

## 2. Summary of the « *exclusive final states production* » sessions

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CEA Saclay

**VM ( $\rho$ ) production and DVCS**

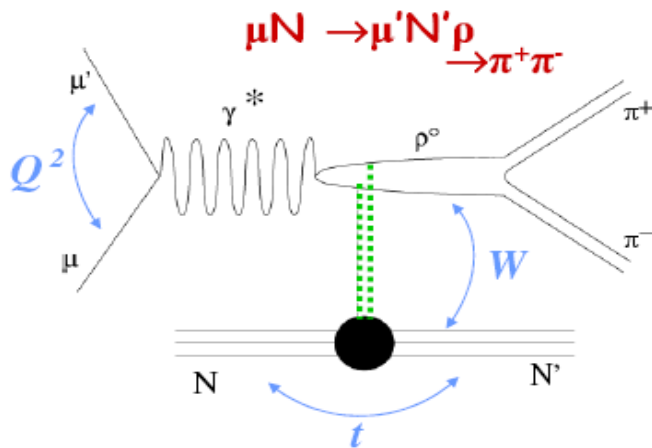
# Diffractive $\rho^0$ production at COMPASS

Nicole d'Hose



2002 : 800,000 evts  
2003 : 1,600,000 evts

+ 2004 : not yet analyzed  
~ same statistics as in 2003



COMPASS:  $3 \cdot 10^{-3} < Q^2 < 7 \text{ GeV}^2$ ,  
 $\langle W \rangle = 10 \text{ GeV}$ ,  $t$  small

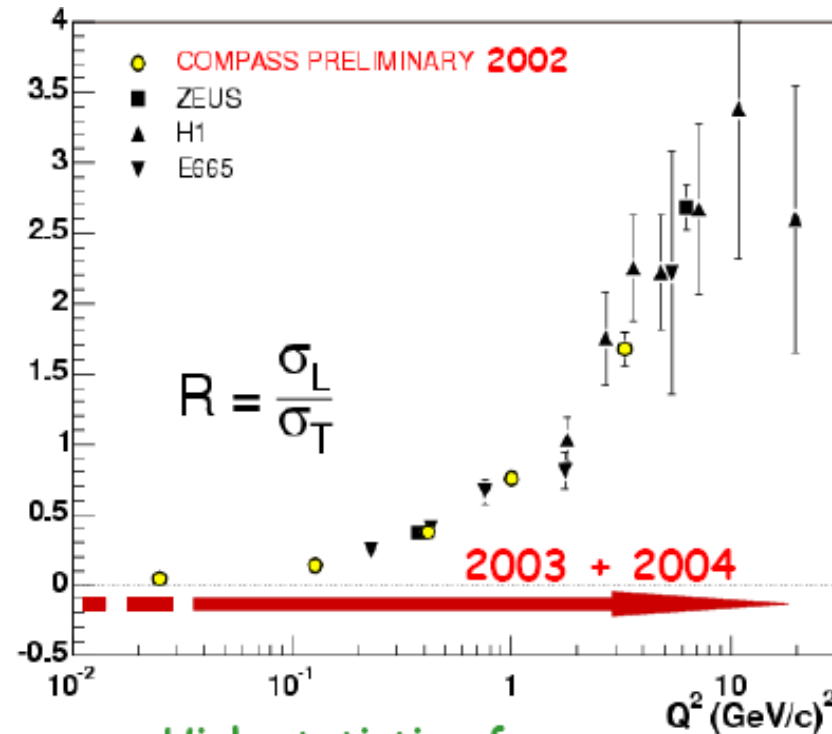
$$R = \frac{\sigma_L}{\sigma_T} = \frac{1}{(\epsilon + \delta)} \frac{r_{00}^{04}}{1 - r_{00}^{04}}$$

Spin density matrix elements:

$$r_{00}^{04} = \frac{|T_{01}|^2 + (\epsilon + \delta) |T_{00}|^2}{N_T (1 + (\epsilon + \delta) R)} \xrightarrow{\text{SCHC}} \frac{\sigma_L}{\sigma_{\text{Tot}}}$$

$$R = \sigma_L / \sigma_T \quad N_T = |T_{11}|^2 + |T_{-11}|^2 + |T_{01}|^2$$

$T_{\lambda\rho\lambda\gamma}$  are helicity amplitudes  
meson photon



- High statistics from  $\gamma$ -production to hard regime
- Better coverage at high  $Q^2$  with 2003 and 2004 data



$$A_1^p = \frac{\sigma_{1/2} - \sigma_{3/2}}{\sigma_{1/2} + \sigma_{3/2}}$$

transverse photons and  
longitudinally polarized nucleons

$$1/2 \quad \vec{s}_\gamma \Rightarrow \Leftarrow \vec{s}_N$$

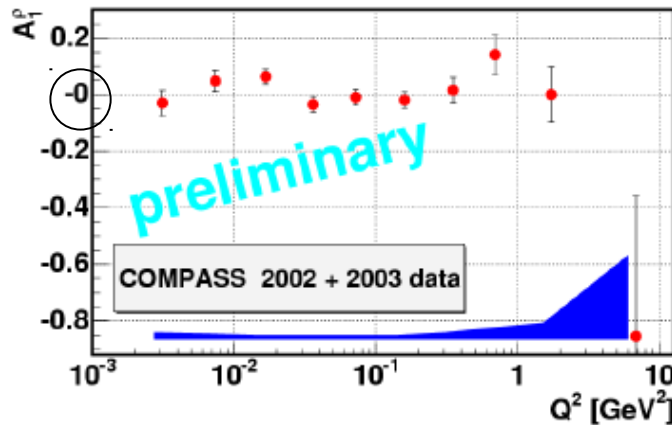
$$3/2 \quad \vec{s}_\gamma \Leftarrow \Leftarrow \vec{s}_N$$

if SCHC

$$A_1^p = \frac{|T_{-1/2-1/2}^{+1+1}|^2 - |T_{-1/2-1/2}^{-1-1}|^2}{|T_{-1/2-1/2}^{+1+1}|^2 + |T_{-1/2-1/2}^{-1-1}|^2}$$

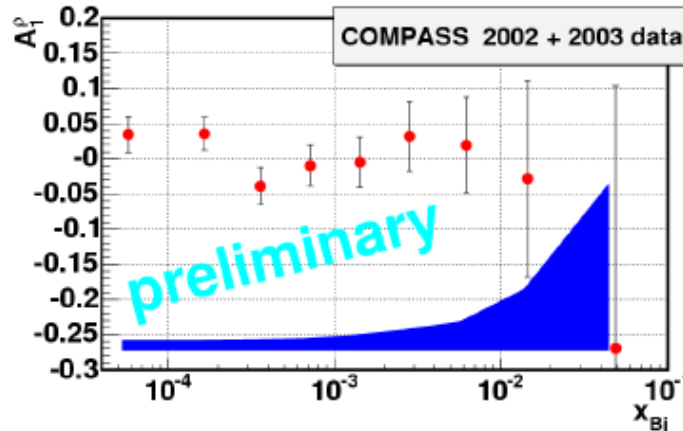
$$A_1^{\text{DIS}} = \frac{\Im m T_{-1/2-1/2}^{+1+1} - \Im m T_{-1/2-1/2}^{-1-1}}{\Im m T_{-1/2-1/2}^{+1+1} + \Im m T_{-1/2-1/2}^{-1-1}}$$

$$A_1^p \approx 2A_1^{\text{DIS}} / (1 + (A_1^{\text{DIS}})^2) \approx 2A_1^{\text{DIS}}$$



Vertical bars:  
statistical errors

Blue bands:  
total systematic errors  
including  
false asymmetries,  
uncertainties on  $P_t$ ,  $P_b$ ,  
parametrization of  $D$ ,  $f$   
effect of  $\eta$   $A_2^p$



Background corrections  
presently studied and  
indicating  
tot. syst. err < stat err.

# Diffractive $\rho^0$ production at HERMES

B. Marianski



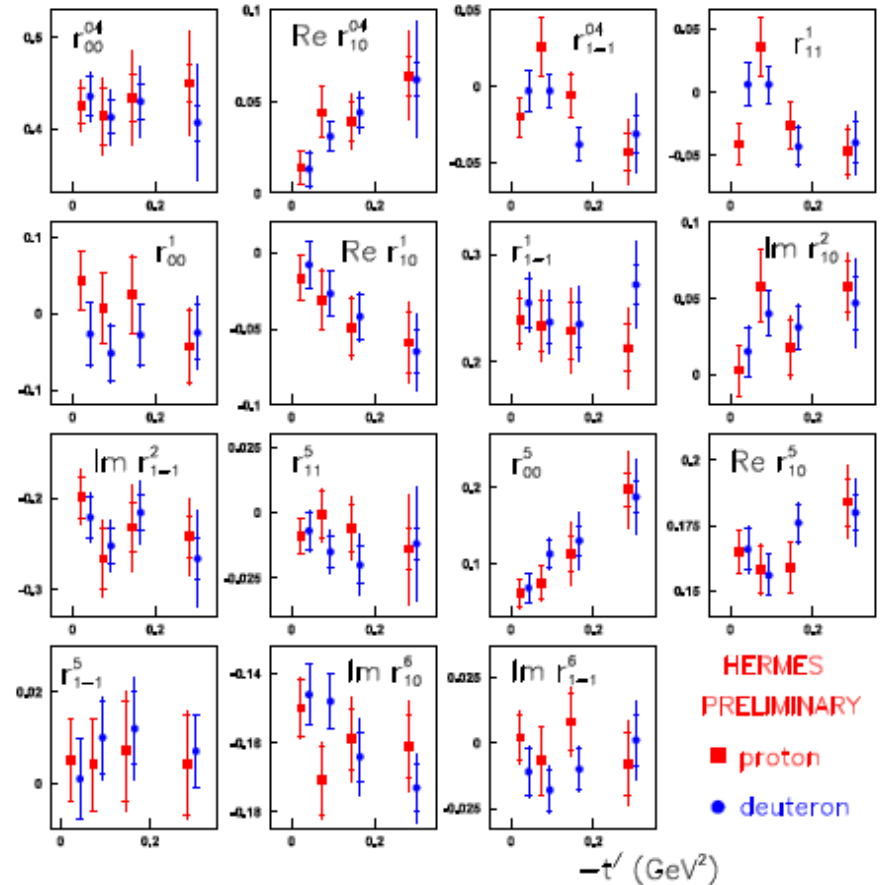
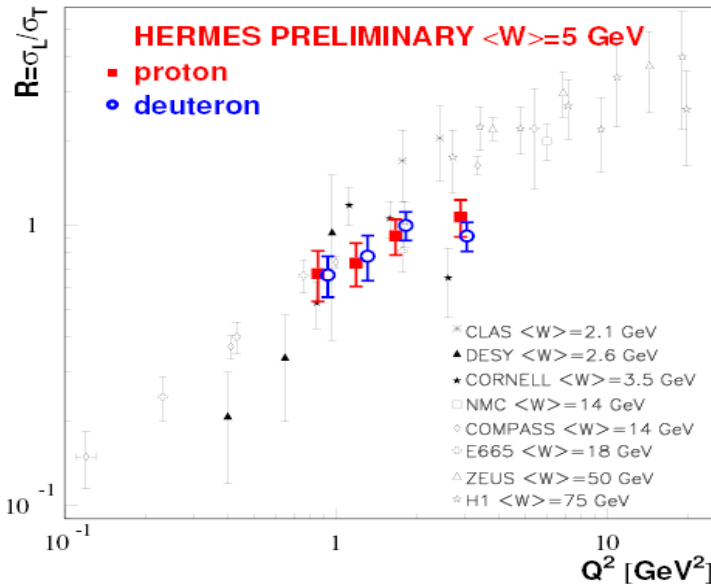
- Targets: **Hydrogen, Deuterium**
- Data collected in years 1996-2000



- **9600** – events H, **16000** – events D

**Kin. range**

$$\begin{aligned}
 &1.0 < Q^2 < 5.0 \text{ GeV}^2 \\
 &3.0 < W < 6.3 \text{ GeV} \\
 &\langle Q^2 \rangle = 1.86 \text{ GeV}^2 \\
 &\langle W \rangle = 5.0 \text{ GeV} \\
 &\langle t' \rangle = 0.130 \text{ GeV}^2
 \end{aligned}$$



Elements which violate SCHC

$\text{Re}\{r_{10}^{04}\}, \text{Re}\{r_{10}^1\}, \text{Im}\{r_{10}^2\}, r_{00}^5$

+ test of the **NPE** hypothesis

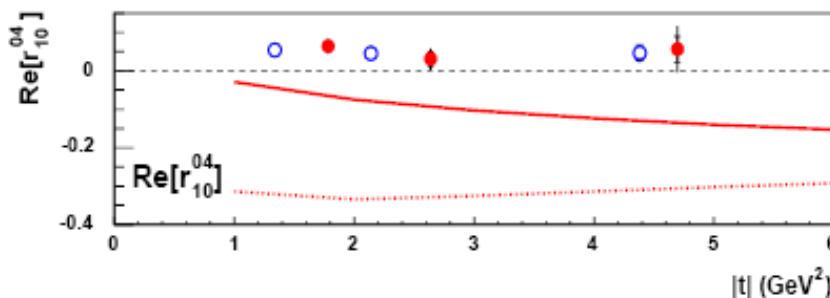
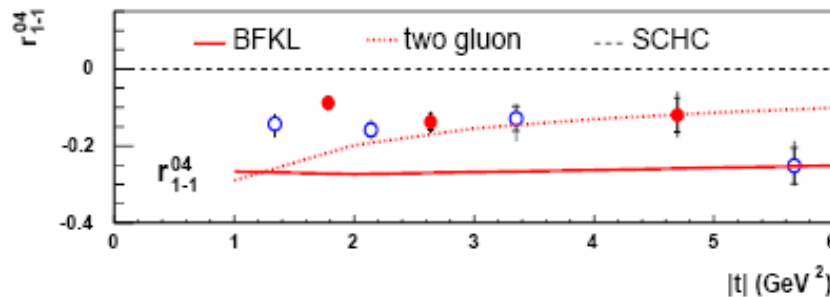
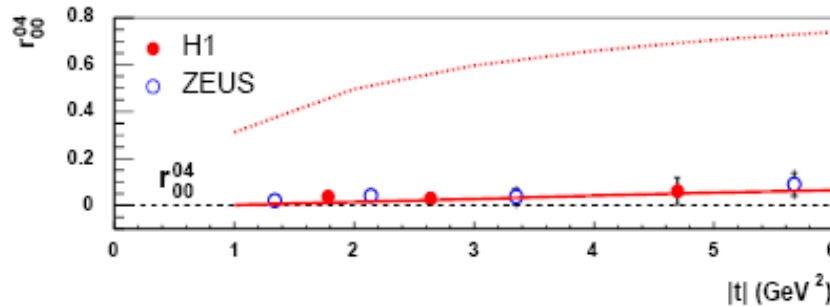
**NPE**  $\mathbb{T}_{-\lambda\rho-\lambda\gamma} = (-1)^{\lambda\rho-\lambda\gamma} \mathbb{T}_{\lambda\rho\lambda\gamma}$

# Large $|t|$ diffractive photoproduction of $\rho$

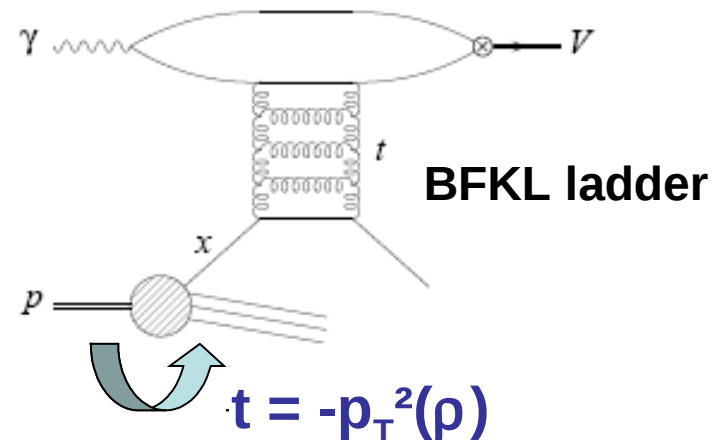
2000 data period  $\Rightarrow \mathcal{L} = 20.1 \text{ pb}^{-1}$



SDME interesting to discriminate between models



- Small  $r_{00}^{04}$  value ( $\sim 5\%$ )  $\Rightarrow$  transversely polarised  $\rho$  meson production dominates
- Two-gluon model hugely overestimates  $r_{00}^{04}$  but BFKL gives a good description
- Large finite value of  $r_{1-1}^{04}$  indicates a significant double-flip contribution  $\Rightarrow$  clear violation of SCHC in  $\rho$  production
- Both models give non-zero prediction with same sign as data





# HERA II diffractive photoproduction of $\rho$ (low $|t|$ )

Description of the  $t$  dependence :  $\frac{d\sigma^{\gamma P}}{dt} = \frac{d\sigma^{\gamma P}}{dt} \Big|_{W_0} \left(\frac{W}{W_0}\right)^{4[\alpha(t)-1]}$

$$\alpha(t) = \alpha_0 + \alpha' \cdot t$$

- First Physics Results using the H1 Fast Track Trigger FTT
- 267000  $\rho^0$  candidates triggered in 570 nb<sup>-1</sup> of 2005 data

Elastic and p-Dissociative  $\rho^0$  Photoproduction Cross Sections, differential in  $W$  and  $t$ , measured in the kinematic range

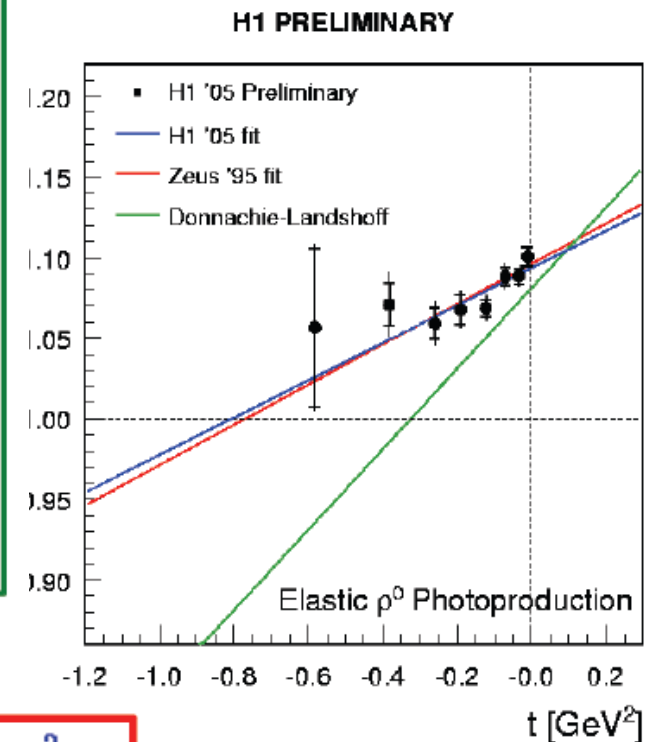
$$Q^2 < 4 \text{ GeV}^2 \quad 20 < W < 90 \text{ GeV}$$

$$|t| < 3 \text{ GeV}^2 \quad (M_Y^2 + Q^2)/(W^2 + Q^2) < 0.01$$

- The Pomeron Trajectory determined, for the first time using data within one experiment
- $\alpha'$  significantly smaller than  $0.25 \text{ GeV}^{-2}$

Puzzle!

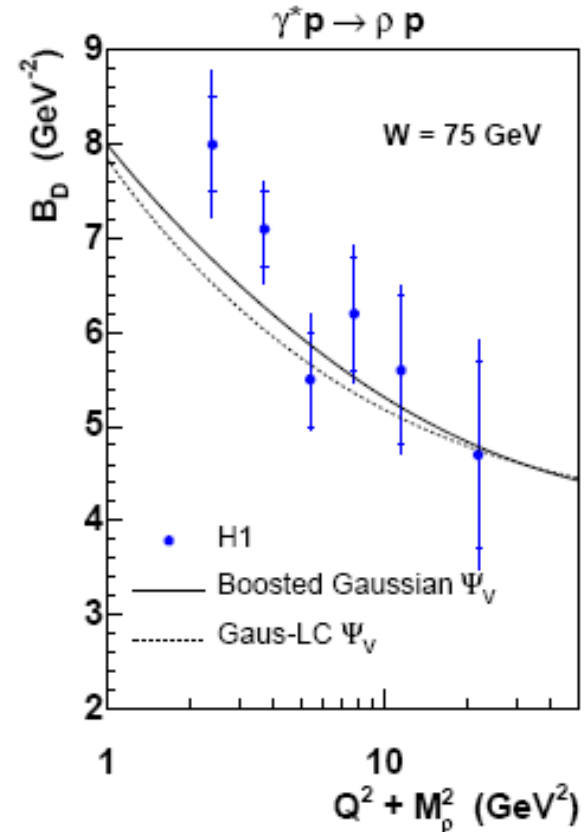
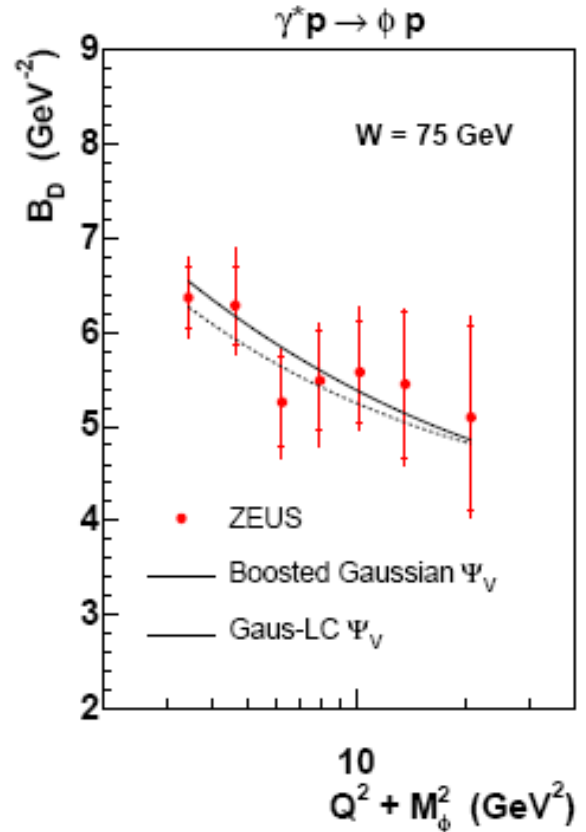
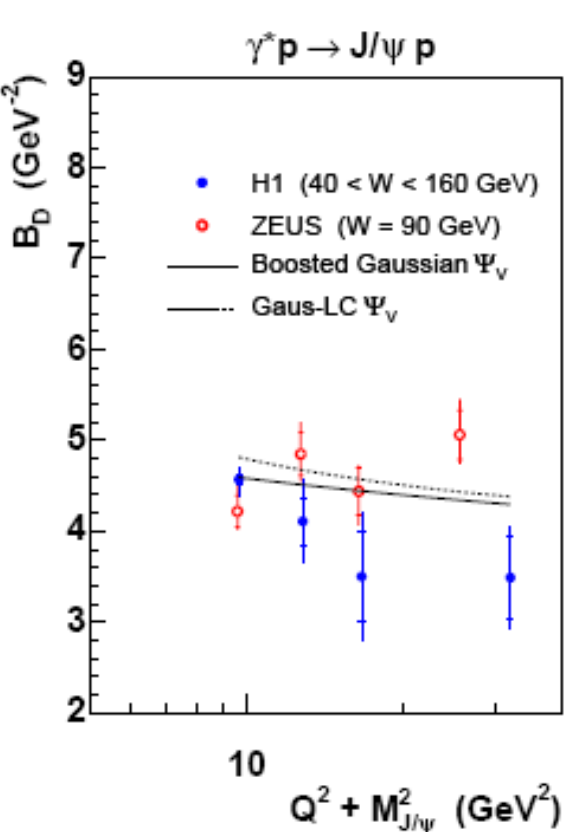
$$\alpha_P(t) = (1.093 \pm 0.003 \begin{smallmatrix} +0.008 \\ -0.007 \end{smallmatrix}) + (0.116 \pm 0.027 \begin{smallmatrix} +0.036 \\ -0.046 \end{smallmatrix}) \text{ GeV}^{-2} \cdot t$$



Exclusive VM : dipole model  
t dependence [ $\langle Q^2 \rangle$ ]

$$\frac{d\sigma^{diff}}{dt} \sim \exp(B_D \cdot t)$$

What about a lower mass state ?  
=> DVCS (production of a  $\gamma$ ) ?

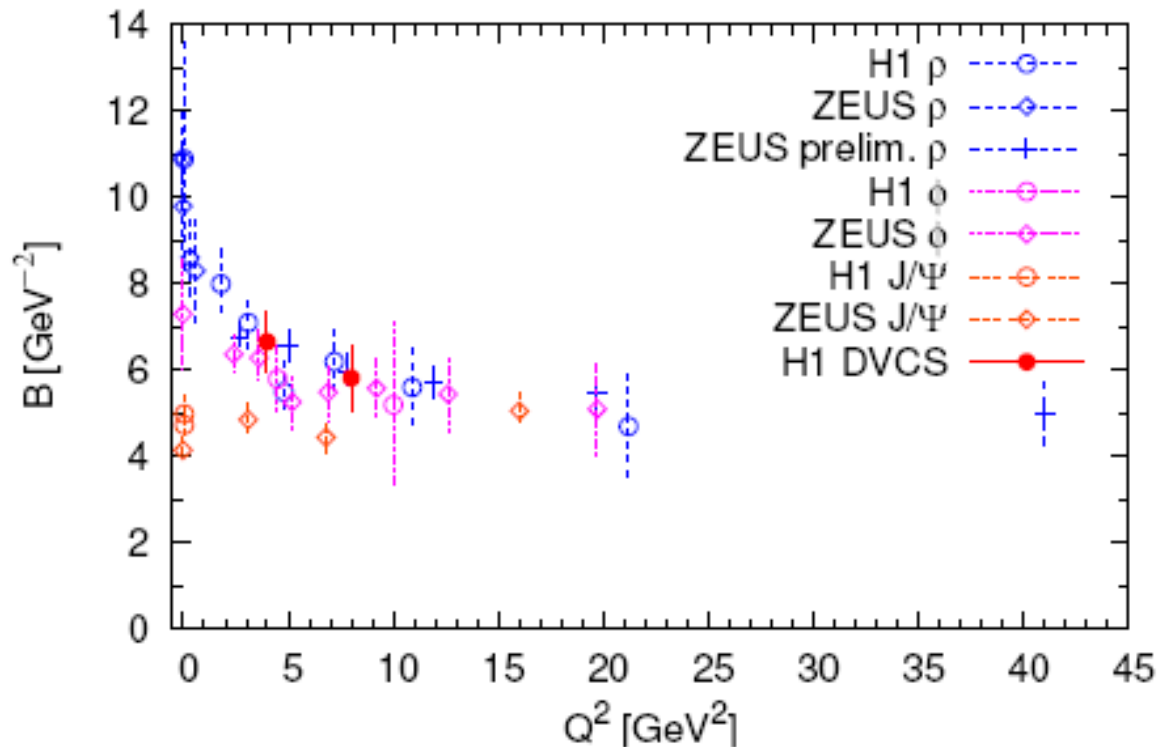


## Review on hard exclusive reactions

$$d\sigma/dt \propto e^{-B|t|}$$

for small  $x$  and  $t$

- ▶  $\rho$  and  $\phi$ :  $\gamma^* \rightarrow q\bar{q}$  “pointlike” for large  $Q^2$   
smaller  $Q^2$ :  $q\bar{q}$  dipole size contributes to  $B$   
 $\leftrightarrow$  large power corrections to collin. approx.
- ▶  $J/\Psi$ :  $\gamma \rightarrow c\bar{c}$  “pointlike” even for  $Q^2 = 0$



**B values large for DVCS (compatible with a soft hypothesis)!  
≠  
hard W dependence  
=>**

**Many ideas discussed**

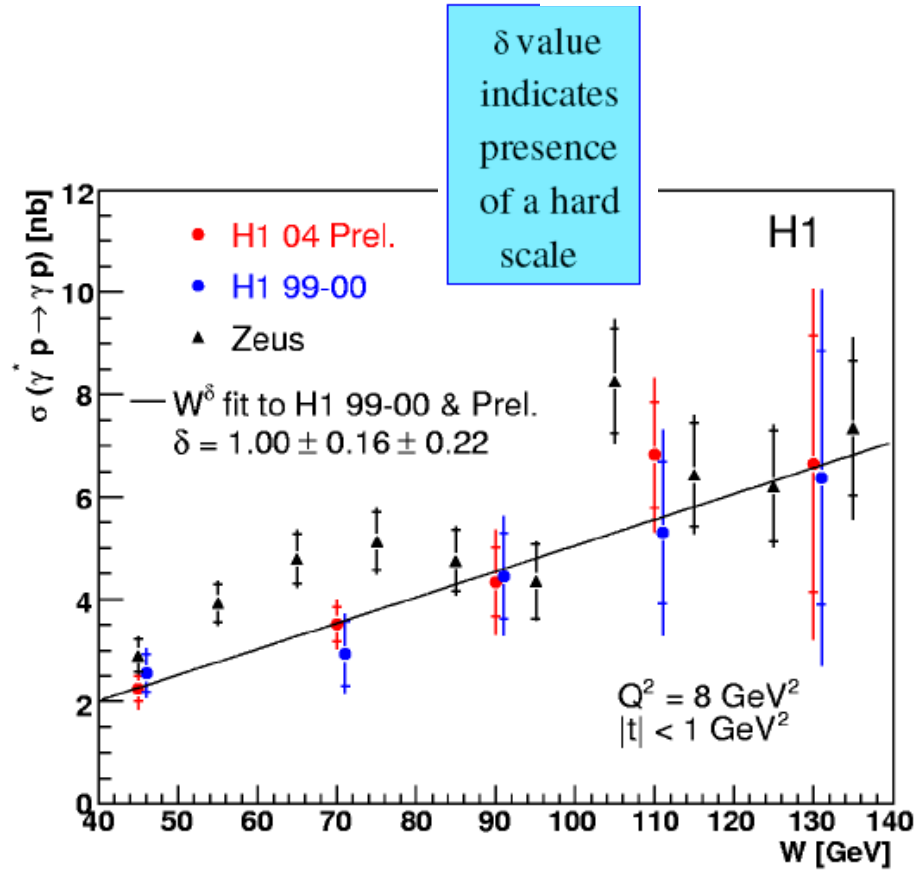
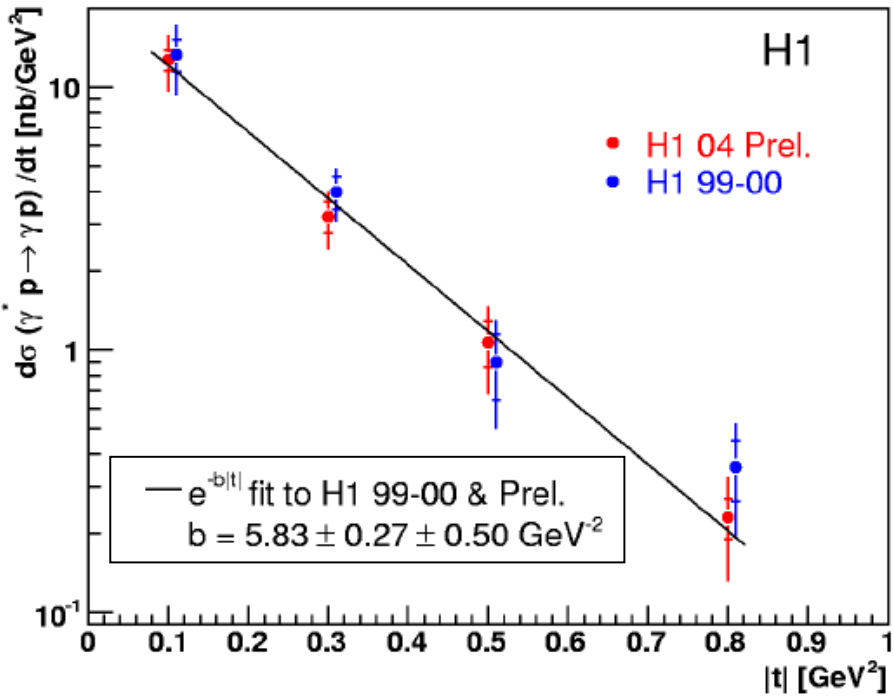


# DVCS at HERA II

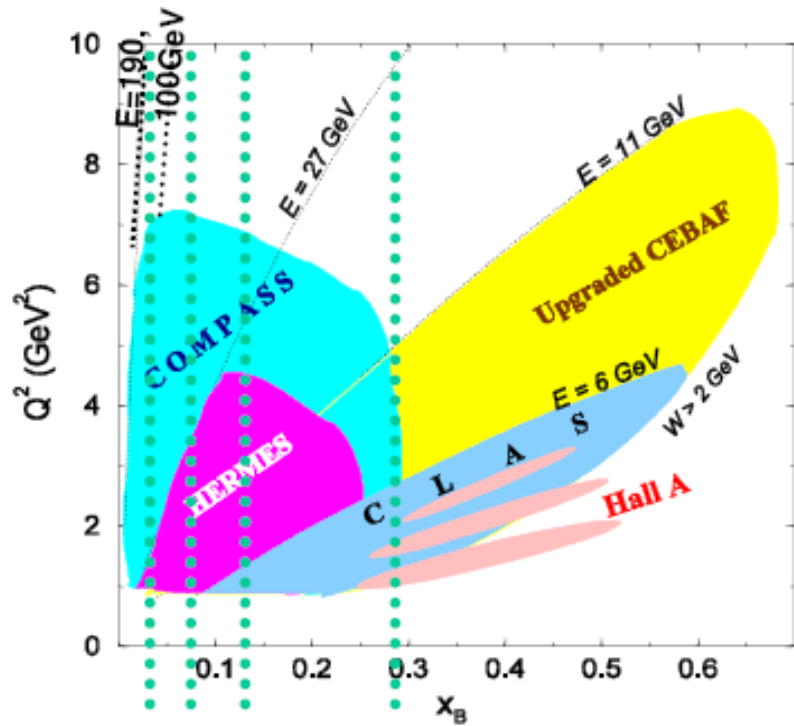


H1 data 2004  
 $L = 39.7 \text{ pb}^{-1}$

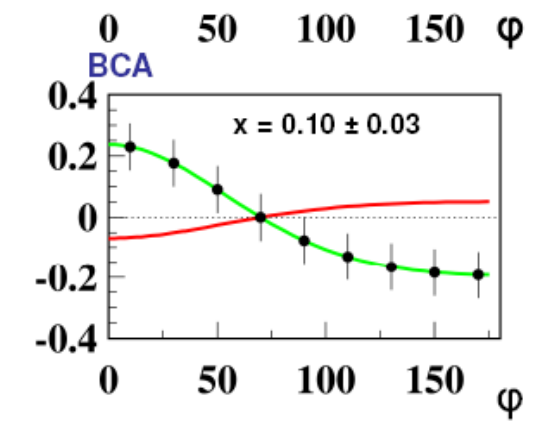
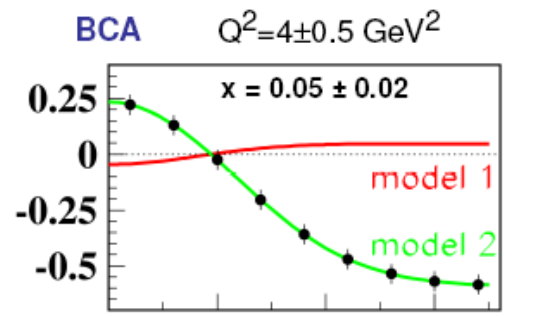
Challenge to complete measurements of 'nb' cross sections at HERA II completed!



# Prospects for GPDs studies at COMPASS



$$\sigma^{\bar{u}^+} - \sigma^{\bar{u}^-} \sim \mathcal{P} \int_{-1}^{+1} dx \frac{H(x, \xi, t)}{x - \xi}$$



Discriminating power for 2 models of GPDs

1. No correlation between x and t => F(t)
2. t dependence in 1/x<sup>α</sup>t (Gribov diffusion)

=> Strong Impact on GPDs

- Assumptions
  - L=1.3 10<sup>32</sup> cm<sup>-2</sup>s<sup>-1</sup>
  - 150 days
  - efficiency=25%

# Roadmap



- 2005: Expression of interest SPSC-EOI-005
- 2006: Test of recoil detector prototype
- Proposal
- 2007-2009: construction of
  - recoil detector
  - LH<sub>2</sub> target
  - ECAL0
- ≥ 2010: Study of GPDs at COMPASS

