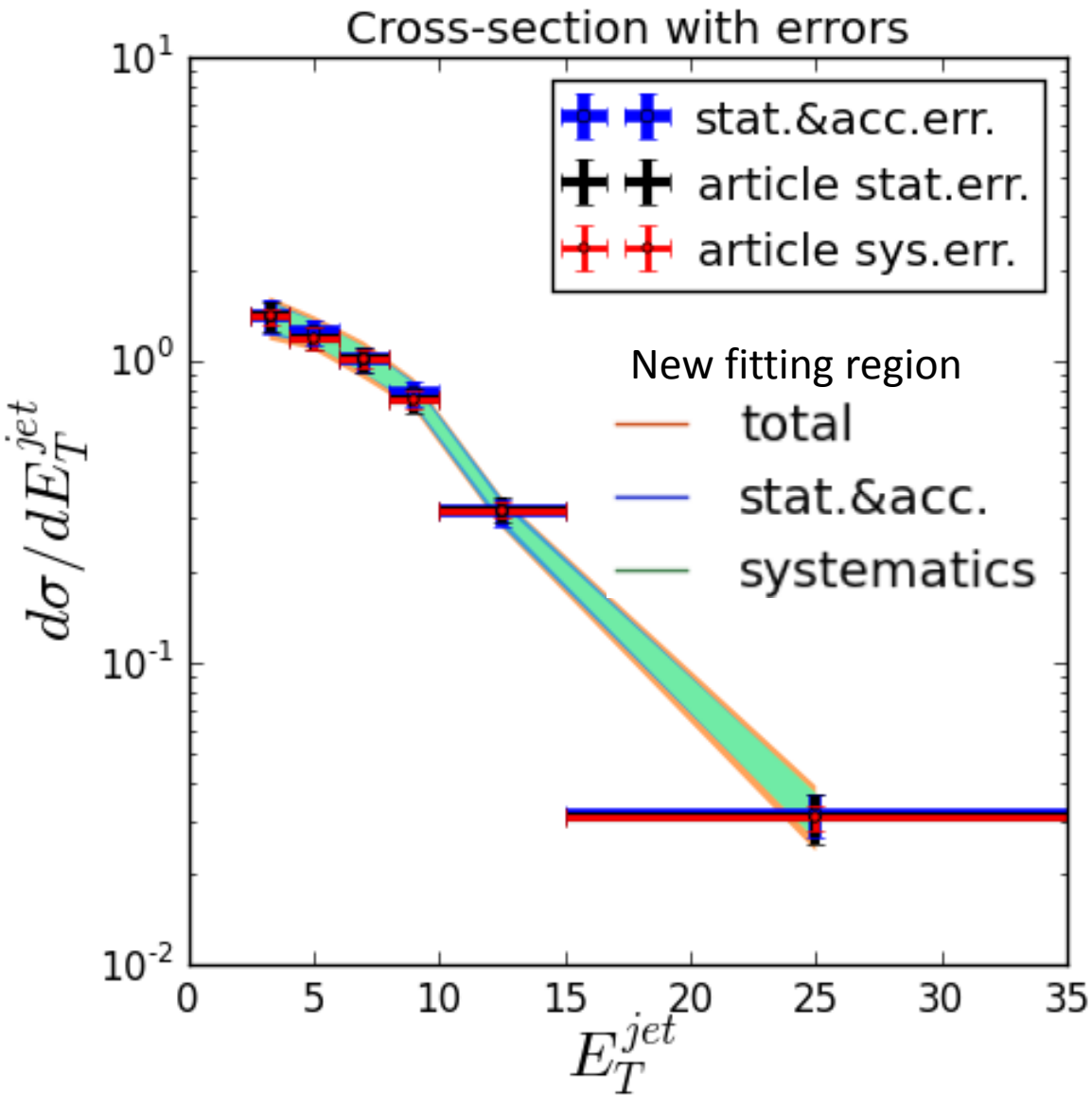
Comparison to previous analysis



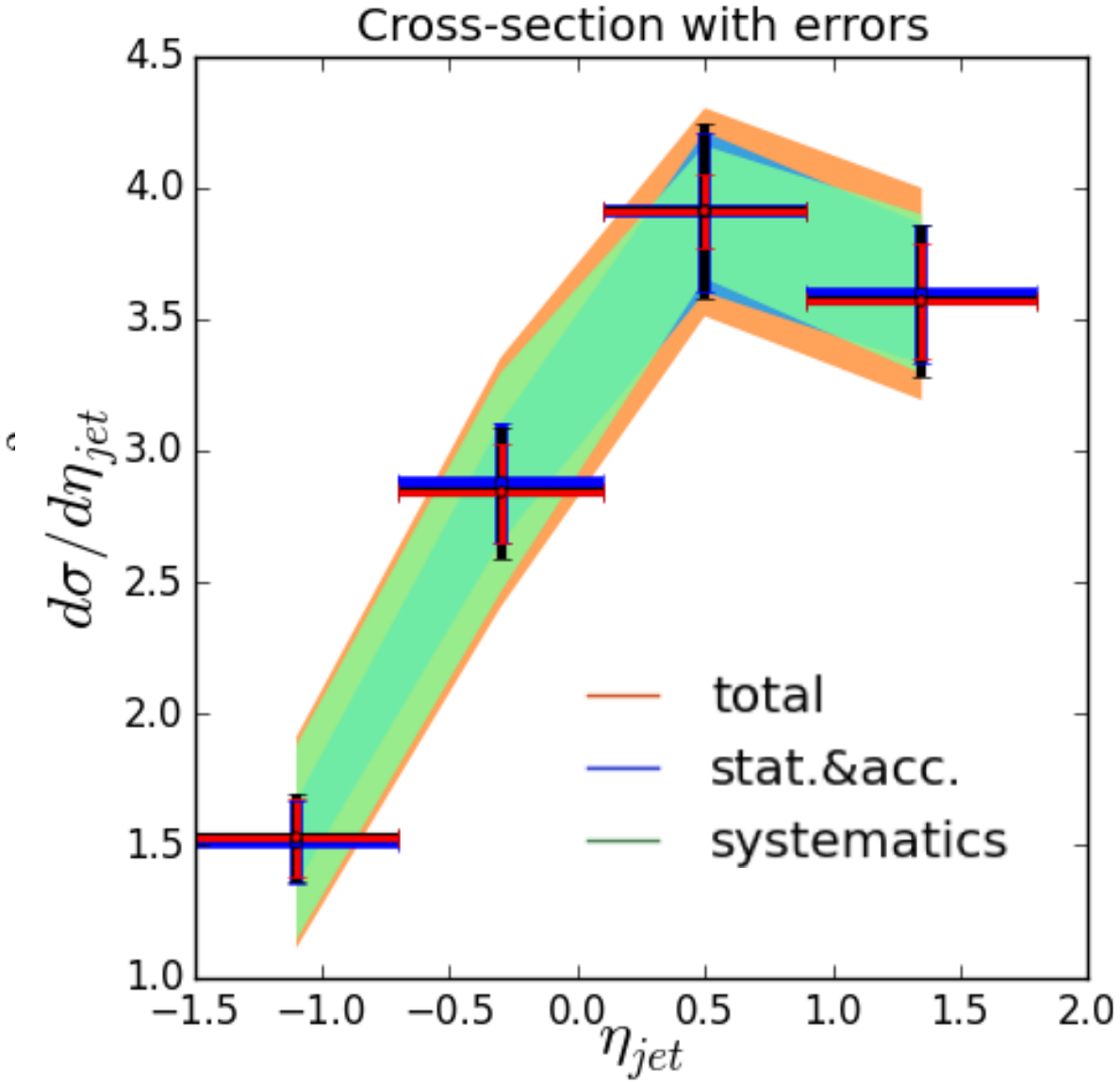


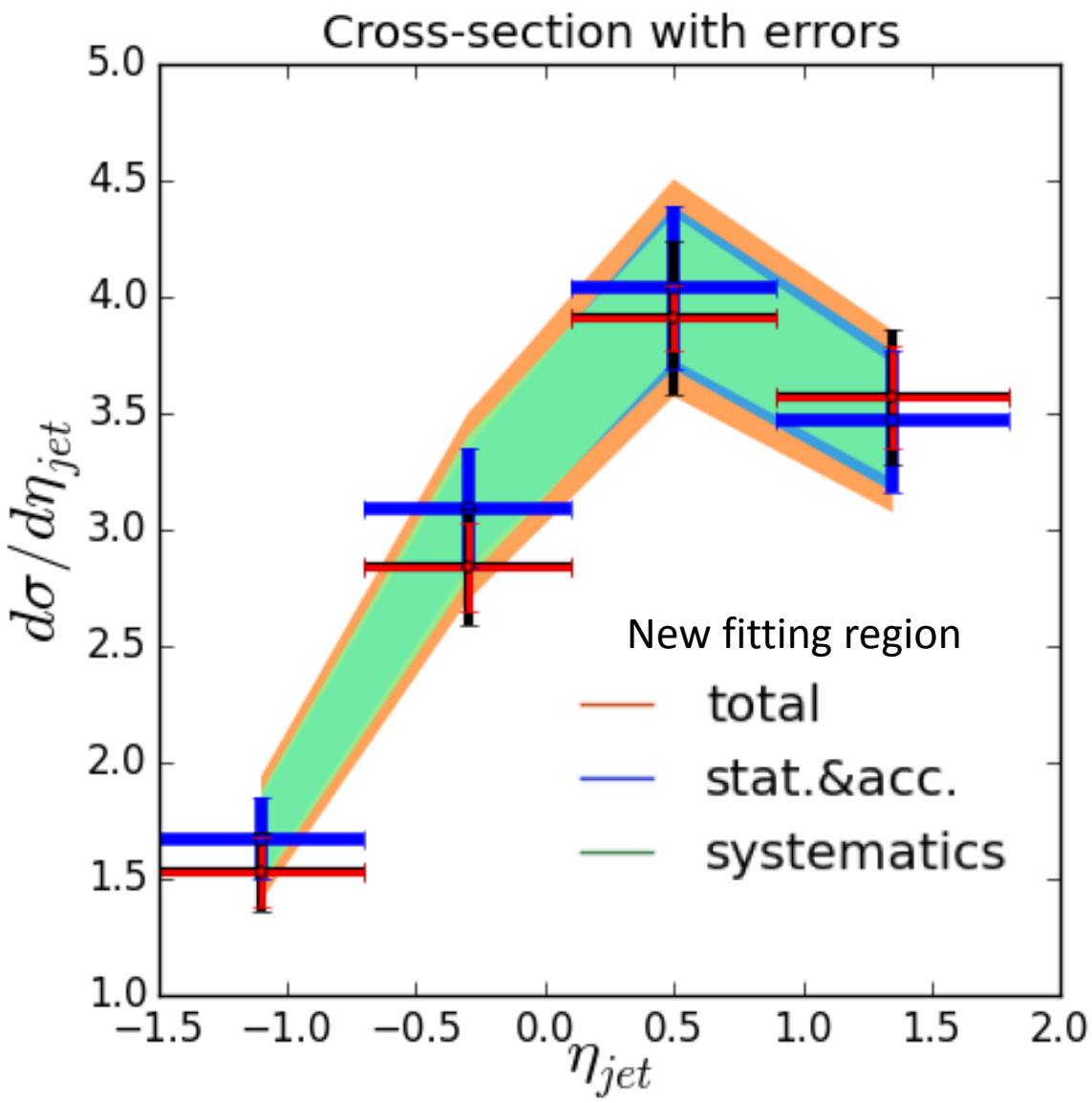
Comparison to previous analysis





Comparison to previous analysis





New variables

- Mooved to new bins
- Moved to new fitting region – excluding the first bin from the fit
  - A bin by bin $min\chi^2$-fitting procedures is done. The minimized function:

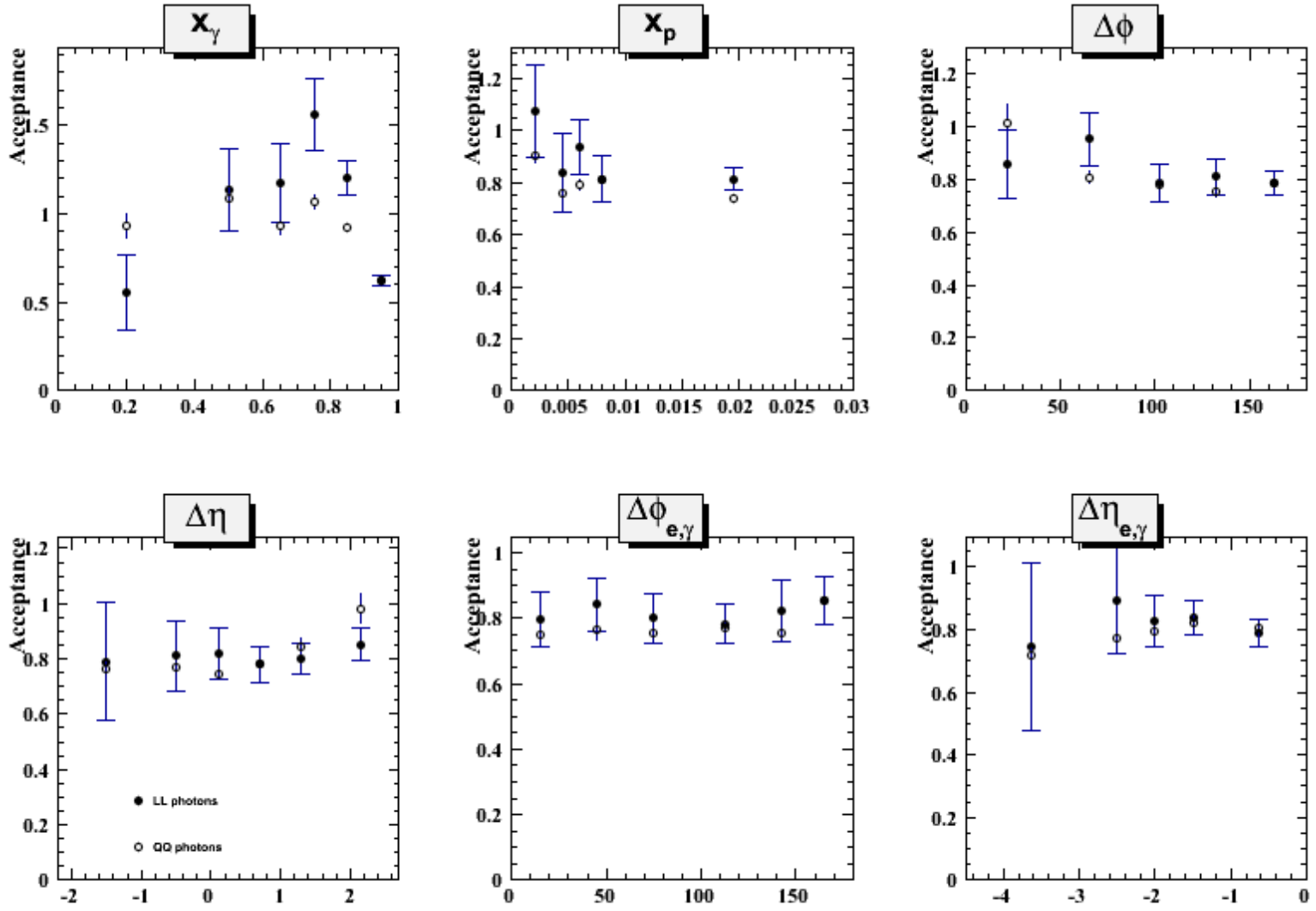
$$\boldsymbol{Data - Photons_{MC} * a - Background_{MC} * (1 - a)}$$

, where ***a*** – fitting parameter,
Phorons$_{MC}$ – LL$_{MC}$ and QQ$_{MC}$ photons (scaled to the number of photon candidates in data before the fitting procedure)

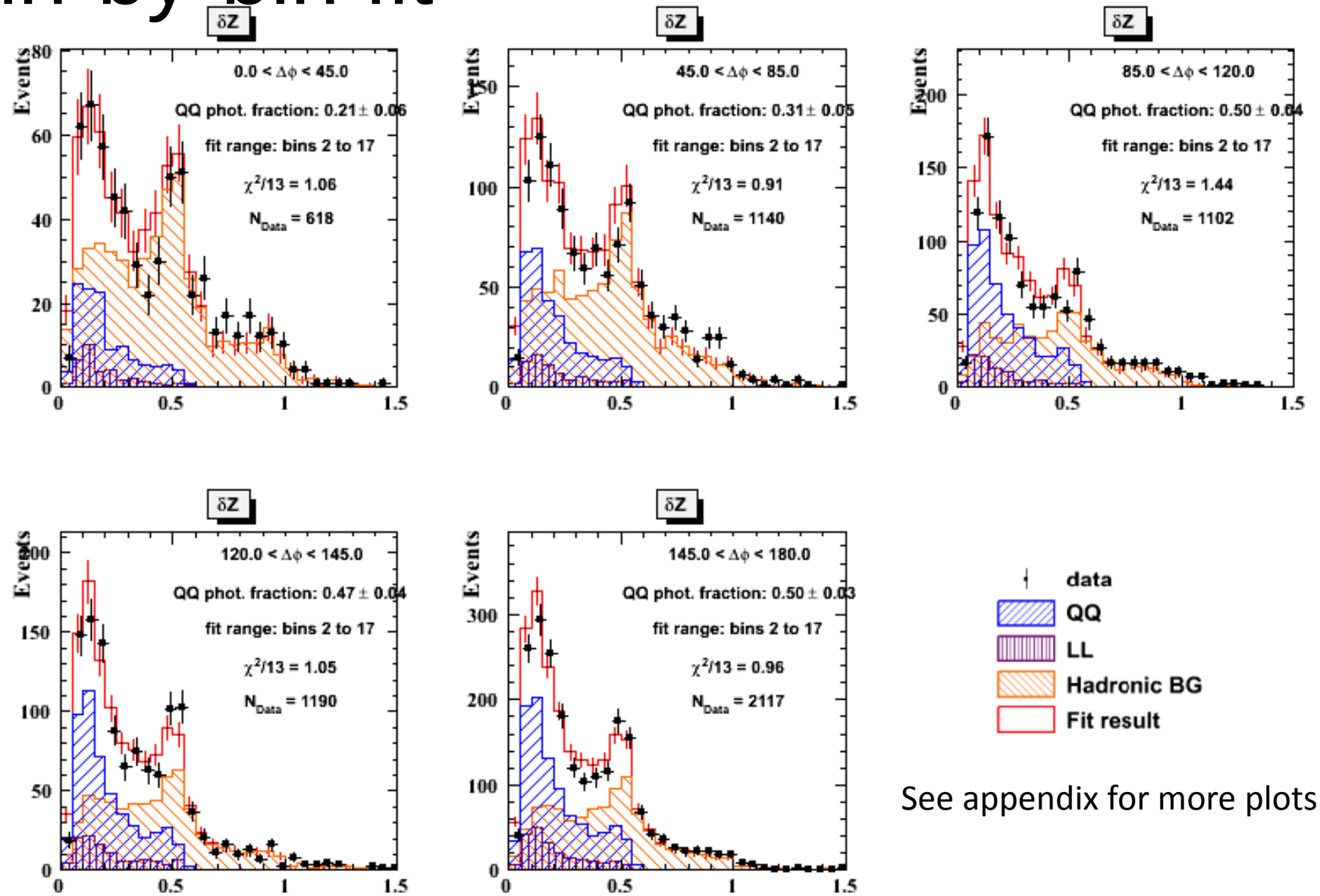
- Recalculated acceptances, purities etc.

Acceptance

$Acc = \frac{N_{detector\ level}}{N_{true\ level}}$ acceptance can be calculated as the relation of corresponding histograms scaled to data luminosity

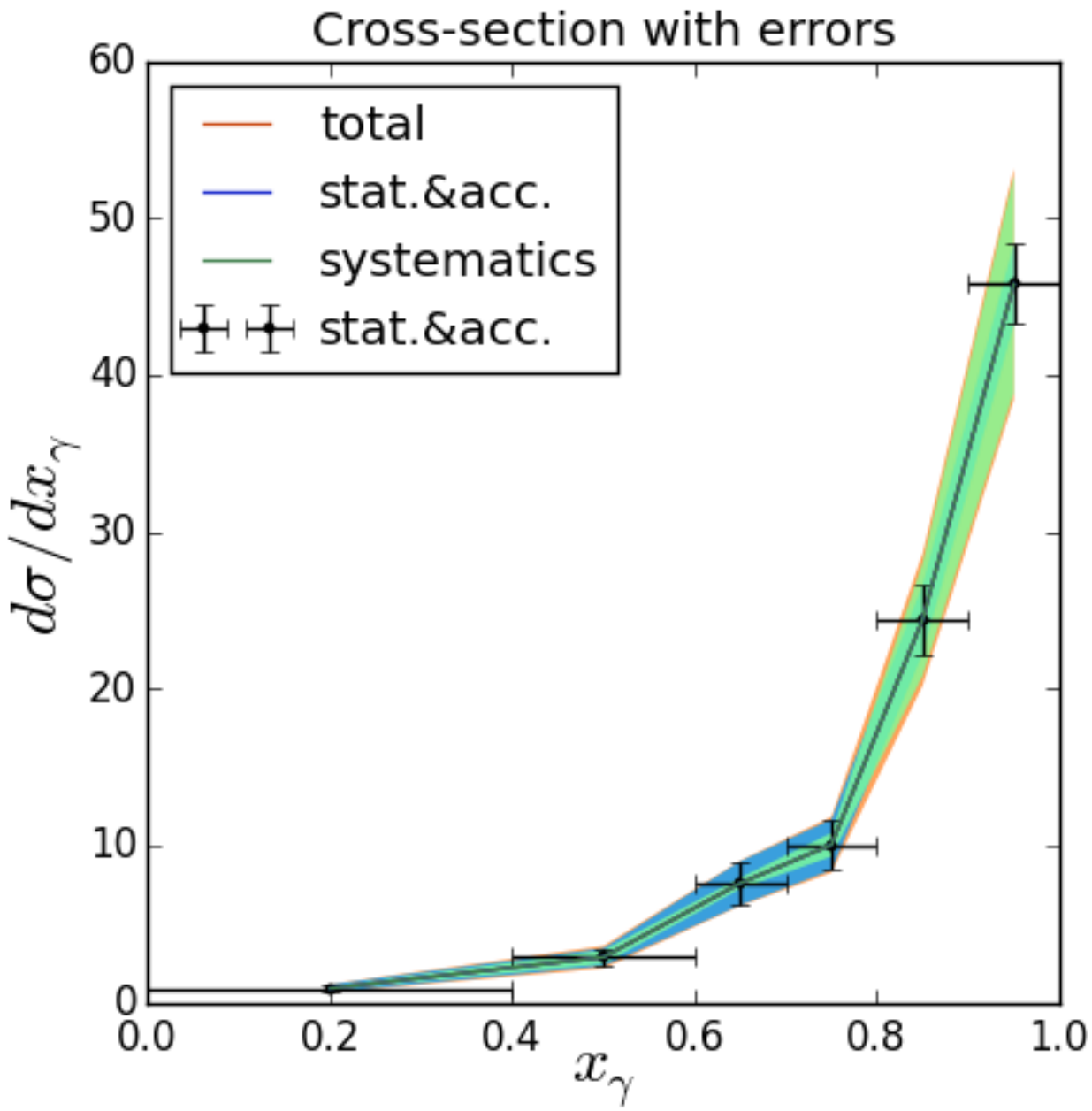


Δφ bin-by-bin fit

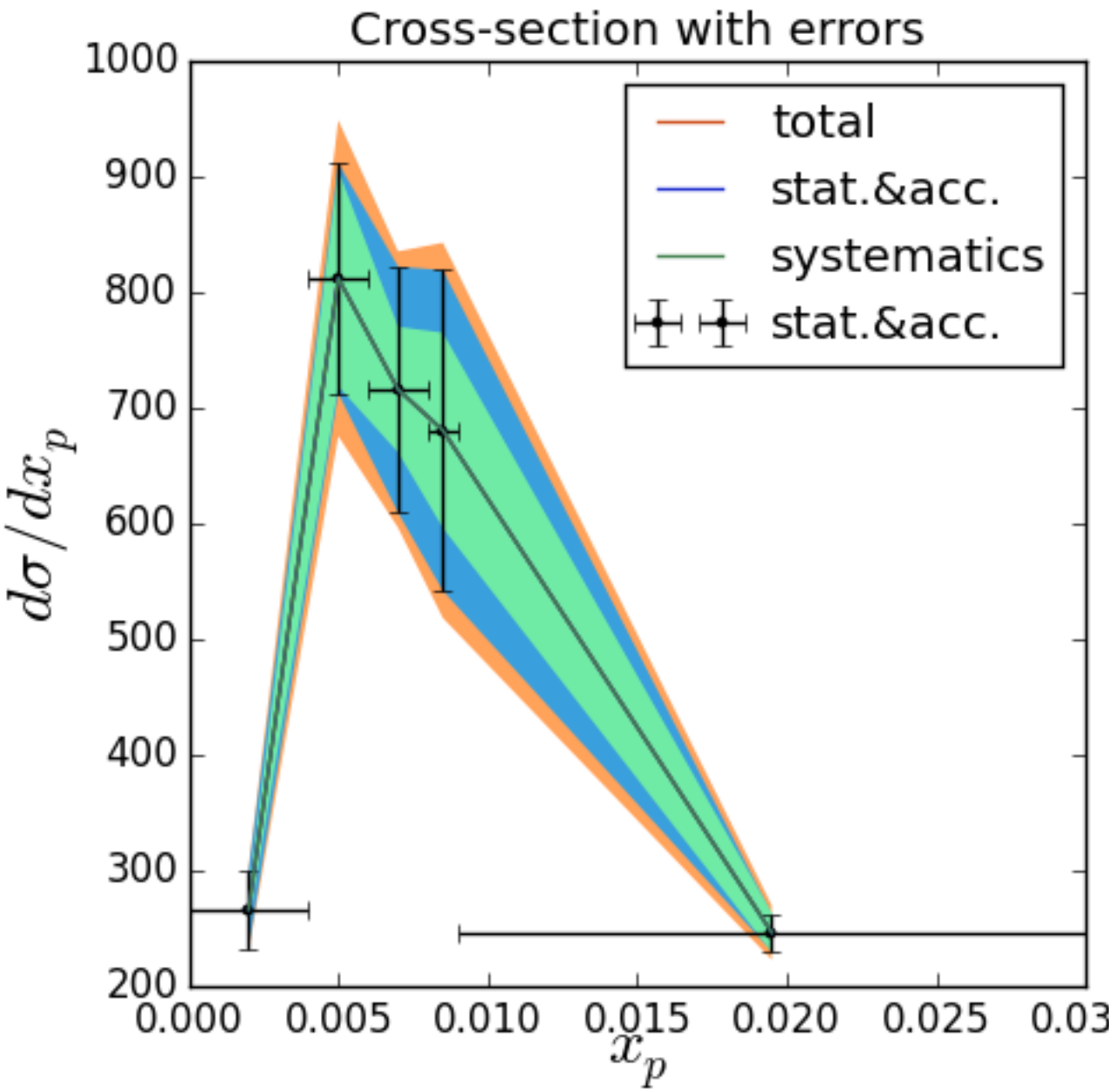


See appendix for more plots

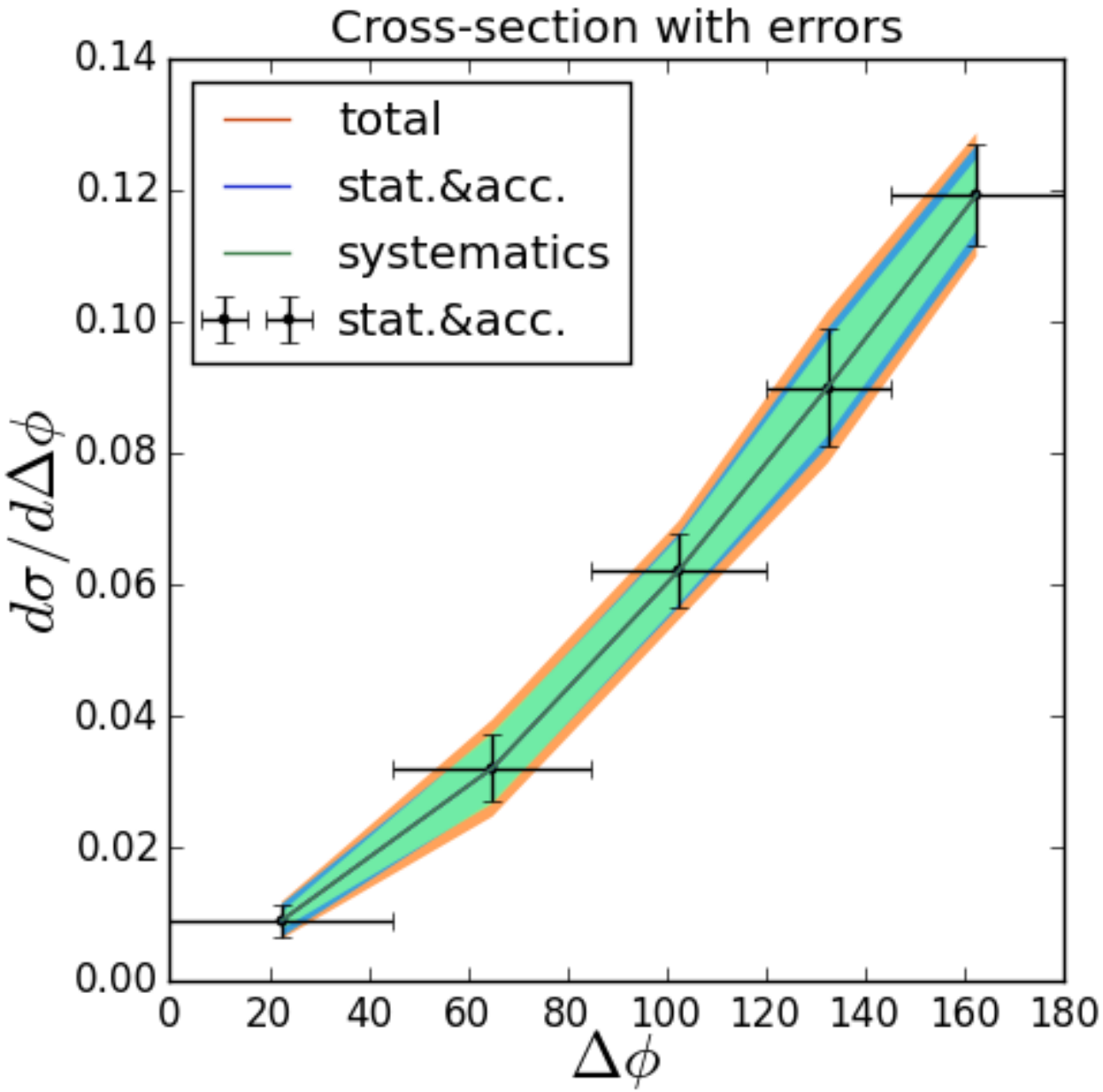
x_γ


Cross-section with errors
total
stat.&acc.
systematics
stat.&acc.
$d\sigma/dx_\gamma$
x_γ
0
10
20
30
40
50
60
0.0
0.2
0.4
0.6
0.8
1.0

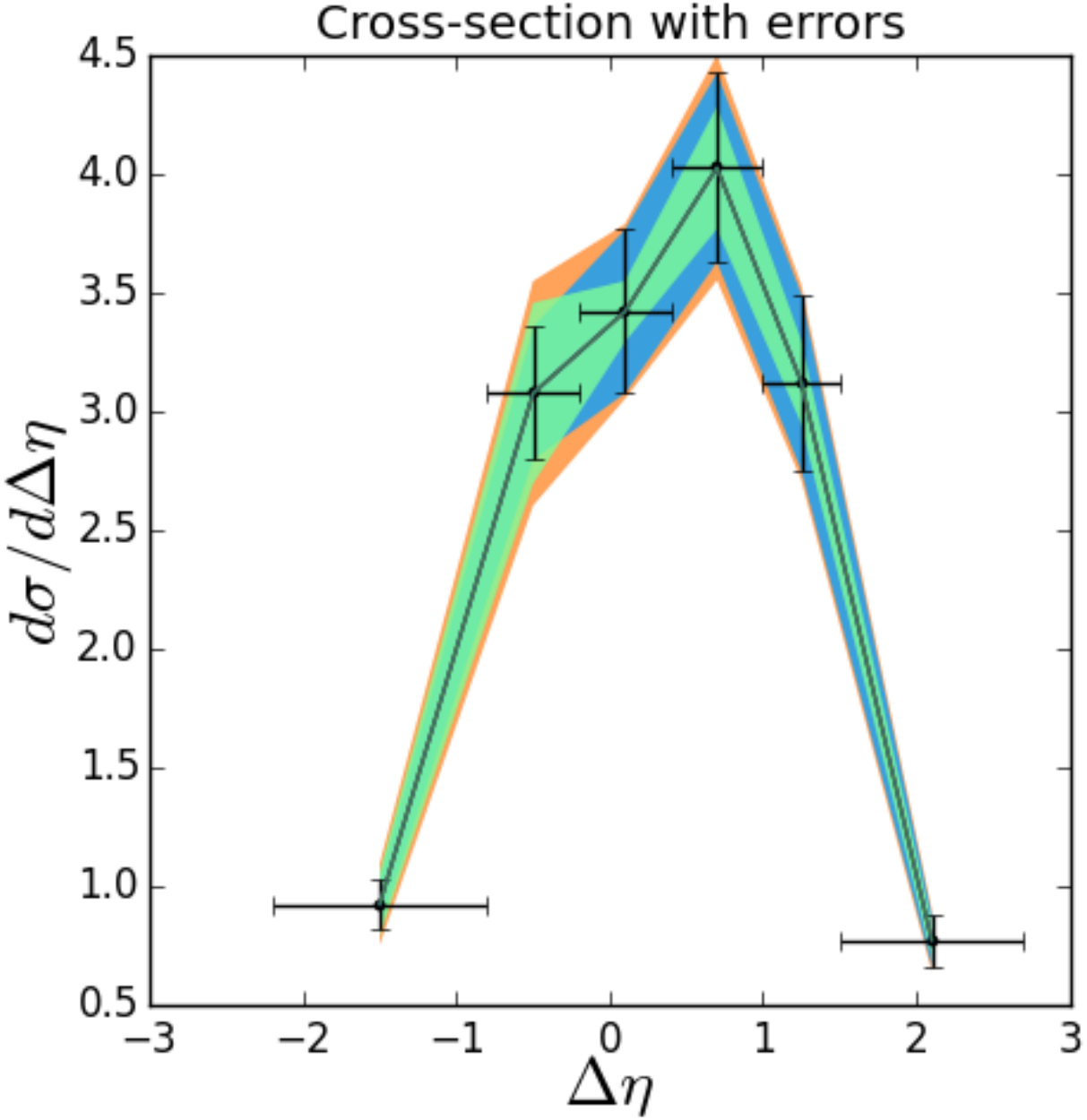
x_p


Cross-section with errors
total
stat.&acc.
systematics
stat.&acc.
$d\sigma/dx_p$
x_p
200
300
400
500
600
700
800
900
1000
0.000
0.005
0.010
0.015
0.020
0.025
0.03

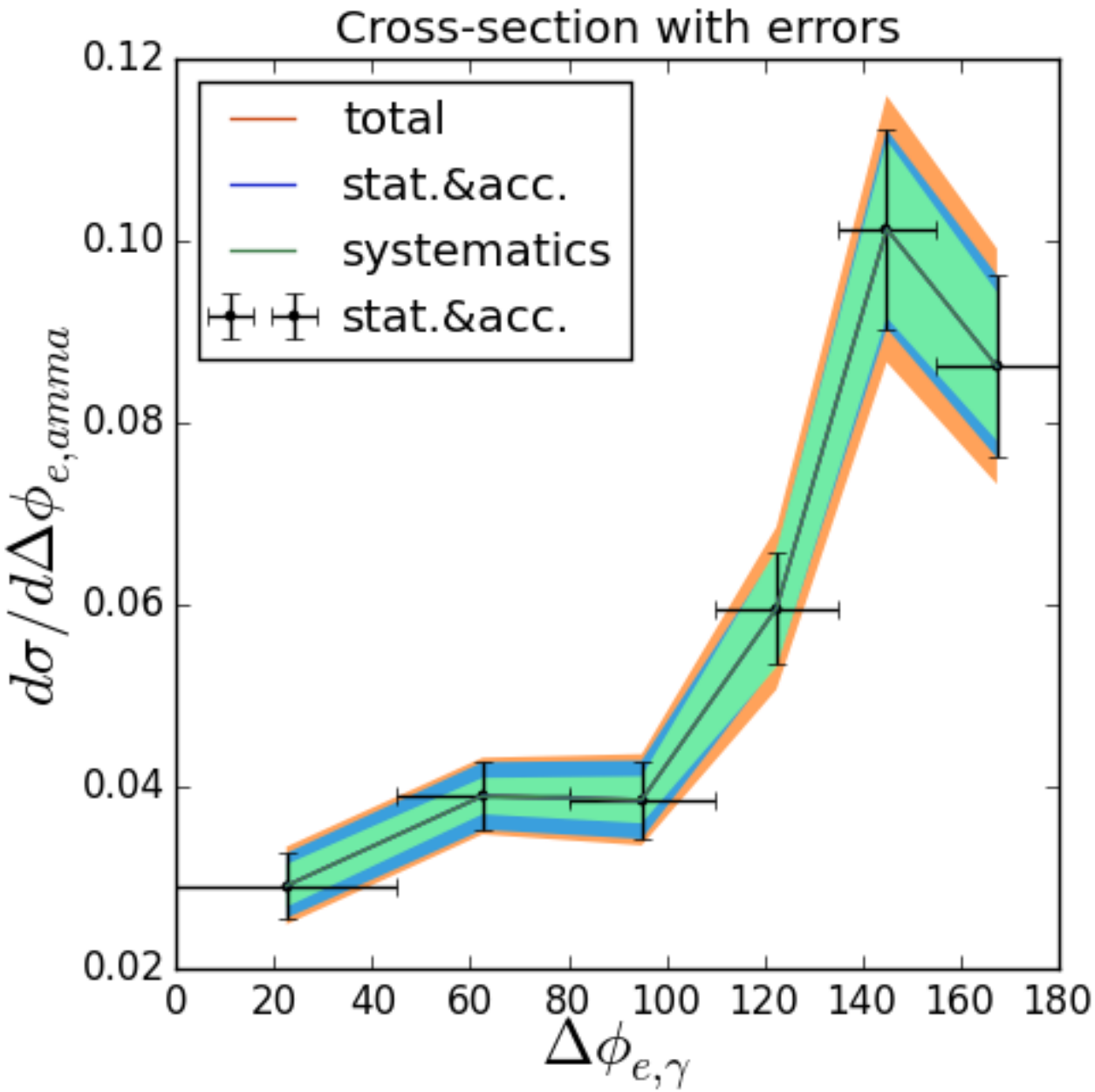
$\Delta\varphi$



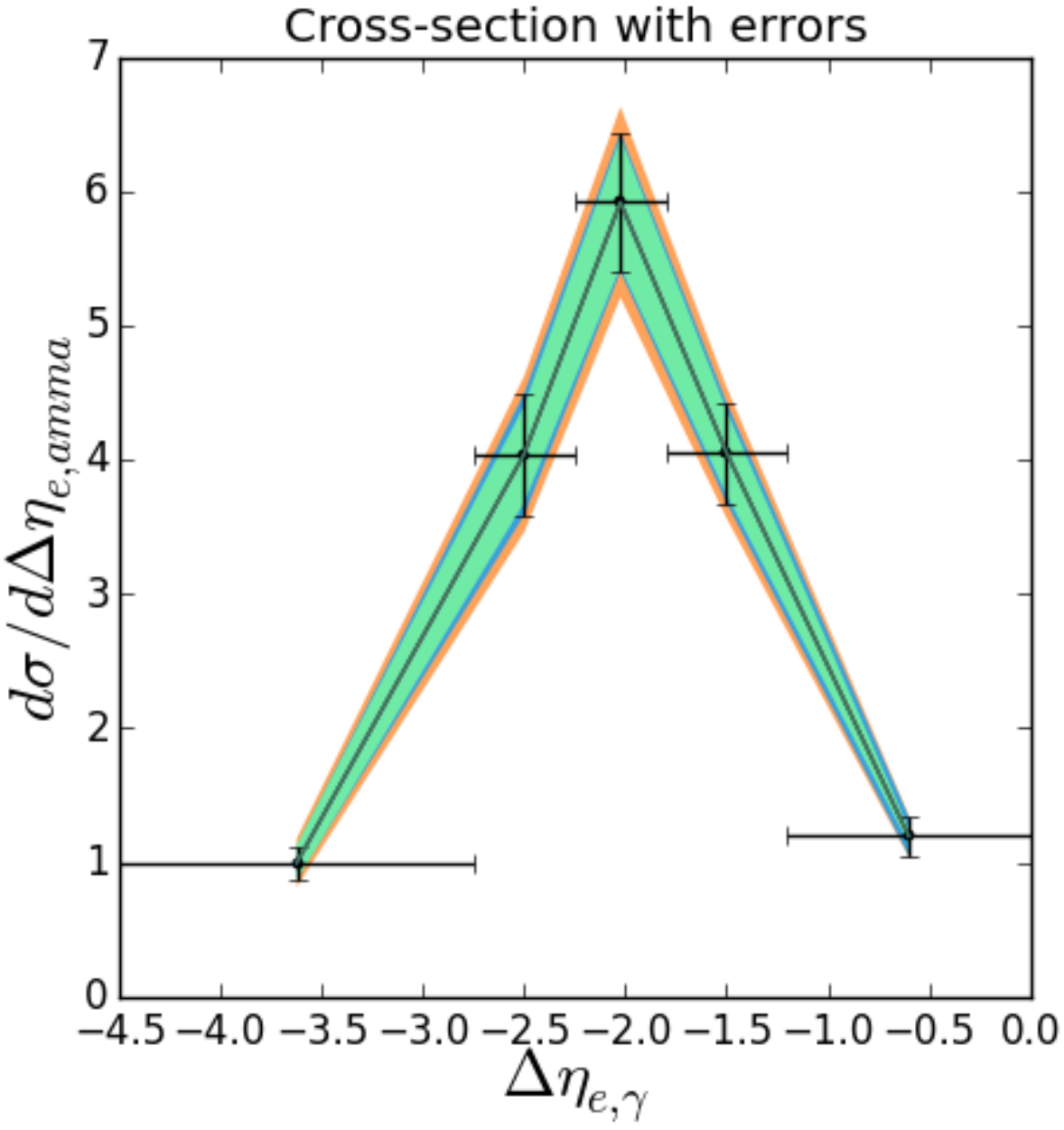
$\Delta\eta$



$\Delta\varphi_{e,\gamma}$



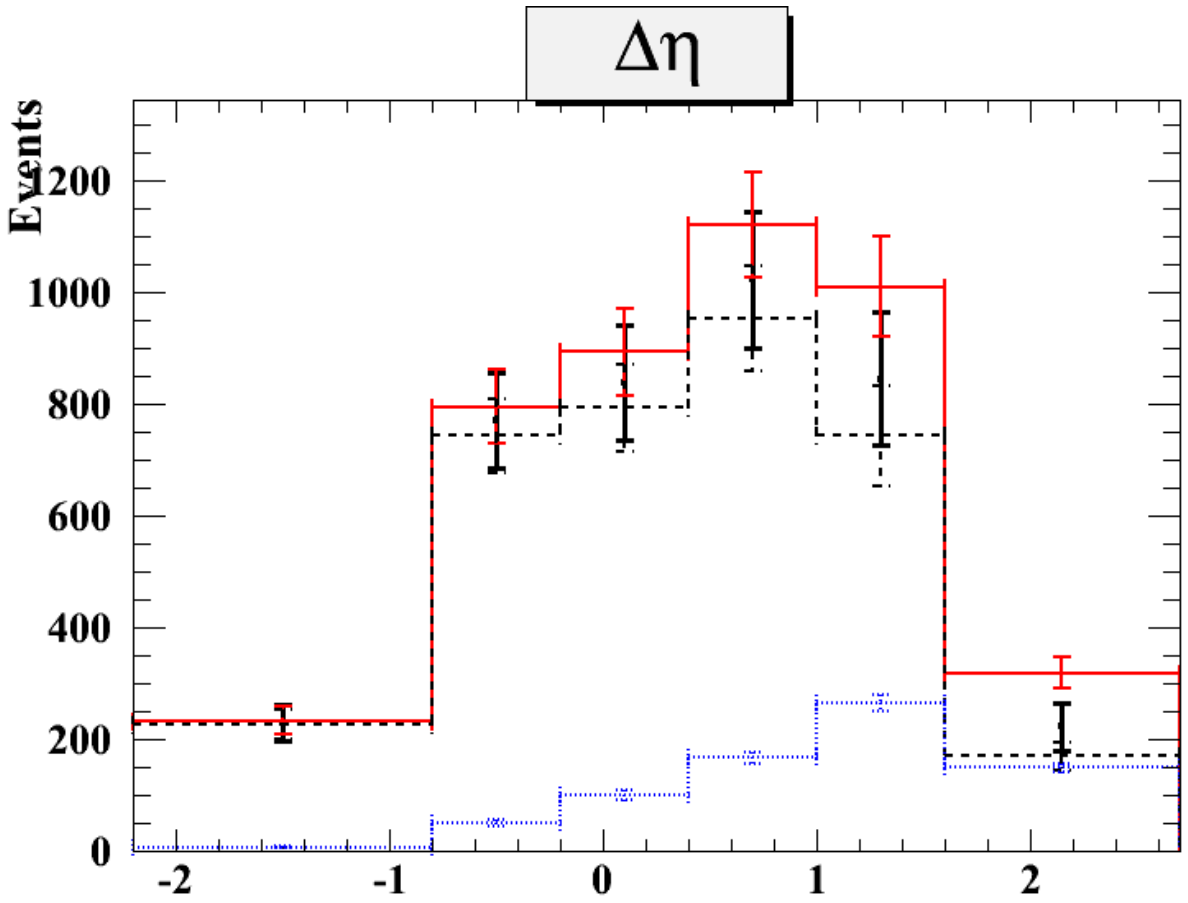
$\Delta\eta_{e,\gamma}$

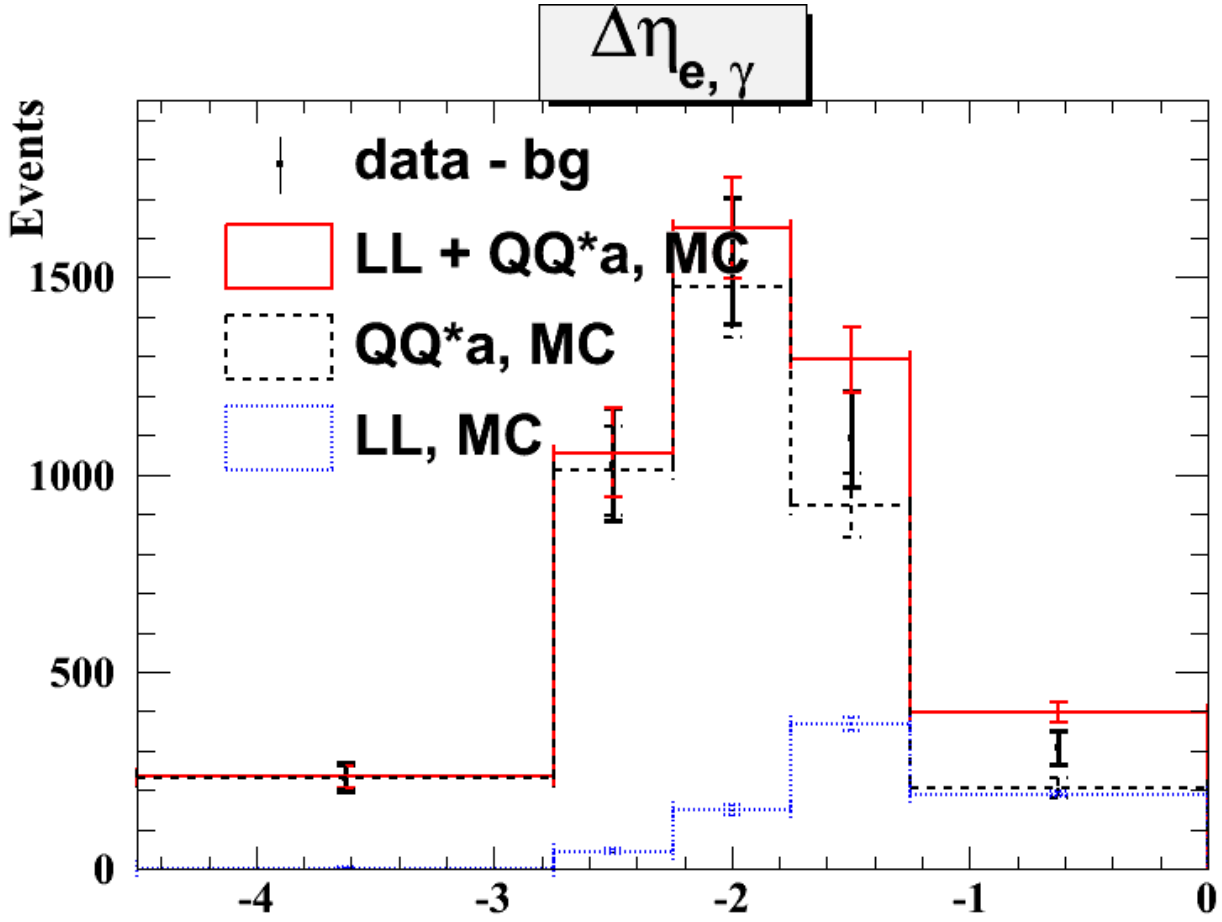


Conclusions

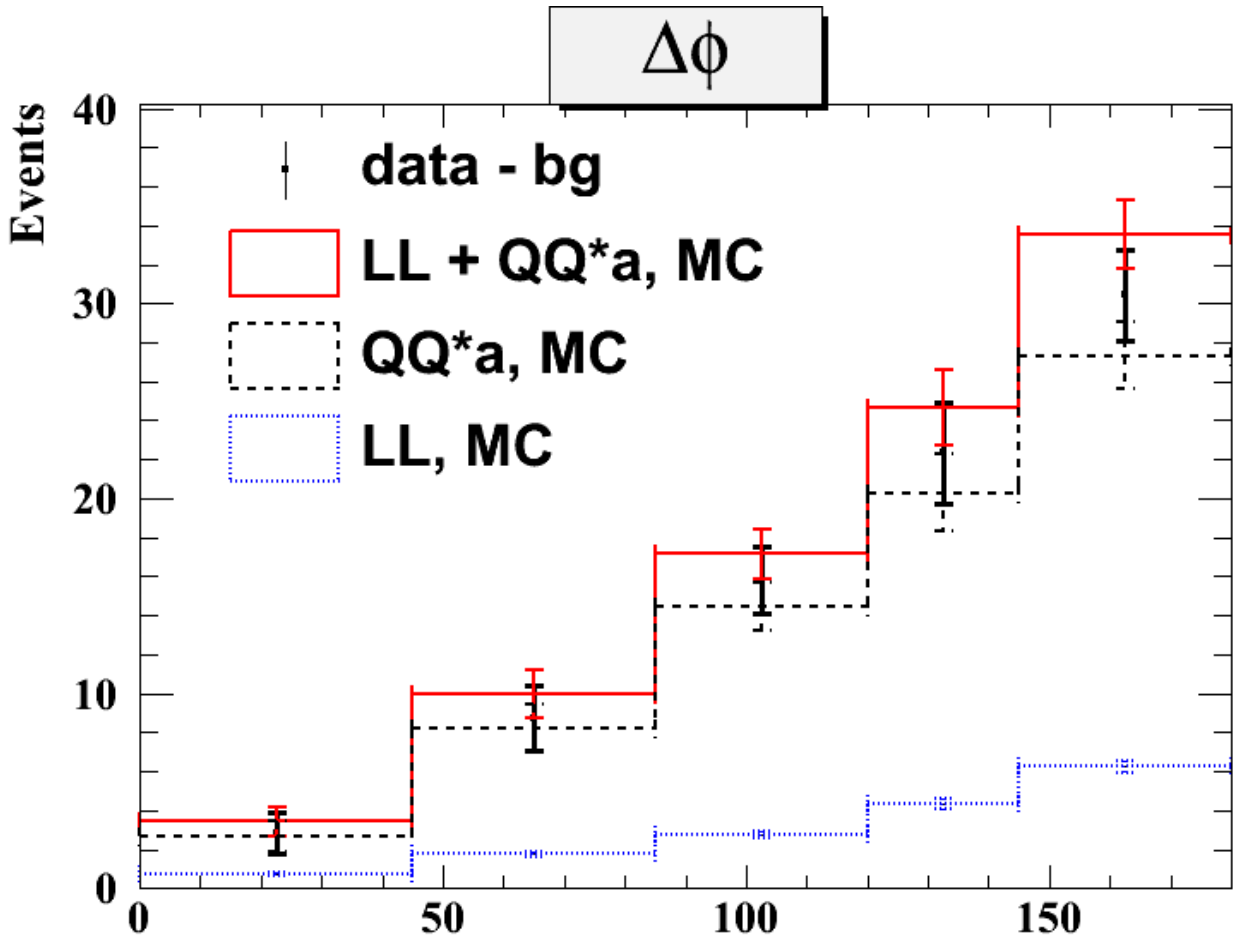
- Based on previous works we will continue studies of prompt photon with accompanying jet production in DIS region
- Come up with final bins and compare results to theoretical models

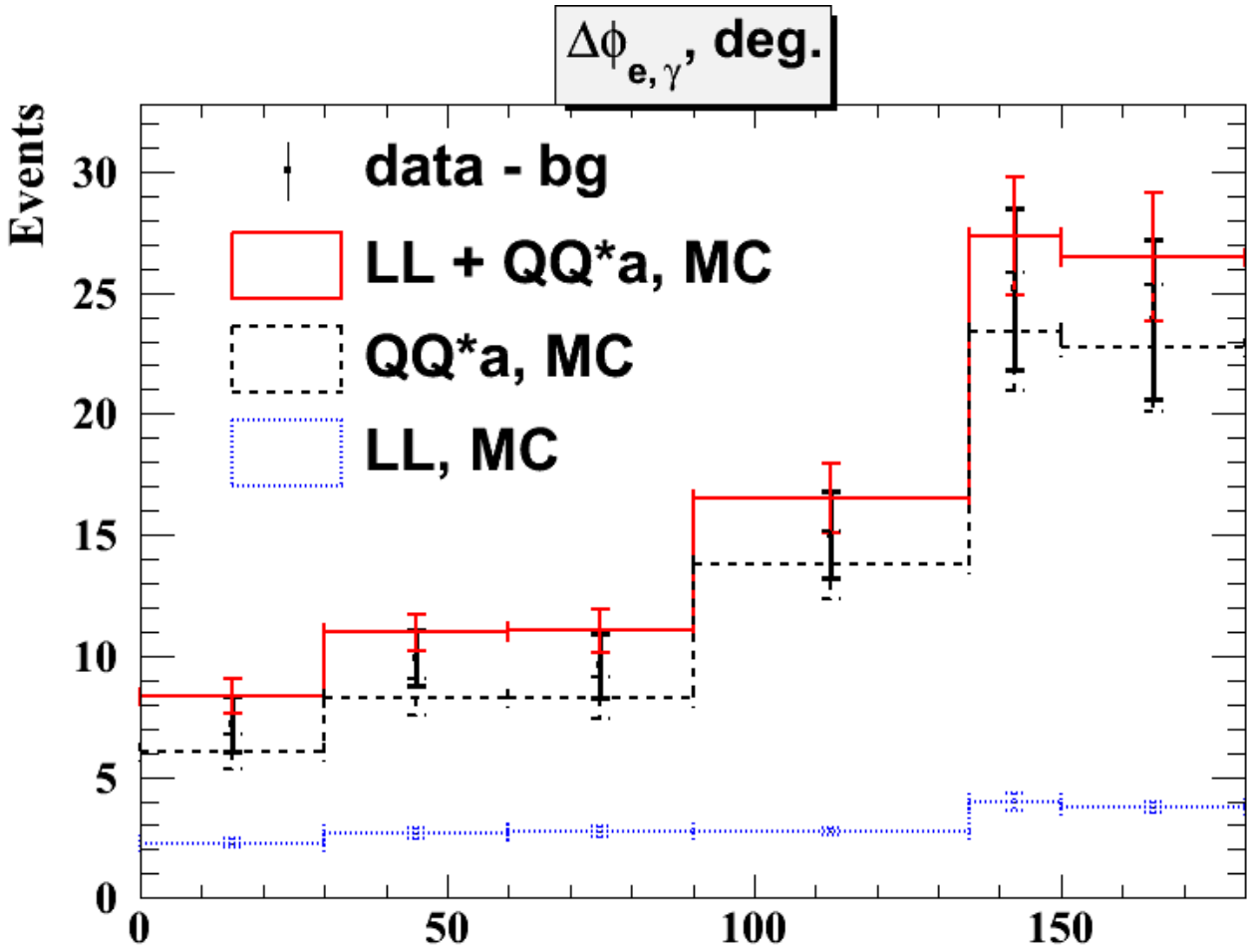
Resulting control plots for Δη's



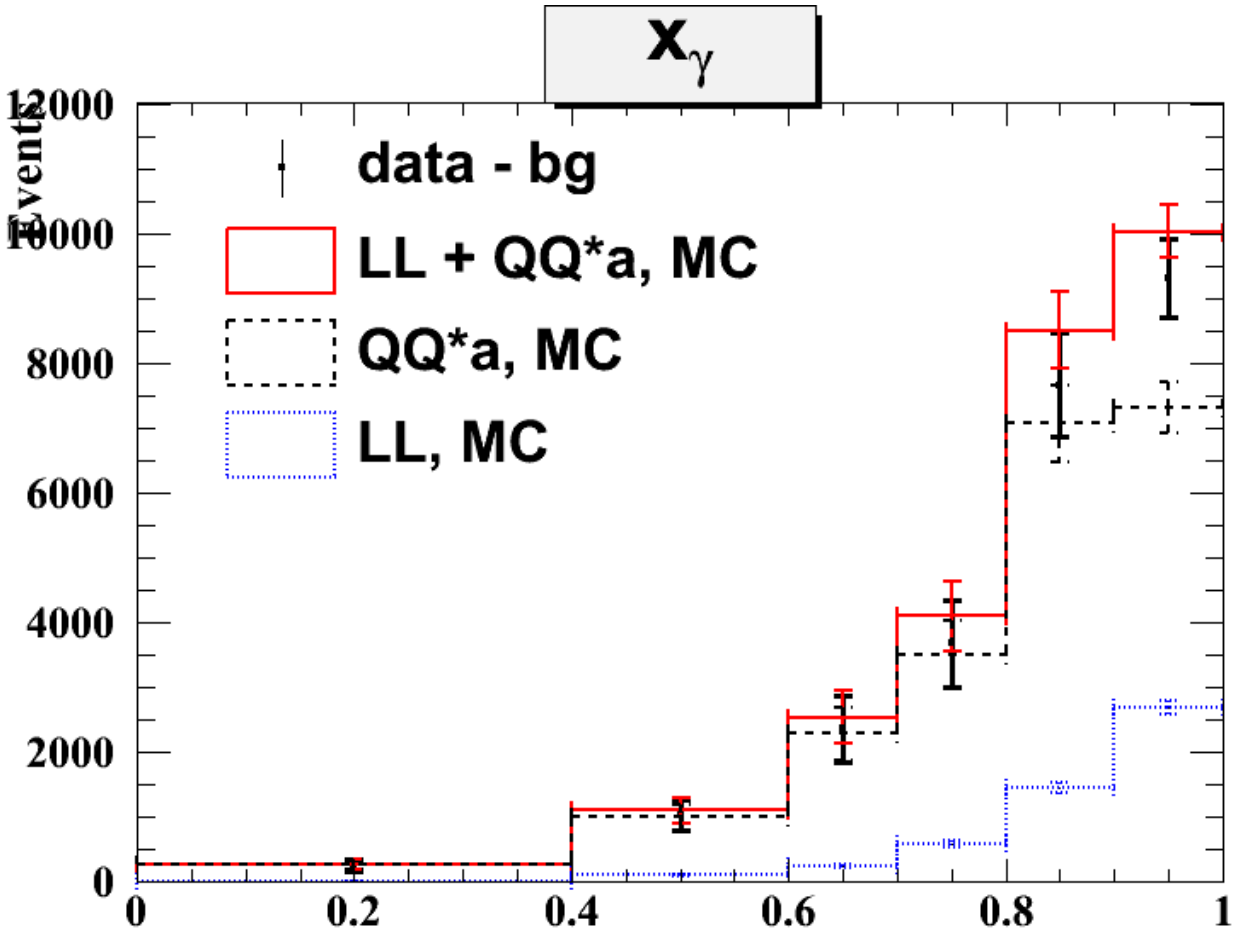


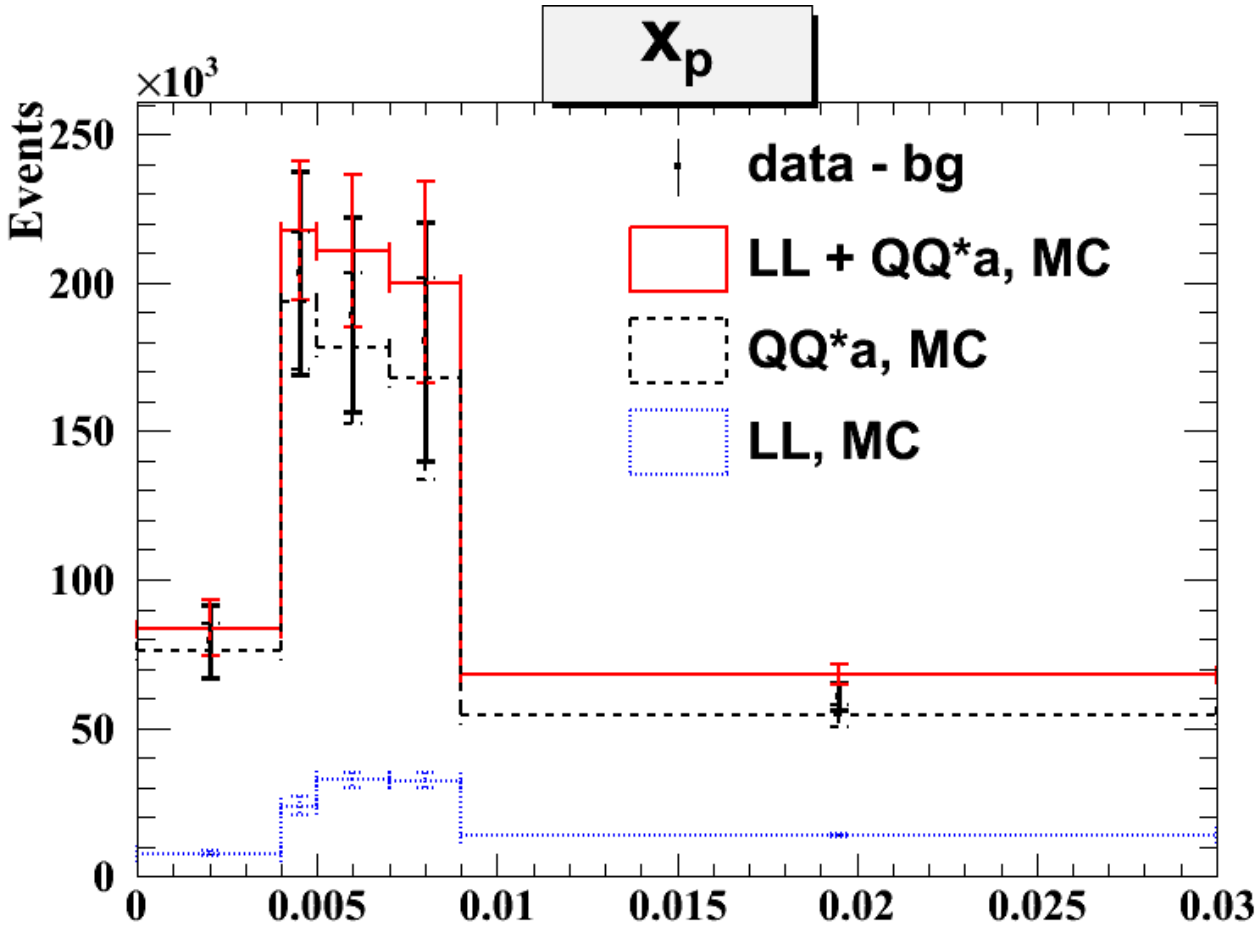
Resulting control plots for $\Delta\varphi$'s



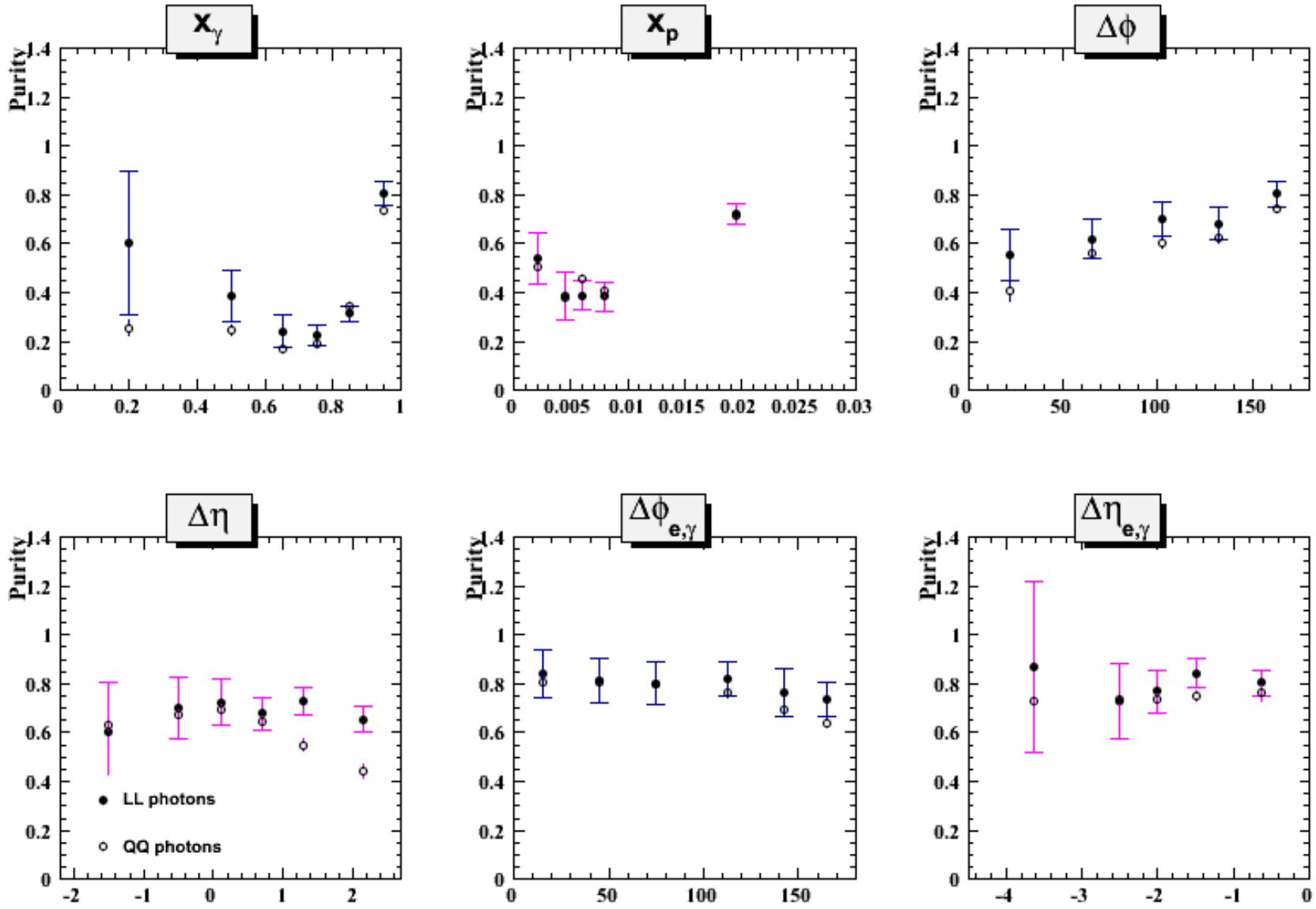


Resulting control plots for x_γ and x_p





Appendix.Purity - is defined as the relation of found with detector level cuts photons to actual



Appendix. Cross sections

- For a given observable Y , the production cross section:

$$\frac{d\sigma}{dY} = \frac{A_{QQ} \cdot N(\gamma_{QQ})}{\mathcal{L} \cdot \Delta Y} + \frac{d\sigma_{LL}^{MC}}{dY}$$

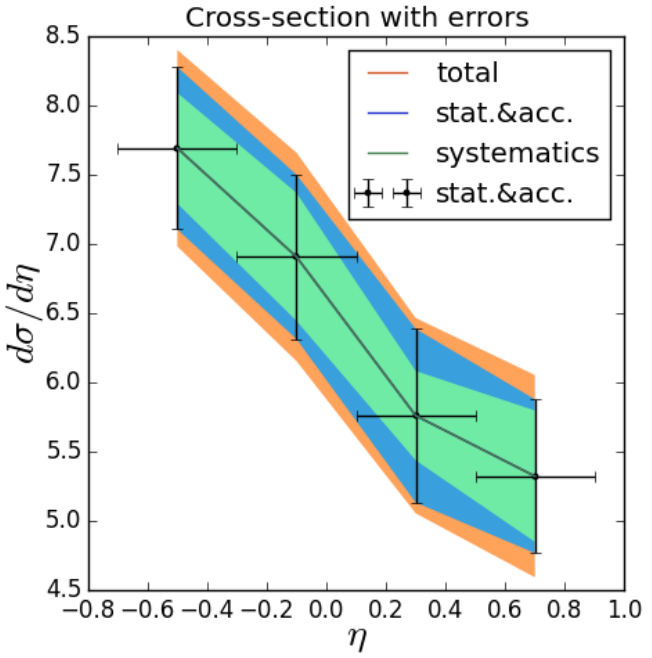
$N(\gamma_{QQ})$ - number of QQ photons extracted from the fit,

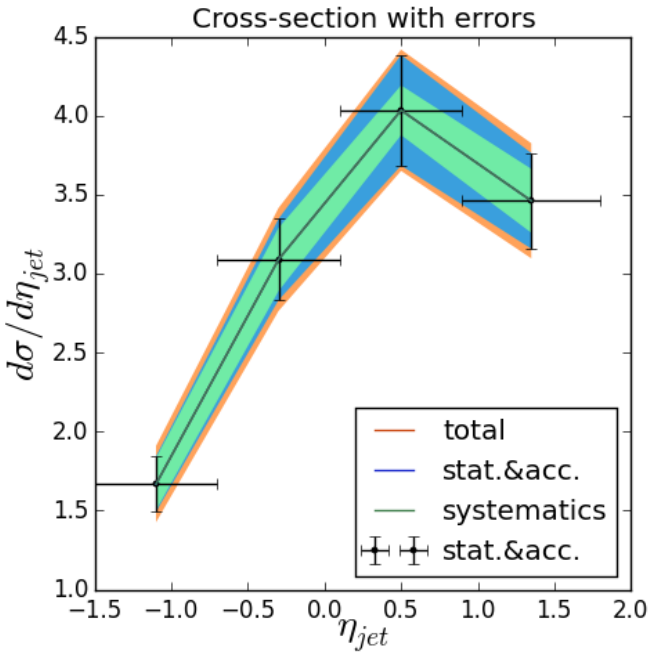
ΔY - bin width,

$\mathcal{L}$ -total integrated luminosity,

σ_{LL}^{MC} - cross section for LL photons

- $A_{QQ} = \frac{N_{detector\ level}}{N_{true\ level}}$ - acceptance correction for QQ photons





Appendix. Fitting procedure

- For the control plots the next procedures was applied for each bin in terms of new variables separately:
  - LL_{MC} and $background_{MC}$ are scaled to the level of data luminosity
  - QQ_{MC} is scaled to the number of photons candidates in data sample after substraction of predicted LL photons.
  - $Background_{MC}$ was scaled to number of photon candidates in data.
  - A bin by bin $min\chi^2$-fitting procedures is done. The minimized function:

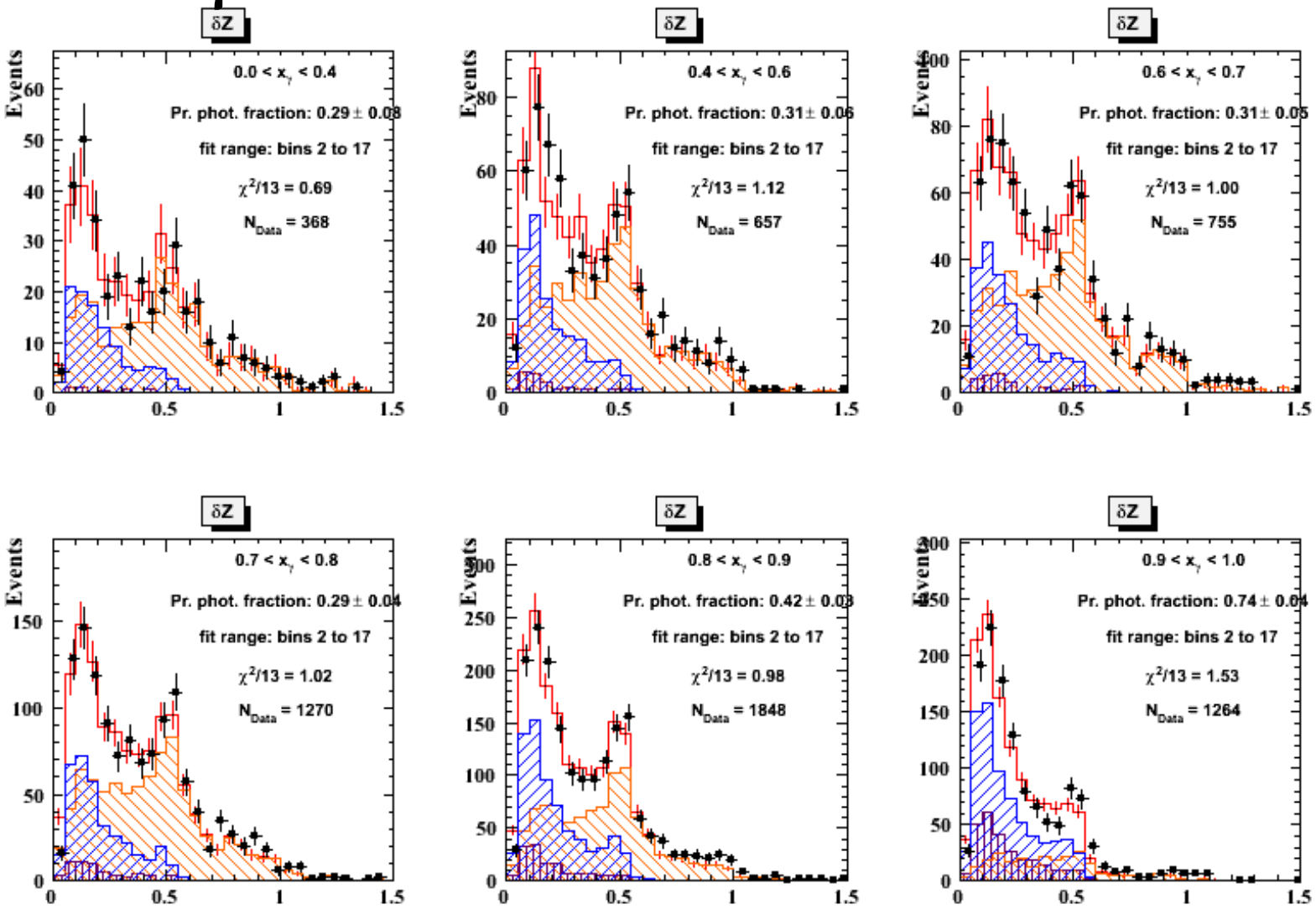
$$\boldsymbol{Data - Photons_{MC} * a - Background_{MC} * (1 - a)}$$

    , where ***a*** – fitting parameter,
    Phorons$_{MC}$ – LL_{MC} and QQ_{MC} photons (scaled to the number of photon candidates in data before the fitting procedure)
  - ***a*** – illustrates the prompt photons fraction in data photon candidates sample

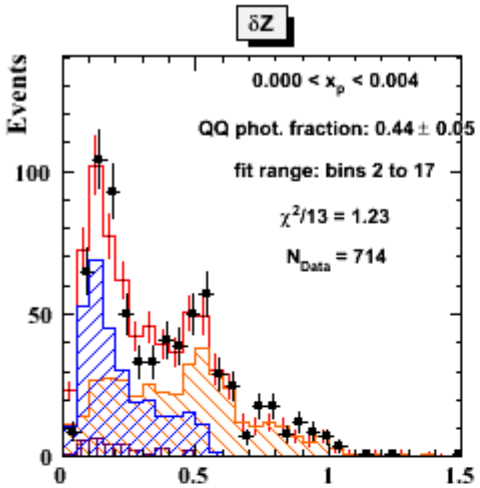
Appendix.Event selection

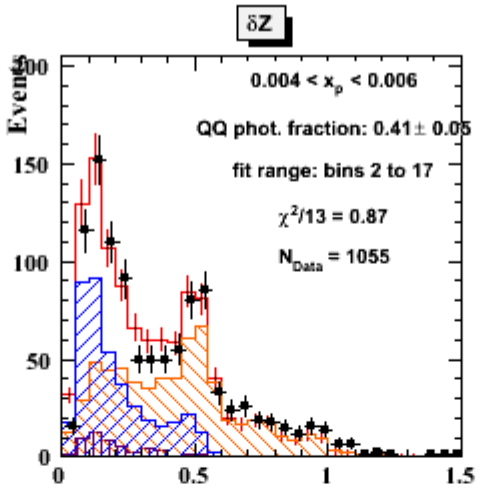
- DIS selection
  - $10 < Q_{el}^2 < 350\ GeV^2$
  - Electron cuts:
    - $E_{e,corr} > 10\ GeV$
    - $140^o < \theta_{el} < 180^o$
    - $|X| < 14.8, cm$
    - $|Y| < 14.8, cm$
- Prompt photon selection
  - $4 < E_T^{\gamma} < 15, GeV$
  - $-0.7 < \eta_{\gamma} < 0.9$
  - $E_{\gamma} \div E_{jet\ with\ \gamma} > 0.9$
  - $\Delta R < 0.2$ – no tracks
  - $E_{EMC} \div (E_{EMC} + E_{HAC})$
- Jet selection (zufos used)
  - $E_T^{jet} > 2.5, GeV$
  - $-1.5 < \eta_{jet} < 1.8$
  - Use jet with $E_{T,max}^{jet}$
- Cleaning
  - Triggers
    - SPP02 for 0405e
    - SPP09 for 06e, 0607p
  - $|Z_{vtx}| < 40, cm$
  - $35 < E - p_z < 65, GeV$
  - Number of vertex tracks not in RCAL > 1

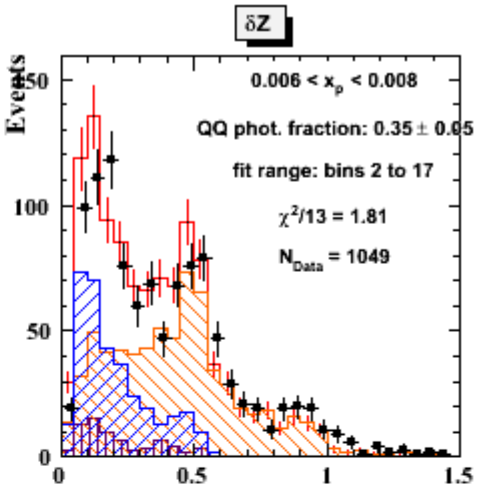
Appendix. x_γ per-bin fitting results

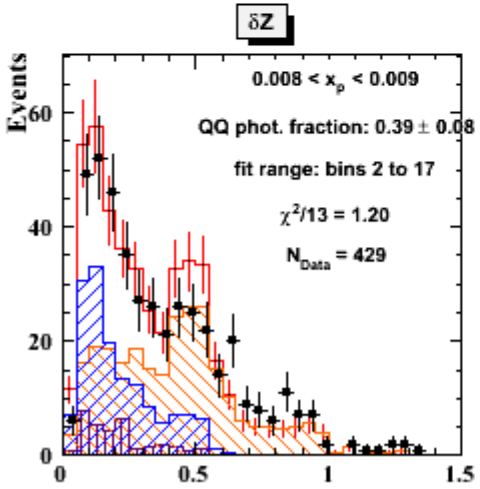


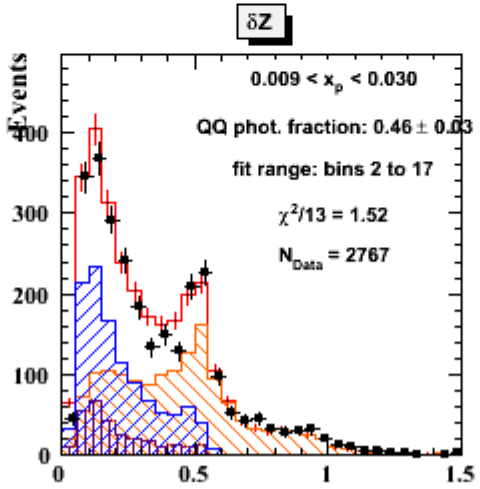
Appendix. x_n per-bin fitting results



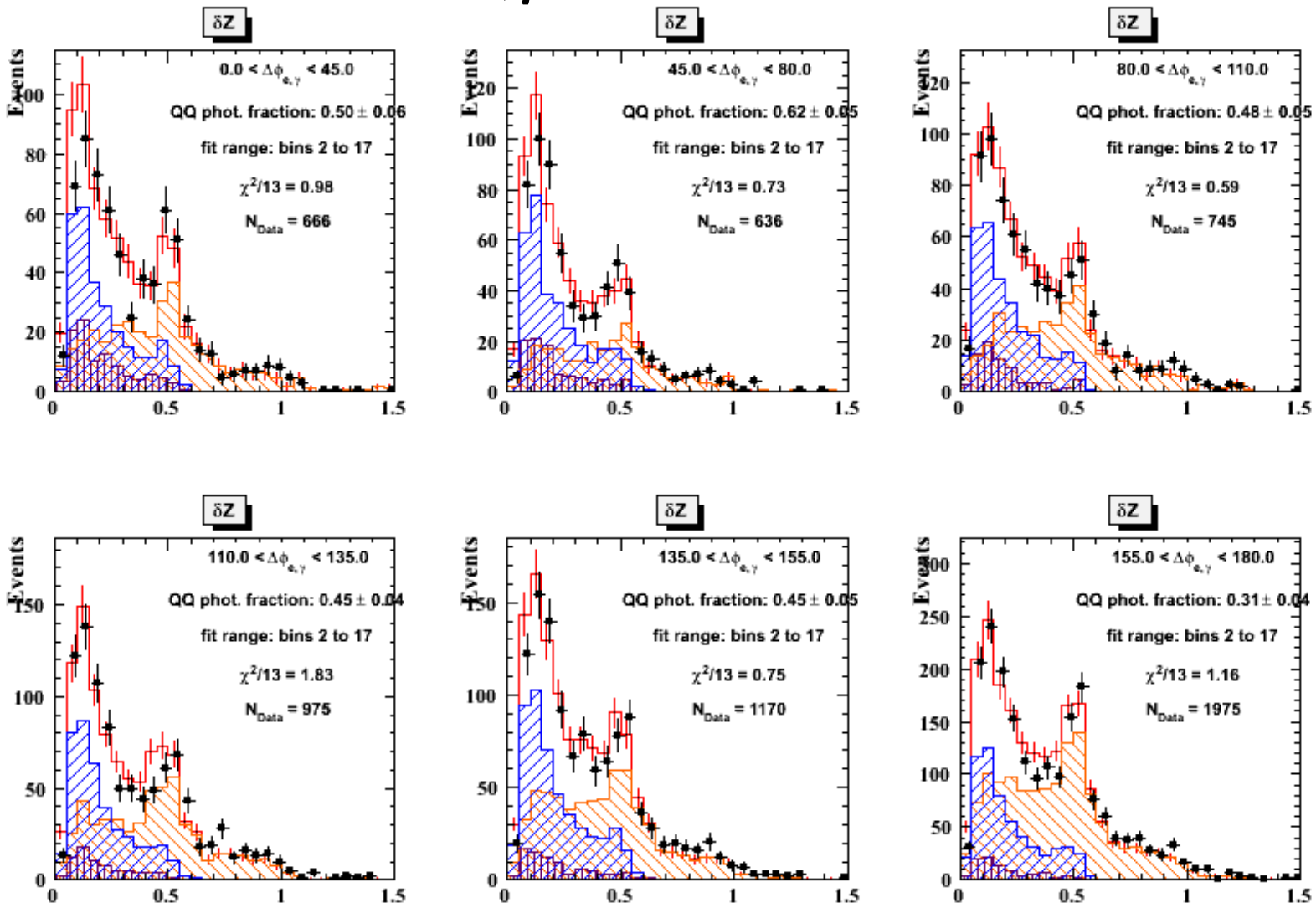




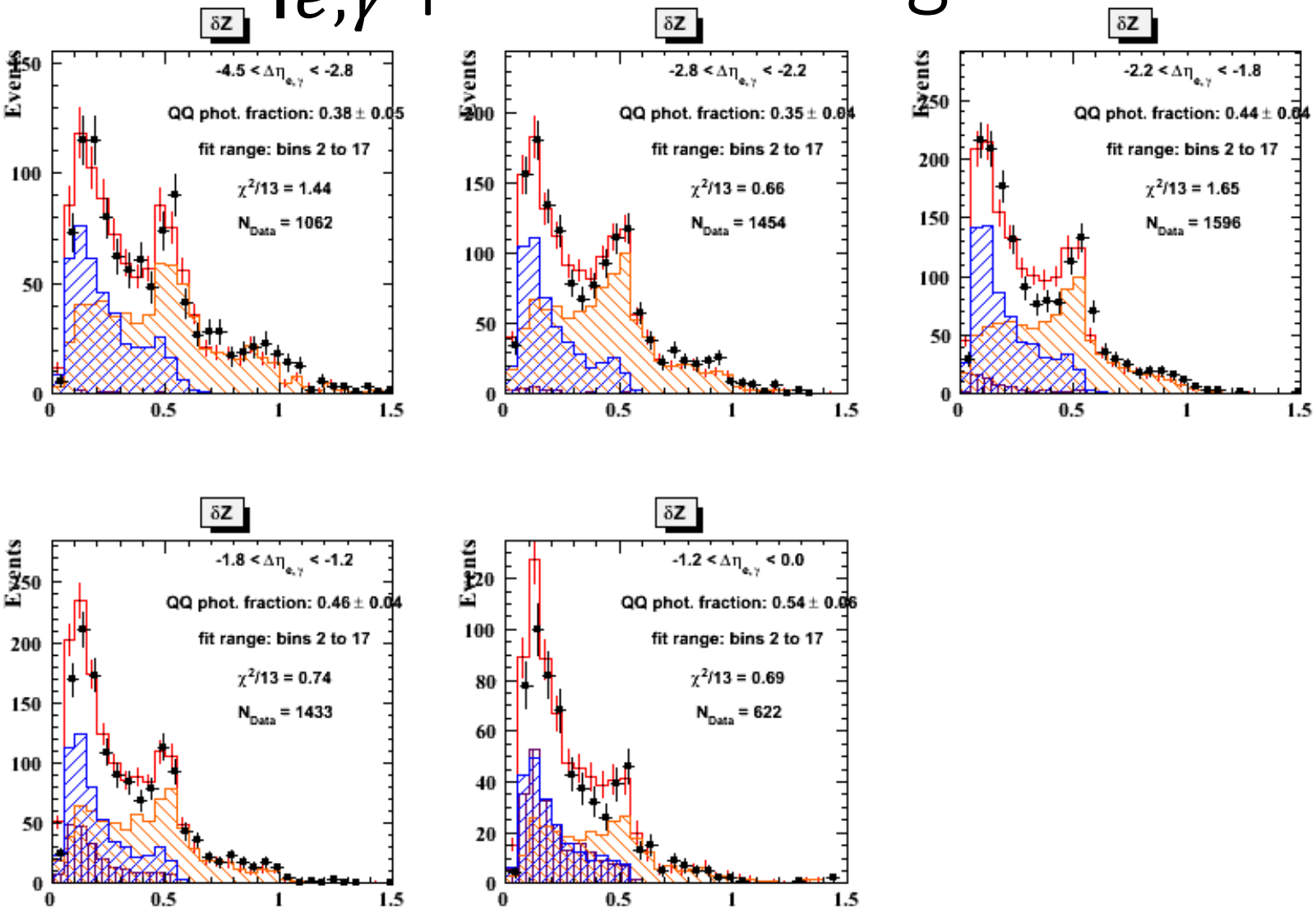




Appendix. $\Delta\phi_{e,\gamma}$ per-bin fitting results



Appendix. $\Delta\eta_{e,\gamma}$ per-bin fitting results



Appendix. Δη per-bin fitting results