INCLUSIVE PROMPT PHOTON PRODUCTION
and
DEEPLY VIRTUAL COMPTON SCATTERING
at HERA.

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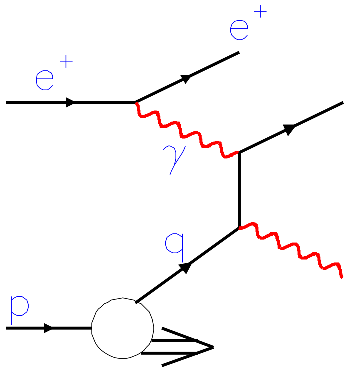
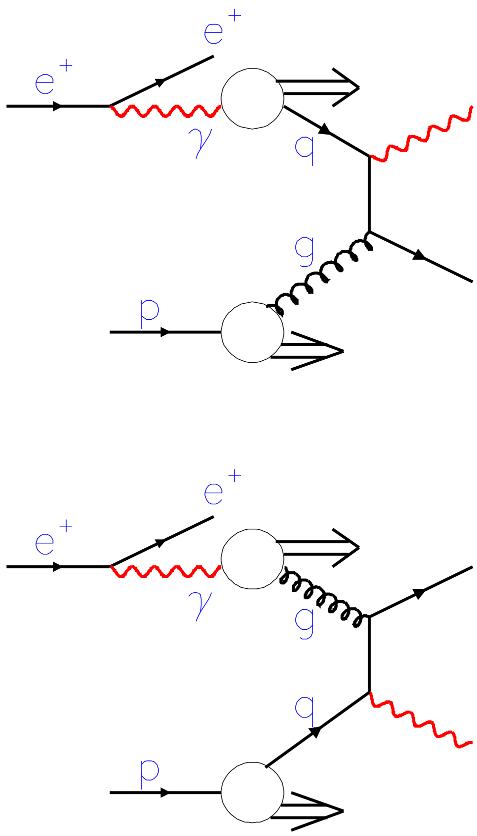
Prompt photon processes in photoproduction

At LO the diagrams are of the following kinds:



Direct

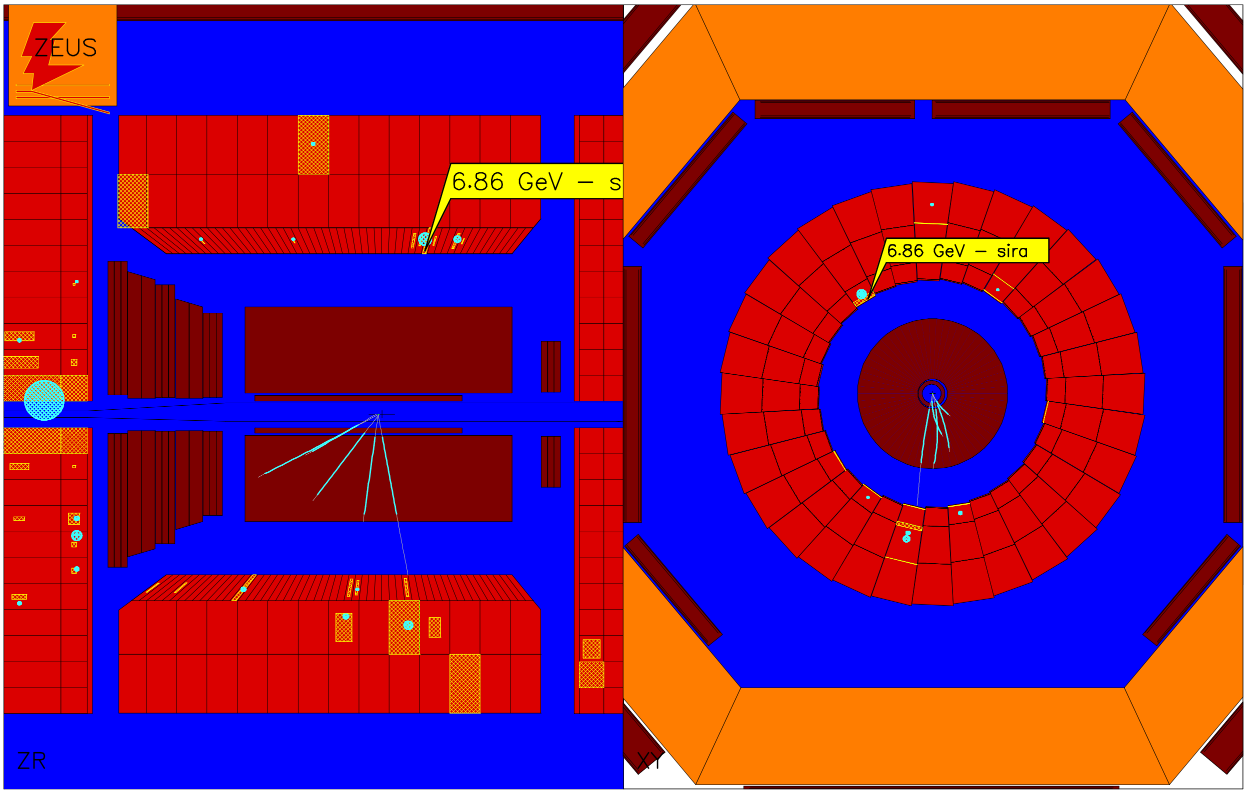


Resolved (examples)

Only one important LO direct process: the Direct Compton process.

In the resolved process, HERA kinematics favour: g from proton, q from incoming γ.

Measurement at HERA:



ZEUS barrel calorimeter has good granularity to separate high E_T γs from π^0 and η backgrounds.

(mainly from $\gamma p \rightarrow$ dijets.)

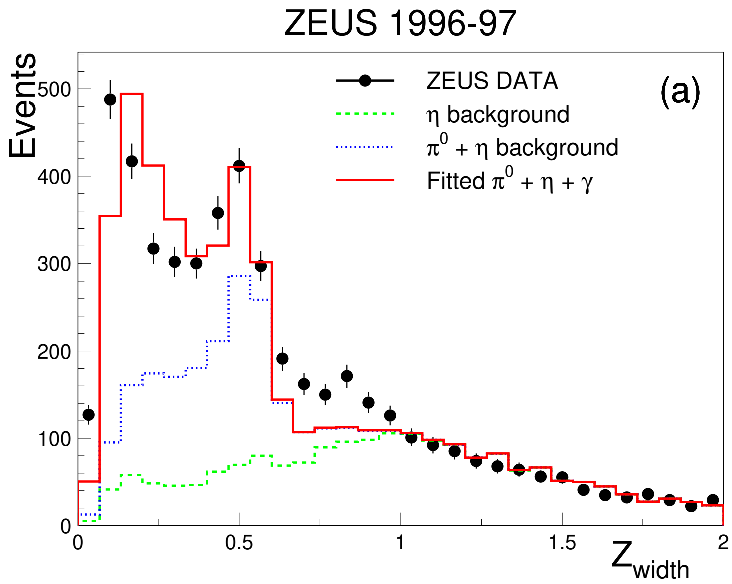
Isolation Criterion:

within cone in η, ϕ of radius 1 around γ demand

$$\Sigma\, E_T \; < \; 0.1\, E_T(\gamma)$$

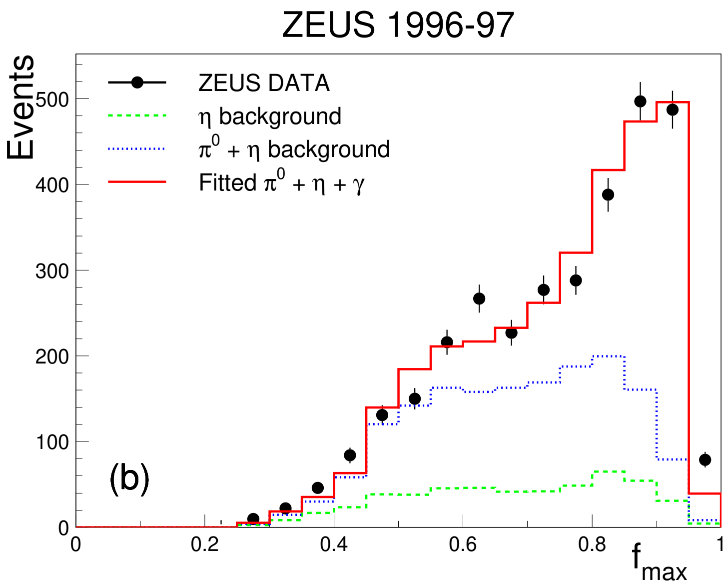
Removes most π^0, η and γs radiated from final state quarks in dijet events.

Width of photon candidate in Z



Structure indicating photons and π^0, and a multi-pion tail modelled as η mesons.

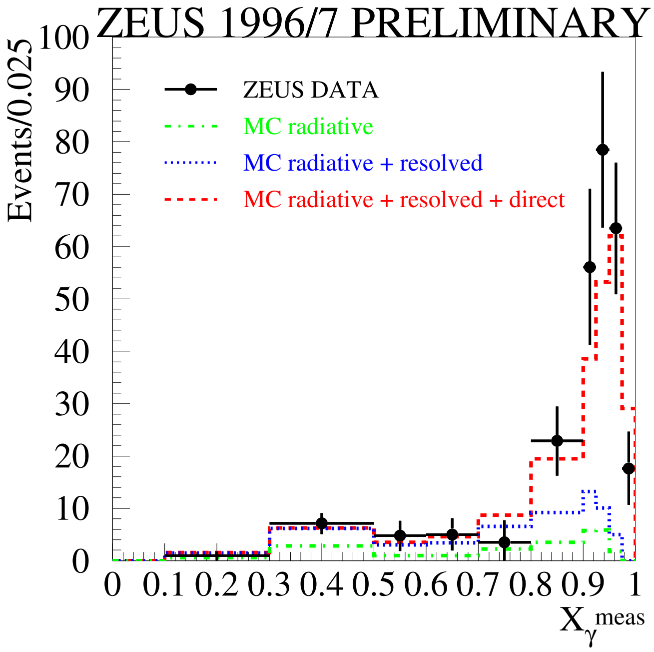
Remove broad clusters. Then look at fraction of cluster energy in highest energy cell:



γ signal can be extracted by comparing numbers of events with f_{max} > 0.75 and < 0.75

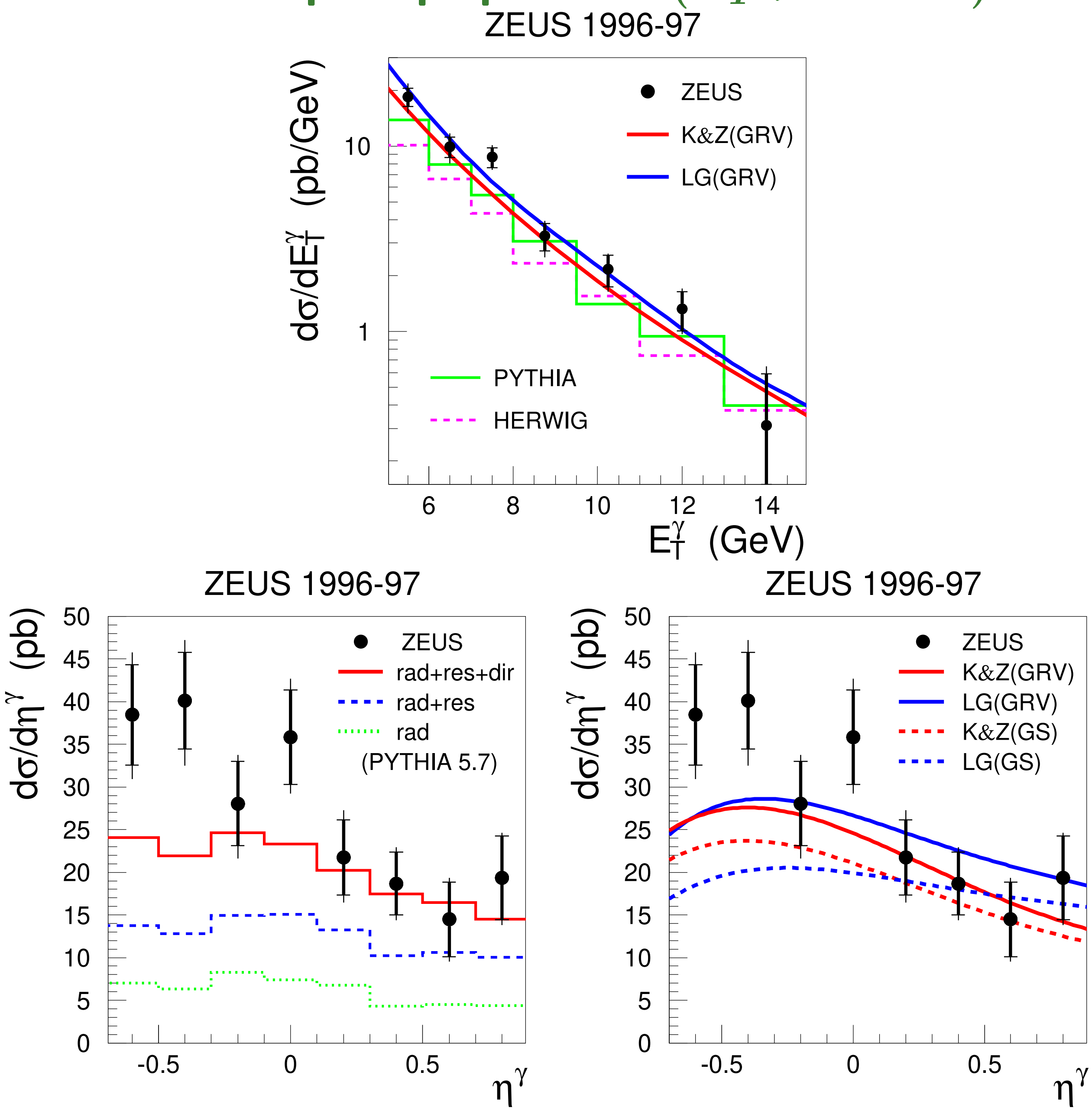
Can use photon + jet events to evaluate x_γ
e.g. measured as

$$\sum_{\gamma+jets}(E-p_z)/\sum_{all\ event}(E-p_z)$$



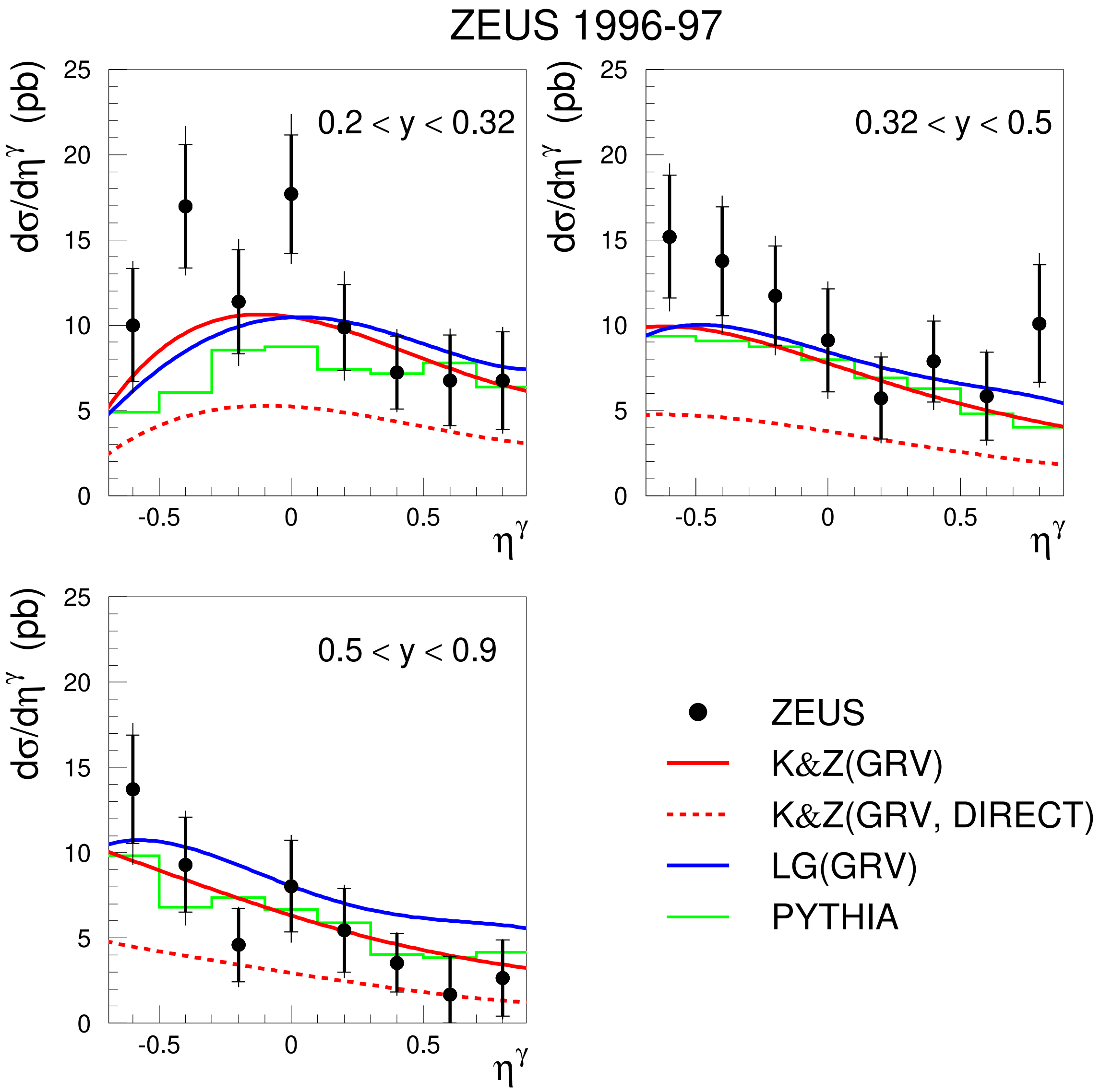
Prominent peak near $x_\gamma = 1$ corresponding to Direct Compton process $\gamma q \rightarrow \gamma q$.
PYTHIA 5.7 seems to give a reasonable description.

Inclusive prompt photons $(E_T > 5GeV)$



PYTHIA does only fairly well (HERWIG is lower).
NLO calculations an improvement.
GRV photon structure apparently favoured.
Signs of a discrepancy?

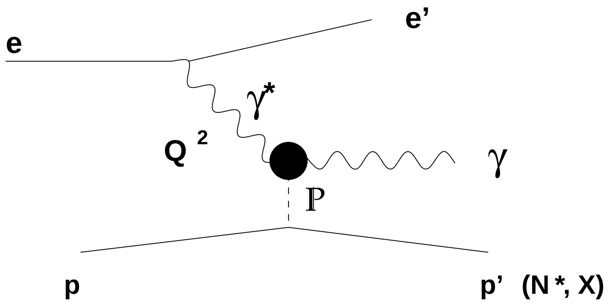
Divide the photon energy range into 3 bands:



Suggestion of possible discrepancy in high x_γ resolved processes.

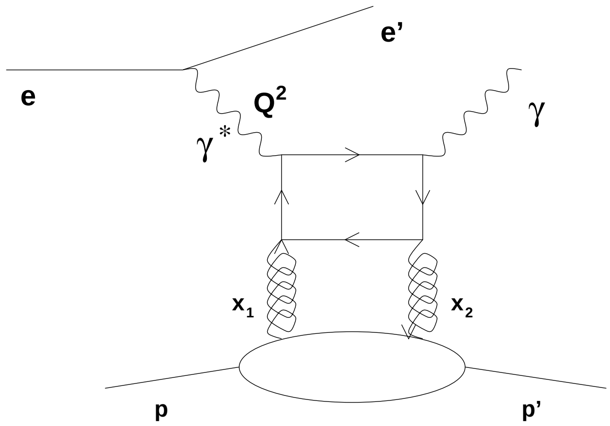
Deeply Virtual Compton Scattering

Aim: to study the γ process



Simpler, compared with hadronic final state.

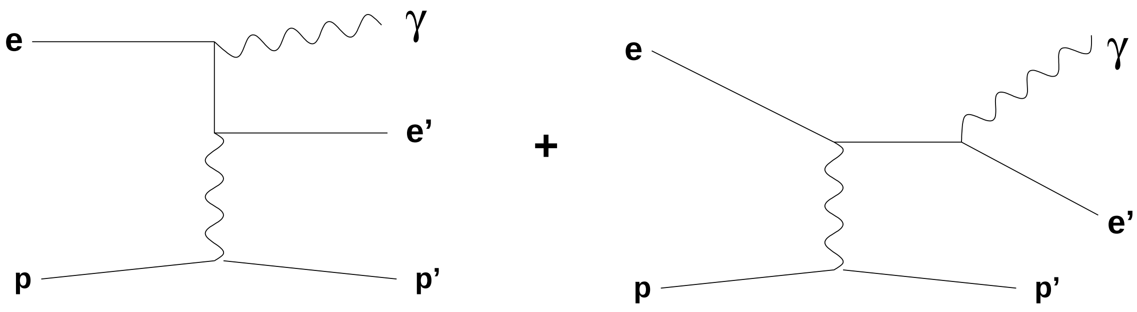
Modelled as:



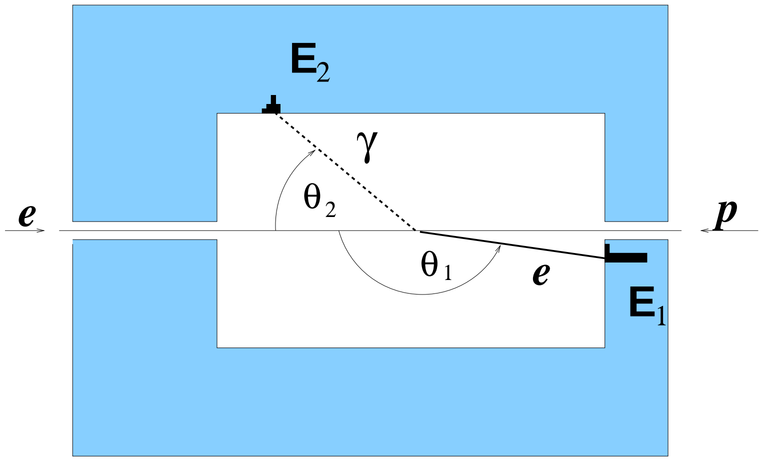
(Frankfurt, Freund & Strikman)

sensitive to skewed (off-diagonal) parton distributions.

BUT interference from QED process (QEDC):



What is measured:



Require just 2 high energy e.m. clusters with:

$\theta_1 > 2.8,\ E_1 > 10$ GeV (angles in radians)
$\theta_2 < 2.4,\ E_2 > 2$ GeV
$|\theta_2 - \theta_1| > 0.8,$
$Q^2 > 6$ GeV^2

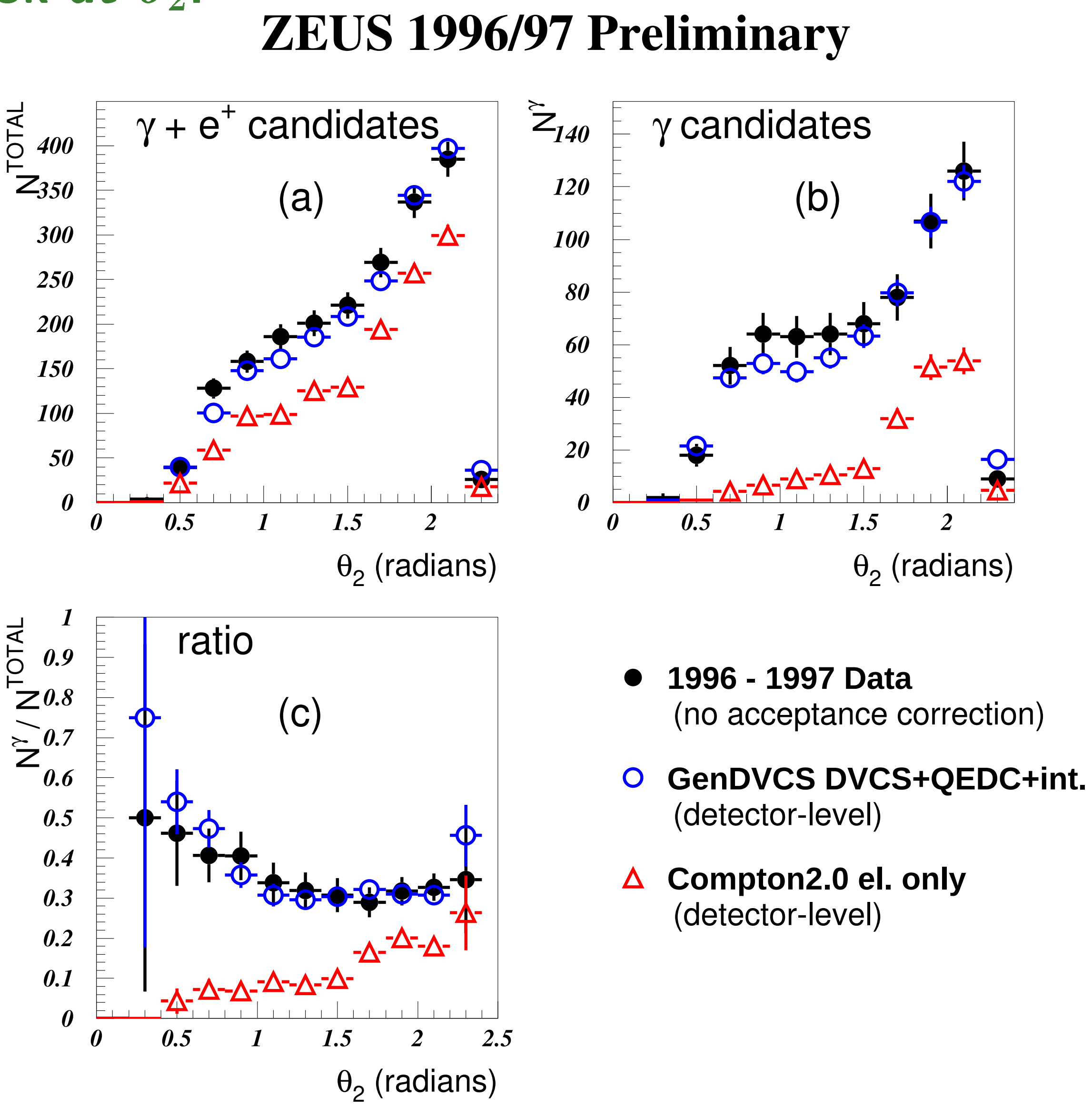
To be a γ candidate there must be no θ_2 track.

In this topology:

DVCS: $2 = \gamma,\ 1 = e$
QEDC: $2 = e,\ 1 = \gamma$ often

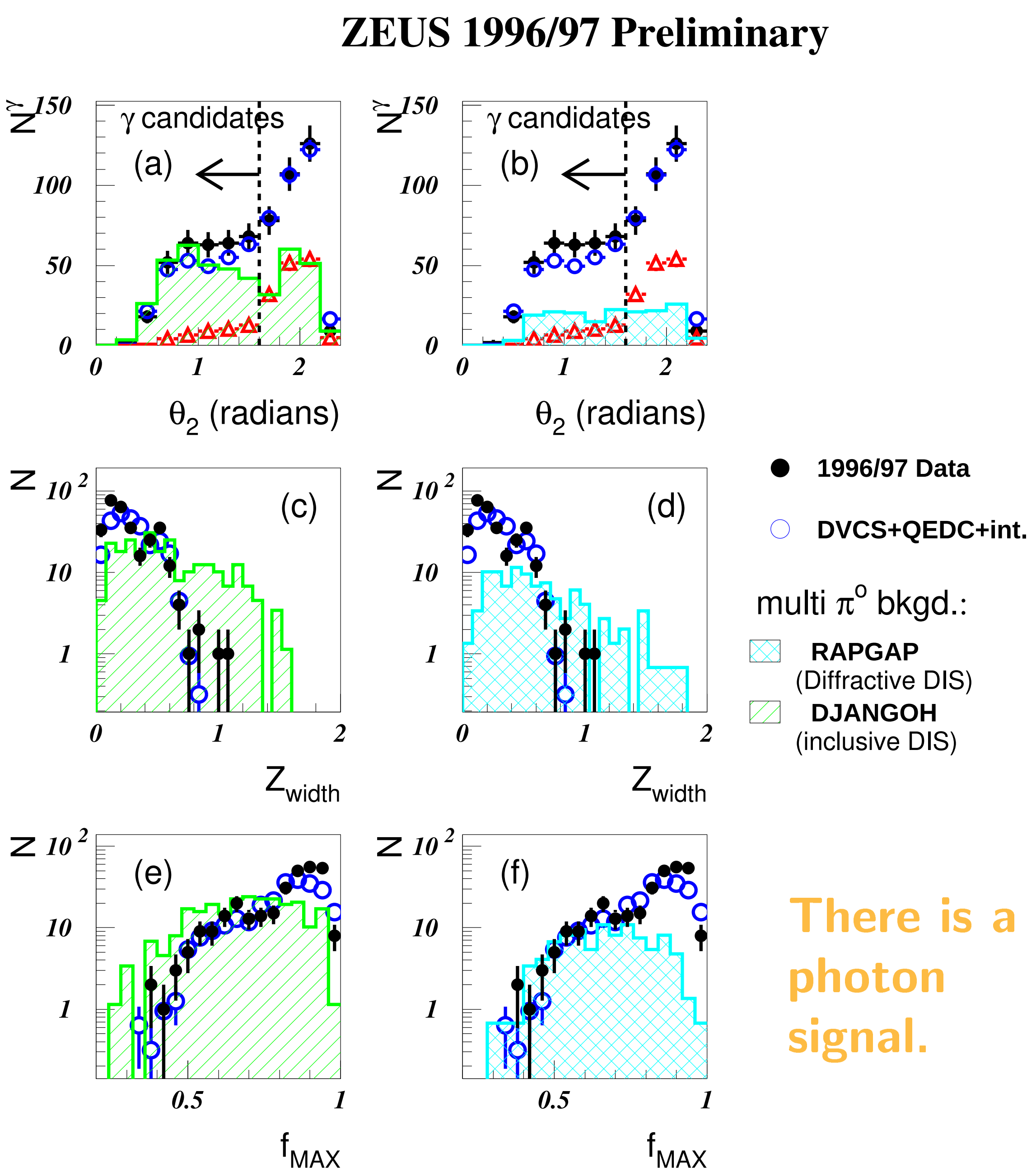
The cuts partially suppress QEDC.

Look at θ_2:



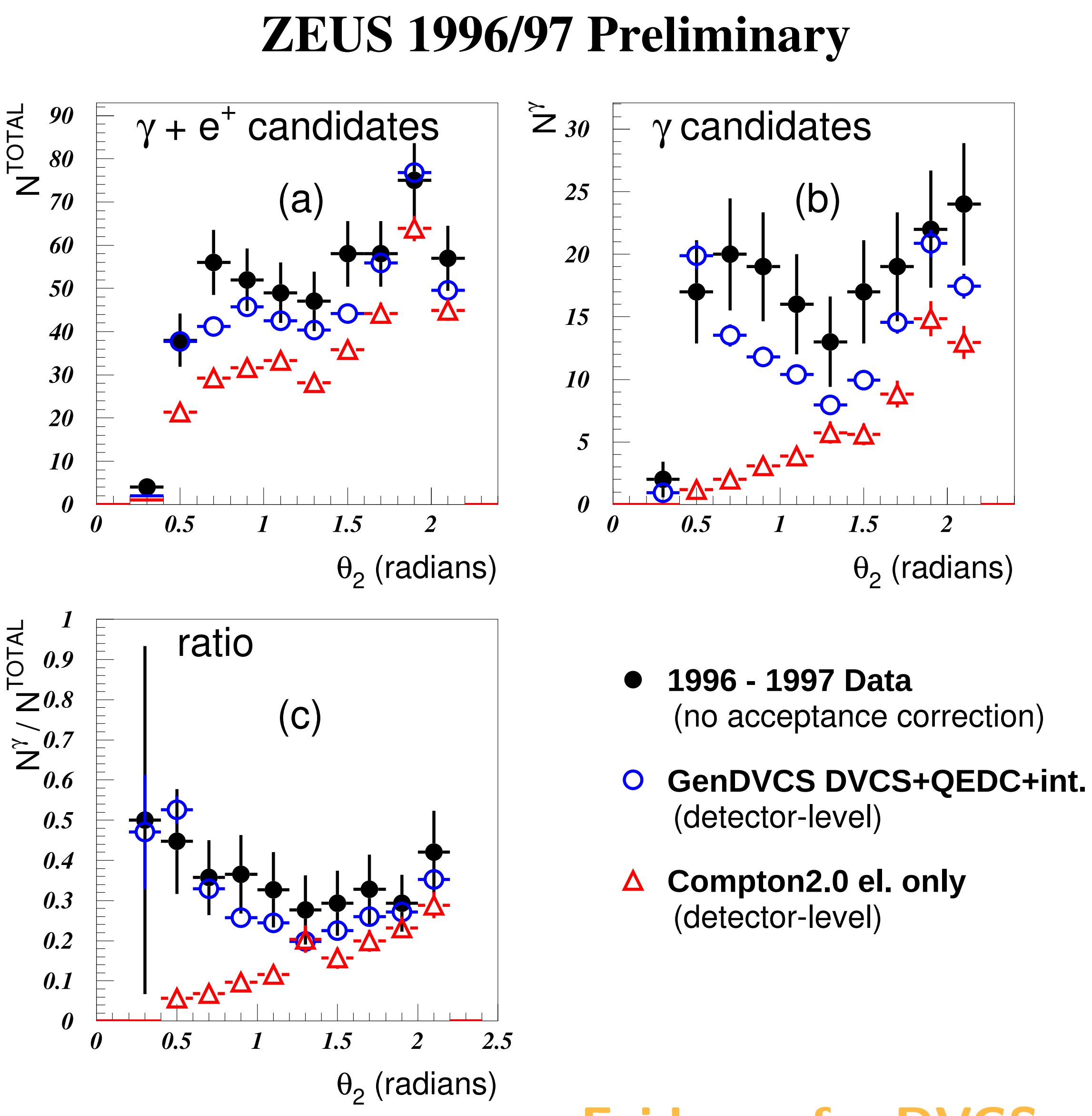
BUT, there may be π^0 etc background!

So look at the γ shower shapes



There is a photon signal.

$E_2 > 5GeV$:



Evidence for DVCS persists.

CONCLUSIONS

- **Prompt photoproduction** in ZEUS shows strong Direct Compton signal in $\gamma + jet$ events.
- Inclusive prompt photons less dominated by Direct process. Good agreement with models over forward rapidities.
- Suggestion of high-x_γ enhancement needs further study.

- **Deeply Virtual Compton Scattering** observed for first time at HERA.
- Observations are in accord with expectations.