

EPS03 - Aachen
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Studies of DVCS and high $|t|$ photon production with the H1 Detector

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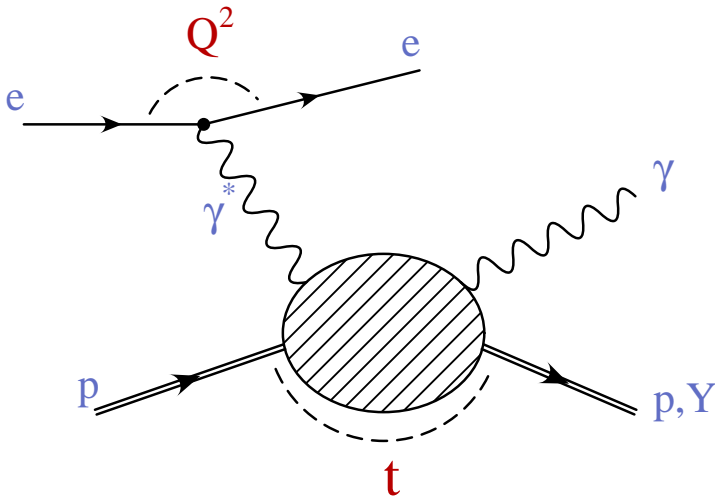
ULB

On behalf of the

H1 Collaboration



Introduction



photon diffraction off proton

- simplest QCD process
 - fully calculable in pQCD
- hard scale Q^2 or t

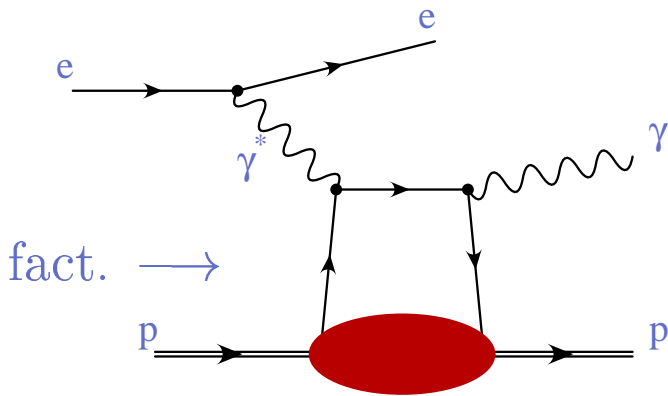
DVCS

high t photon

- New measurement of DVCS
- First observation and cross section measurement of high t photons

QCD

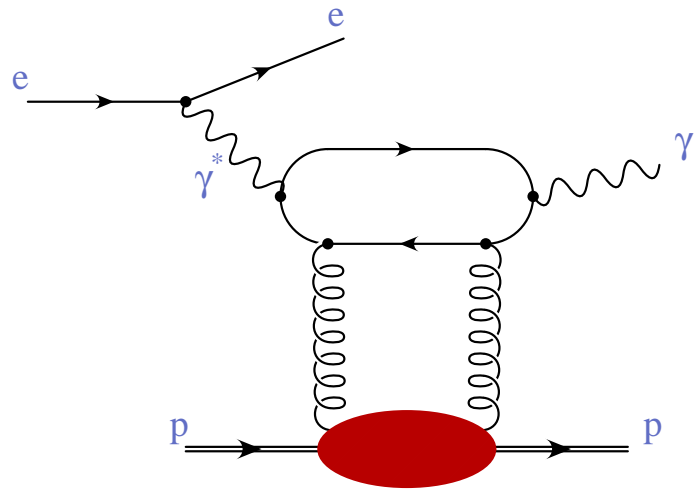
LO



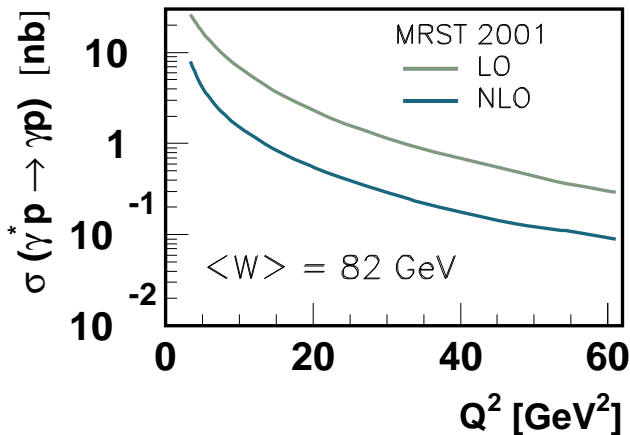
H1, ZEUS

HERMES, CLAS

NLO



H1, ZEUS



NLO leading twist calc. by
[A. Freund and M. McDermott](#)

Eur.Phys.J. **C23** (2002) 651

Input: GPD

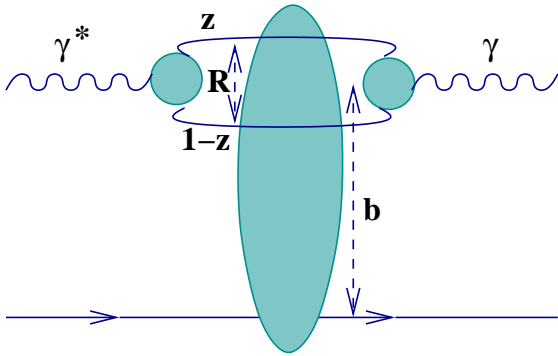
GPD modeling Freund [hep-ph/0306012]

$$GPD(x, \xi, Q^2, t) \sim \frac{PDF\left(\frac{x-\xi/2}{1-\xi/2}, Q^2\right)}{1-\xi/2} \times e^{-b|t|}$$

PDF: MRST2001 and CTEQ6

$$b = b_0(1 - 0.15 \log(Q^2/2)) \text{ GeV}^{-2}$$

Colour Dipole Models : in the proton rest frame



- γ^* fluctuates in $q\bar{q} + q\bar{q}g + \dots$

$$\mathcal{A} = \int dR^2 dz \psi^{in} \sigma_{\text{dipole}} \psi^{out}$$

- ψ^{in} and ψ^{out} calculable

- σ_d is modeled

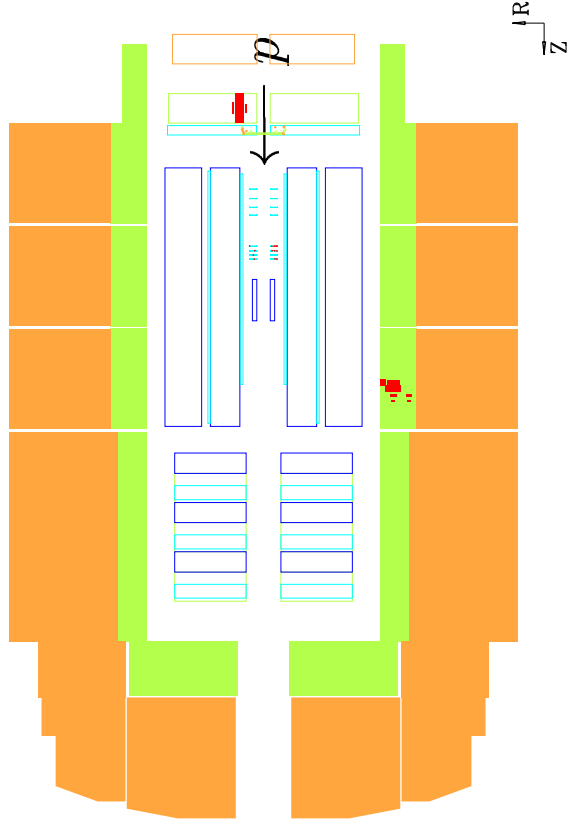
Donnachie-Dosch: hard + soft IP

Phys.Lett. B502 (2001) 74

Favart-Machado: GBW saturation model applied to DVCS
(with and without DGLAP evolution: BGBK)

[hep-ph/0302079] to appear in EPJ

DVCS Analysis



H1 data 2000 $\int \mathcal{L} = 26 \text{ pb}^{-1}$

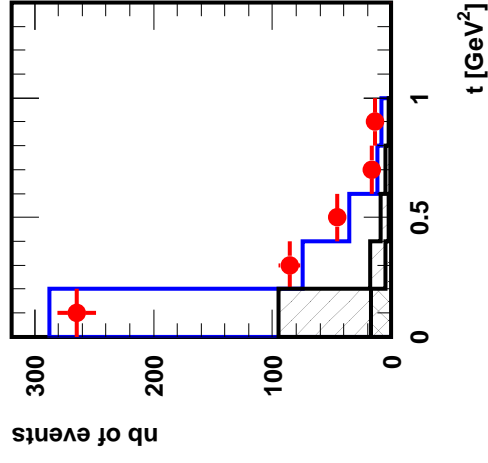
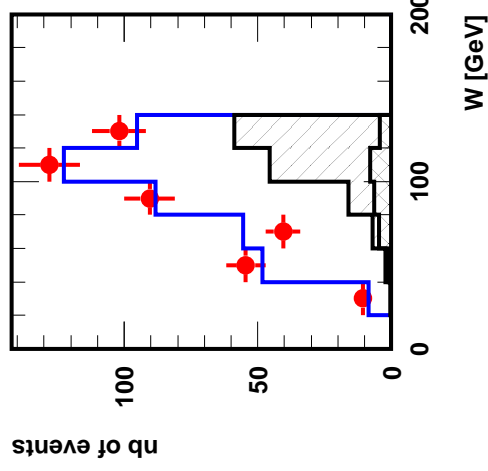
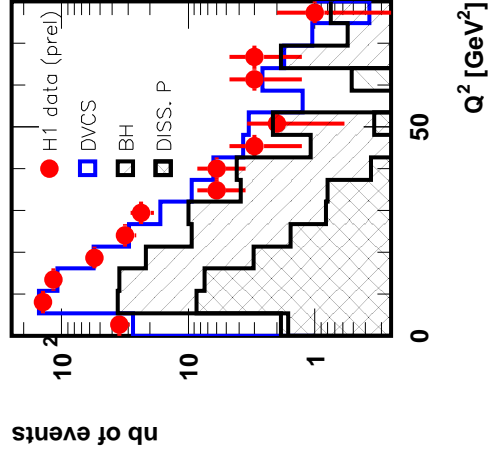
$E_e > 15 \text{ GeV}$

$E_\gamma > 2 \text{ GeV}$

$E_3 < 0.5 \text{ GeV}$

elast. no track, Fwd

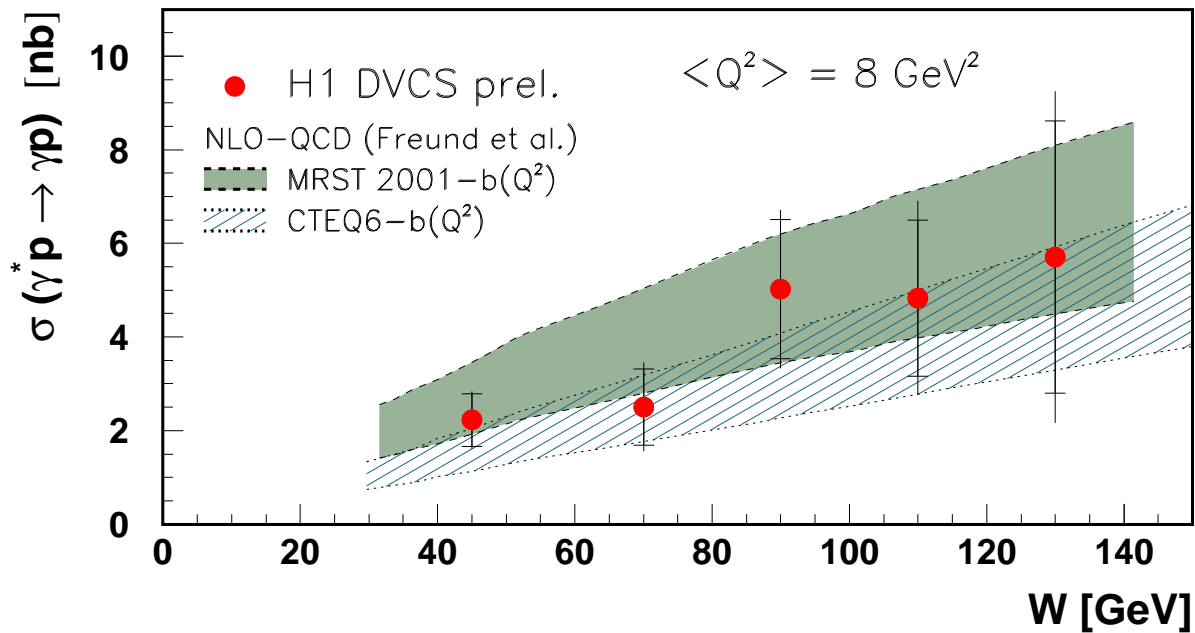
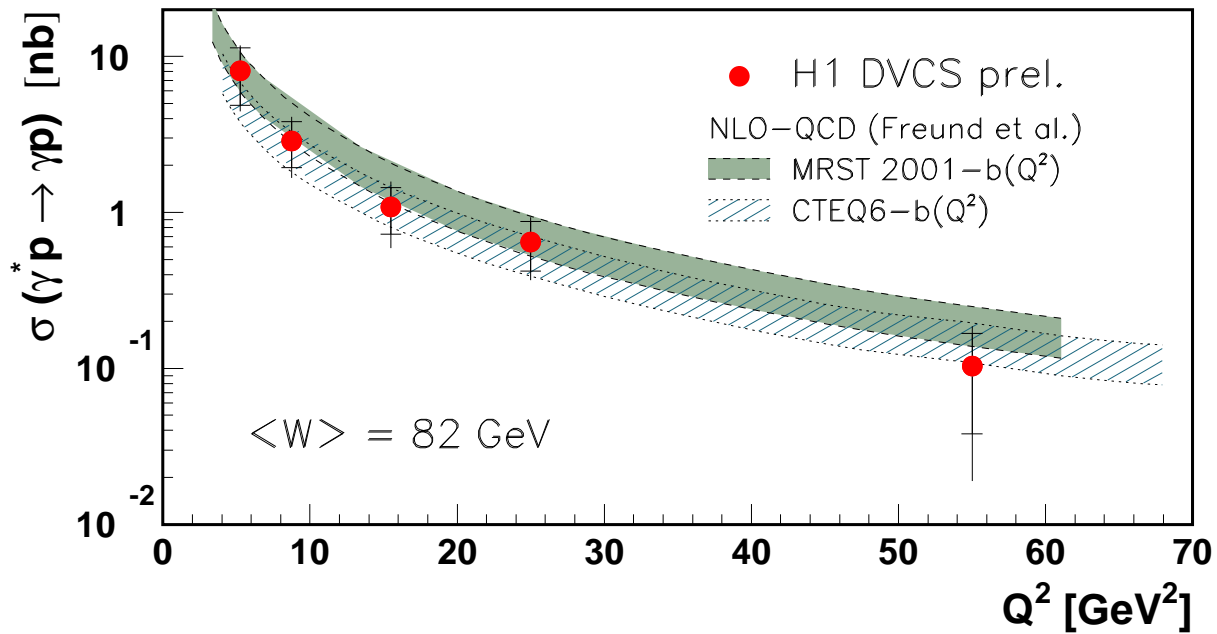
H1 preliminary



$4 < Q^2 < 80 \text{ GeV}^2$ $30 < W < 140 \text{ GeV}$ $|t| < 1 \text{ GeV}^2$

H1 Results

data 2000 $\int \mathcal{L} = 26 \text{ pb}^{-1}$

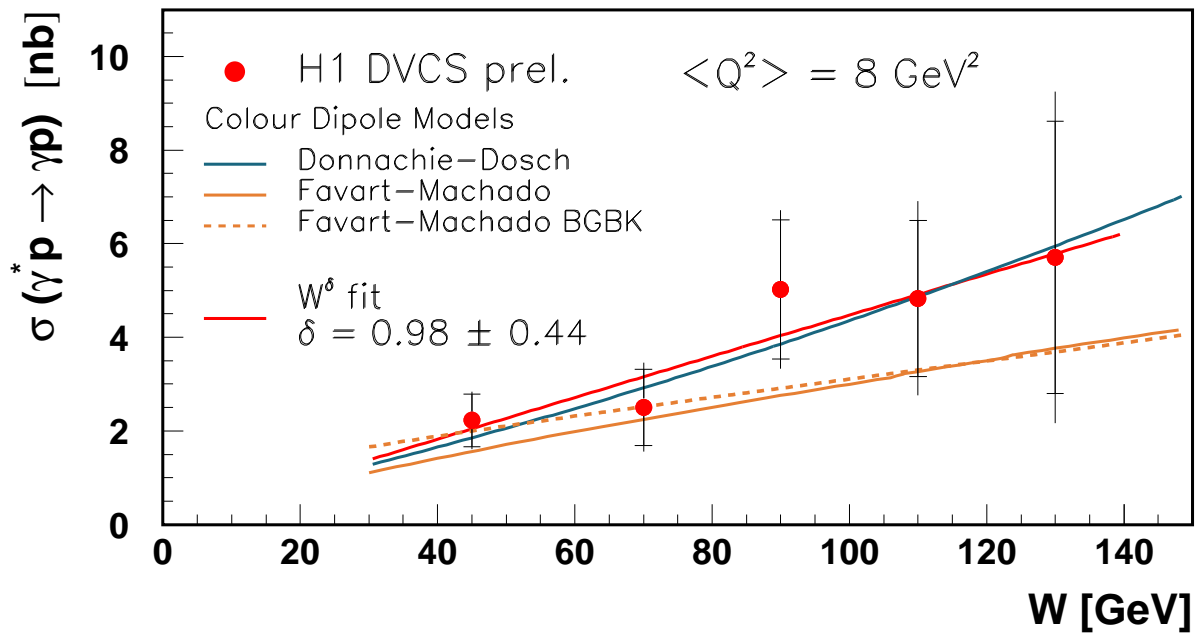
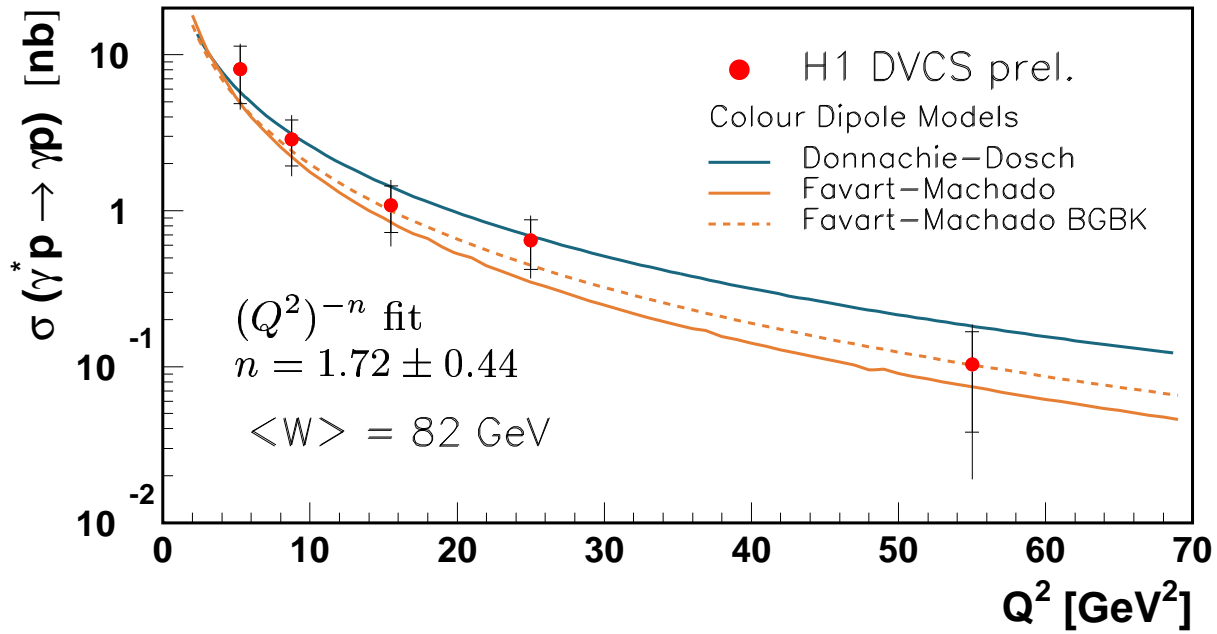


$$5 < b_0 < 9 \text{ GeV}^{-2}$$

⇒ Good description by QCD - NLO calculations

⇒ Need to measure t dependence

H1 Results



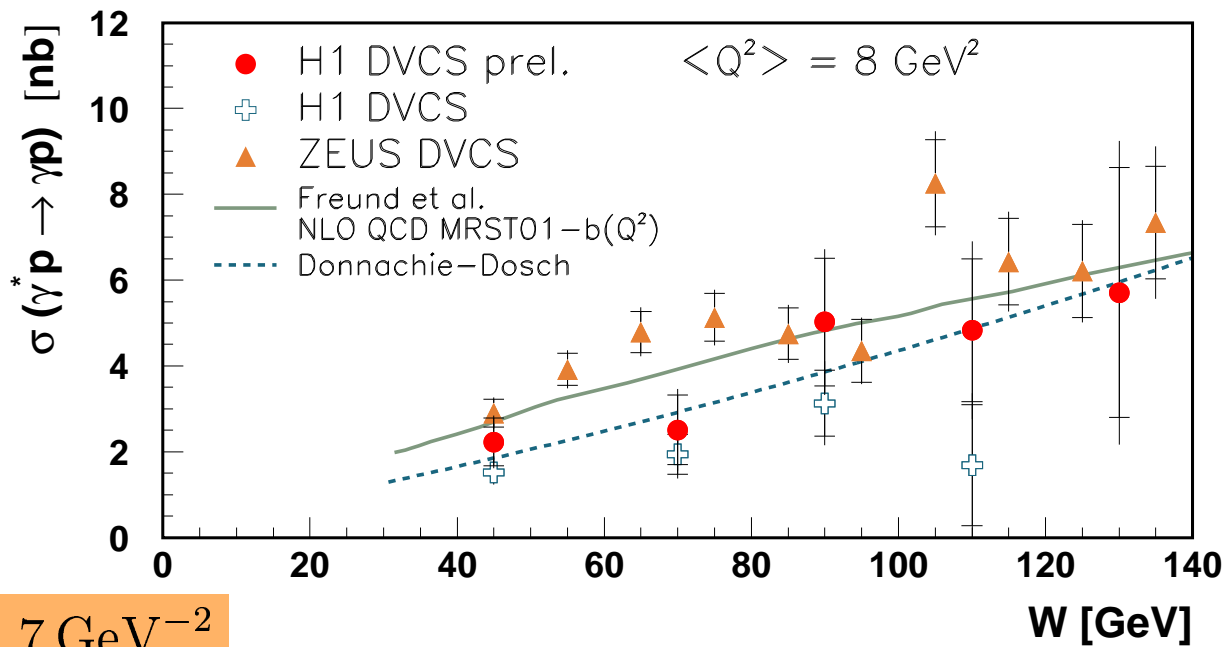
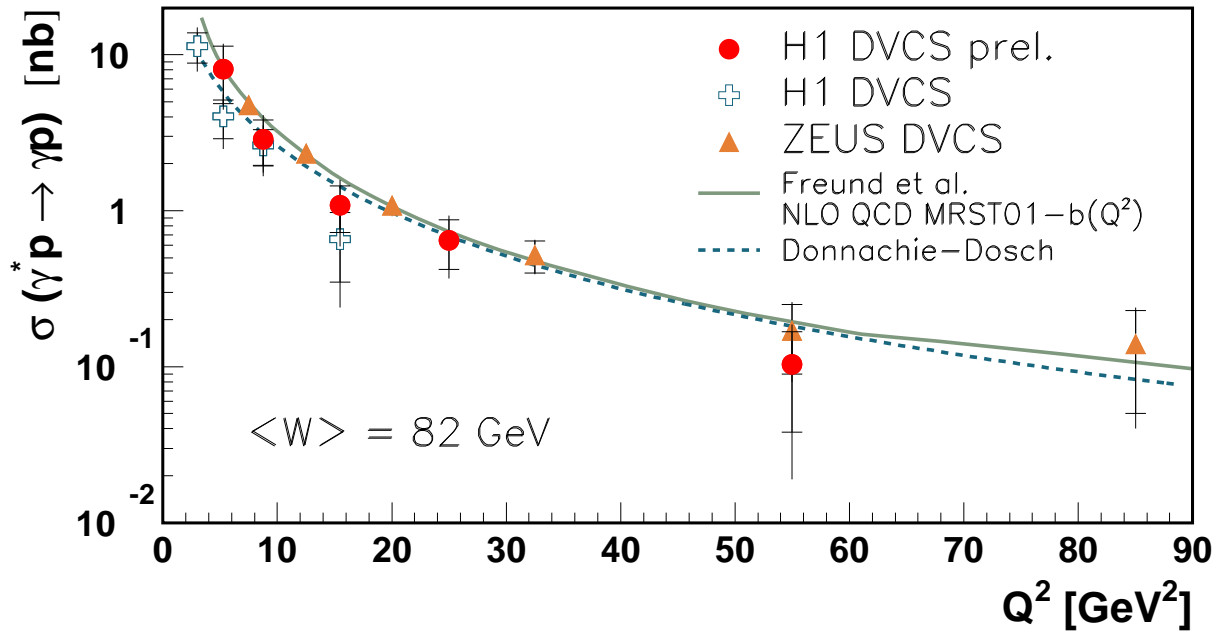
$b = 7 \text{ GeV}^{-2}$

⇒ n small than for VM ($n(\rho) = 2.60 \pm 0.04$)

⇒ δ indication of a hard regime

⇒ Both Dipole models in **agreement** with data.
 W slope better described by Donnachie-Dosch.

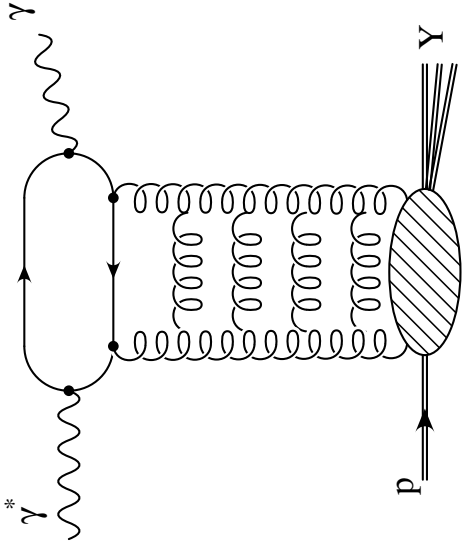
All H1 and ZEUS Results



$b = 7 \text{ GeV}^{-2}$

- ⇒ Good agreement between H1 results
- ⇒ Fair agreement between H1-prel and ZEUS results except for $W \sim 70$ GeV: H1 lower by 2σ

First Measurement of Diffractive high t photons



- photoproduction $Q^2 < 0.01 \text{ GeV}^2$
- high t and low $x \rightarrow$ BFKL prediction
- dominated by p dissociation
- Bethe-Heitler kinematically suppressed

data 1999-2000 $\int \mathcal{L} = 40 \text{ pb}^{-1}$

Tagged photoproduction
($0.3 < y < 0.6$)

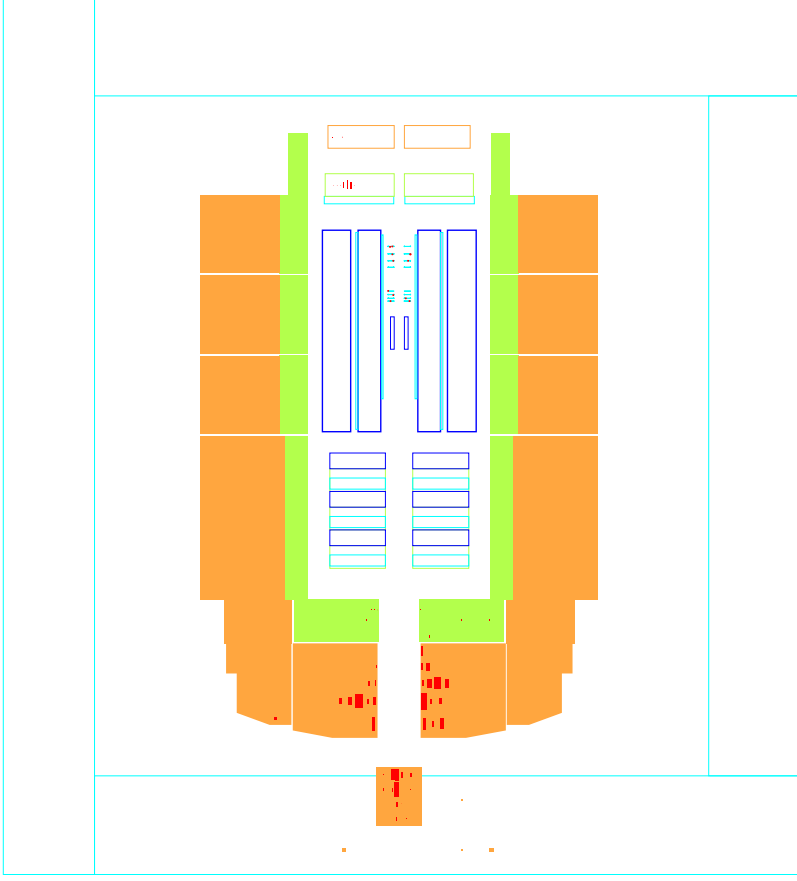
Photon in Bwd Calo

$$E_\gamma > 8 \text{ GeV} \quad p_\gamma^T > 2 \text{ GeV}$$

Y system in Fwd Calo

$$y_{\mathcal{P}} = \frac{\sum_{Fwd} (E - P_z)}{2 E_\gamma} < 0.018$$

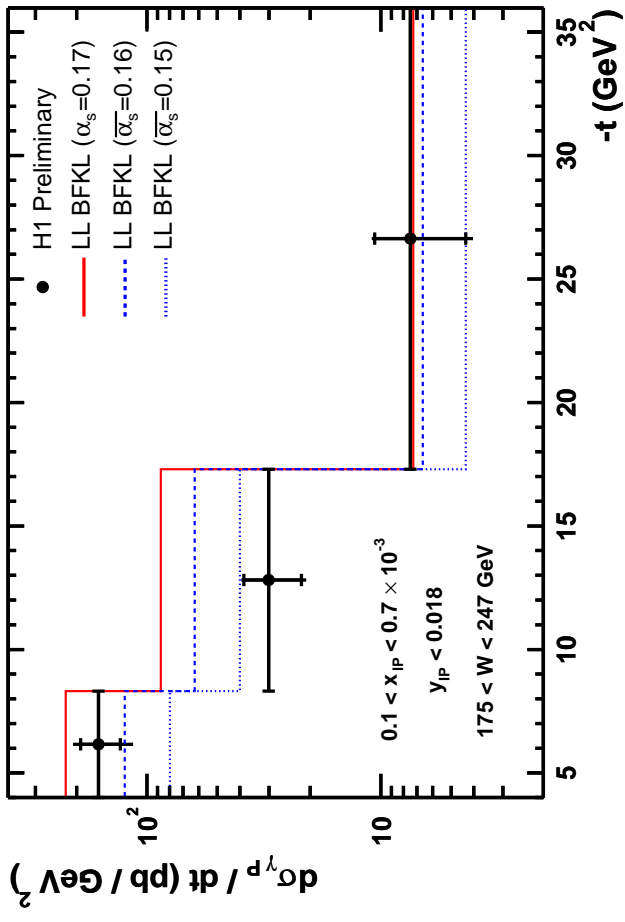
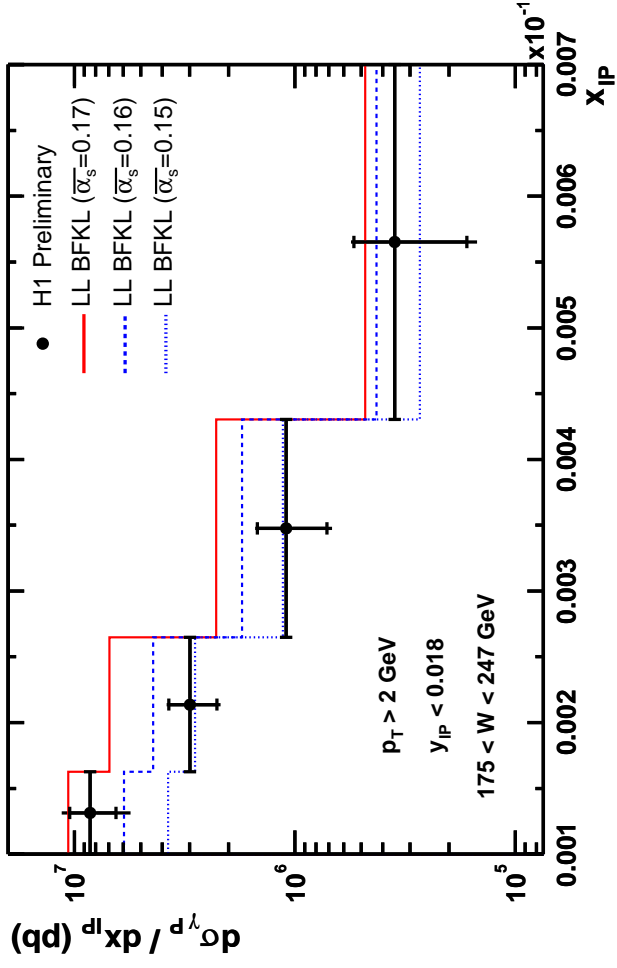
$$\Delta\eta > 2$$



$$|t| \simeq (p_\gamma^T)^2 \quad x_{\mathcal{P}} \simeq \frac{(E - P_z)_\gamma}{2 E_p}$$

Diffractive high t photons

data 1999-2000 $\int \mathcal{L} = 40 \text{ pb}^{-1}$



- Cross section basically described in shapes and Norm. by LL BKFL ($\bar{\alpha}_s \sim 0.15 - 0.17$).

Conclusion and Perspectives

- HERA using colliding beams is a very favorable place to study the **diffraction of photons**:
 - as a diffractive process in terms of **pQCD**
 - to access **GPD** (in part. gluons)
 - in a **wide kinematic range**.
- **DVCS** cross sections as a function of Q^2 , and as a fct. of W have been measured with higher precision within H1.
 - in agreement with different dipole models and QCD predictions, and provide first constrains on GPDs.
 - in agreement with previous H1 results and with ZEUS results
- **First observation** and σ measurement of **high t photons**, in basic agreement with **LL BFKL** predictions
- **HERA II**:
 - much higher statistics (1 fb^{-1})
 - higher precision : no p diss with (**new**) proton tagging
 - asymmetry measurements (charge and helicity).