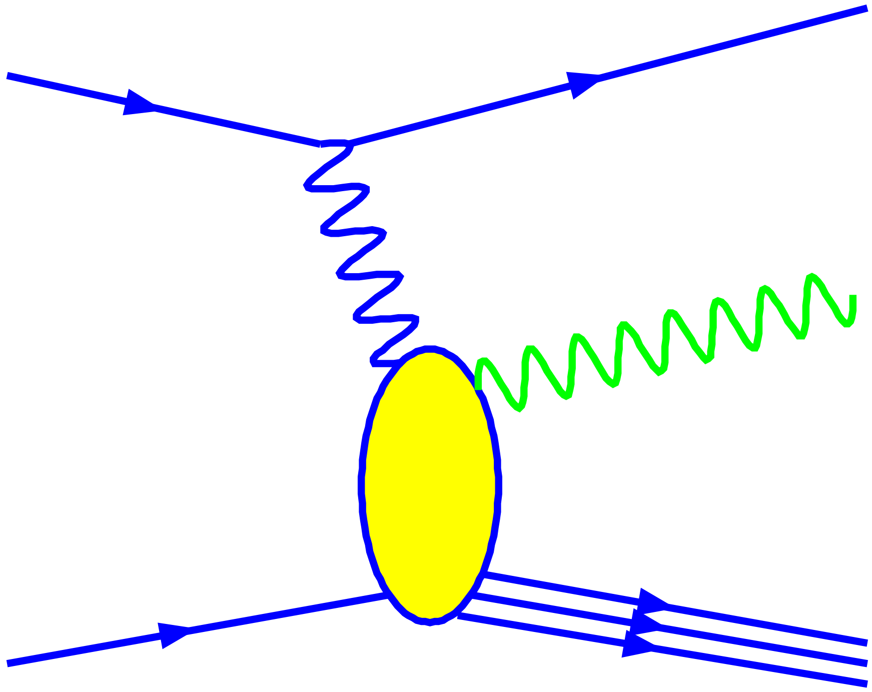
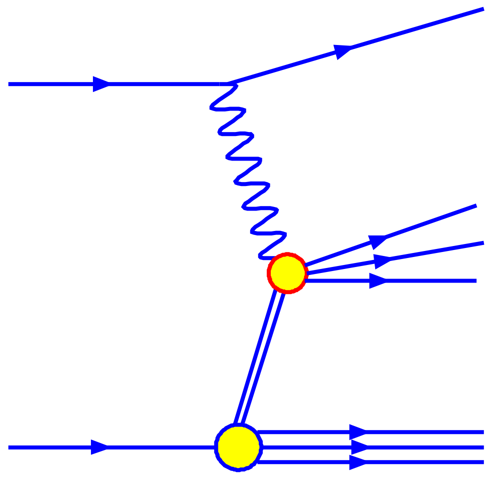
Diffractive Photon Production

$$(\gamma^* p \to \gamma p)$$

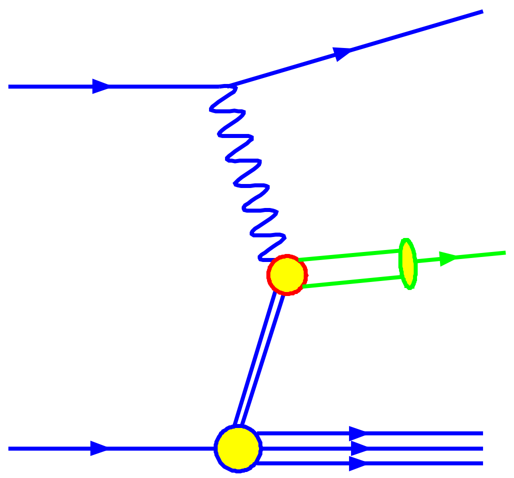


David Reyna (DESY)

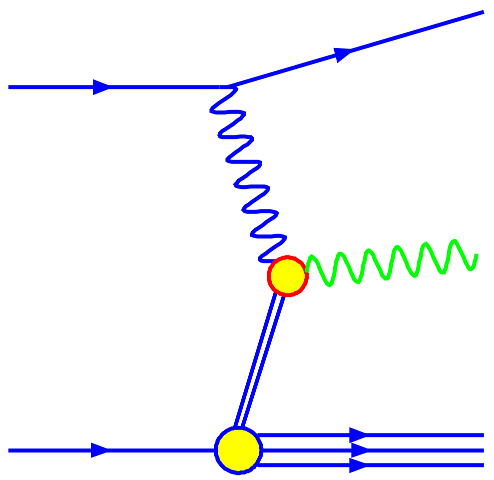
Experimental Motivation



+ Theoretically well defined
– Experimental jet definition uncertainty
– Gap loss due to uncertainty in hadronic final state

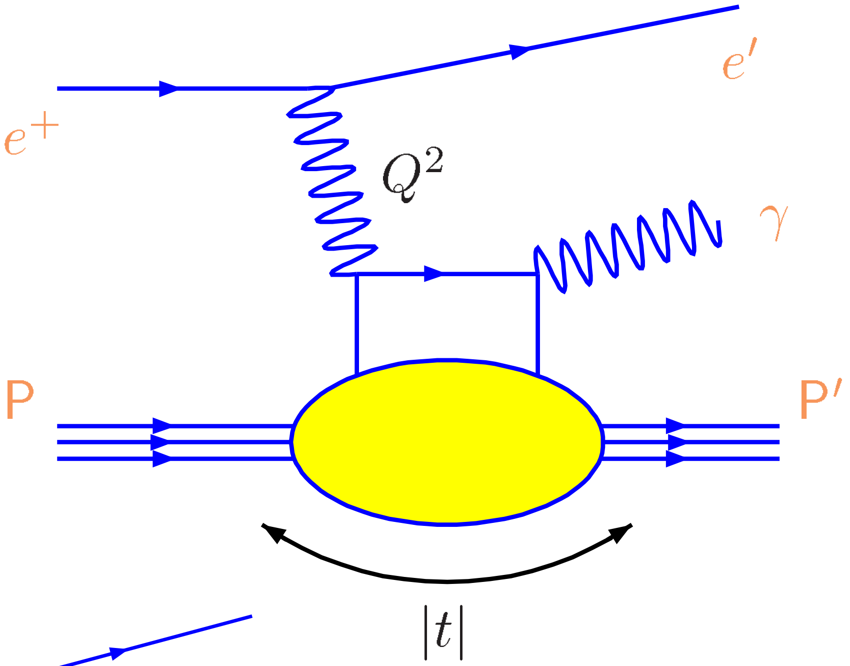


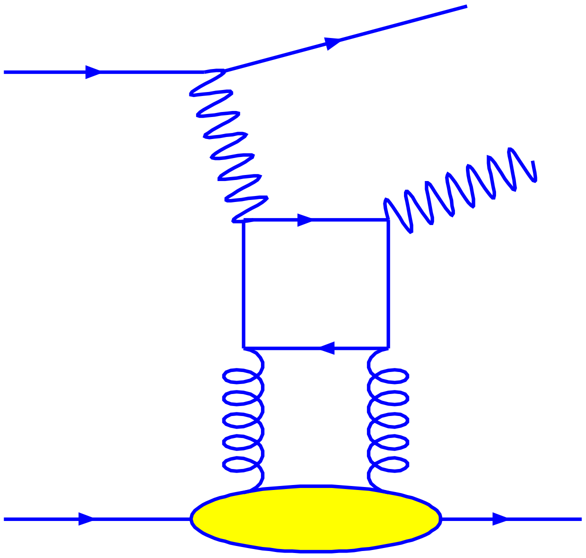
+ Experimentally well defined
– VM final state wave function uncertainty
– Increased acceptance restrictions on decay products



+ Well defined Theoretically and Experimentally
+ Full detector acceptance available
– Photon detection is difficult

Photon Processes

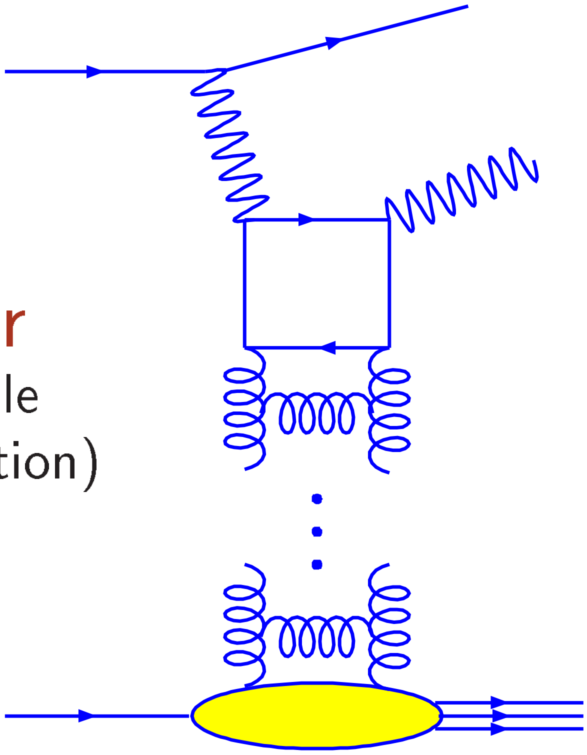




2 Gluon Exchange

$Q^2 \rightarrow$ hard scale

elastic proton (low $|t|$)

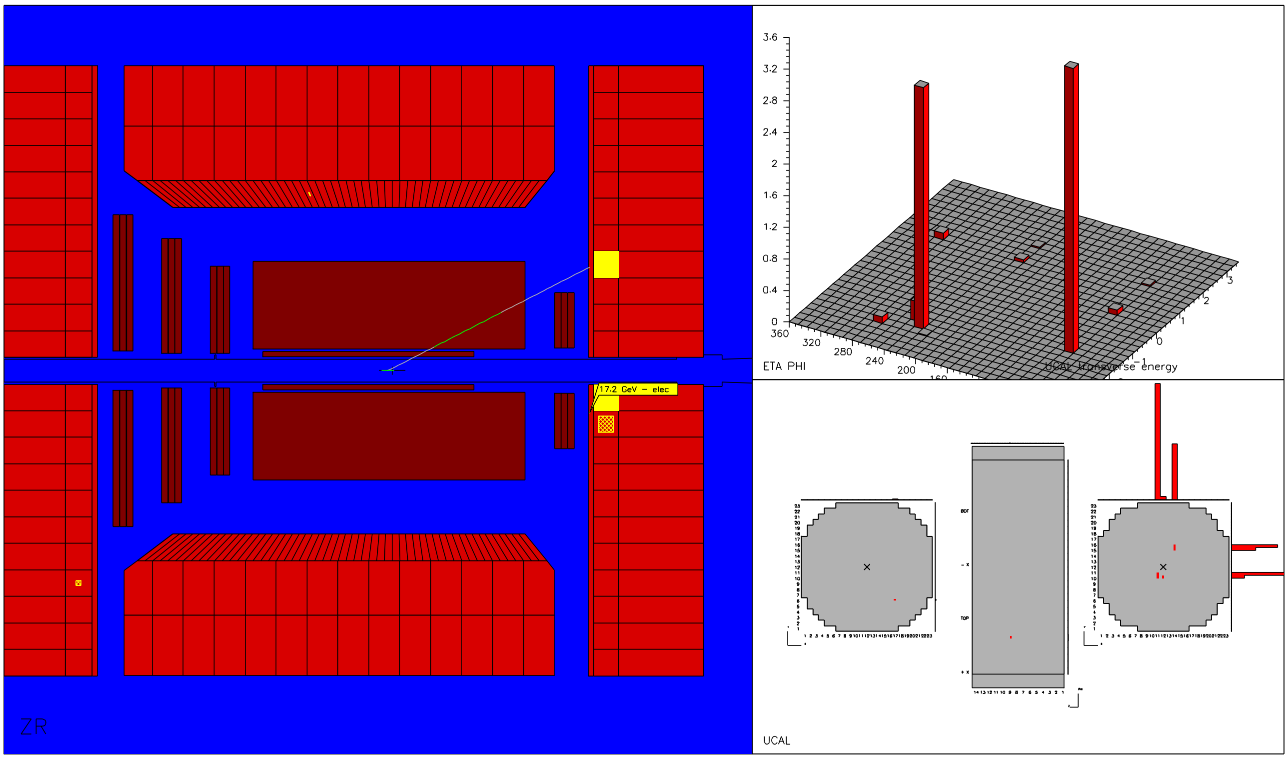


BFKL Ladder

$|t| \rightarrow$ evolution scale

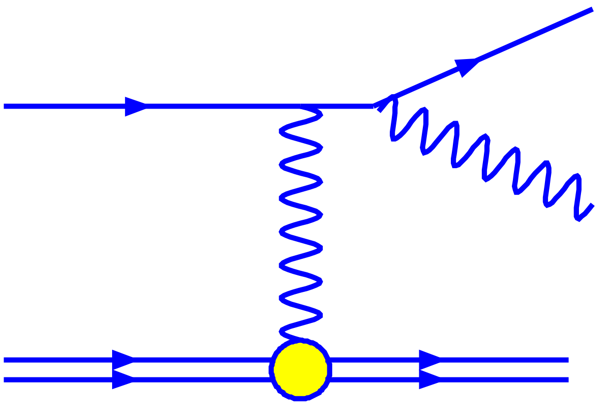
low Q^2 (photoproduction)

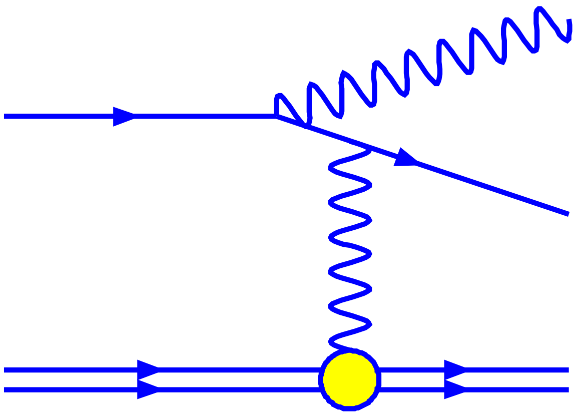
QED Background



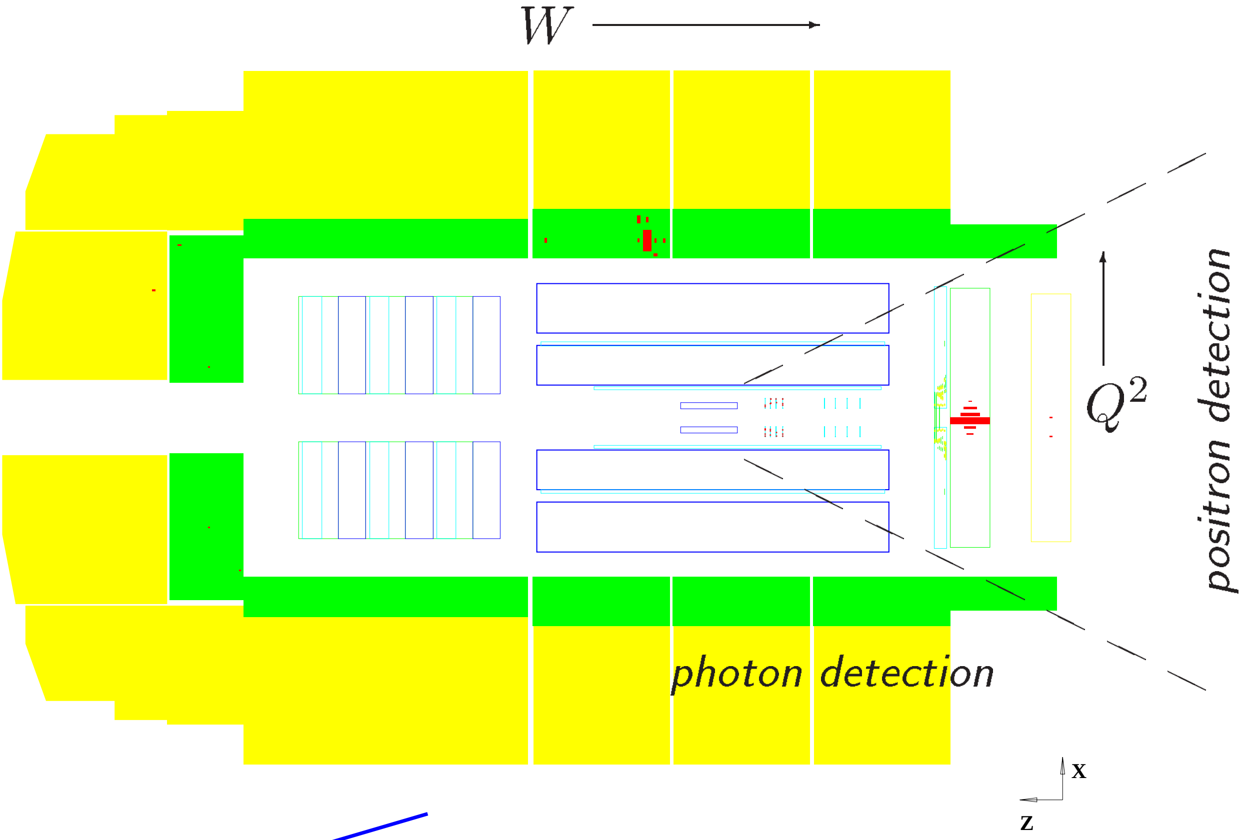
Compton process favors small opening angle

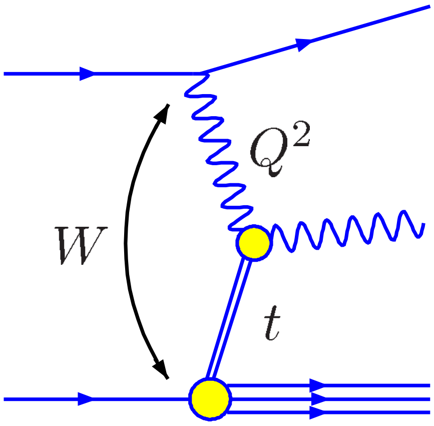
Primarily balanced in θ and ϕ

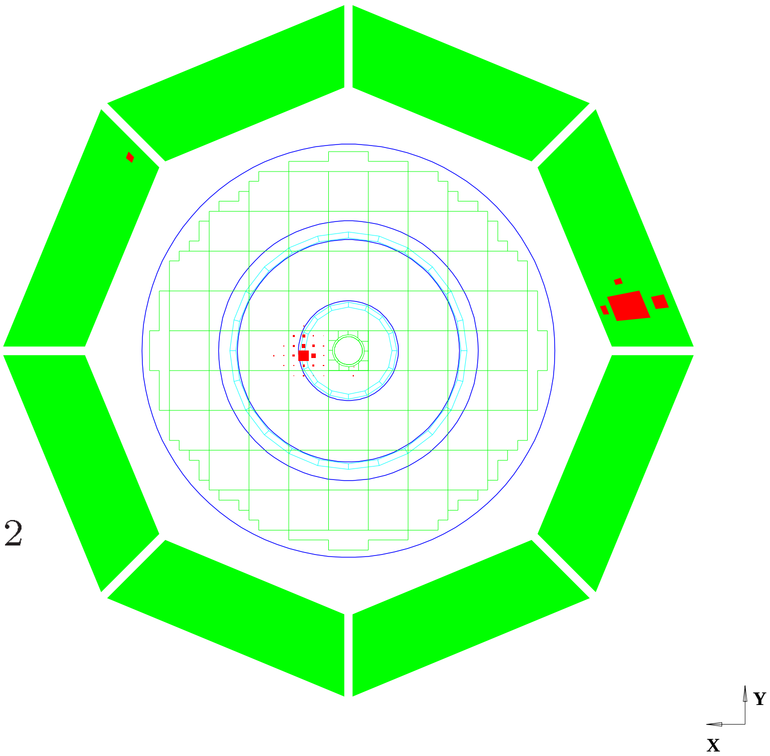




Detector Kinematics

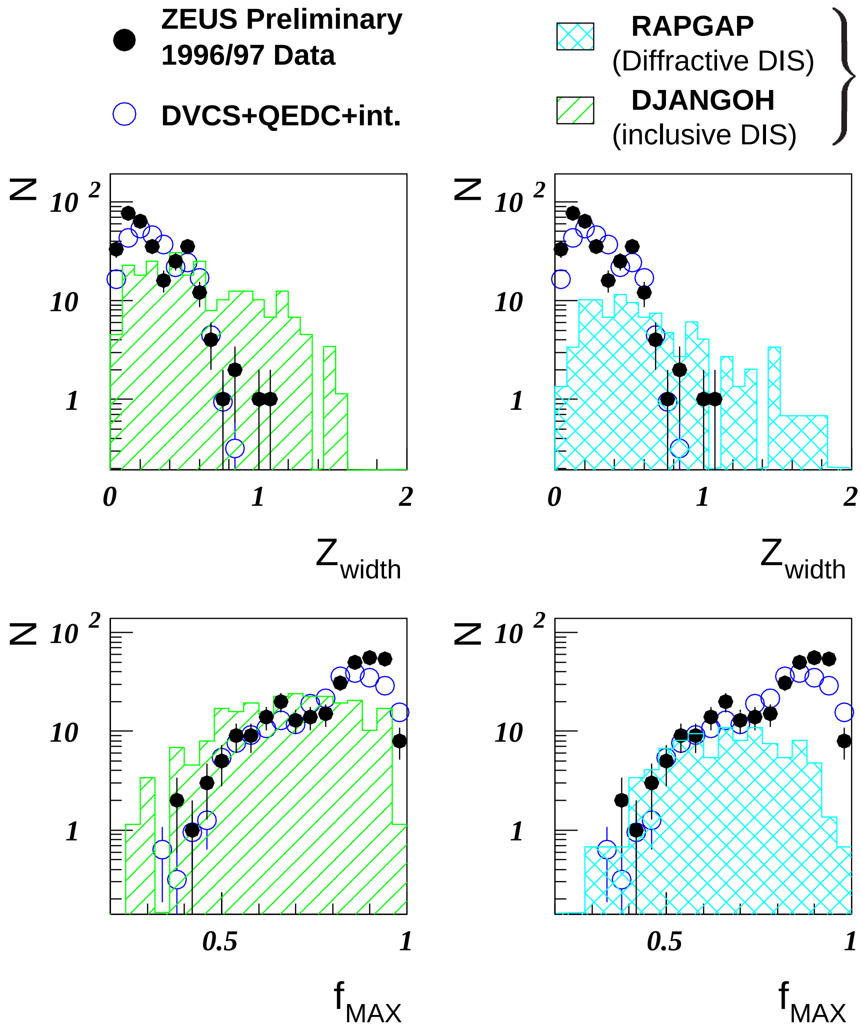






$$|t| \simeq |\vec{p}_{T(e^+)} + \vec{p}_{T(\gamma)}|^2$$

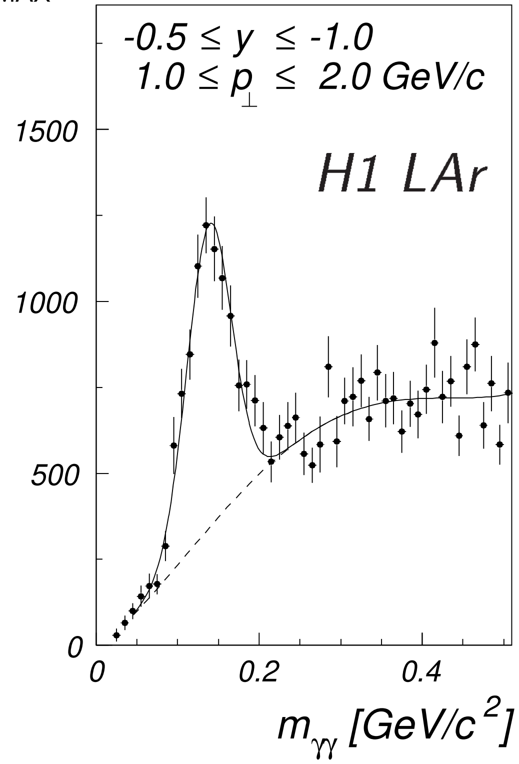
Photon vs. Neutral Hadron



π^0, η^0 event generation

Cluster properties disfavor neutral hadron decays

Additional H1 granularity allows π^0 reconstruction for $p_{T(\pi^0)} \leq 3$ GeV



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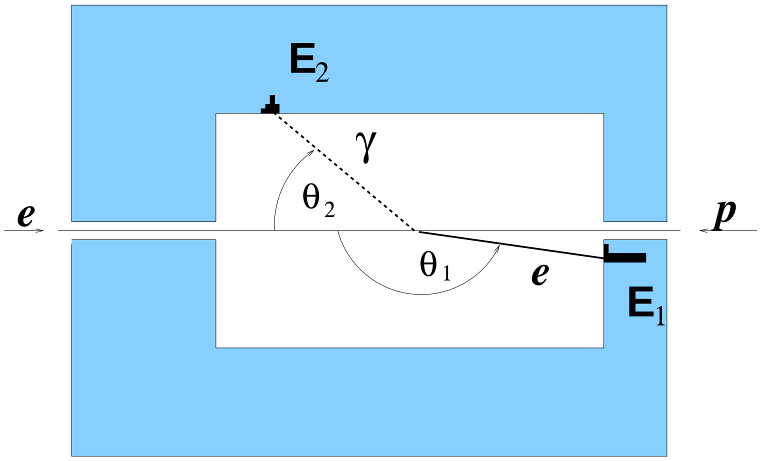
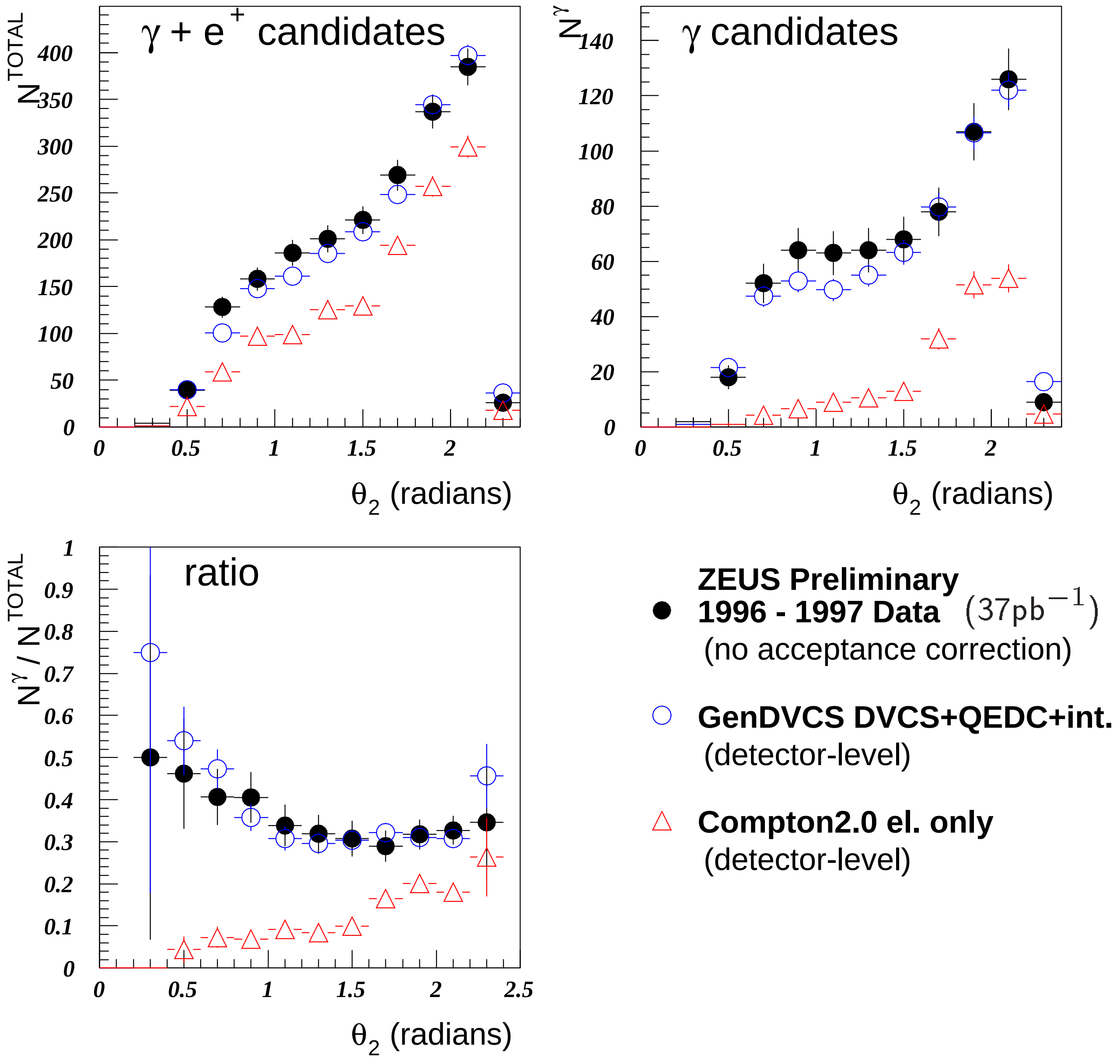
Detector Distributions (ZEUS)

$\theta_1 > 160°$
$E_1 > 10$ GeV

$\theta_2 < 137°$
$E_2 > 2$ GeV

$|\theta_2 - \theta_1| > 45°$
$Q^2 > 6$ GeV^2



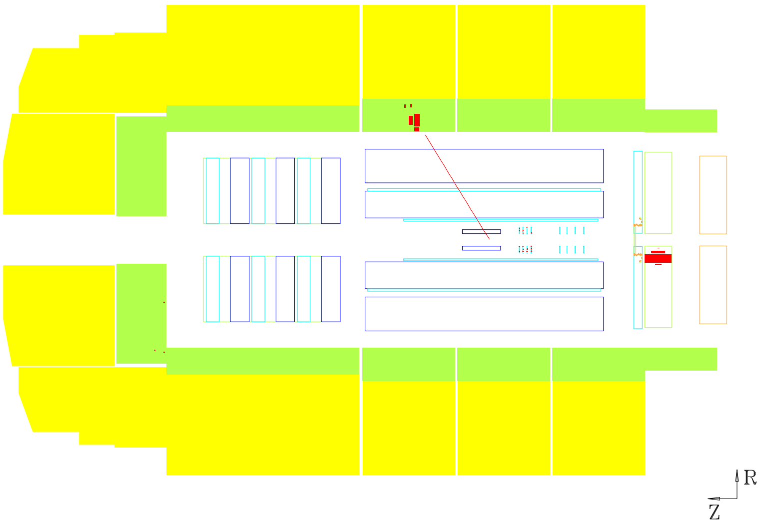


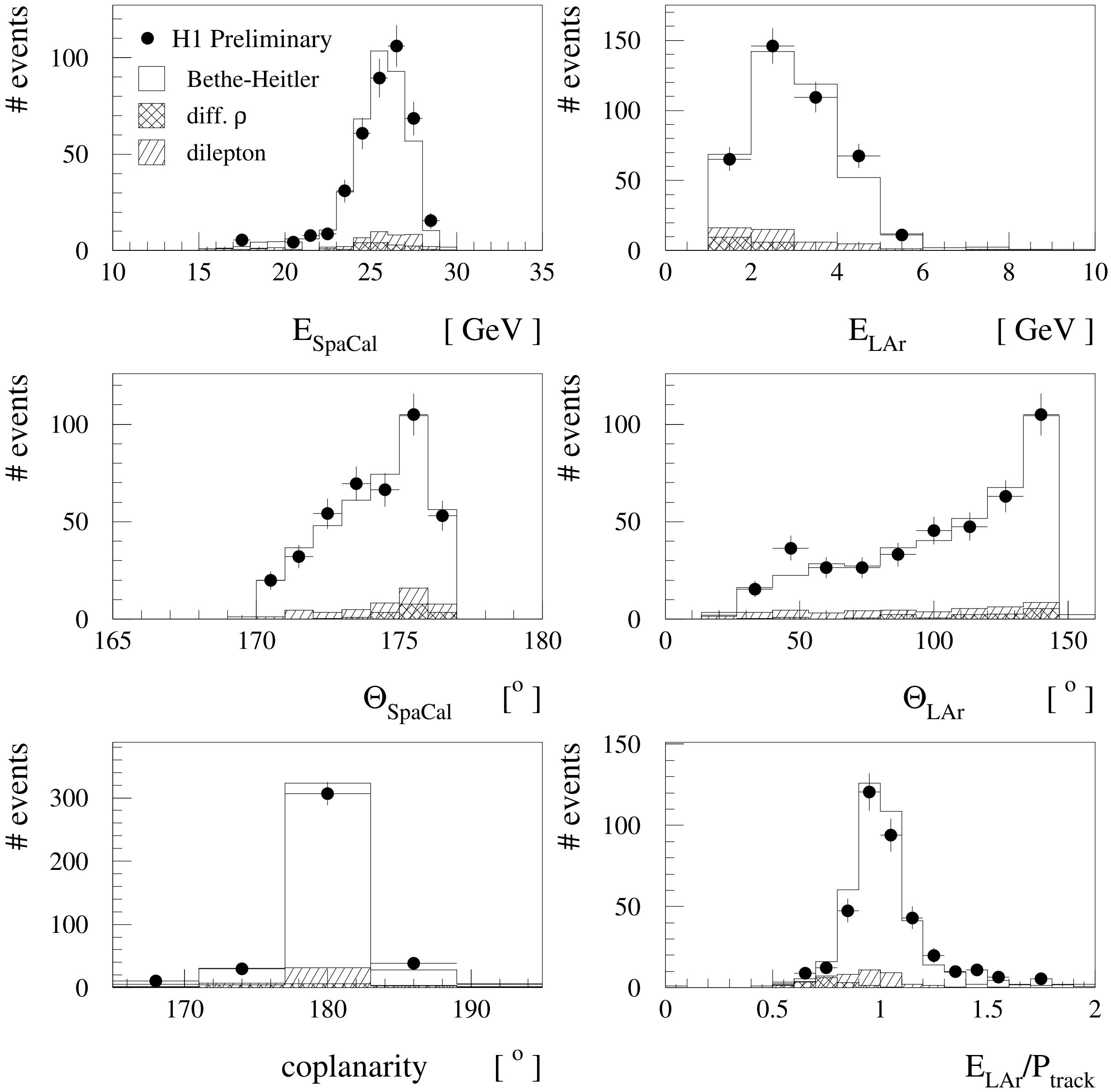
Detector Distributions (H1 – e^+)

$\theta_{SpaCal} > 155°$
$E_{SpaCal} > 15$ GeV

$\theta_{LAr} < 142°$
$p_{T_{LAr}} > 1$ GeV

$2 < Q^2 < 20$ GeV^2
$30 < W < 120$ GeV
$|t| < 1$ GeV^2



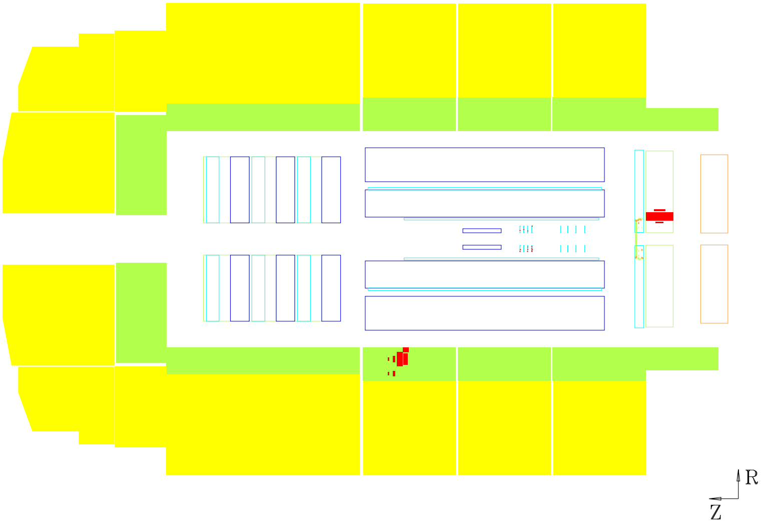


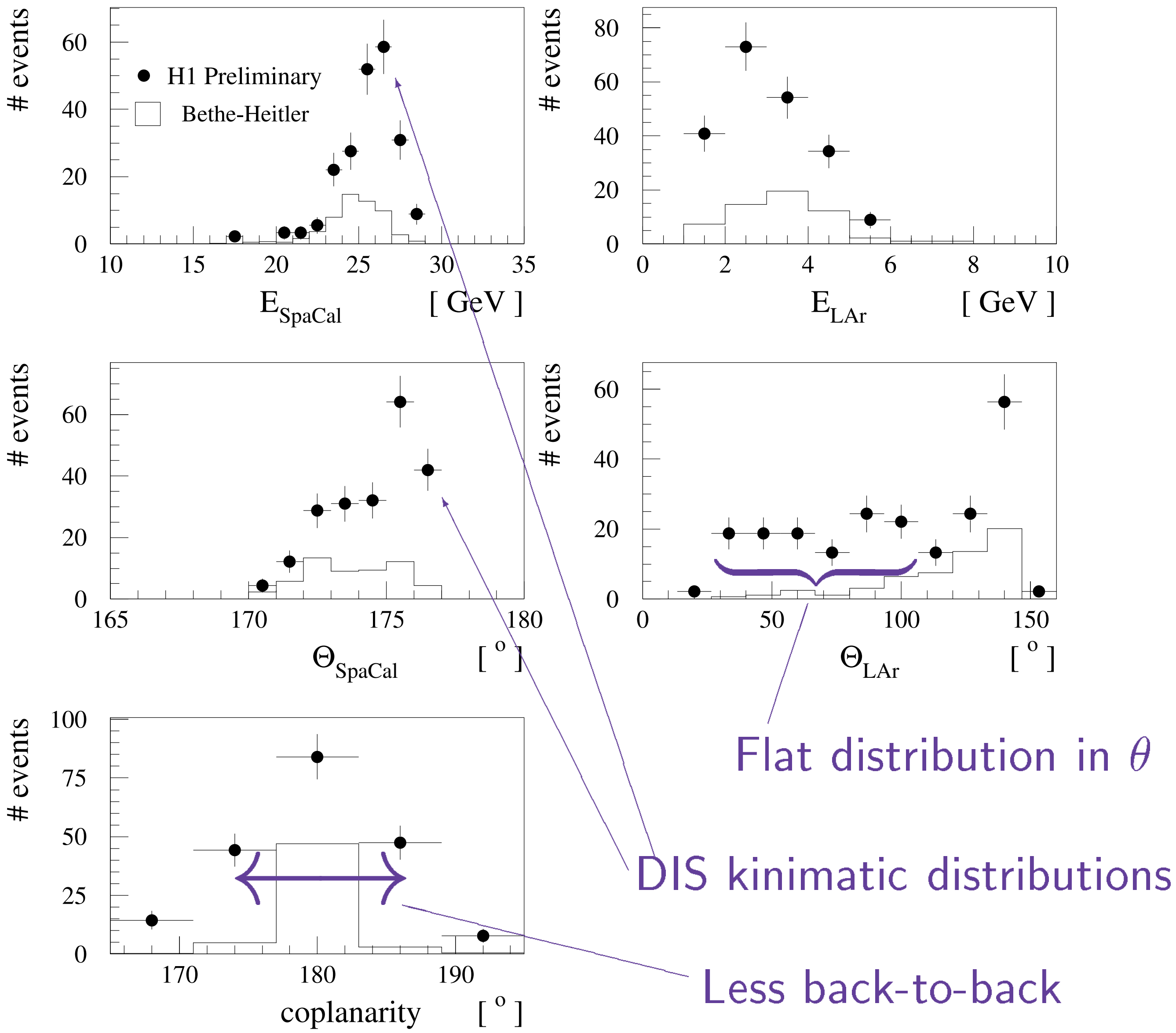
Detector Distributions (H1 – γ)

$\theta_{SpaCal} > 155°$
$E_{SpaCal} > 15$ GeV

$\theta_{LAr} < 142°$
$p_{T_{LAr}} > 1$ GeV

$2 < Q^2 < 20$ GeV^2
$30 < W < 120$ GeV
$|t| < 1$ GeV^2





H1 Cross Section Measurement

Selected Data

1997 Luminosity: 8 pb^{-1}
e^+ in SpaCal ($E > 15$ GeV)
γ in LAr ($p_T > 1$ GeV; no track)
No Additional Cluster ($E > 0.5$ GeV)
No Forward Activity

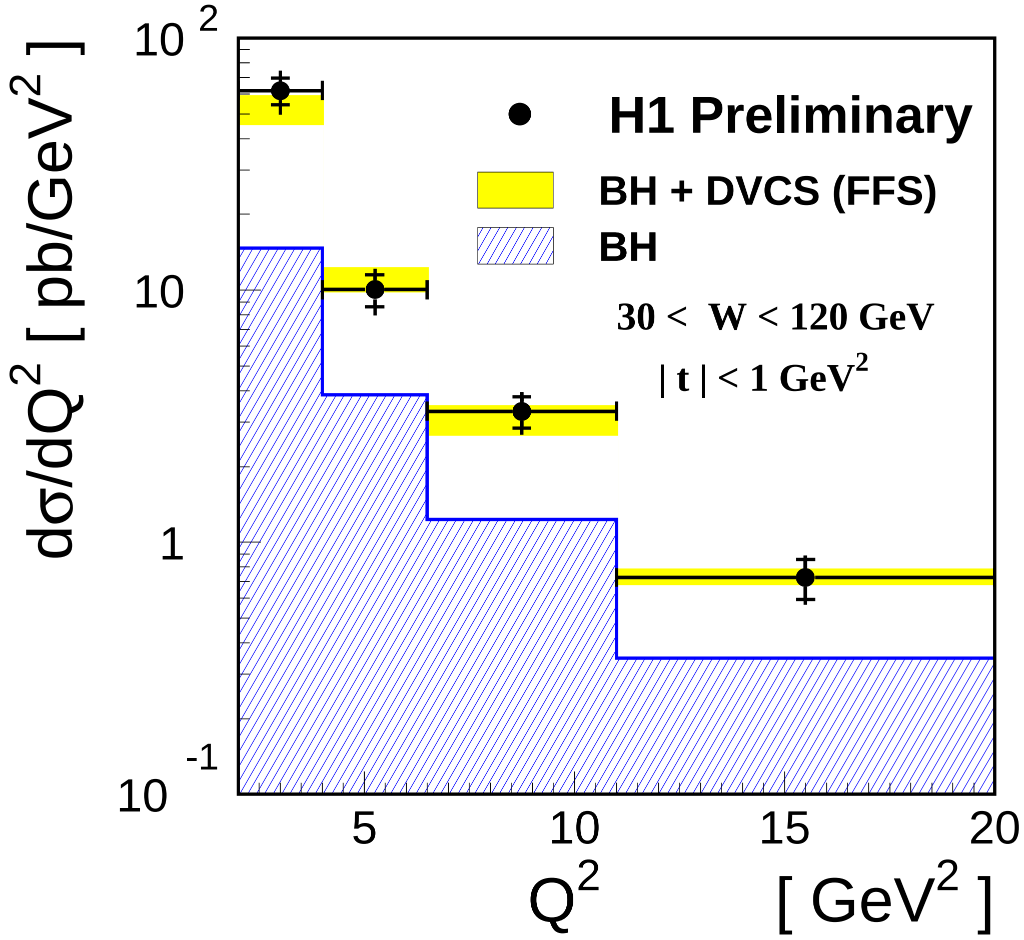
Data Corrections:

Detector Acceptance and Efficiencies
Undetected Proton Dissociation ($\sim 10\%$)
QED Initial State Radiation

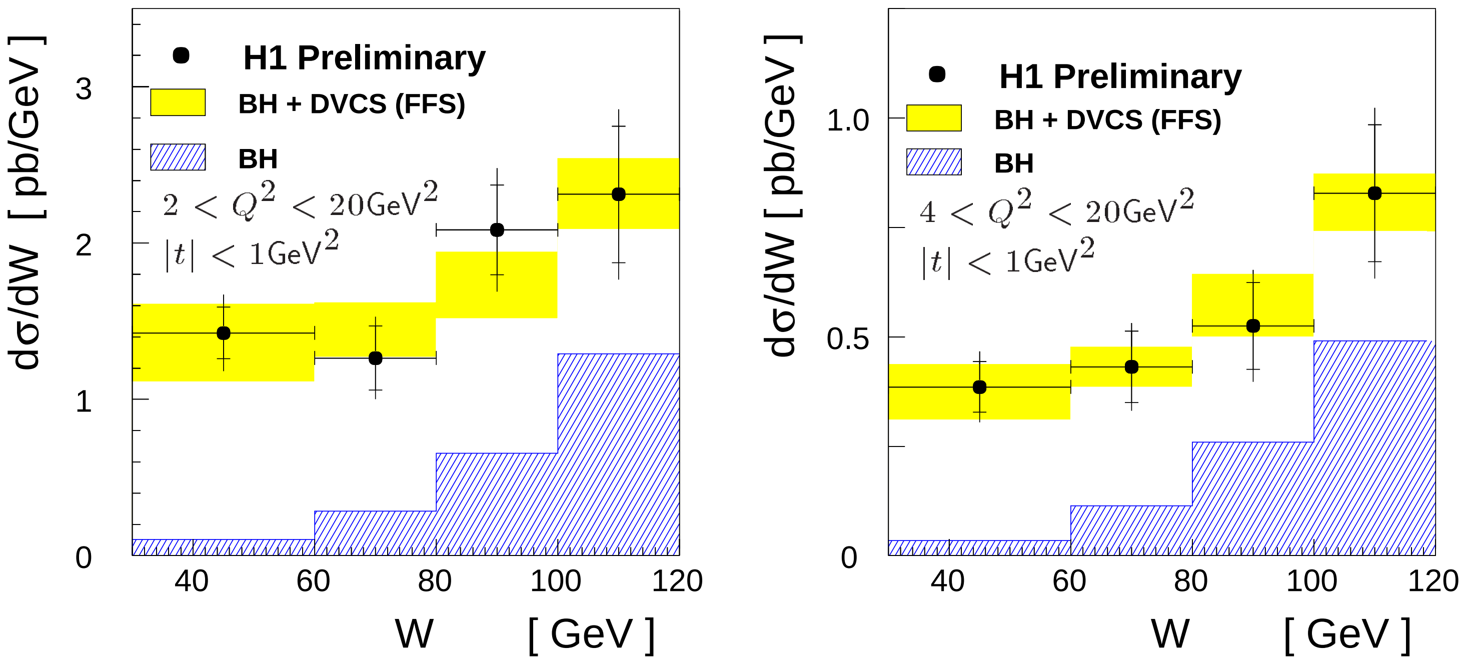
Primary Systematic Errors:

Angular Resolution ($5 - 10\%$)
Dissociative Background Subtraction (5%)
Acceptance Corrections (10%)

H1 – Results



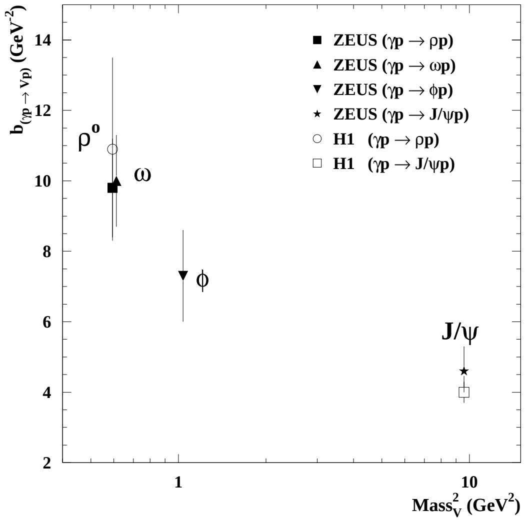
⋆ Data are consistent with DVCS Monte Carlo (even down to $Q^2 \sim 2$ GeV^2)



A Comment on Monte Carlos

ZEUS and H1 have separately implemented the equations of Frankfurt, Freund and Strikman *Phys. Rev. D58 (1998) 114001*

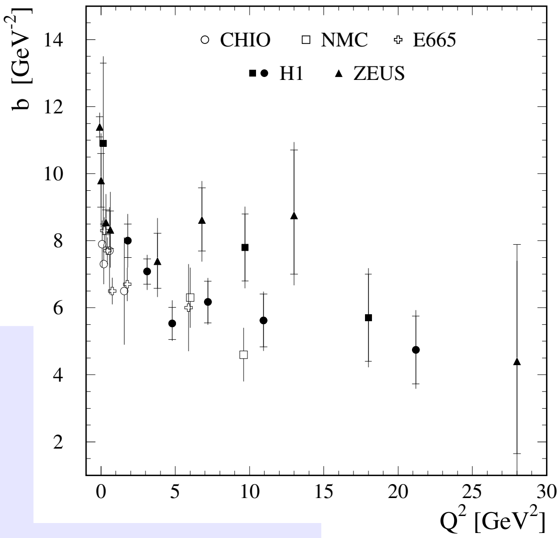
$\Rightarrow$ They Agree



$|t|$ - Dependence (e^{-bt})

Sets Normalization of Monte Carlo Predictions

ZEUS – 4.5
H1 – 7 $\div$ 10



Proton Dissociation

No MC Description exists for QED or γ production

Needed for $\frac{d\sigma}{dt}$ measurement
(Expect different $|t|$ - dependence)

Needed for high-$|t|$ measurement
(Acceptance Corrections and Efficiencies)

Conclusions

A Non-QED γ process is clearly seen in DIS

$\frac{d\sigma}{dQ^2}$ and $\frac{d\sigma}{dW}$ presented for $eP \rightarrow eP\gamma$

$$2 < Q^2 < 20 \text{ GeV}^2$$
$$30 < W < 120 \text{ GeV}$$
$$|t| < 1 \text{ GeV}^2$$

Q^2 evolution consistent with DVCS calculation

Ongoing Analysis:
- $|t|$-dependence
- More Statistics
- DVCS - BH Interference
- Expanded Kinematics

$\gg$ Need to Better Describe Proton Dissociation $\ll$