DVCS at HERA

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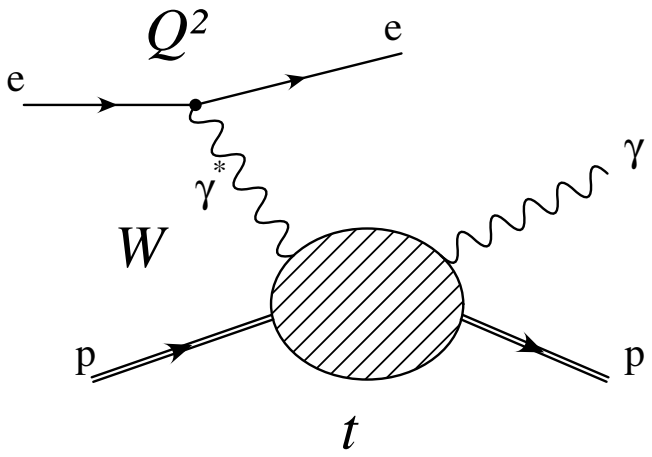
on behalf of

- Introduction
- Measurements at HERA I
- Prospects for the Future

Introduction

DVCS



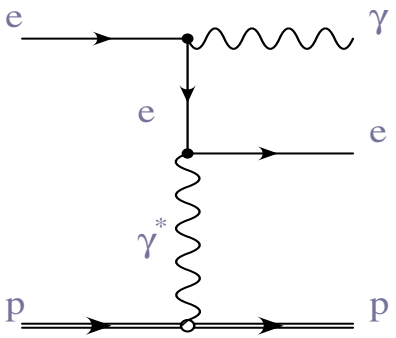
HERA:

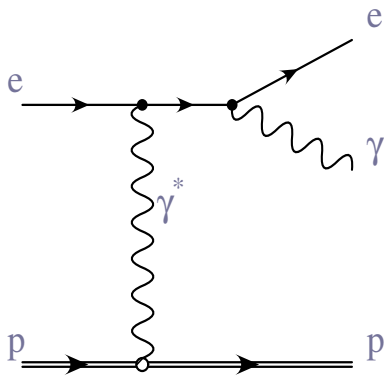
$$2\,GeV < Q^2 < 100\,GeV$$

$$30\,GeV < W < 140\,GeV$$

$$10^{-4} < x < 10^{-2}$$

Bethe–Heitler



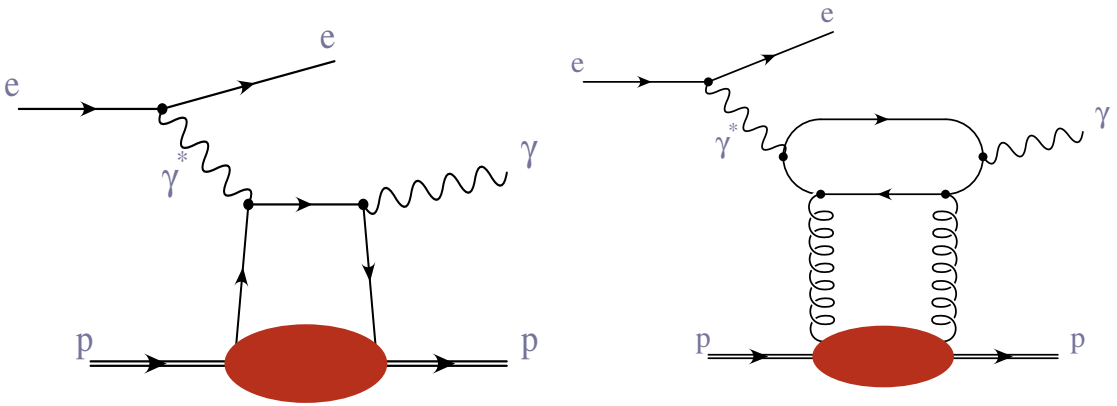


→ Detailed studies of underlying dynamics

→ Background and Interference

Introduction

GPD based models:

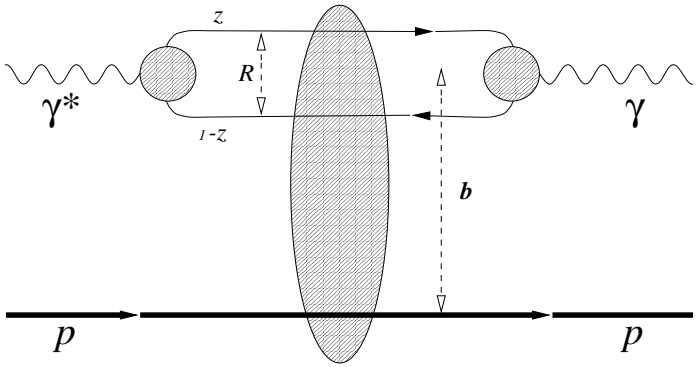


$$A \sim \int \frac{dx}{x} C\left(\xi/x, Q^2\right) G\left(x, \xi, Q^2\right)$$

- Frankfurt, Freund and Strikman
- Freund and McDermott

→ see talk by A. Freund

Colour Dipole Models:



$$A \sim \int \psi_{ini} \sigma_D \psi_{out}$$

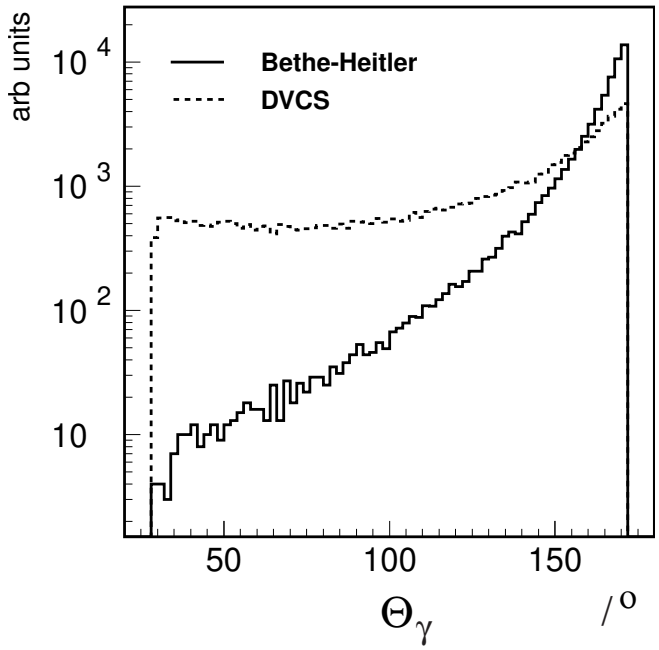
- Donnachie and Dosch
- Forshaw, Kerley and Shaw
- McDermott, Frankfurt, Guzey and Strikman

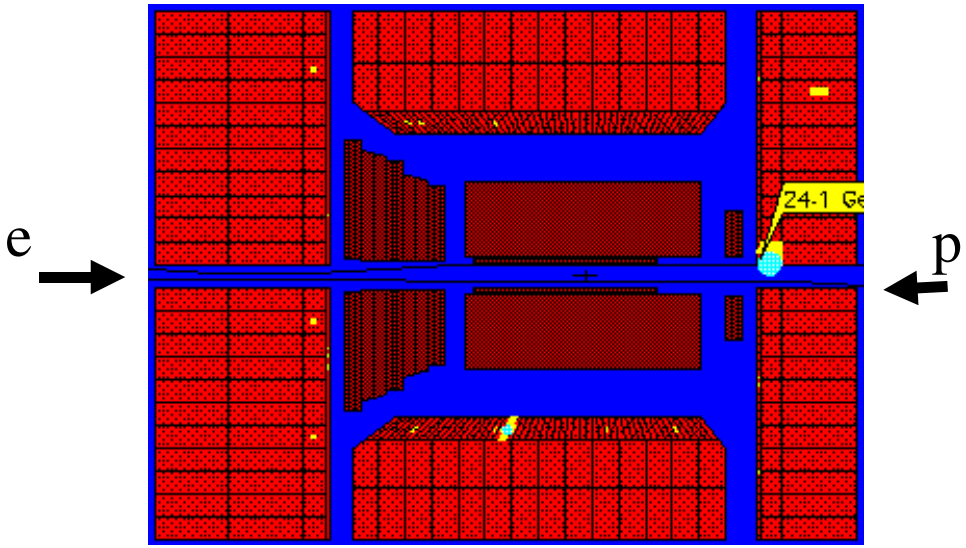
→ see talk by R. Sandapen

Measurements: Analysis Strategy

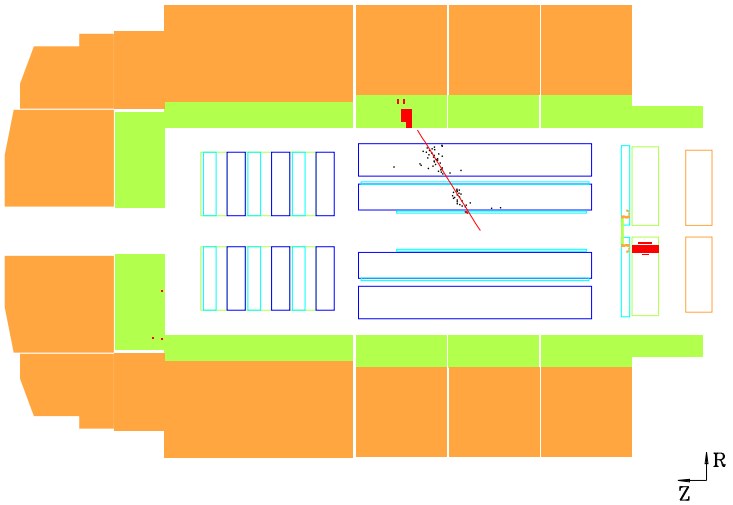
Event selection:

- backward cluster
- central cluster
- no additional activity



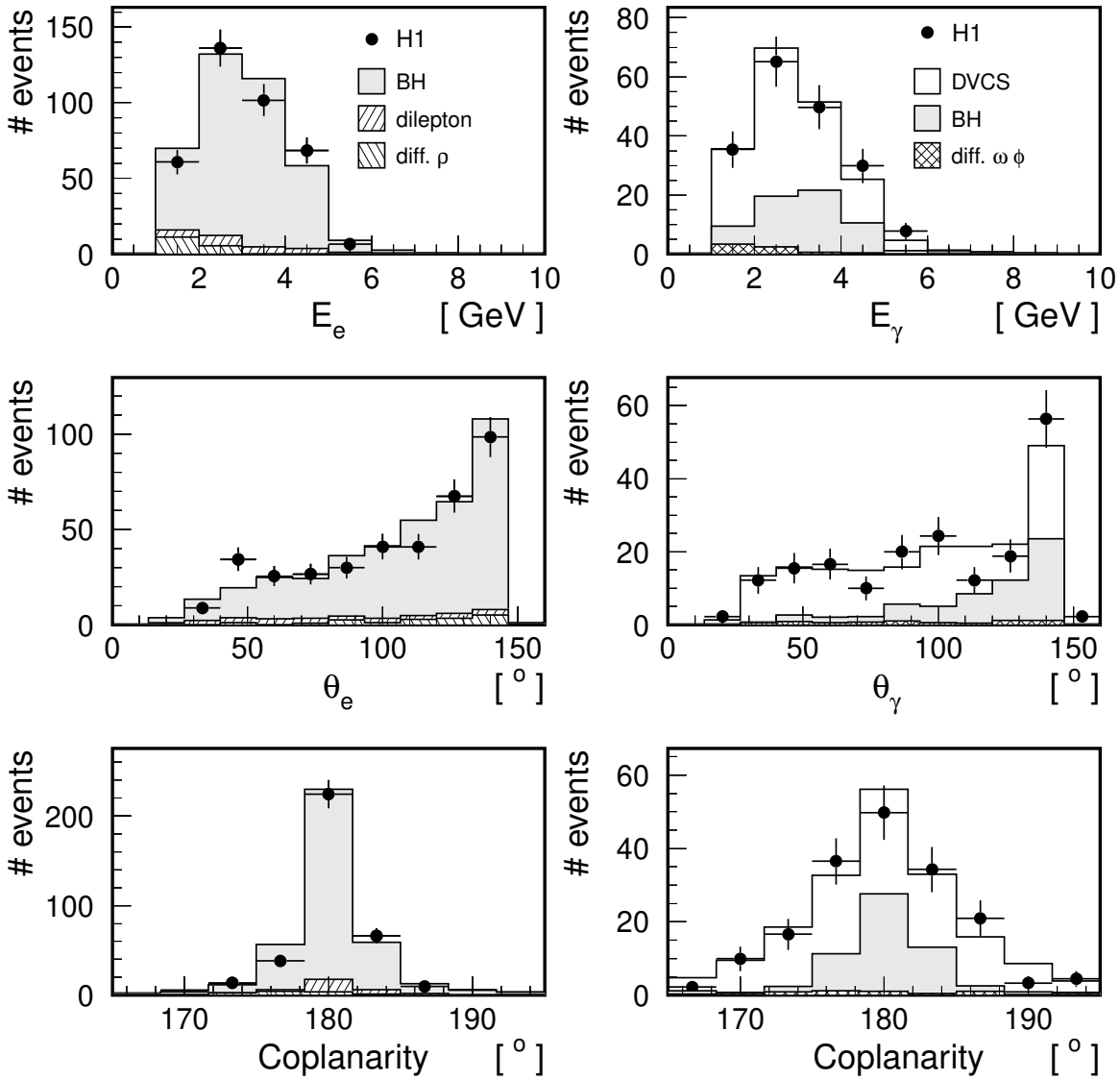


signal sample



control sample

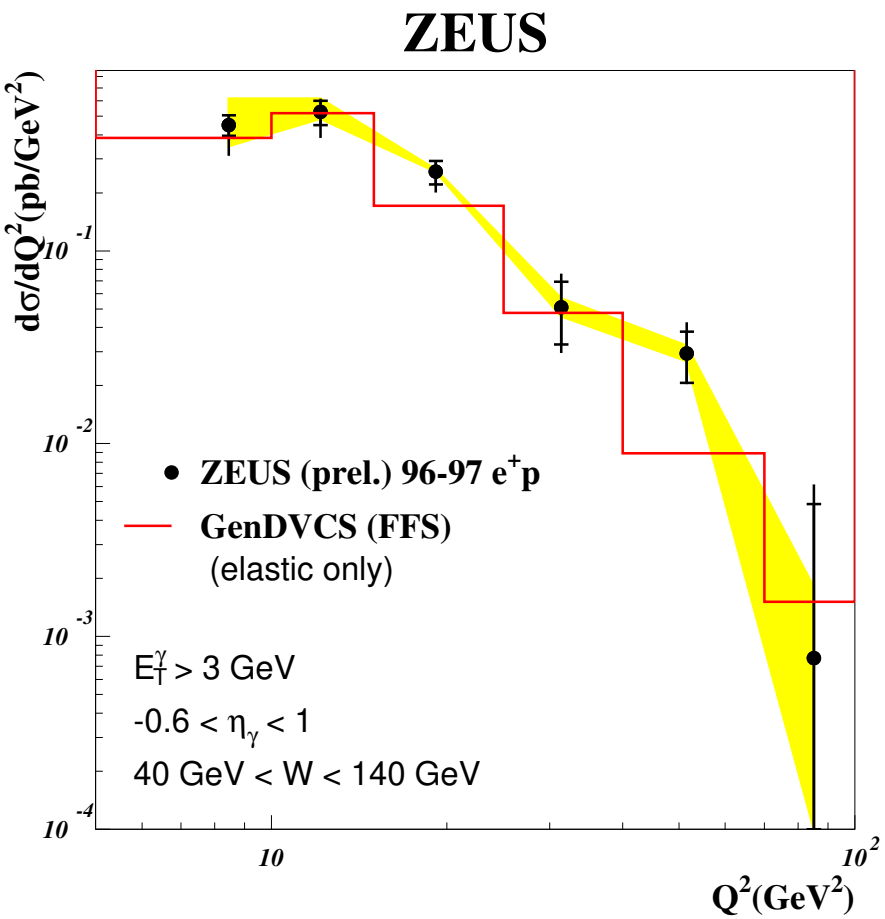
Measurements

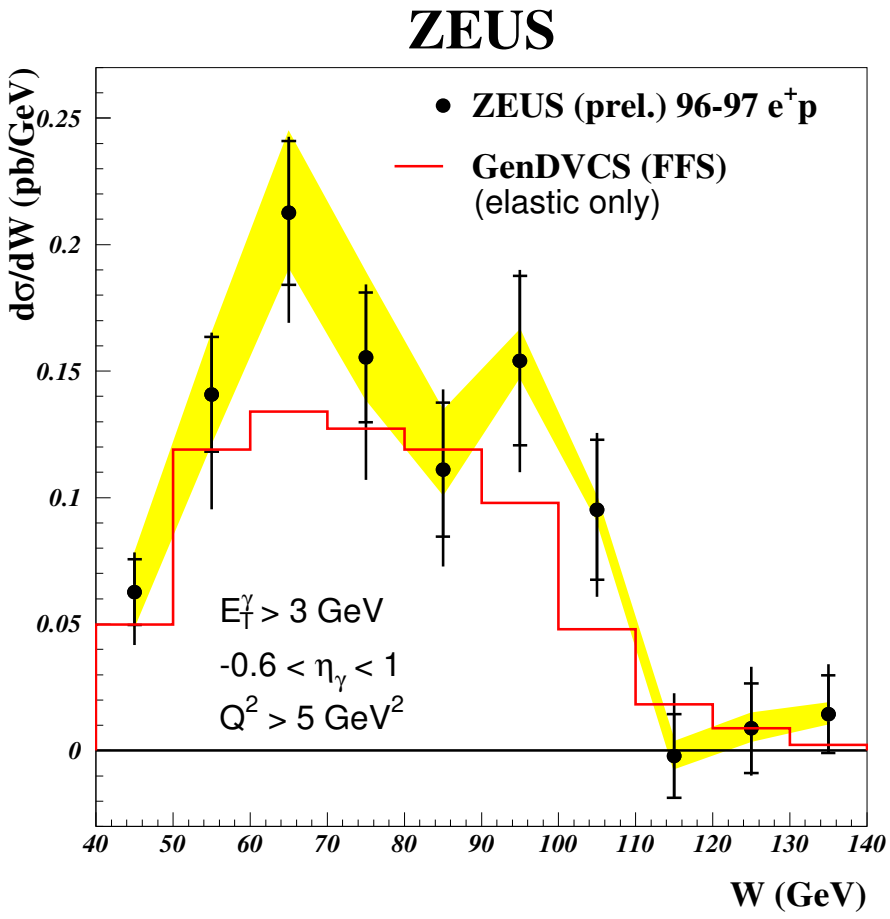


Detector response well understood

Clear Signal observed

Measurements: ZEUS





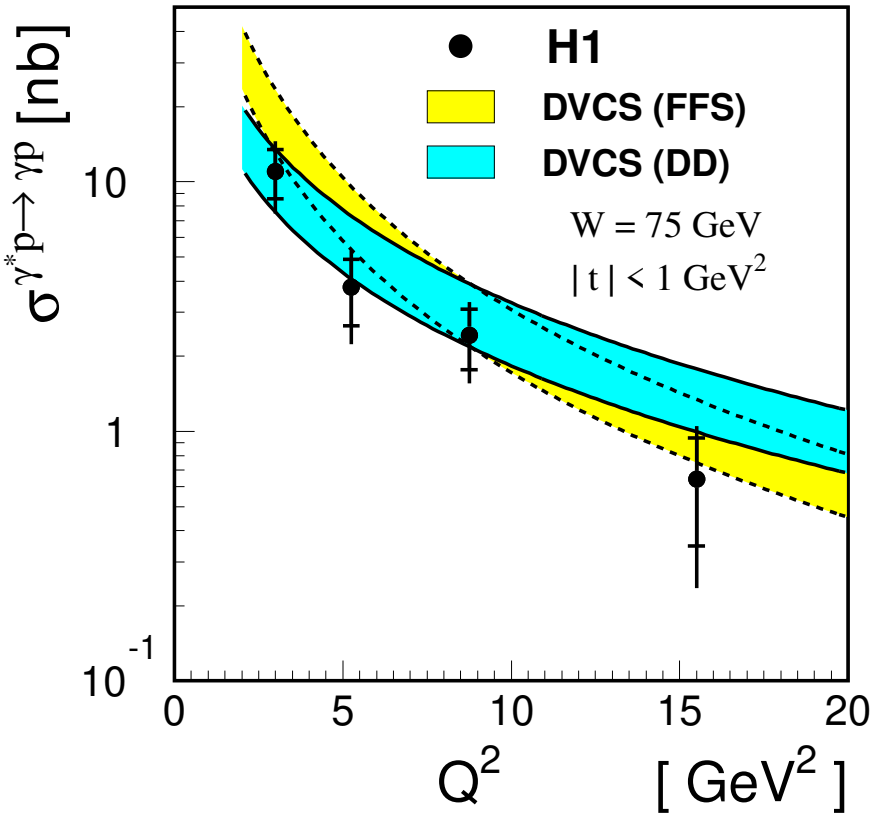
Bethe–Heitler subtracted

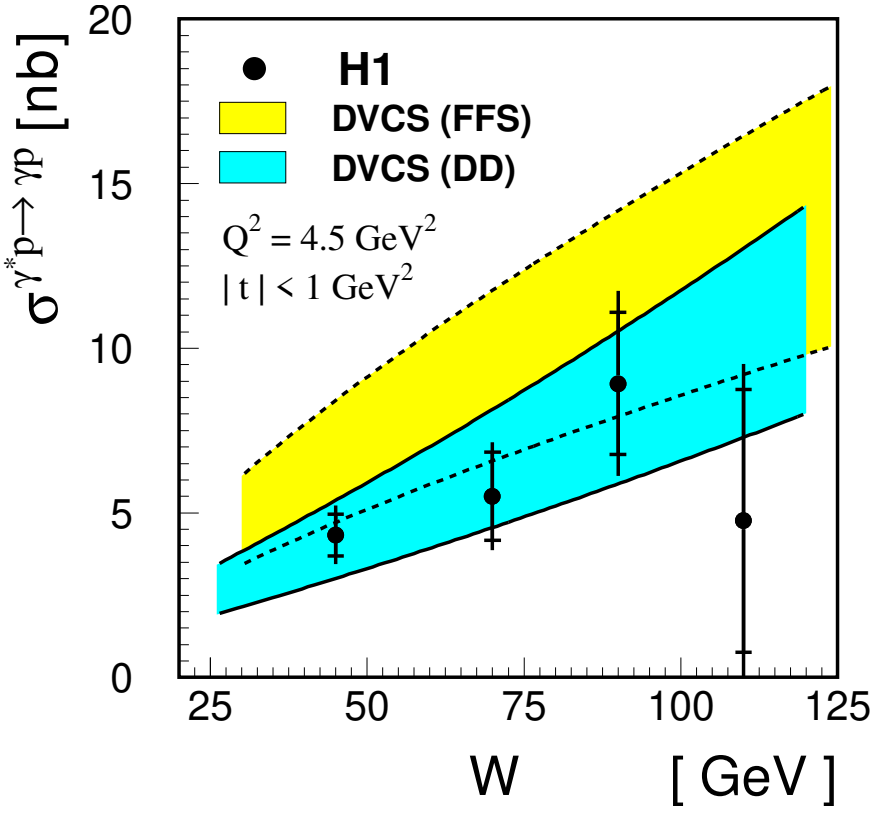
→ measurement described by DVCS prediction from FFS

note: proton dissociation has not been subtracted (~20%)

Measurements

$$\frac{d\sigma^{ep\to e\gamma p}}{dQ^2\,dy}(Q^2,y)=\Gamma(Q^2,y)\cdot\sigma^{\gamma^* p\to\gamma p}$$

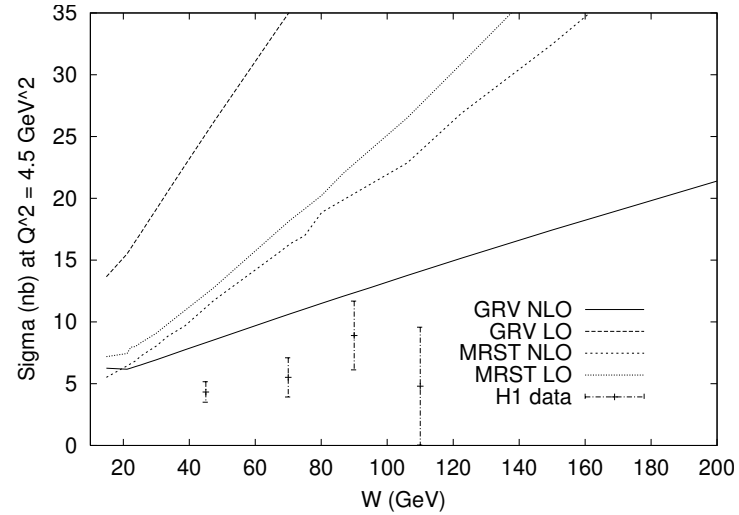


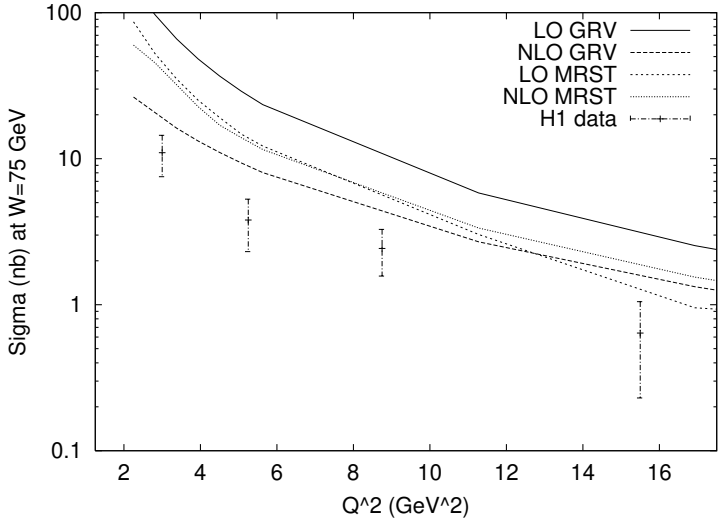


Good description by both: – QCD based calculations and
– semiclassical dipol models

Measurement

Comparison of LO/NLO QCD calculations to H1 data





Freund and McDermott

Radyushkin model:

ordinary pdf –> GPD

Uuuhps !?

→ see talk by A. Freund

Prospects for the Future

Increase of Luminosity: $1\ fb^{-1}$

so far:

H1 $\sim$ 8 pb^{-1}

ZEUS $\sim$ 40 pb^{-1}

→ Precision

Polarisation:

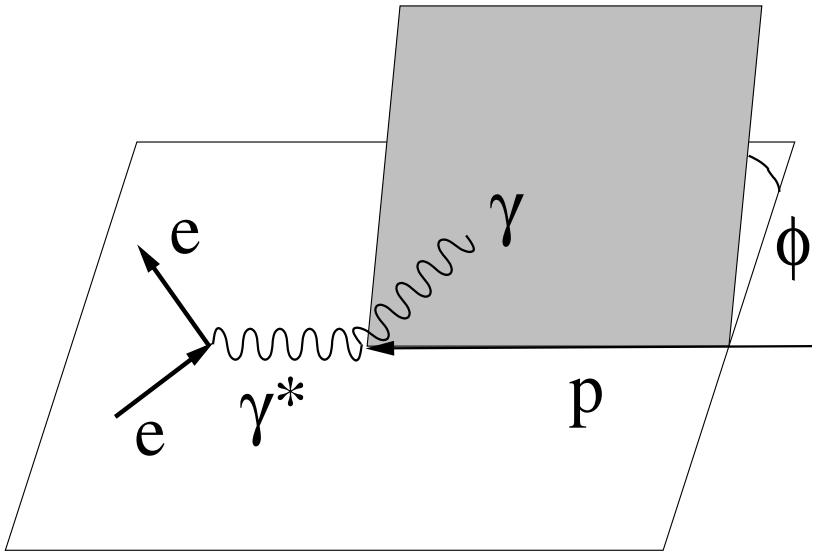
electron	proton	
•	•	HERA I
← −+	•	HERA II → Asymmetries
→ −+		
→ −+	→	HERA III?
← −+	←	

Prospects for the Future

$$\frac{d\sigma}{dx\,dy\,dt\,d\phi} \sim |\tau_{BH}|^2 + |\tau_{DVCS}|^2 + I$$

$$|\tau_{DVCS}|^2 \sim \left(C_0^{DVCS} + C_1^{DVCS}\cos\phi + S_1^{DVCS}\sin\phi\right)$$

$$I \sim \left(C_0^{I} + C_1^{I}\cos\phi + S_1^{I}\sin\phi\right)$$



2 kind of measurements

➔Fourier decomposition

➔Asymmetries

Coefficients contain information about:

Generalised Parton Distributions

$$H, \tilde{H}, E, \tilde{E}$$

Prospects for the Future

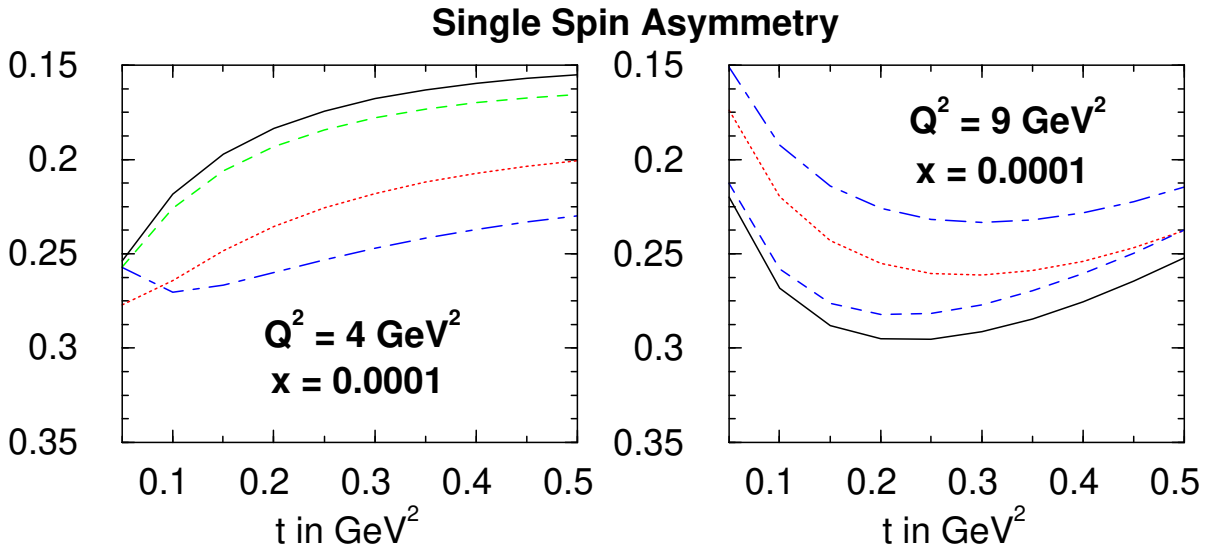
Single Spin Asymmetry

$$SSA = \frac{\int_0^{\pi} \frac{d\left(\sigma^{\Leftarrow} - \sigma^{\Rightarrow}\right)}{d\phi} d\phi - \int_{\pi}^{2\pi} \frac{d\left(\sigma^{\Leftarrow} - \sigma^{\Rightarrow}\right)}{d\phi} d\phi}{\int_0^{2\pi} \frac{d\sigma}{d\phi} d\phi}$$

$$SSA \sim \Im \int_{-1+\xi}^{1} \frac{dx}{x} C\left(\xi/x, Q^2\right) H\left(x, \xi, Q^2\right) + \ldots$$

pQCD

GPD



Prospects for the Future

new and upgraded detectors:

VFPS

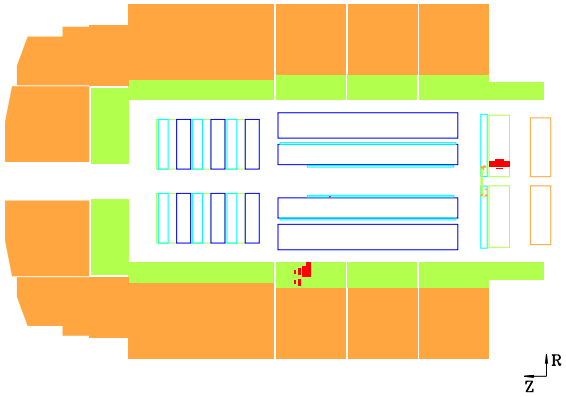
t measurement at small W

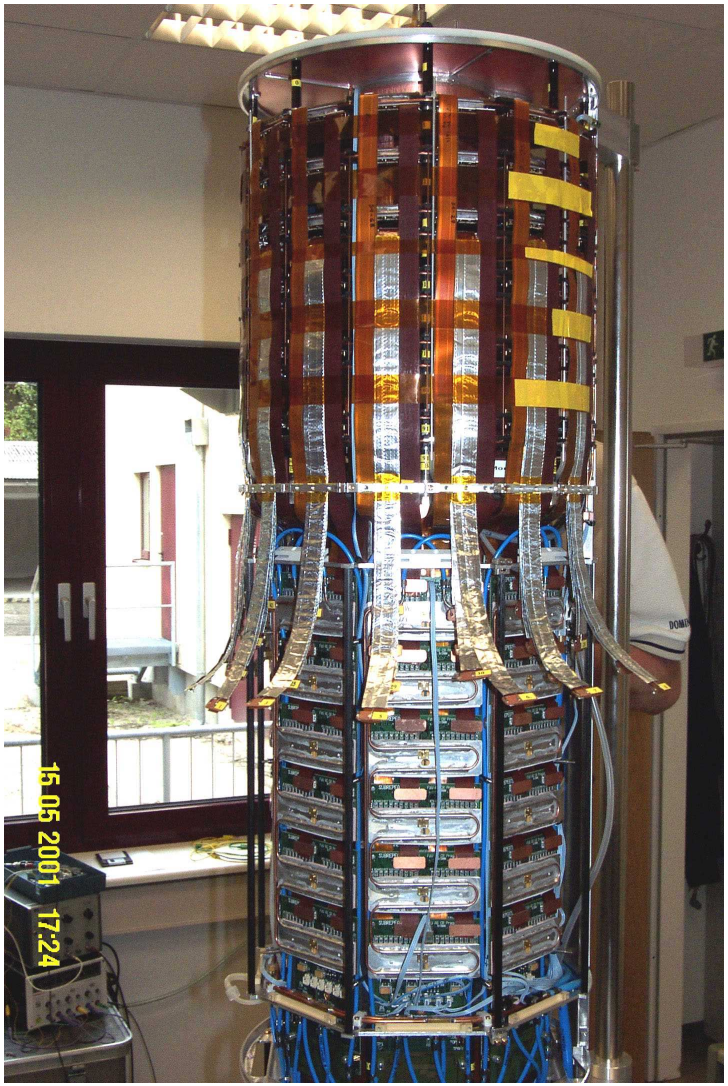
→ see talk P. R. Newman

The upgraded H1 BST →

precise measurement θ_e ϕ_e

Z_{vertex} → θ_y



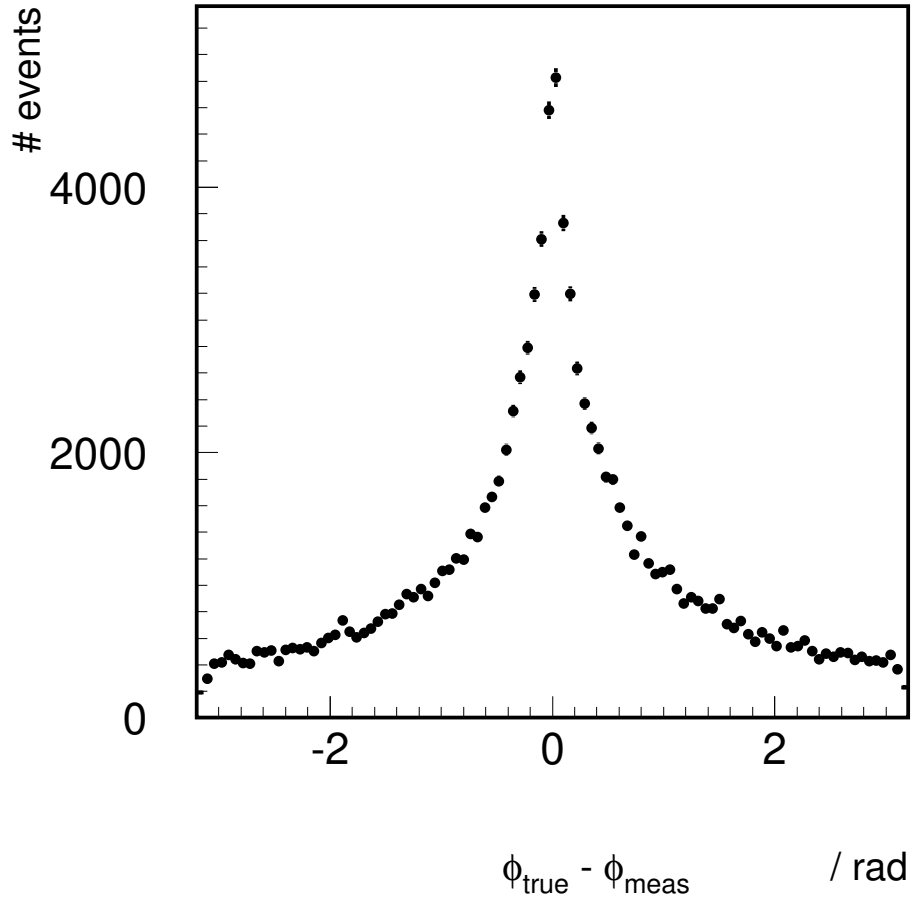


→ Improvement of systematic errors

Prospects for the Future

ϕ is defined in the $\gamma^* p$ CMS

limited detector resolution can spoil the ϕ measurement due to the boost



→ Asymmetry measurements are feasible

Conclusions

- Measurements of cross sections
- Models are able to explain the data

  $\Rightarrow$ FFS, Dipole Models ok

  $\Rightarrow$ Freund and McDermott?

- Bright Future for DVCS at HERA II

  $\Rightarrow$ Statistics, Polarisation

- We are prepared

  $\Rightarrow$ new and upgraded detectors –> Systematics