DVCS and its t-dependence at HERA-II

L. Favart

I.I.H.E.
Université Libre de Bruxelles.

On behalf of

ULB

Content

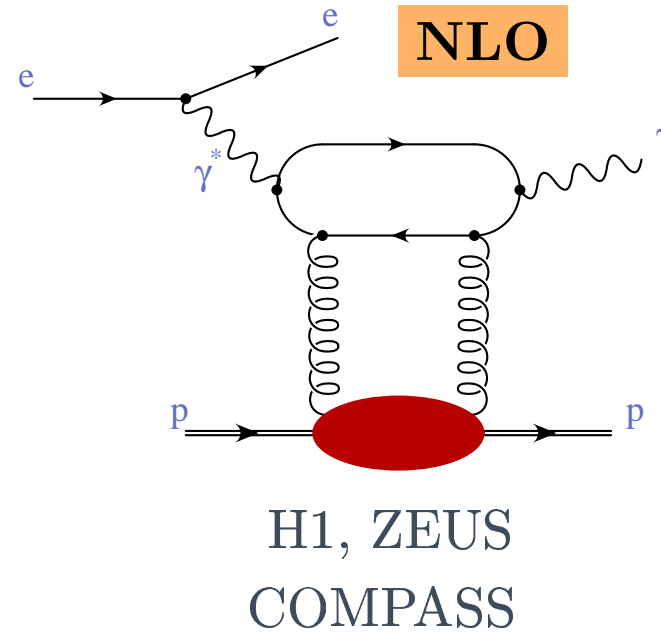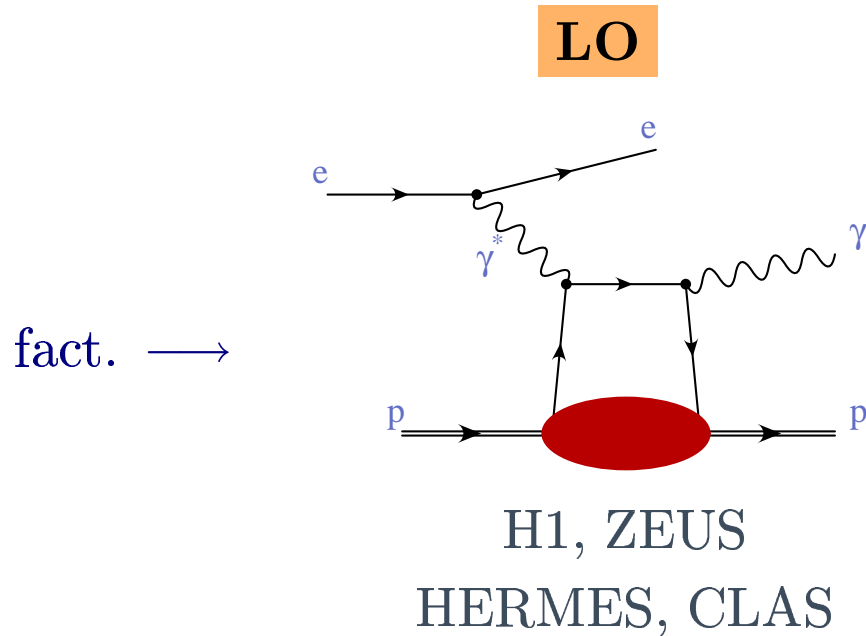XVIth International workshop on

Deep-Inelastic Scattering

- **Data e^- HERA II - 2005-06**

- **integrated lumi of 145 pb^{-1}**

- **Finalized cross section results**
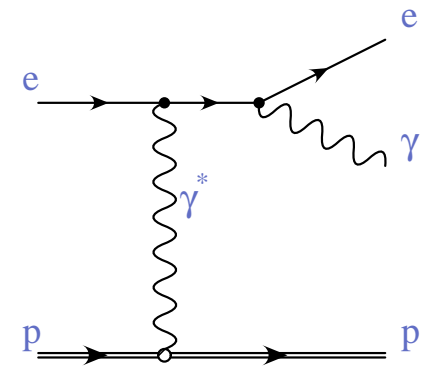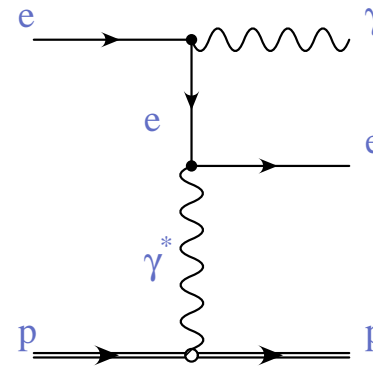
- **Phys. Lett. B 659 (2008) 796.**

DIS08 - London - 7-11th of April 2008

DVCS - Introduction

LO

H1, ZEUS
HERMES, CLAS
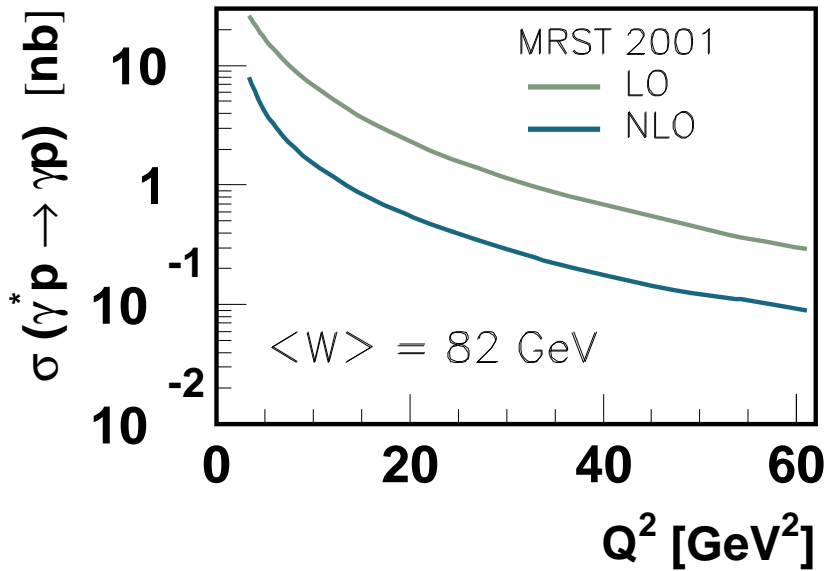
NLO

H1, ZEUS
COMPASS

fact. $\longrightarrow$

- **HERA (ep)**: wide range in Q^2, W and t accessible

  at high Q^2 and low x

- Sensitivity to GPD (gluons)

- Bethe-Heitler Process (Background + Interference)

- interference term $\rightarrow \mathcal{A}_{DVCS}$ (asymmetry measurements)

QCD predictions

- Fully calculable in QCD

- NLO leading twist (+ twist three) calc. by A. Freund and M. McDermott
  Eur.Phys.J. **C23** (2002) 651

- Only input: **GPDs**

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

- implemented MC MILOU.

GPD input:

   DGLAP region: $|x| > \xi$

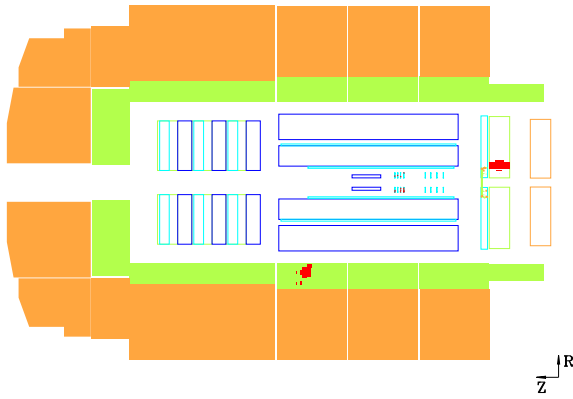$\mathcal{H}^q(x, \xi, t; \mu^2) = q(x; \mu^2)\, e^{-b|t|}$ q singlet

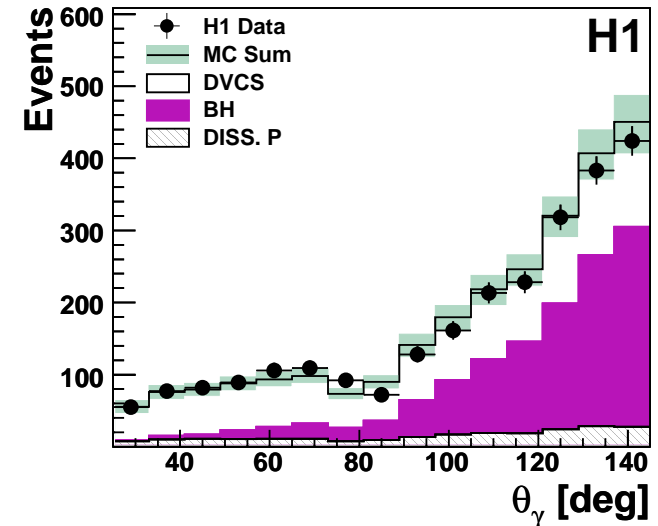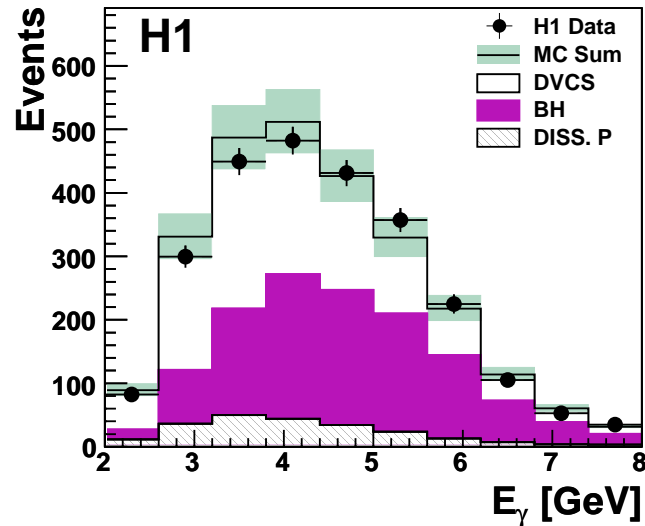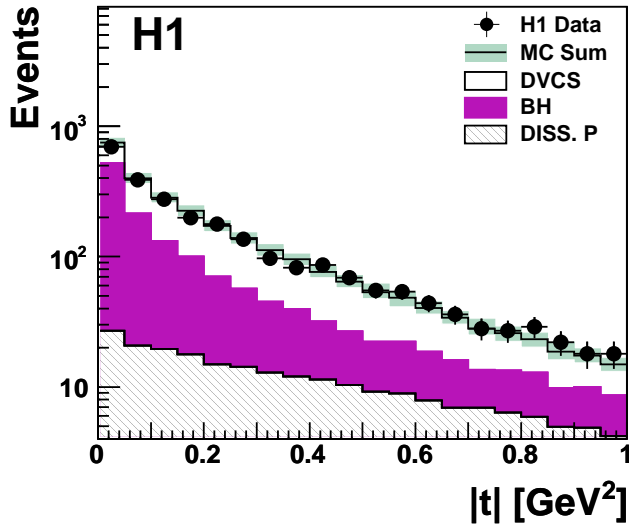$\mathcal{H}^g(x, \xi, t; \mu^2) = x\, g(x; \mu^2)\, e^{-b|t|}$ gluons

MRST2001 and CTEQ6

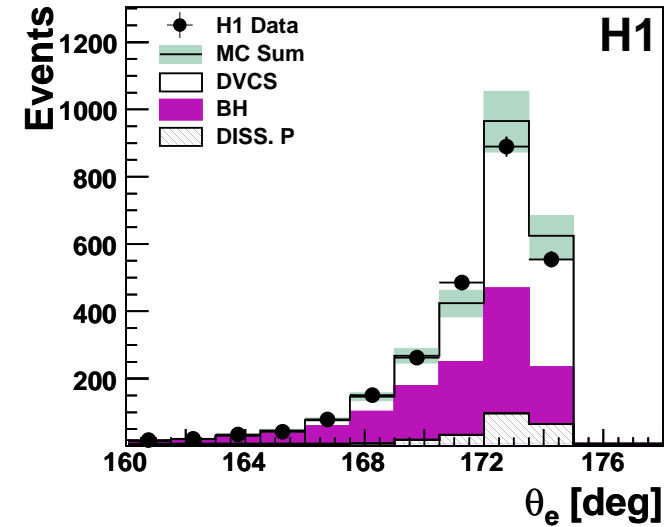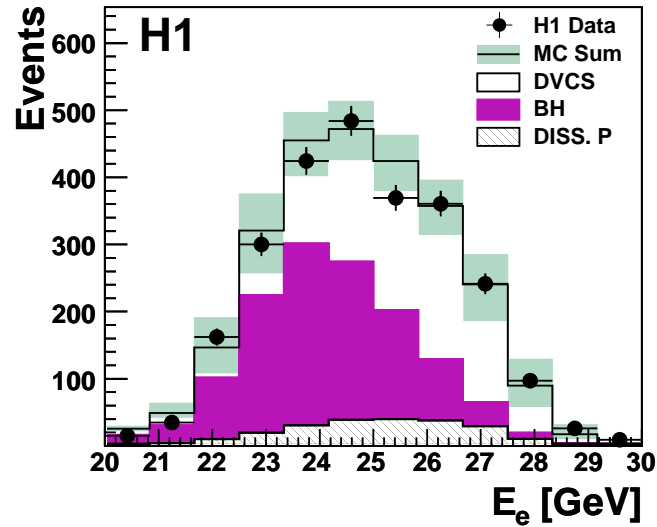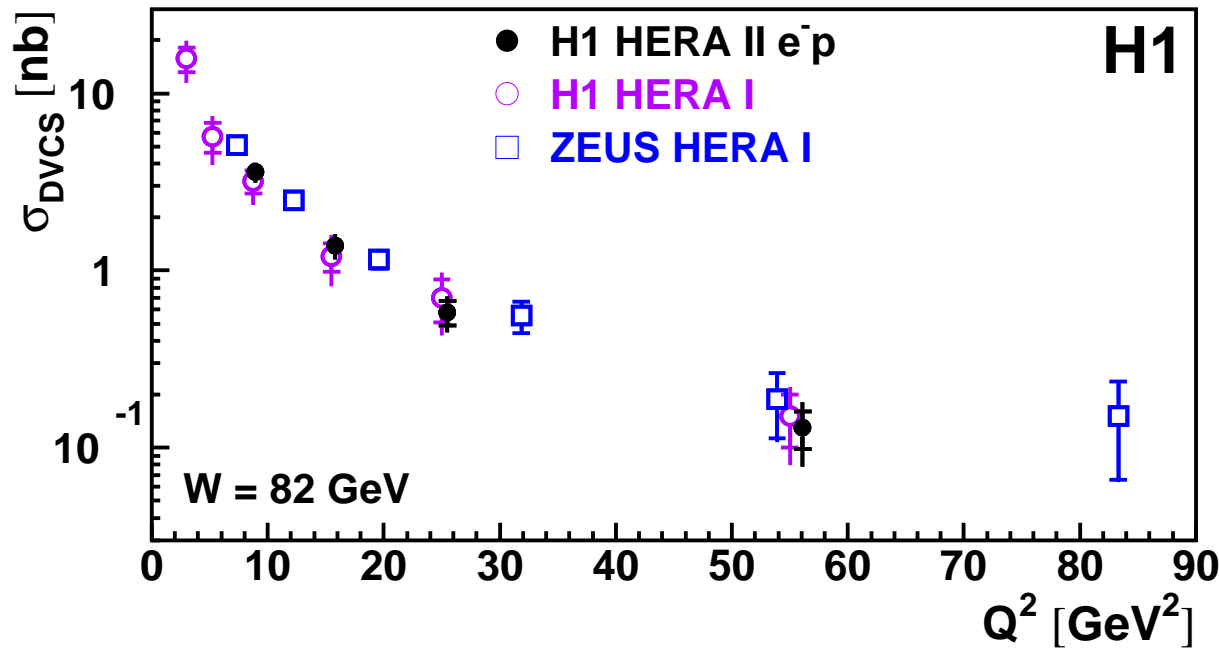   ERBL region: $|x| < \xi$

simple analytic function

DVCS H1 Events

H1 e^- data 2005-06
Int. lumi = 145 pb^{-1}
2538 events.
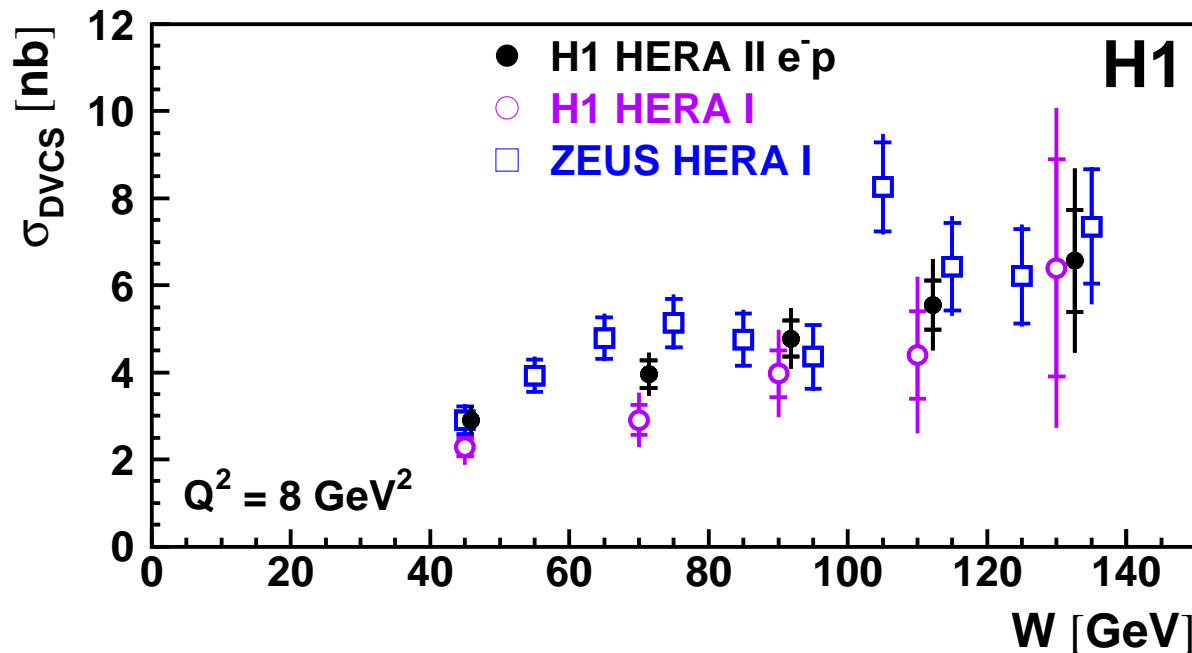
Basic Cross section measurements

After subtraction of Bethe-Heitler contribution,

$$\frac{\mathrm{d}^3\sigma_{ep\to e\gamma p}}{\mathrm{d}W\mathrm{d}Q^2\mathrm{d}|t|} =$$

$$\Gamma(W,Q^2)\,\frac{\mathrm{d}\sigma_{DVCS}}{\mathrm{d}|t|}(W,Q^2)$$

→ in agreement with previous results

→ improved precision
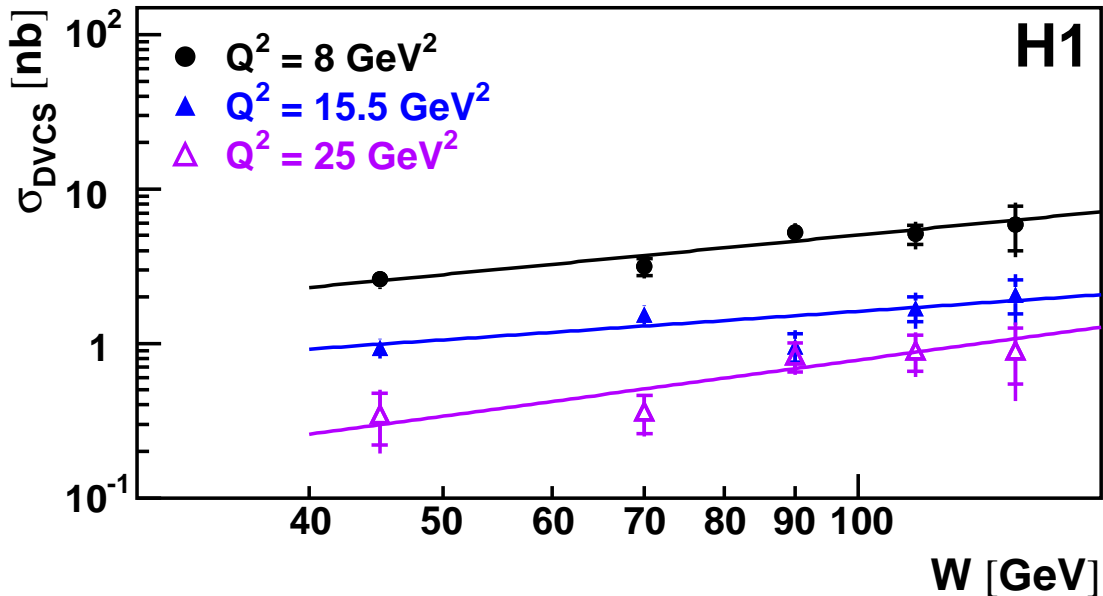
W dependence for three Q^2 values

→ Fit W^δ:

Total sample gives:
$$\delta = 0.74 \pm 0.11 \pm 0.16$$
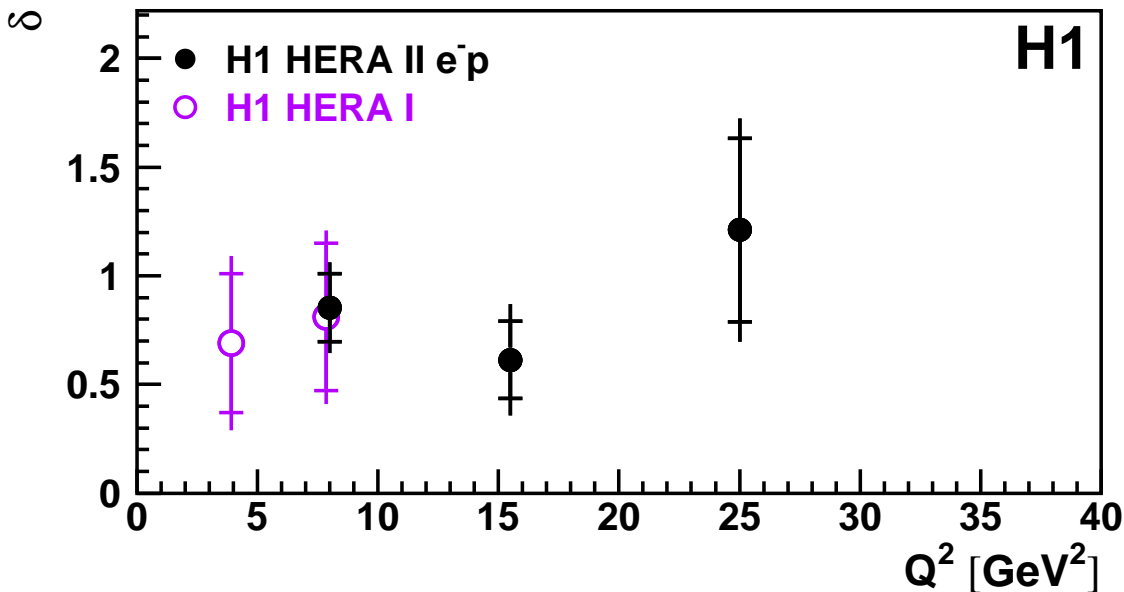
→ indication of a hard regime

→ in agreement with VM production

t slope

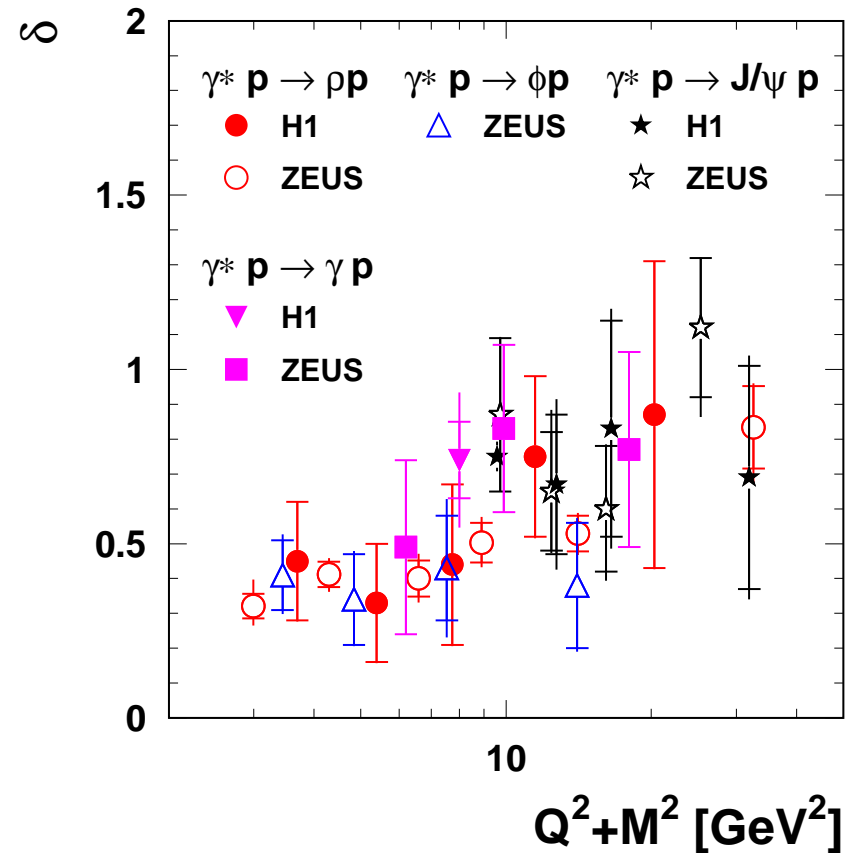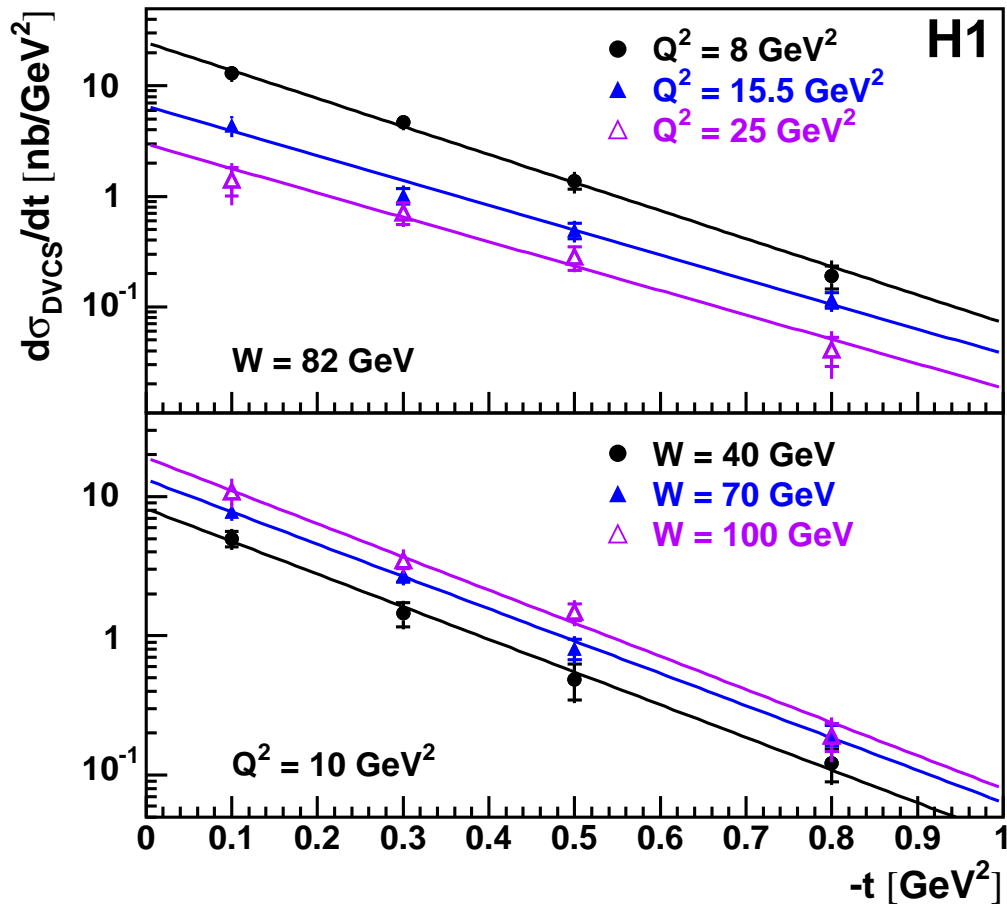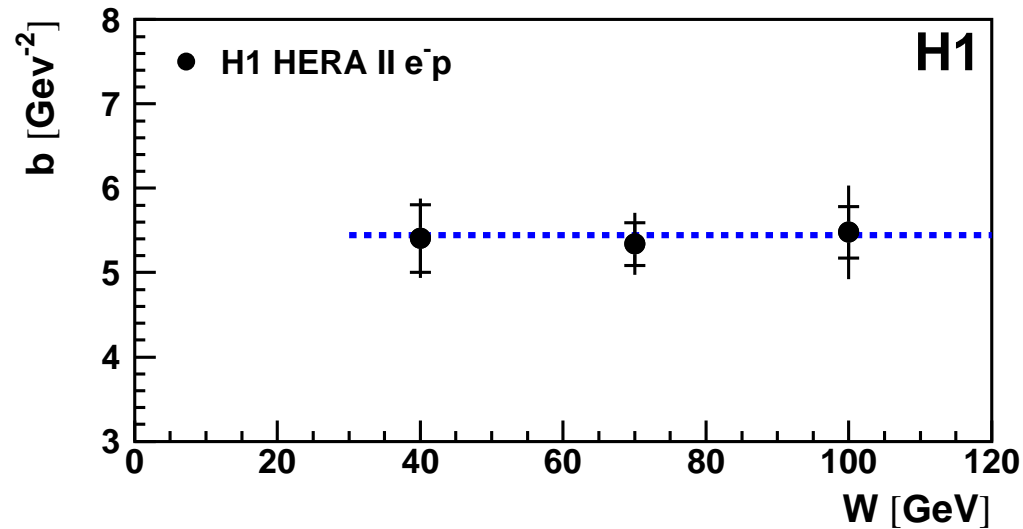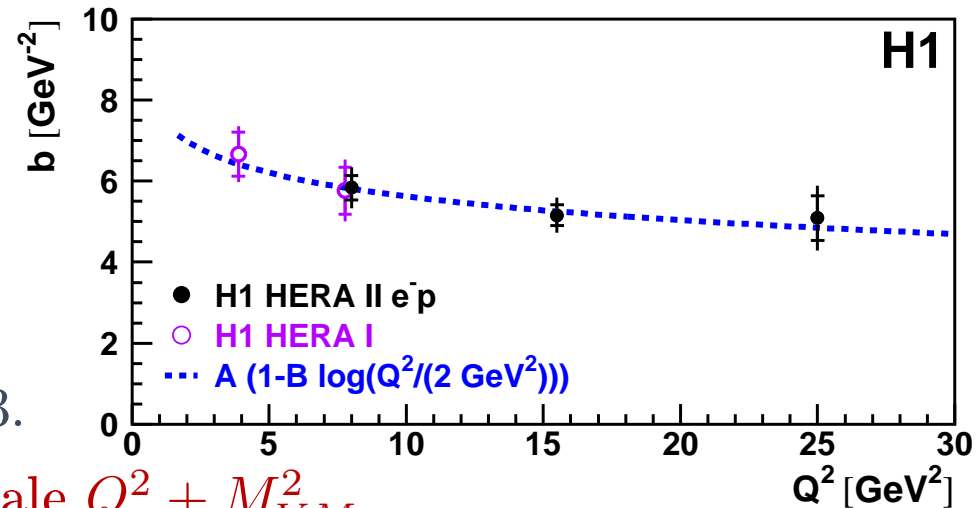$$b(Q^2) = A\left(1 - B\log(Q^2/2)\right)$$

A and *B* fitted to:

$A = 6.98 \pm 0.54 \text{ GeV}^{-2}$ $B = 0.12 \pm 0.03.$

⇒ Similar behaviour with VM using the scale $Q^2 + M_{VM}^2$

• First *t* slope measured vs *W*

⇒ no *W* dependence

DVCS: QCD interpretation

- correct Q^2 dependence of the propagator and of b in the cross section:

$$S = \sqrt{\frac{\sigma_{DVCS} \; Q^4 \; b(Q^2)}{(1 + \rho^2)}}$$

- skewing factor: around 2

$$R = \frac{\mathcal{Im} \; A(\gamma^* p \to \gamma p)}{\mathcal{Im} \; A(\gamma^* p \to \gamma^* p)}$$

$$= \frac{4 \sqrt{\pi} \; \sigma_{DVCS} \; b(Q^2)}{\sigma_T(\gamma^* p \to X) \sqrt{(1 + \rho^2)}}$$

-$\sigma_T(\gamma^* p \to X)$ taken from QCD analysis of inclusive DIS H1 measurement.
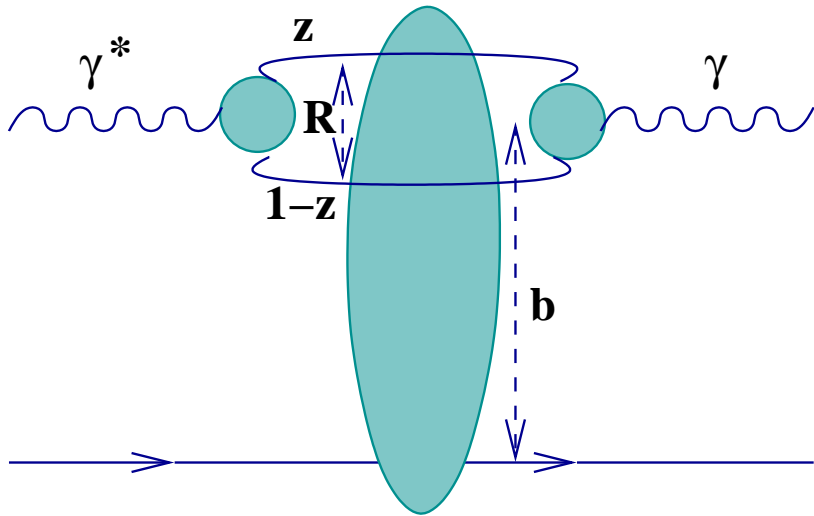
⇒ important skewing factor

⇒ Q^2 evolution close to the one of DIS (pure DGLAP)
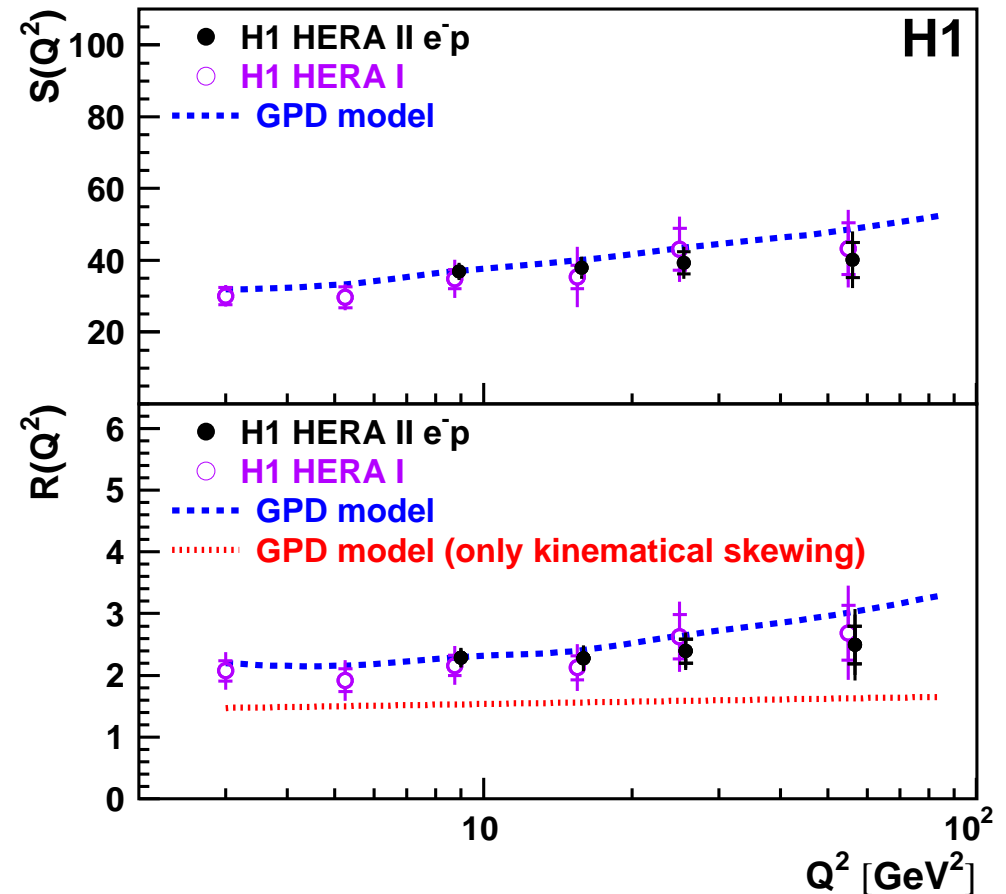
Colour Dipole Models

In the proton rest frame

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

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

- ψ^{in} and ψ^{out} calculable

- σ_{d} is modeled

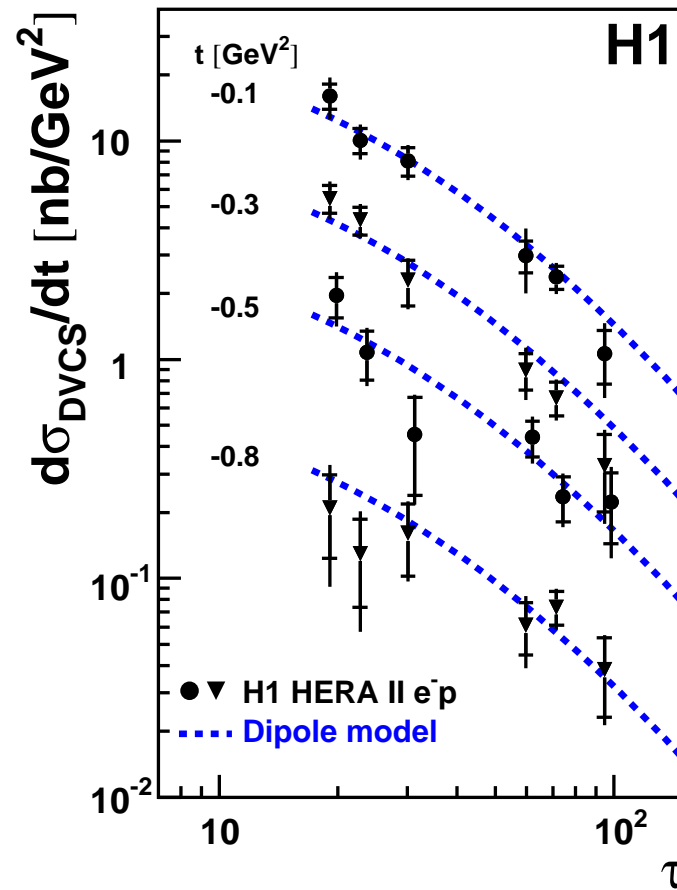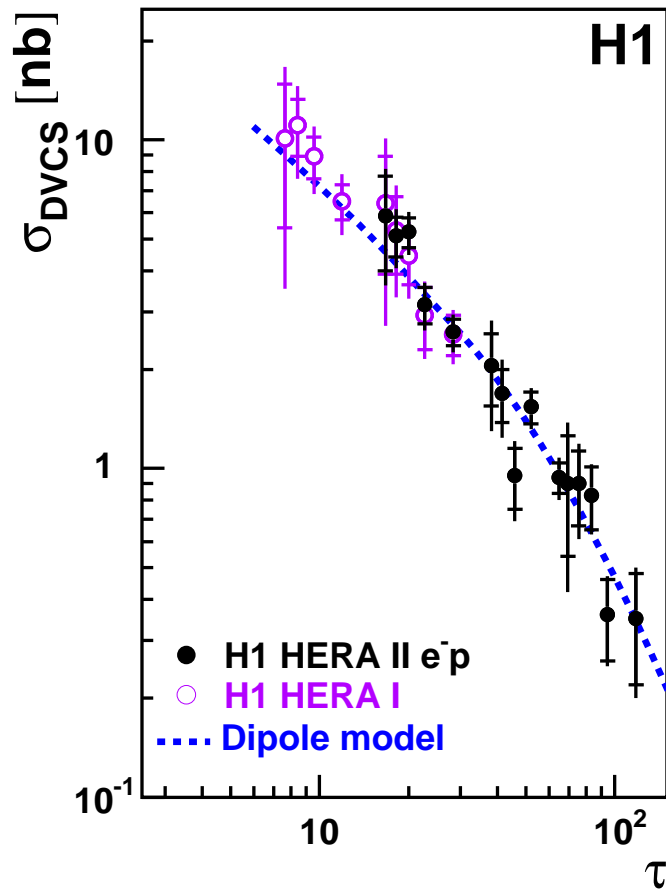- many models for σ_{d} exist.

C. Marquet, R. Peschanski and G. Soyez: [hep-ph/0702171]
- includes saturation given by the geometric scaling extended here to the off-forward case ($|t| > 0$)

$$\sigma_{DVCS}(x, Q^2) = \sigma_{DVCS}(\tau), \quad \text{with} \quad \tau = \frac{Q^2}{Q_s^2(x)}.$$

$Q_s(x) = Q_0(x_0/x)^{-\lambda/2}$ using $Q_0 = 1$ GeV, $\lambda = 0.25$ and $x_0 = 2.7 \; 10^{-5}$

Dipole approach

- here lower Q^2 points from previous H1 publication [hep-ex/0505061] are included.

➡ Data globally described by the geometric scaling approach

➡ compatible with a saturation scale independent of t

Conclusions

DVCS cross sections as a function of Q^2, W and t have been measured with HERA-II e^- data.

- int. luminosity used increased by factor 4 w.r.t. H1 HERA-I data

- improved precision achieved in the t slope and the W dependence measurements.

- First measurement of the W dependence of the t slope

- in good agreement with NLO QCD predictions, based on GPD model: no intrinsic skewing needed.

- set constraints on gluon and sea GPDs.

- in agreement with various dipole model predictions.

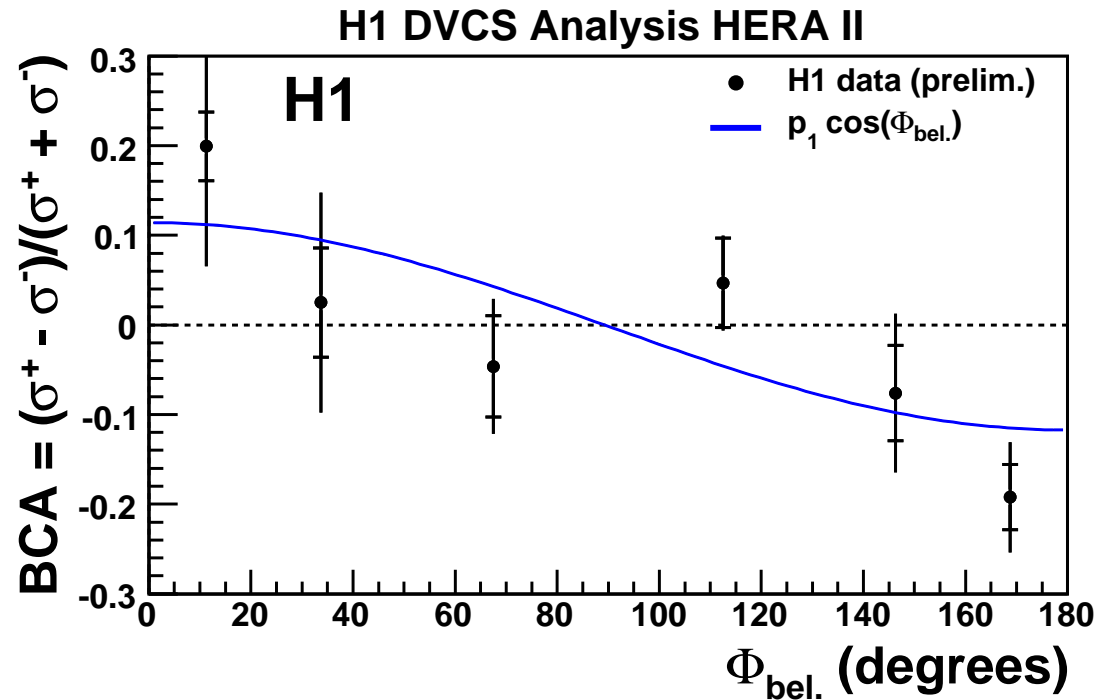- in particular with geometric scaling: no t dependence observed in the saturation scale.

Back-up Slides

Beam Charge Asymmetry

New H1 measurement based on 291 pb^{-1} of HERA II data (e^+ and e^-).

- First DVCS BCA measured at HERA.

$$BCA \equiv \frac{\sigma(e^+p) - \sigma(e^-p)}{\sigma(e^+p) + \sigma(e^-p)} \sim p_1 cos(\Phi)$$

$0.05 < |t| < 1$ GeV^2 - before deconvolution by the ϕ resolution.