DIS 2005

XIII International Workshop on Deep Inelastic Scattering

Highlights from diffraction at HERA and TEVATRON

Marta Ruspa
Xavier Janssen

27 April – 1 May 2005, Madison, Wisconsin, USA

Marta

Session 4 - Inclusive Diffraction (14:00->15:40) CC — Room: Ideas-E

14:00	ZEUS F2D results (20') (transparencies)	H. Lim (DESY Hamburg)
14:20	H1 F2D and diffractive charge current results (25') (transparencies)	P. Laycock (U Liverpool)
14:45	ZEUS results on rapidity gap events in charged and neutral current processes at large Q2 (15') (transparencies)	L. Adamczyk (U Krakow of Mining and Metallurgy)
15:00	Pomeron structure and diffractive parton densities (15') (transparencies)	A. Levy (U Tel-Aviv)
15:15	HERA diffractive structure function data and parton distributions (15') (transparencies)	P. Laycock (U Liverpool)

Session 5 - HFS and Leading Baryons (16:10->17:50) — Room: Ideas-E

16:10	Analysis of diffractive DIS data and its implications (25') (document)	Alan Martin (U Durham)
16:35	Discussion (15')	
16:50	Hadronic final states in diffraction at H1 (20') (transparencies)	T. Anthonis (U Antwerpen)
17:10	Measurement of the dijet cross sections for events with a leading neutron at H1 (20') (transparencies)	Armen Bunyatyan (MPI-Heidelberg/Yerevan)
17:30	H1 diffractive D* in DIS (20') (transparencies)	M. Beckingham (DESY Hamburg)

Session 6 - Hard Diffraction Factorisation (I) (09:00->10:40) — Room: Ideas-E

09:00	H1 dijets (photoproduction and DIS) (25') (transparencies)	M. Mozer (U Heidelberg)
09:25	Diffractive dijets in photoproduction at ZEUS (20') (transparencies)	R. Renner (ZEUS) (U Bonn)
09:45	D0 results in diffraction (25') (transparencies)	Luis Mundim (D0) (U Rio de Janeiro)
10:10	CDF new results (25') (transparencies)	K. Goulianos

Xavier

Session 1 - Exclusive Final States (I) (16:30->18:10)		**Room:** Ideas-E
16:30	New data on elastic J/psi production from H1 at HERA (25') (transparencies) cc	C. Kiesling (MPI Munich)
16:55	Vector mesons production at ZEUS (30') (transparencies)	D. Szuba (Krakow U of Mining and Metallurgy)
17:25	Diffractive production of vector mesons and the gluon at small x (25') (transparencies)	T. Teubner
Session 2 - Joint session with spin physics WG (09:00->10:40)		**Room:** Ideas-E
09:00	Measurement of deeply virtual compton scattering at H1 (20') (transparencies)	S. Glazov (DESY Hamburg)
09:20	Measurement of deeply virtual compton scattering at HERMES (20') (transparencies)	M. Kopytin (DESY Zeuthen)
09:40	Exclusive meson production at HERMES (20') (transparencies)	A. Vandenbroucke (U Gent)
10:00	Semi-inclusive production of pions and kaons: Exclusive channels vs. independent fragmentation (20') (transparencies)	C. Weiss (JLab)
10:20	Status and new results from DVCS at JLab (20') (transparencies)	Gagik Gavalian (Old Dominion University)
Session 3 - Exclusive Final States (II) (11:10->12:50)		**Room:** Ideas-E
11:10	Diffractive photoproduction of rho mesons with large momentum transfer at H1 (20') (transparencies)	C. Gwilliam (U Manchester)
11:30	Diffractive rho0 production at COMPASS (20') (transparencies)	N. d' Hose (DAPNIA-SPP,Saclay)
11:50	Vector meson electroproduction at small Bjorken-x and generalized parton distributions. (20') (transparencies)	P. Kroll (U Wuppertal)
12:10	Diffractive dijet photoproduction (25') (transparencies)	M. Klasen (U Grenoble)

Valeri

Session 7 - Hard Diffraction Factorisation (II) (11:10->12:50)		Room: Ideas-E
11:10	Double pomeron physics at LHC (25') (transparencies) CC	M. Albrow (FNAL)
11:35	Multigap diffraction at LHC (15') (transparencies)	K. Goulianos (U Rockefeller)
11:50	Hard diffraction from parton rescattering in QCD (20') (transparencies)	S. Brodsky (SLAC)
12:10	Discussion on factorisation (40') (transparencies)	all

Session 8 - RHIC / Towards LHC (14:00->15:40)		Room: Ideas-E
14:00	A_N measurement in the CNI region, at sqrt = 200 GeV in polarized pp elastic scattering at RHIC (20') (transparencies)	W. Guryn (BNL)
14:20	Recent results on inelastic diffraction with Au-Au, d-Au and pp beams at RHIC (20') (transparencies)	S. White (BNL)
14:40	Photoproduction at hadron colliders (15') (transparencies)	S. Klein (BNL)
14:55	Mini review on saturation (25') (transparencies)	E. Levin (U Tel Aviv)
15:20	Review of BFKL (20') (transparencies)	J. R. Andersen (U Cambridge)

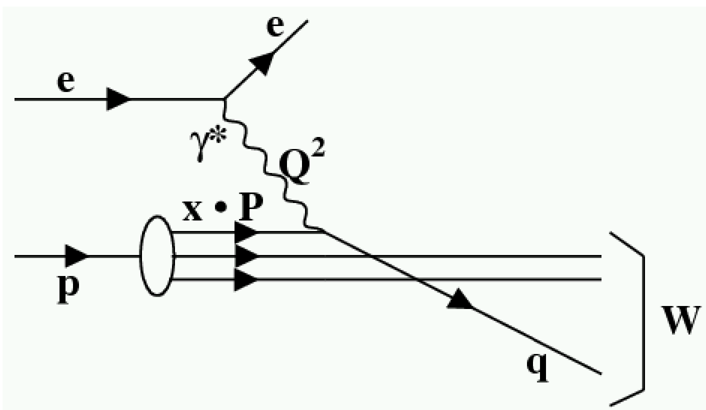
Session 9 - Towards LHC (16:10->17:50)		Room: Ideas-E
16:10	Forward proton tagging for forward physics at LHC (20') (transparencies)	Brian Cox (U Manchester)
16:30	Measurement of hard and soft diffraction at the LHC (20') (transparencies)	H. Kowalski (DESY Hamburg)
16:50	Physics with Totem experiments at LHC (35')	K. Eggert (CERN)
17:25	Studies of high energy photon interactions at the LHC (20') (transparencies)	K. Piotrzkowski (U Cath. Louvain)
17:45	Diffractive production of massive states at the LHC (20') (transparencies)	C. Royon (DAPNIA-SPP, Saclay)

Diffractive DIS at HERA

cc

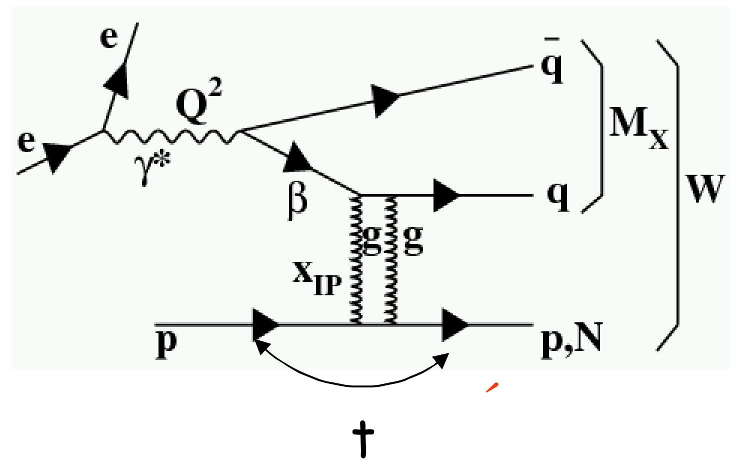
HERA: 10% of low-x DIS events are diffractive

Standard DIS



Probe structure of proton → F_2

Diffractive DIS



Probe structure of color singlet exchange → F_2^D

Diffractive DIS at HERA

HERA: 10% of low-x DIS events are diffractive

Q^2 = virtuality of photon =
= (4-momentum exchanged at e vertex)^2

t = (4-momentum exchanged at p vertex)^2
typically: $|t|<1$ GeV^2

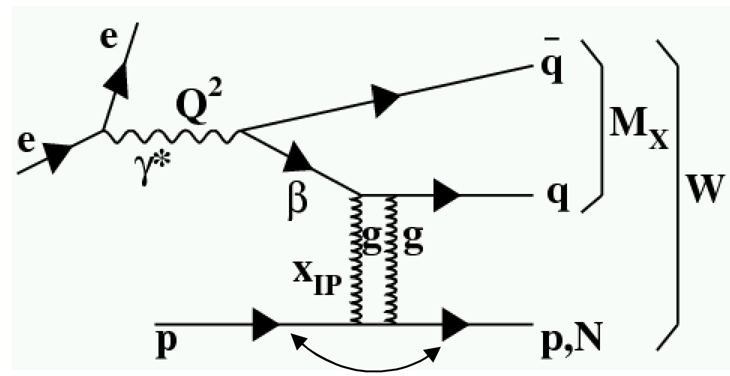
W = invariant mass of γ-p system

M_X = invariant mass of γ-IP system

x_{IP} = fraction of proton's momentum taken by IP

β = Bjorken's variable for the IP
= fraction of IP momentum carried by struck quark
= x/x_{IP}

Diffractive DIS

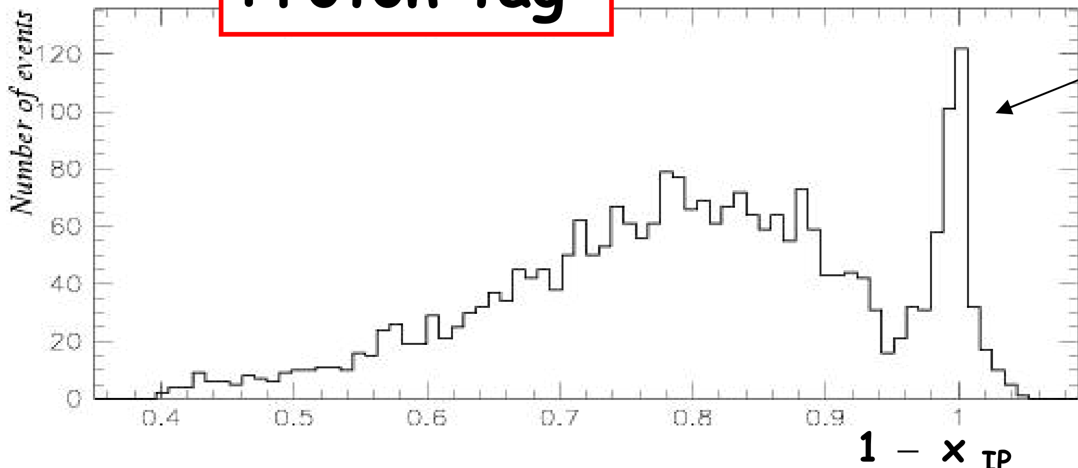


t

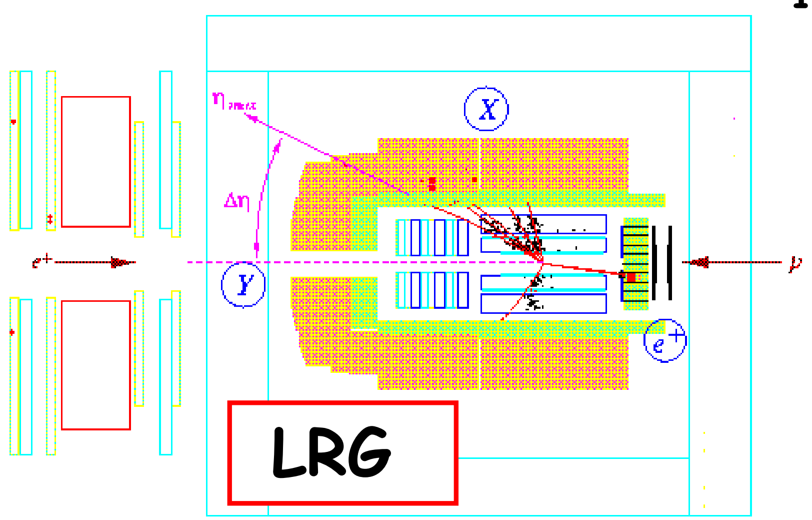
Probe structure of color singlet exchange → F_2^D

Diffractive events selection

Proton tag

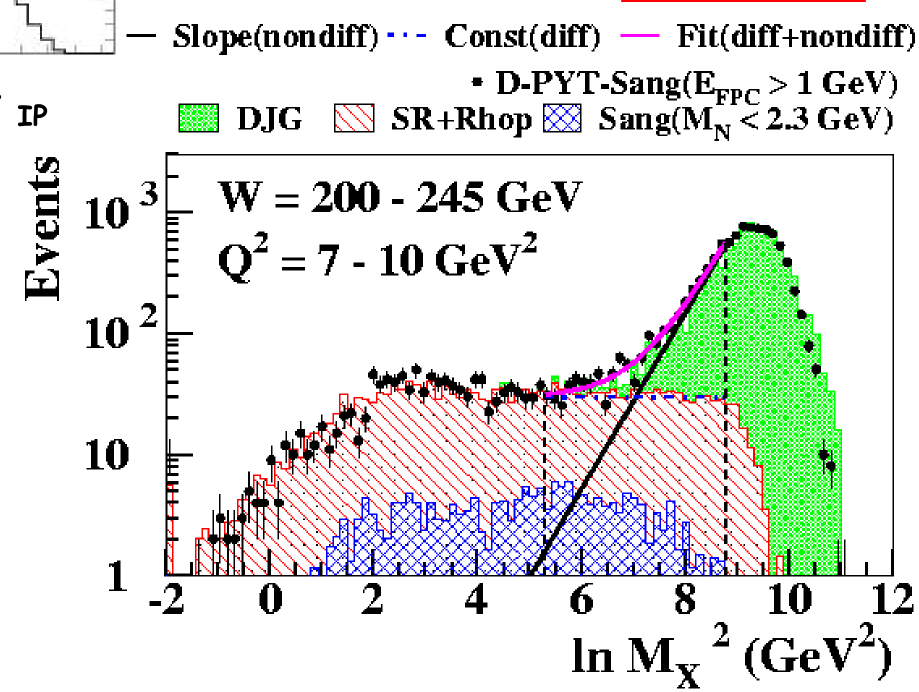


Diffractive peak

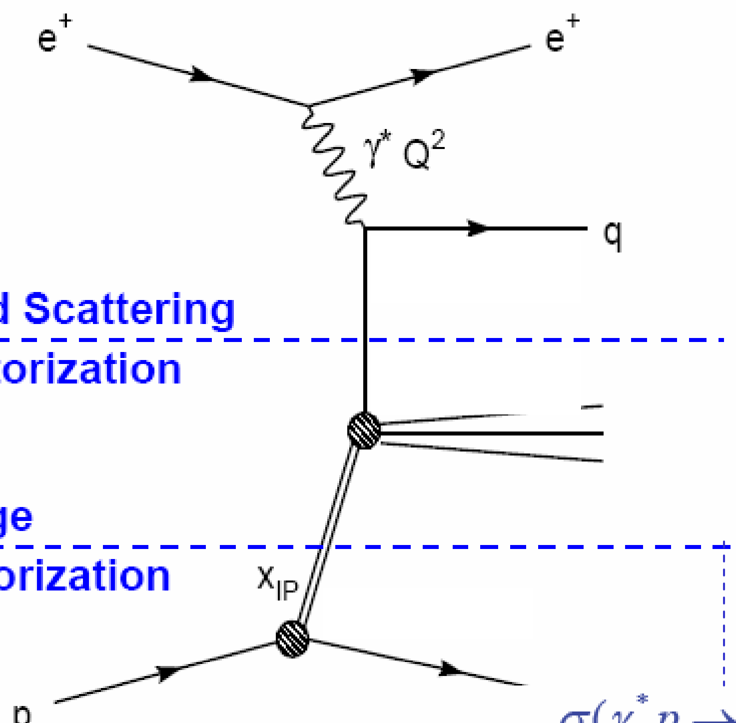


LRG

M_x



Factorization in diffraction



$$\sigma(\gamma^* p \to Xp) \approx p_{q/p}(x_{IP}, t; x, Q^2) \otimes \hat{\sigma}_{\gamma^* p}(x, Q^2)$$

$$\sigma(\gamma^* p \to Xp) \approx f_{IP/p}(x_{IP}, t) \otimes p_{q/p}(\beta, Q^2) \otimes \hat{\sigma}_{\gamma^* p}(\beta, Q^2)$$

Regge motivated pomeron flux

$$f_{IP/p}(x_{IP}, t) = \frac{e^{Bt}}{x_{IP}^{2\alpha(t)-1}}$$

Shape of diffractive pdfs independent of x_{IP} and t

Inclusive diffraction

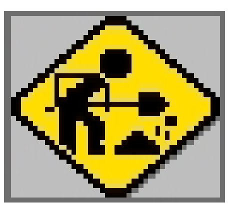
Towards HERA $F_2^{D(3)}$ and PDFs?

ZEUS Data:

- "Study of Deep Inelastic Inclusive and Diffractive Scattering with the ZEUS Forward Plug Calorimeter" (Mx method)
  DESY-05-011, accepted by Nucl. Phys. B — $2.4 < Q^2 < 39$ GeV^2 (98-99)
- "Dissociation of virtual photons in events with a leading proton at HERA" (Leading Proton)
  Eur. Phys. J C38 (2004) 43 — $2.7 < Q^2 < 55$ GeV^2 (97)

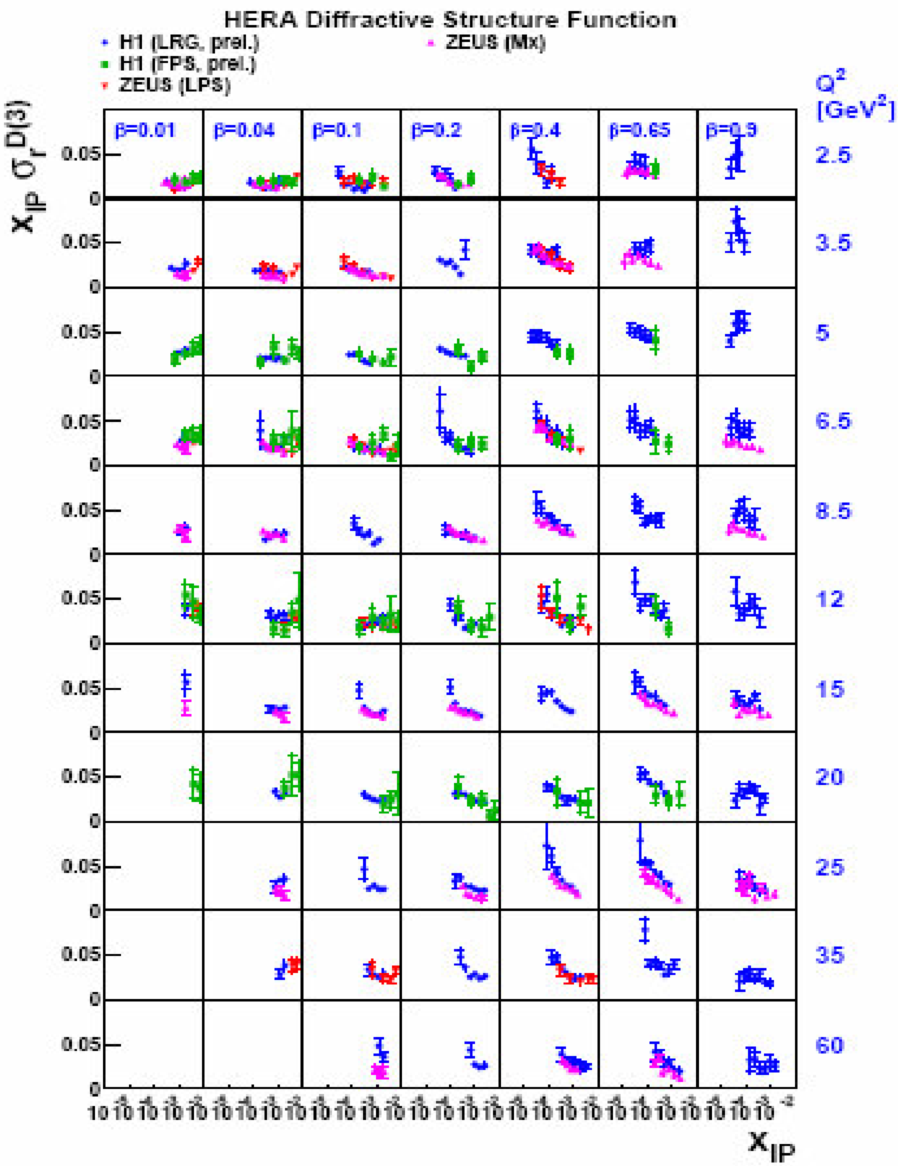
H1 Data:

- "Measurement of semi-inclusive diffractive deep-inelastic scattering with a leading proton at HERA" (Leading Proton)
  Paper 6-984 subm. to ICHEP 2002, H1prelim-01-112 — $2.6 < Q^2 < 20$ GeV^2 (99-00)
- "Measurement of the Diffractive DIS Cross Section at low Q^2 " (LRG method)
  Paper 981 subm. to ICHEP 2002, H1prelim-02-112 — $1.5 < Q^2 < 12$ GeV^2 (99)
- "Measurement and NLO DGLAP QCD Interpretation of Diffractive Deep-Inelastic Scattering at HERA" (LRG method)
  Paper 980 subm. to ICHEP 2002, H1prelim-02-012 — $6.5 < Q^2 < 120$ GeV^2 (97)
- " Measurement of the Inclusive Diffractive Cross Section $\sigma_r^D(3)$ at high Q^2" (LRG method)
  Paper 5-090 subm. to EPS 2003, H1prelim-03-011 — $200 < Q^2 < 1600$ GeV^2 (99-00)



- ❖ QCD DGLAP NLO fit "a la H1"
- ❖ pQCD fit "a la Martin et al."

Diffractive structure function

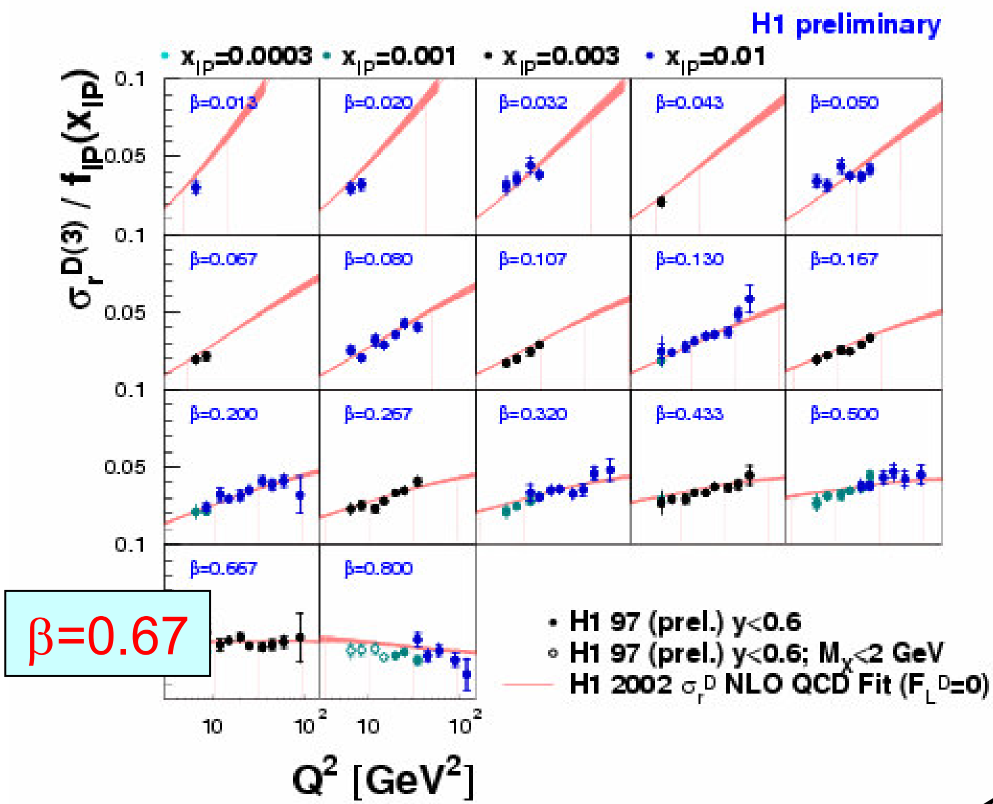


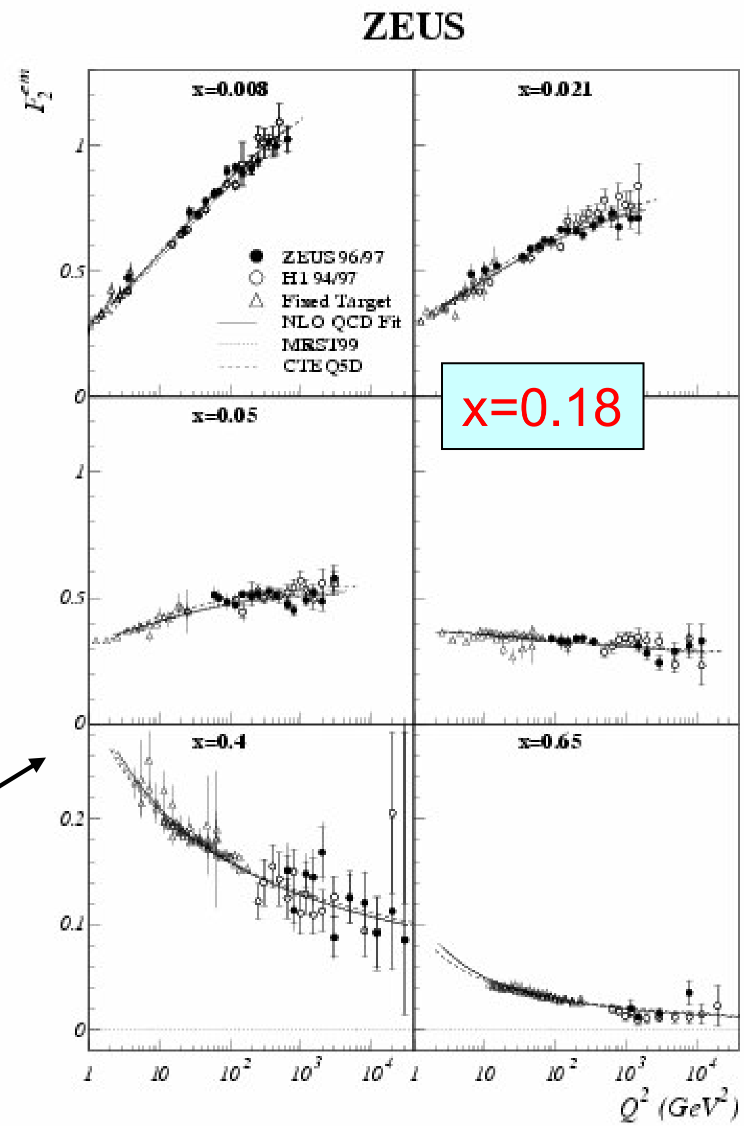
Precise data

Wide kinematic coverage

- M_x: higher β region
- LPS: higher x_{IP} region

Scaling violation of $F_2^{D(3)}$





Inclusive data

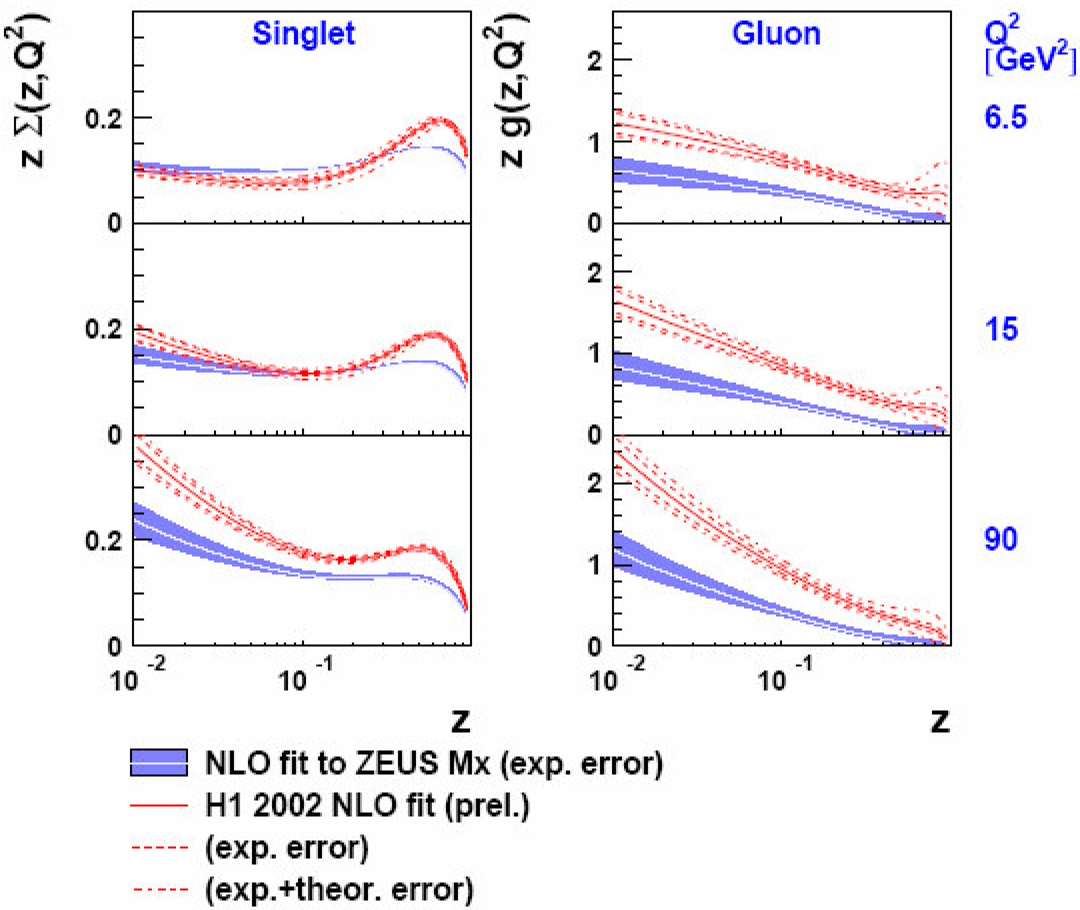
- Positive scaling violations to highest β

$\rightarrow$ lot of gluons

NLO DGLAP fits

by P. Newmann, F.-P. Schilling, P Laycock

NLO QCD fits to H1 and ZEUS data



Regge factorization assumed

Observations:

- Singlet similar at low Q^2, evolving differenly to higher Q^2
- Gluon factor ~ 2 smaller than H1 gluon

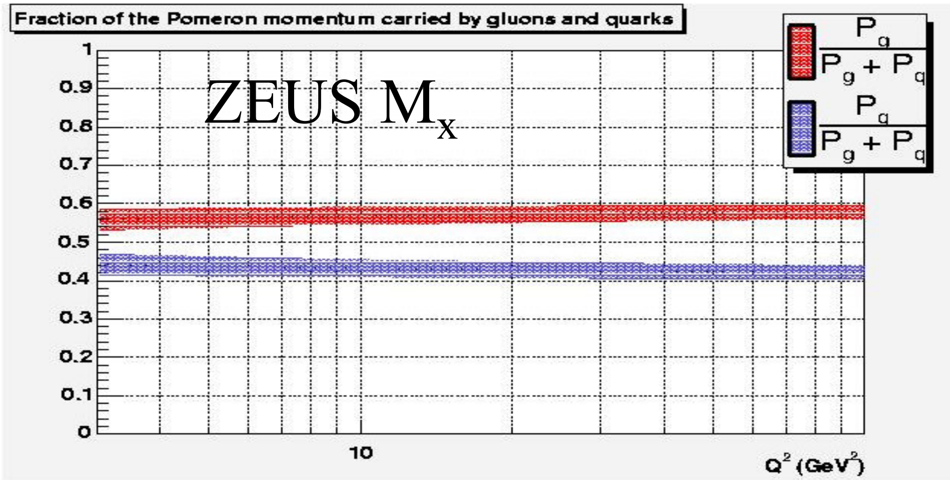
Reminder that data comparisons revealed differences

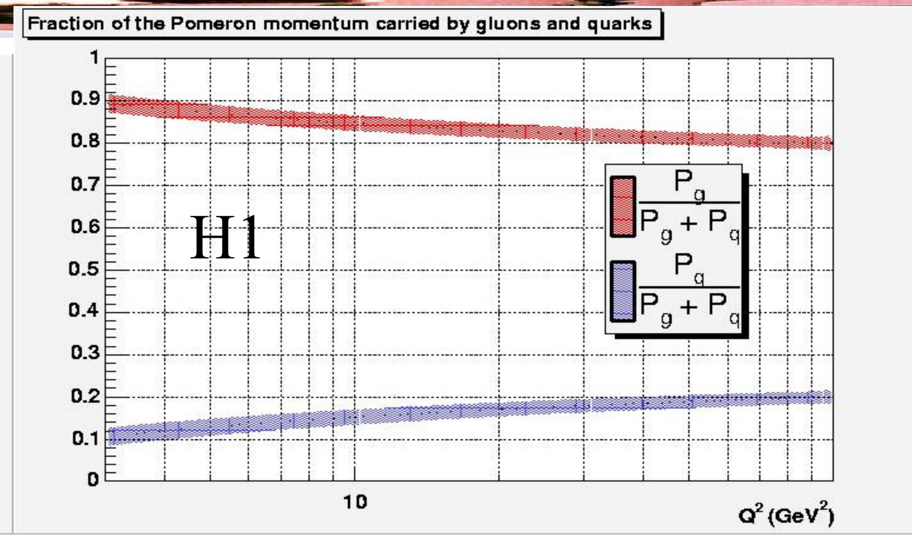
- at low M_X (high β)
  Most of those points are not included in the fit
- in the Q^2 dependences
  Different Q^2 evolution means different gluon

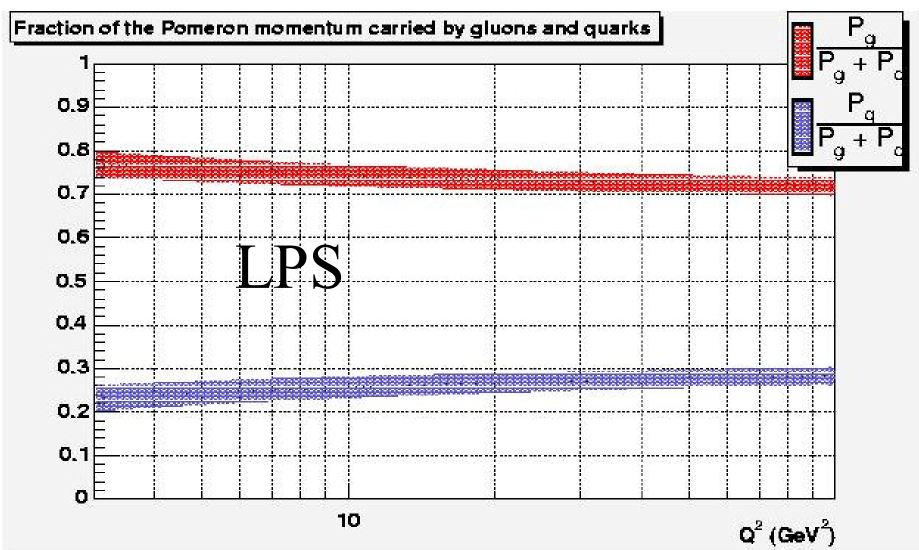
$\rightarrow$ Observed differences in the data explain the differences in the extracted pdfs

quark/gluon momentum fration

by A. Levi and collaborators







Diffractive partons from perturbative QCD

Alan Martin, Misha Ryskin and Graeme Watt

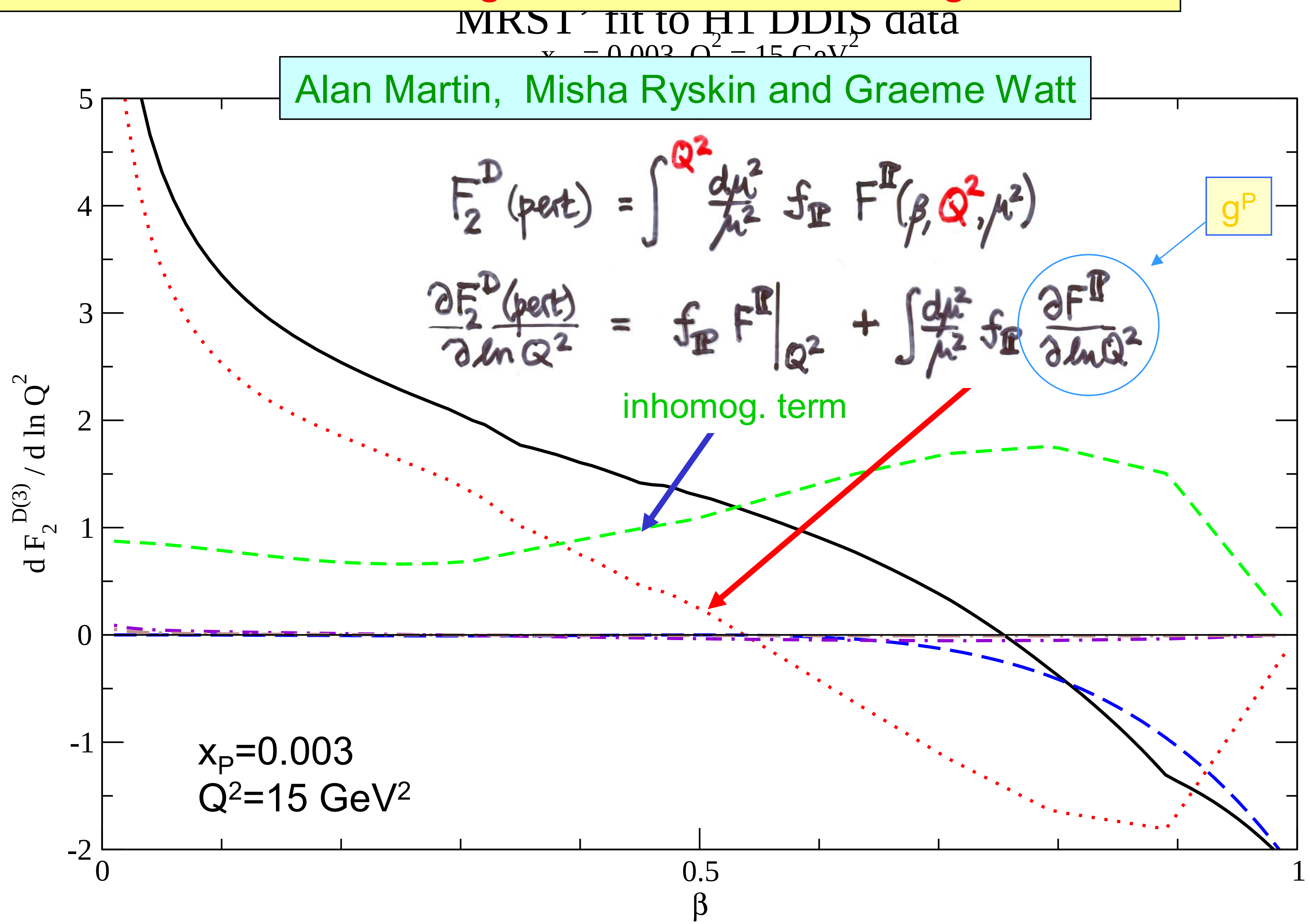
Conventionally DDIS analyses use two levels of factorisation
- collinear factorization and Regge factorization

- ★ We replace Regge factorization by pQCD
- ★ Collinear factorization, which holds asymptotically, needs modification in the HERA regime:
  - -- inhomogeneous term in DGLAP evolution
  - -- direct charm contribution
  - -- twist-4 F_L^D component
- ★ We present universal diffractive partons

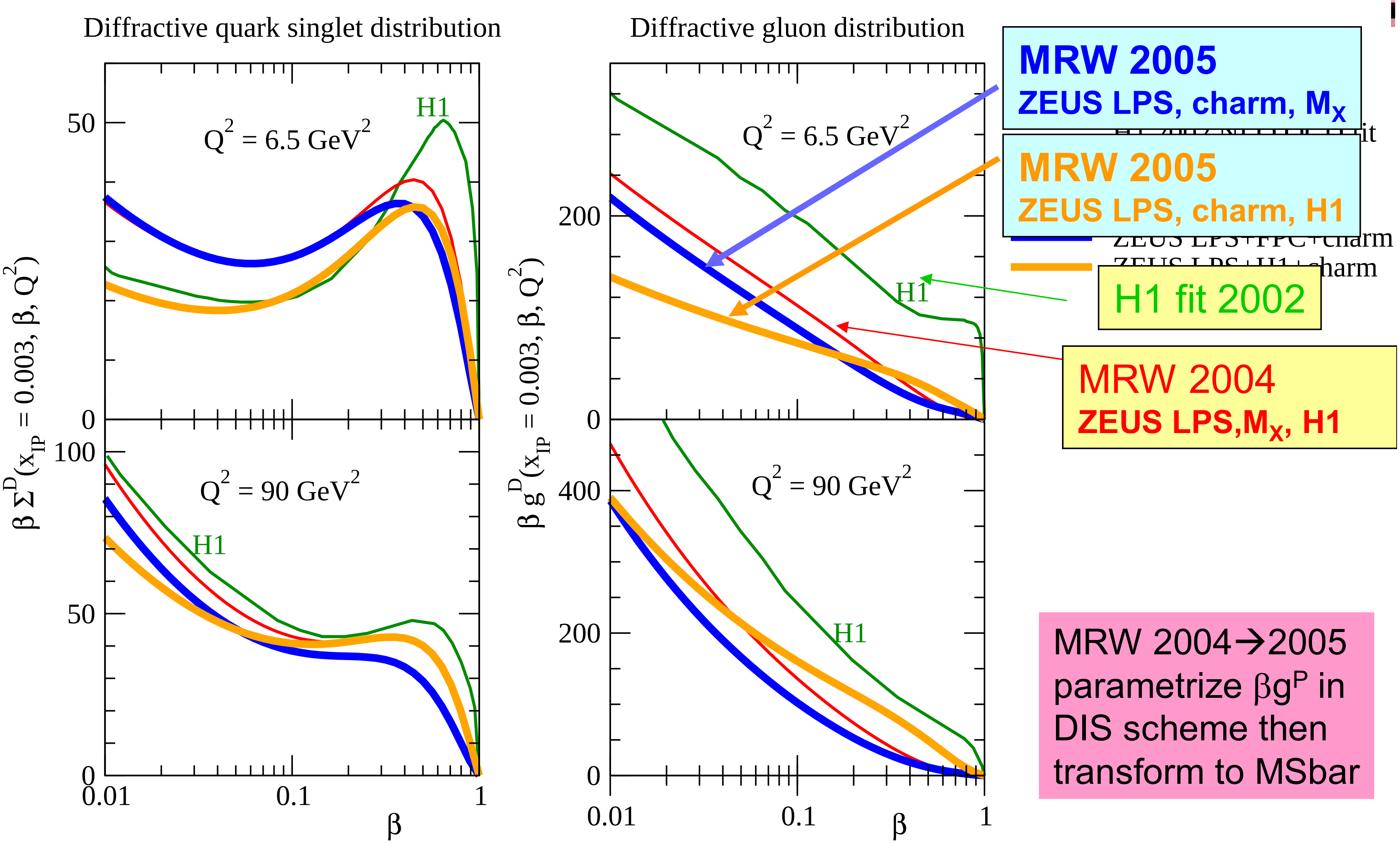
(Note: need quark-antiquark Pomeron, in addition to two-gluon Pomeron)

Alan Martin, DIS05
Madison, April 2005

inclusion of the inhomogeneous term makes g^P smaller



MRW fit

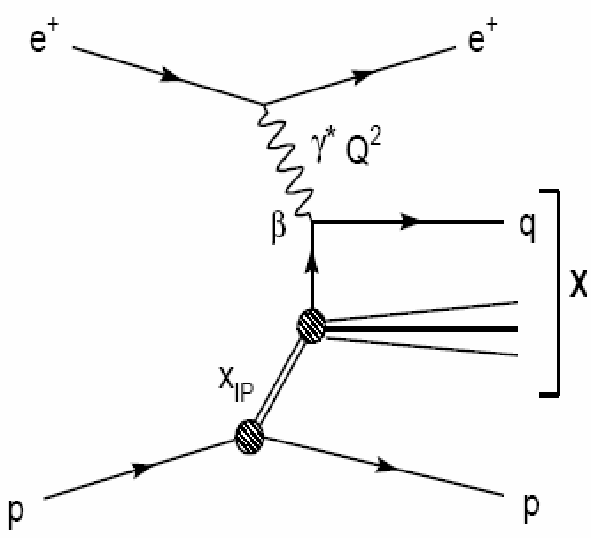


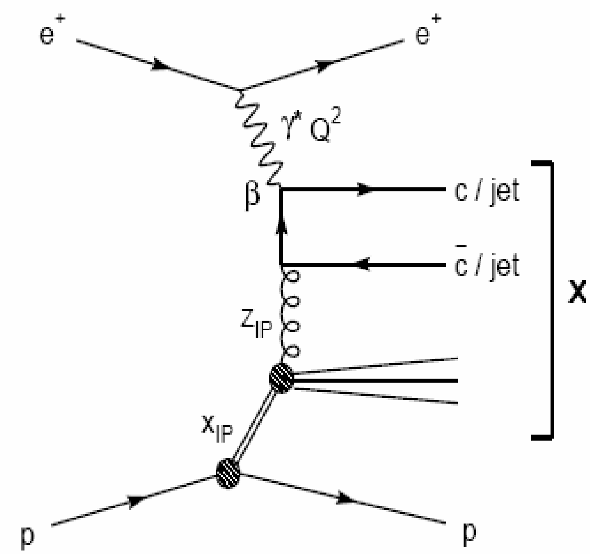
MRW 2004→2005 parametrize βg^P in DIS scheme then transform to MSbar

Exclusive DDIS processes

Test hard scattering factorization

Get PDFs from inclusive Diffraction → Predict Cross Sections from exclusive Final States in Diffraction



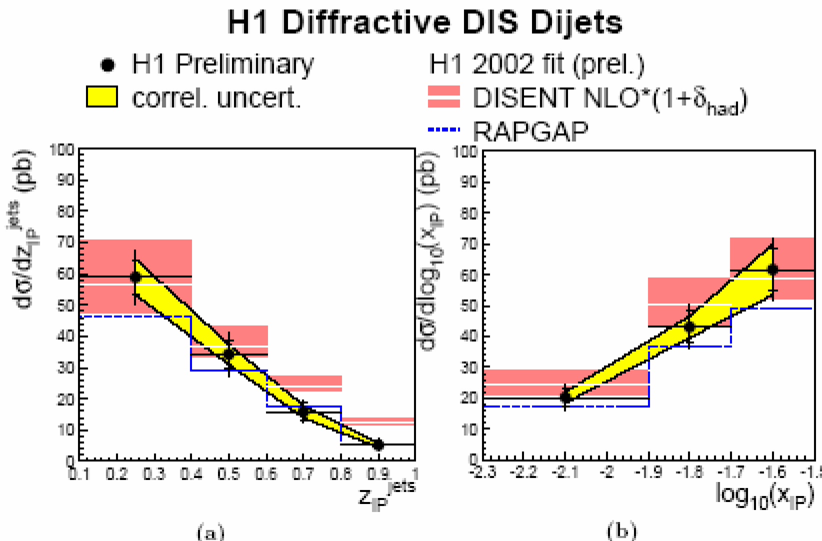


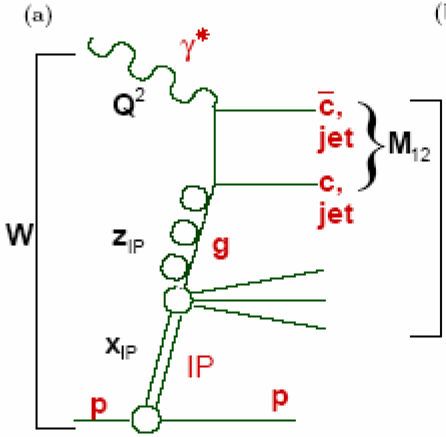
Gluon density only indirectly from scaling violations

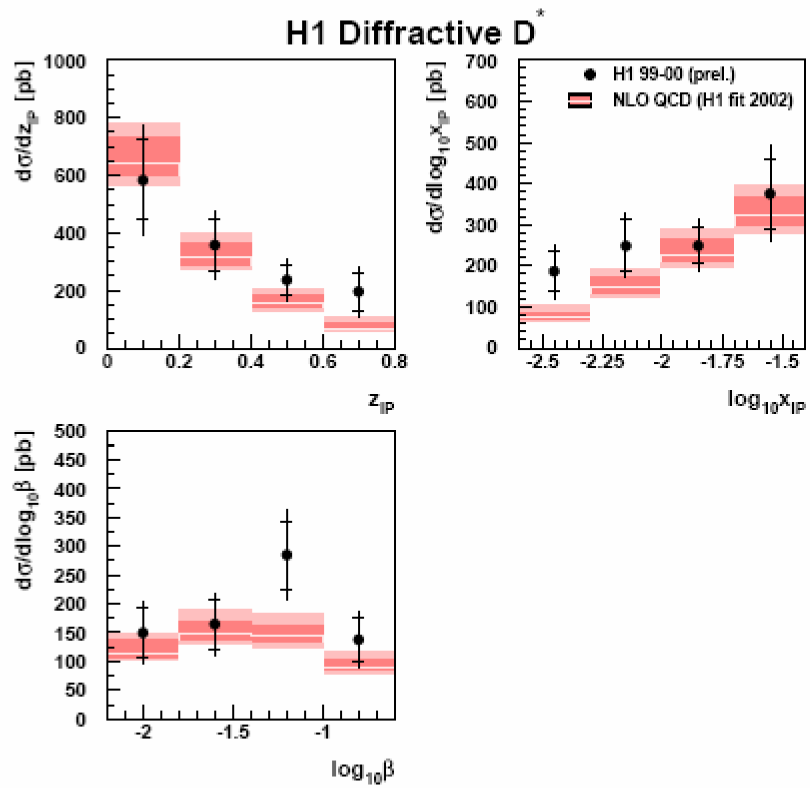
Direct access to gluon density

Dijet and D* in DIS

M. Beckingham M. Mozer



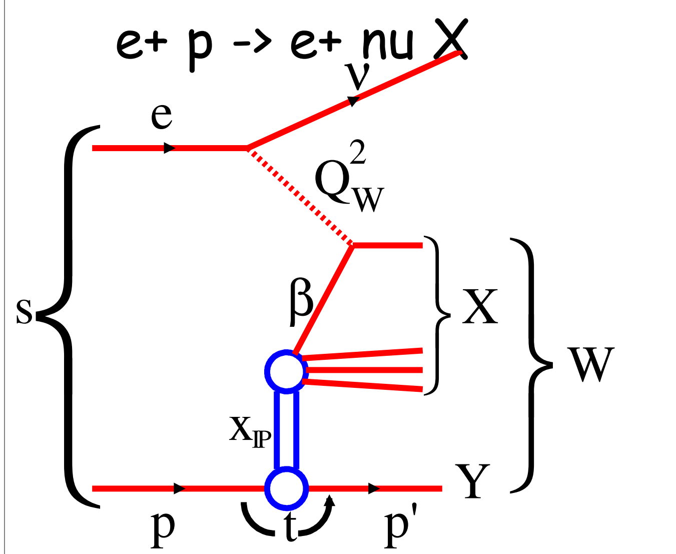




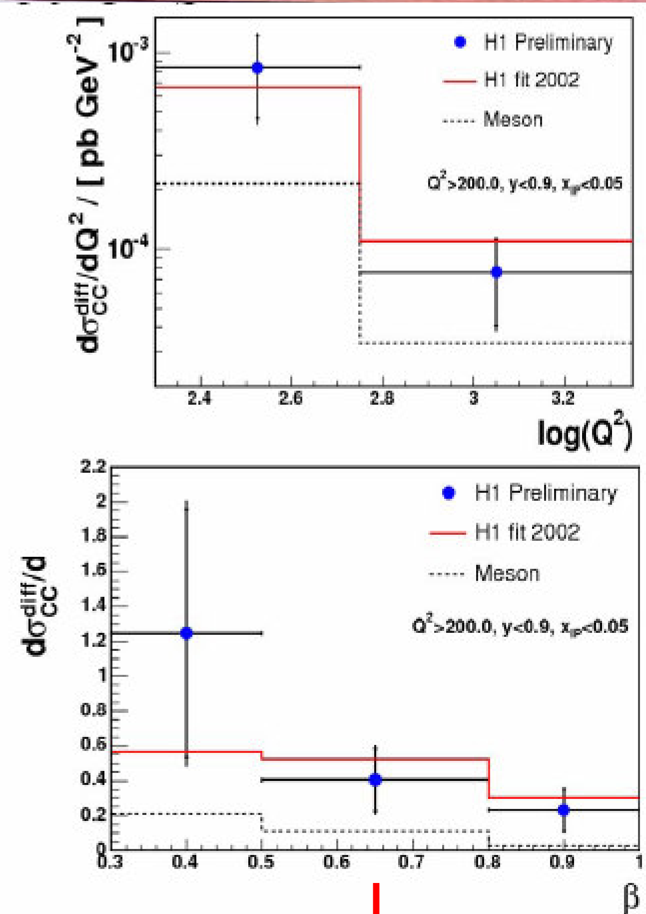
➔ Validity of QCD factorization in diffractive DIS within exp. and theor. uncertainties

Diffractive CC results

P.Laycock



Q^2>200 GeV^2



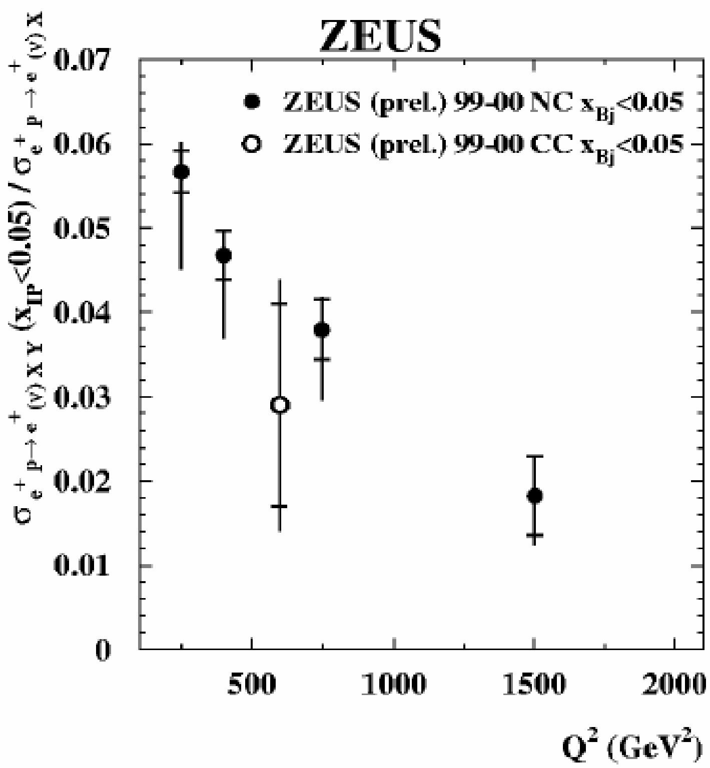
- Measure diffractive PDFs at large scale (200 GeV2 < Q2 < 200 GeV2) ➔ predictions of large mass states in hadron-hadron collisions (needed up to M_H)

Comparison with H1 fit 2002 (lower Q^2 NC): xp, Q2 and β dependences well described

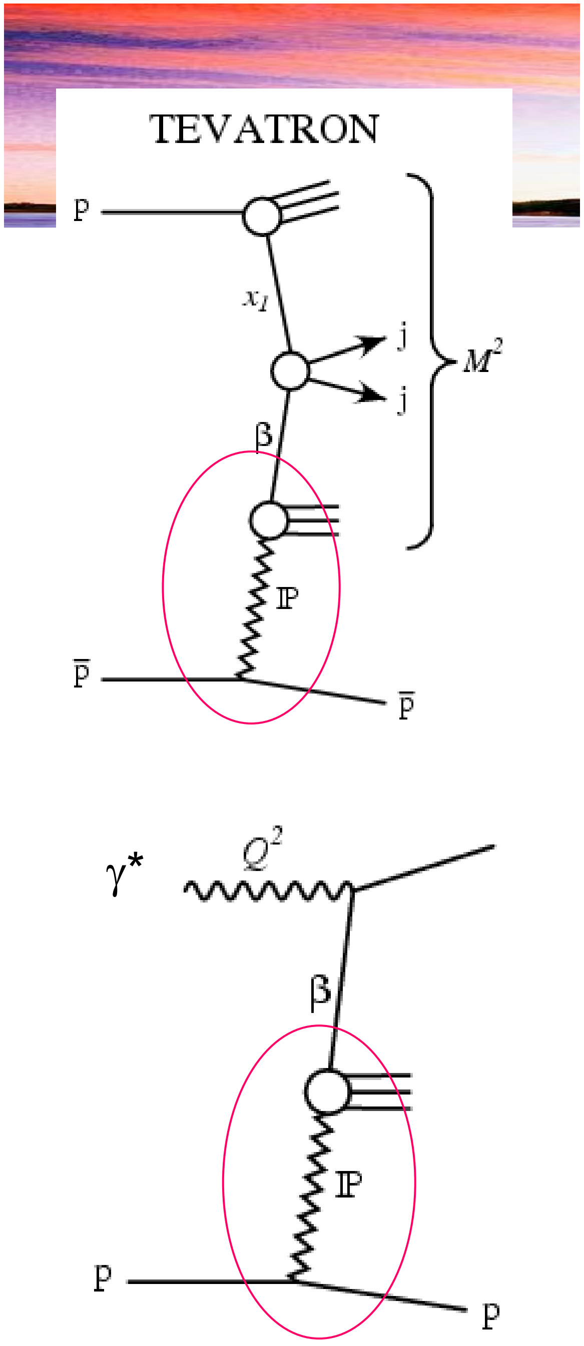
Diffractive CC results

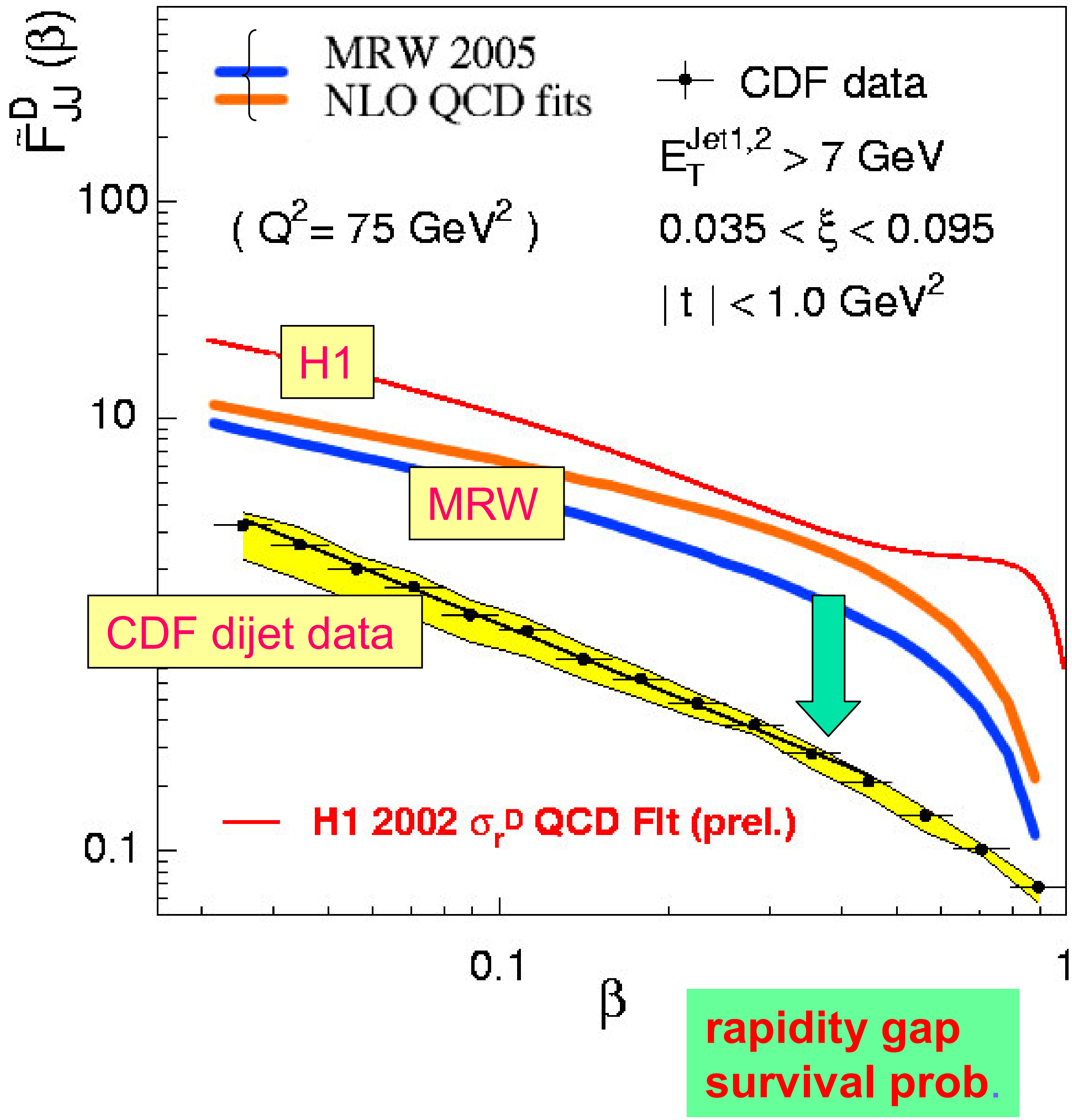
L. Adamczyk

Ratio $\sigma_{e^+p \to e^+(\nu) X Y}(x_{IP}<0.05) / \sigma_{e^+p \to e^+(\nu) X}(x_{Bj}<0.05)$ vs. Q^2



➔ Ratio compatible between NC and CC processes


TEVATRON
p
x1
j
j
M²
β
IP
p̄
p̄
γ*
Q²
β
IP
p
p

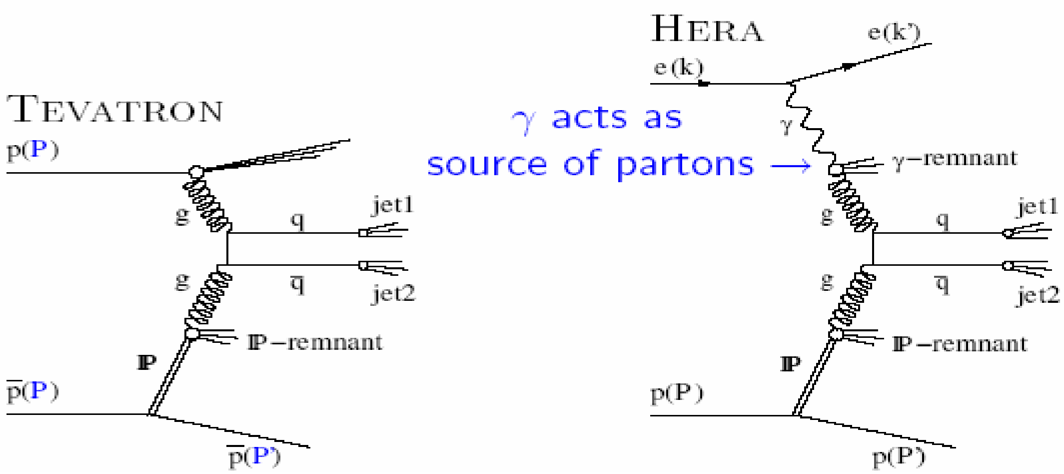

F̃JJD (β)
MRW 2005
NLO QCD fits
CDF data
ET Jet1,2 > 7 GeV
(Q² = 75 GeV²)
0.035 < ξ < 0.095
| t | < 1.0 GeV²
H1
MRW
CDF dijet data
H1 2002 σrD QCD Fit (prel.)
100
10
0.1
0.1
1
β
rapidity gap
survival prob.

Diffractive CC results

- HERA PDFs estrapolated to TEVATRON:

Factorization breaks due to interactions of spectator partons
[Kaidalov et al. EPJ C21 (2001)]

- production of diffractive dijets in $p\bar{p}$–collisions similar to resolved γ-process in ep–collisions:



Suppression also expected for resolved PhP at HERA (R=0.34)

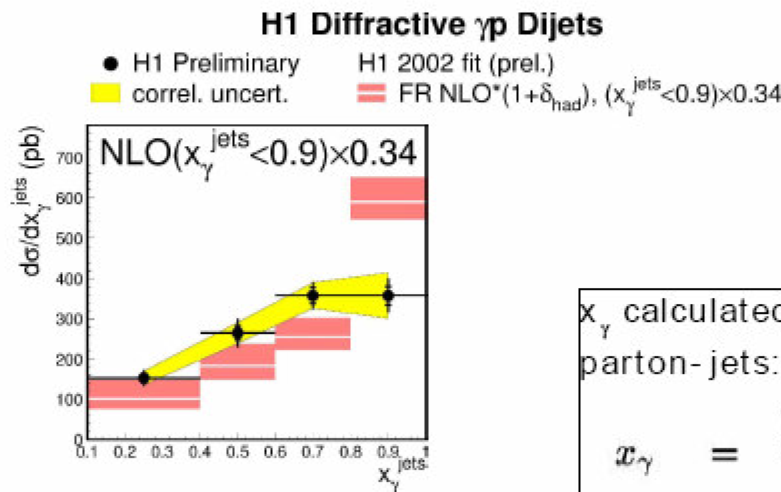
[Phys. Lett. B567 (2003), 61]

Dijet in PhP

M. Mozer

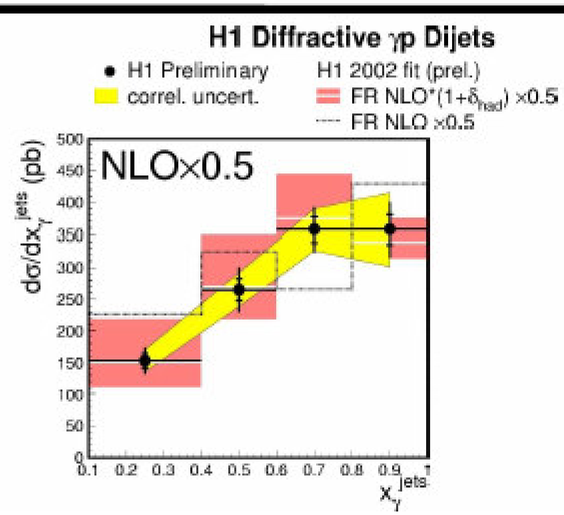
<u>direct unsuppressed:</u>

does not describe x_γ shape



<u>global suppression:</u>

describes data within uncertainties



Suppression of only the resolved contribution at NLO is disfavoured by the data

x_γ calculated from parton-jets:

$$x_\gamma = \frac{\sum_{jets}(E-p_z)}{2yE_e}$$

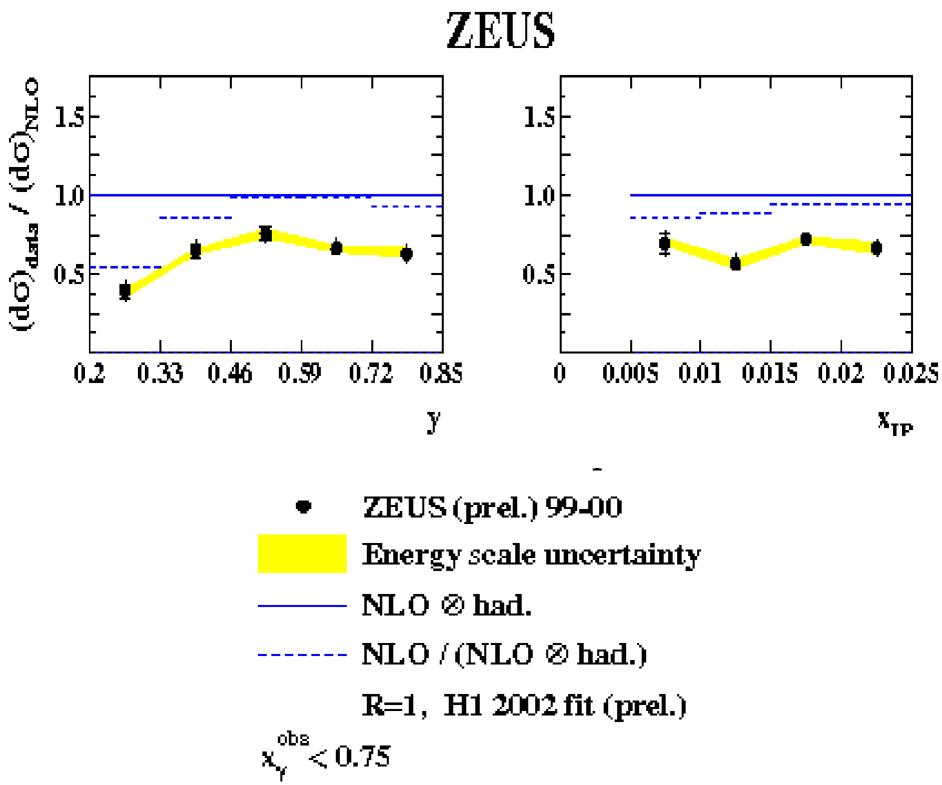
$x_\gamma > 0.9$ contains
90% direct
10% resolved

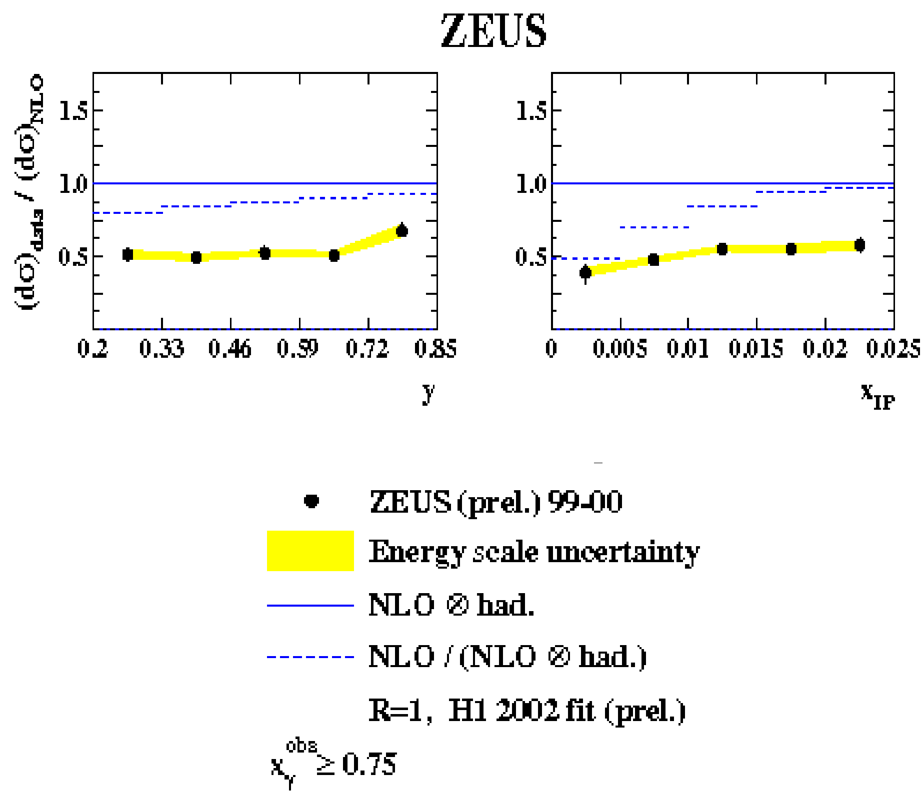
Good description by global suppression 0.5

Dijet in PhP

R. Renner

resolved enriched (x_γ< 0.75) | **direct enriched (x_γ < 0.75)**





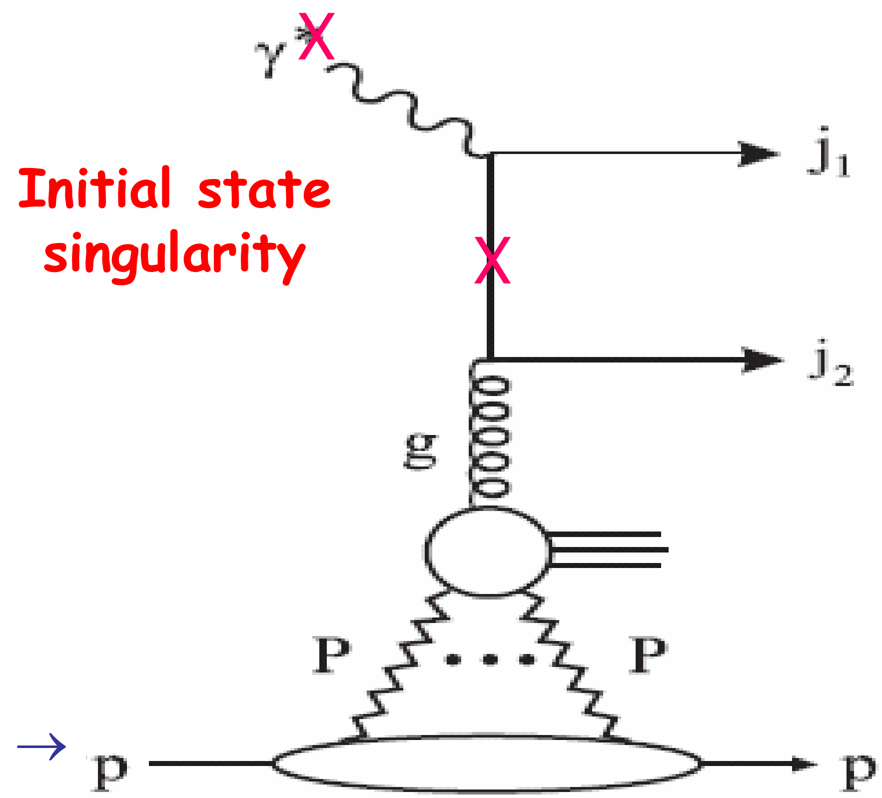
→ **Data lower by a factor ~ 0.5 vs NLO MC**

M. Klasen interpretation

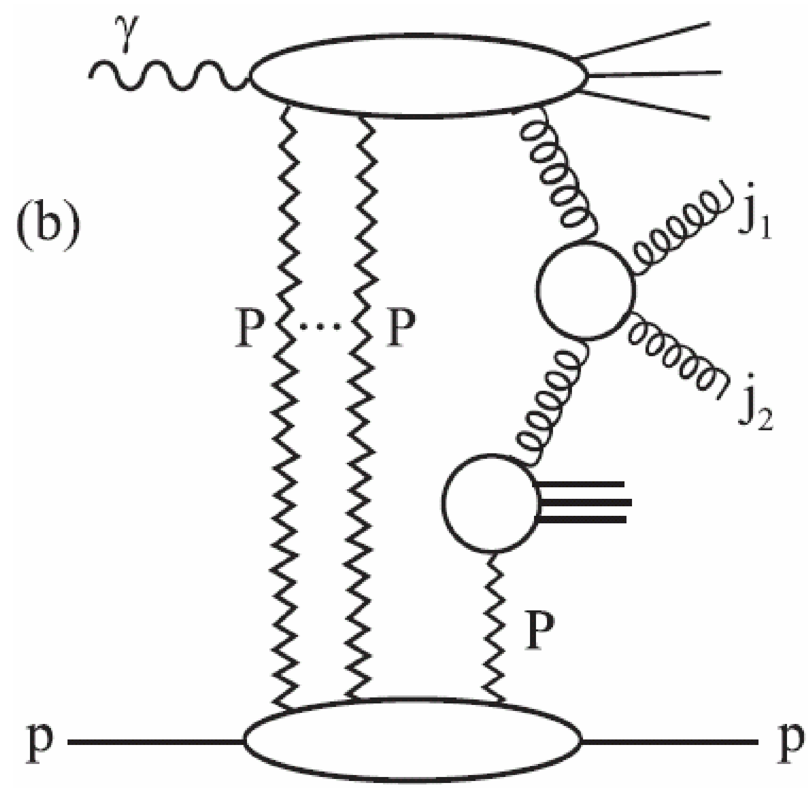
M. Klasen

Direct photoproduction:

Initial state singularity

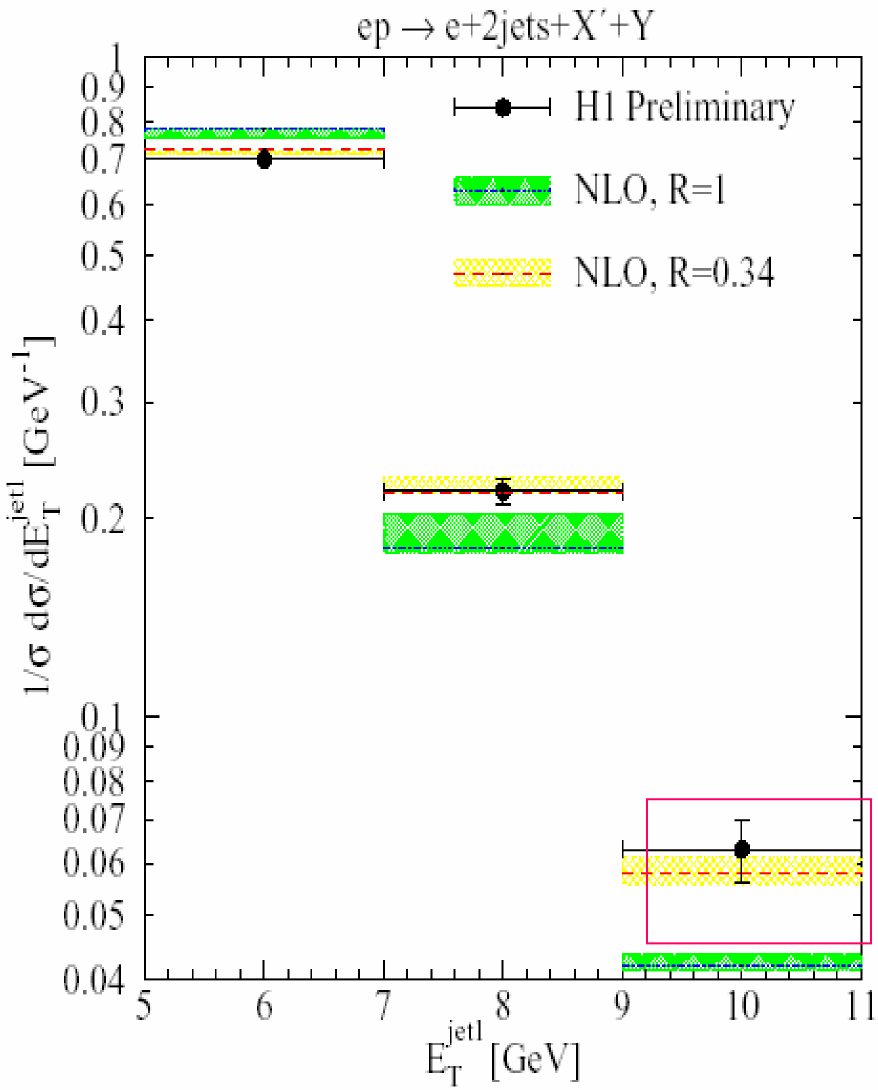


Resolved photoproduction:



M. Klasen interpretation

M. Klasen



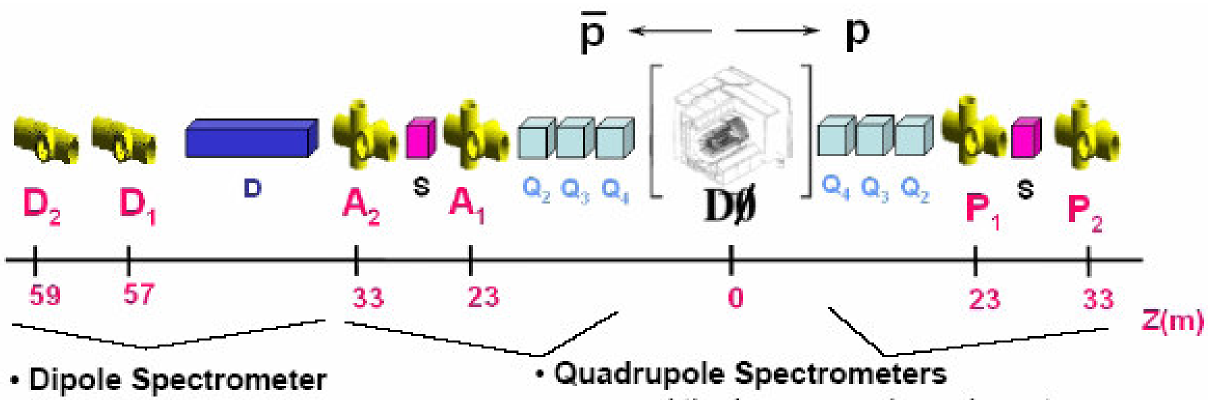
Importance of large E_T:
- Direct process dominates
- IS singularity less important
- Hadronization corrections small
- Experimentally directly accessible
- Less sensitive than $x\gamma$

Result:
- Suppressed result agrees
- Unsuppressed 50% too low

Suggestion from discussion:
- Measure diff/incl
- D^* in Php

Diffraction at TEVATRON

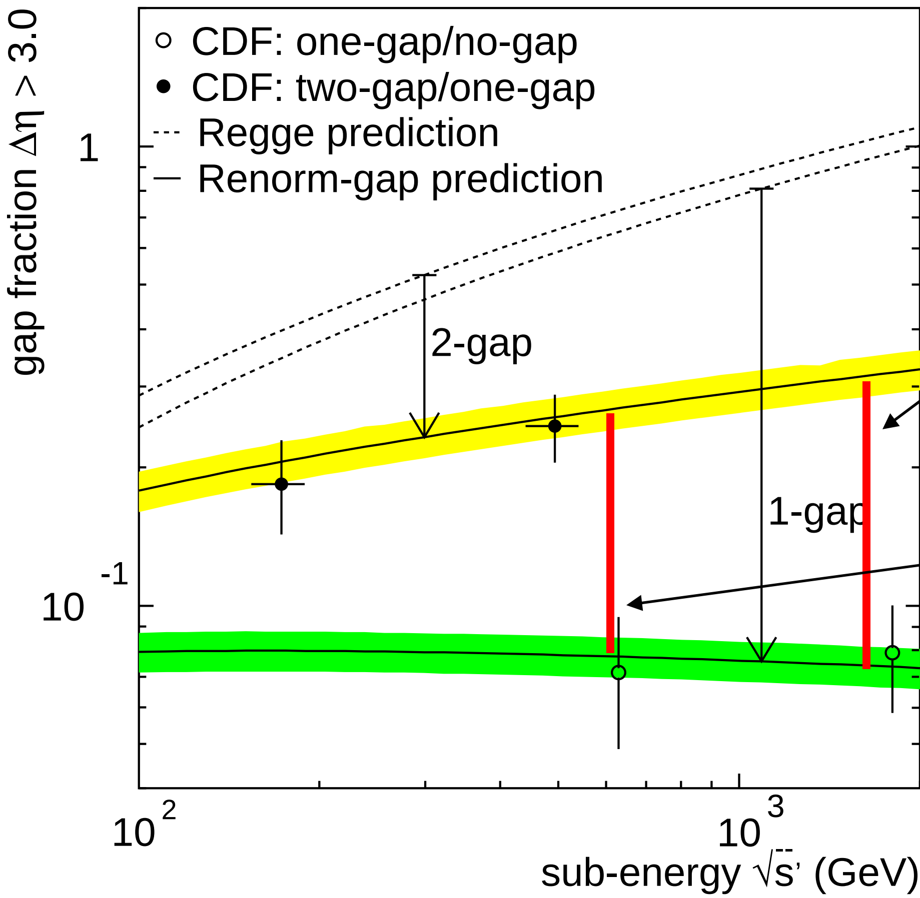
Now both CDF and D0 have roman pots and are actively pursuing broad diffractive physics program

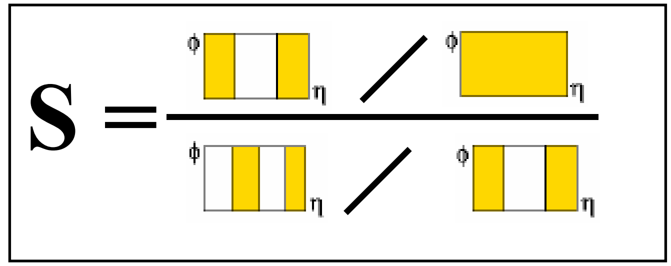


- FPD being calibrated and working as planned.
- Level 1 FPD triggers being commissioned (new data samples).
- Comparing measurements with FPD tag vs. Gap tag yields new insight into processes

Gap survival probability

K. Goulianos





$$S^{1-gap/0-gap}_{2-gap/1-gap}(1800\ \mathrm{GeV}) \approx 0.23$$

$$S^{1-gap/0-gap}_{2-gap/1-gap}(630\ \mathrm{GeV}) \approx 0.29$$

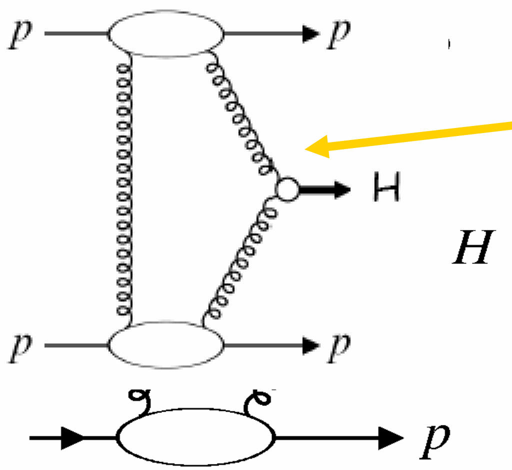
Results similar to predictions by:

Gotsman-Levin-Maor

Kaidalov-Khoze-Martin-Ryskin

Soft color interactions

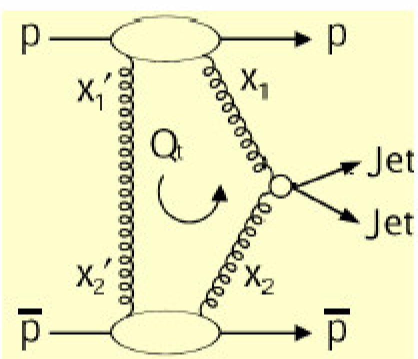
TEVATRON to LHC



Vacuum quantum numbers !

Attractive Higgs studies at LHC

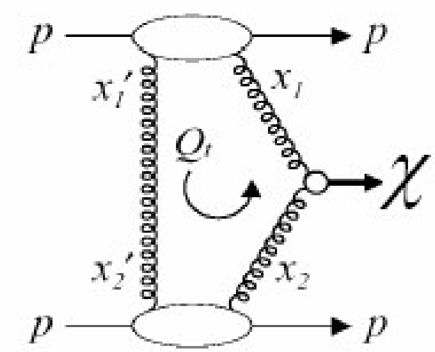
Exclusive DPE dijet production



$R_{jj}=M_{jj}/M_X$

Much larger cross section

Exclusive low-mass states



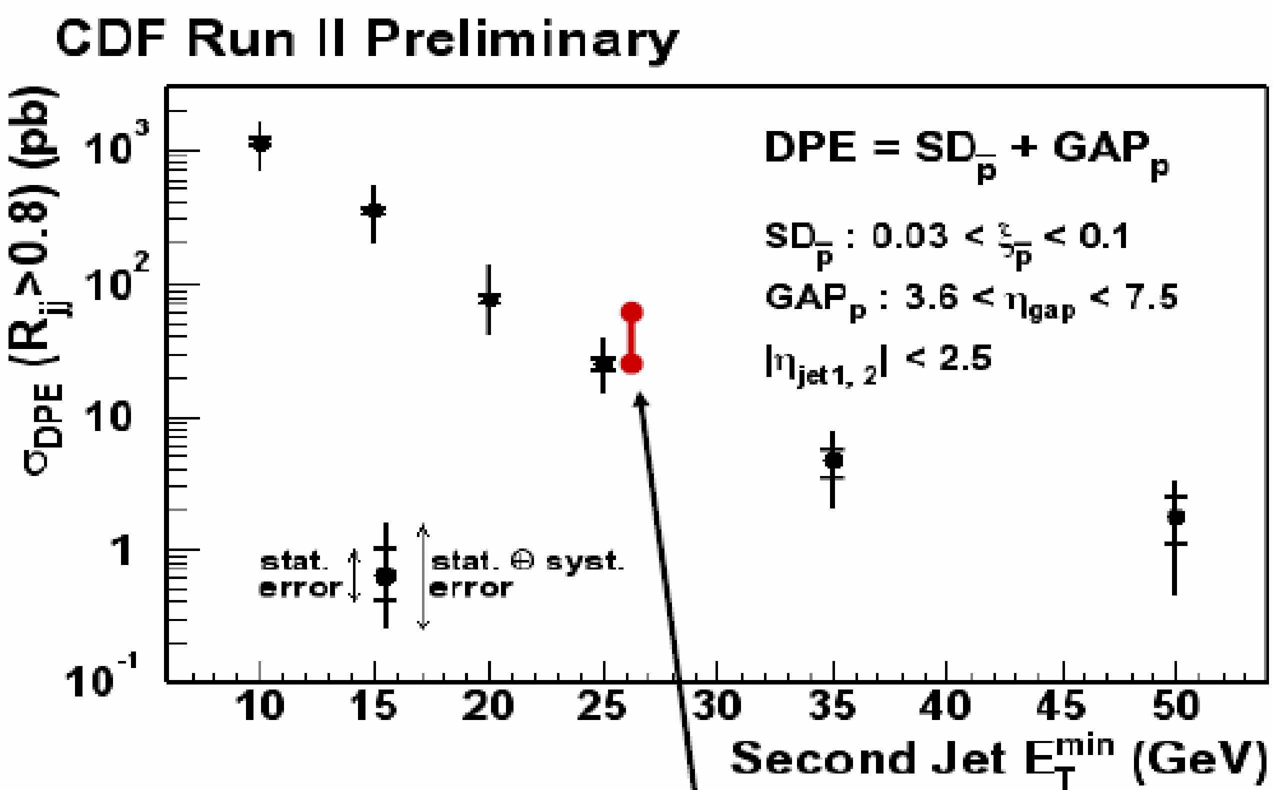
$p\bar{p} \to p\chi\bar{p}$

$\to J/\psi\,\gamma \to \mu\mu\gamma$ (γ is soft)

(same quantum numbers as Higgs boson)

Limits on excl. dijet production

K. Goulianos



Martin, Kaidalov, Khoze, Ryskin, Stirling
(hep-ph/0409258): ~ 40 pb (E_T>25 GeV) (factor ~2 uncertainty)

Vector Meson Production

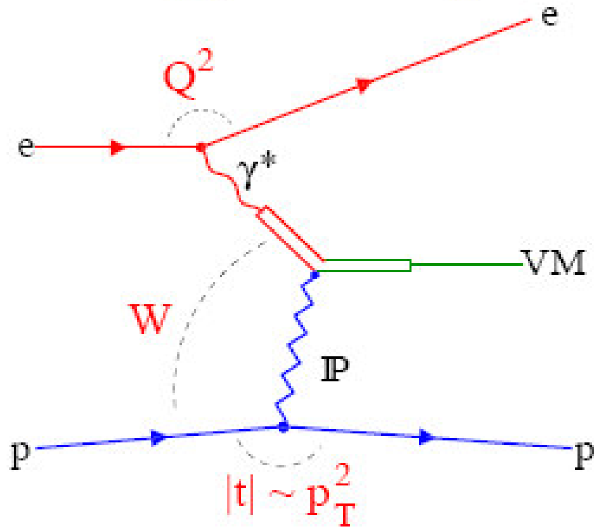
And

Deeply Virtual Compton Scattering

Introduction

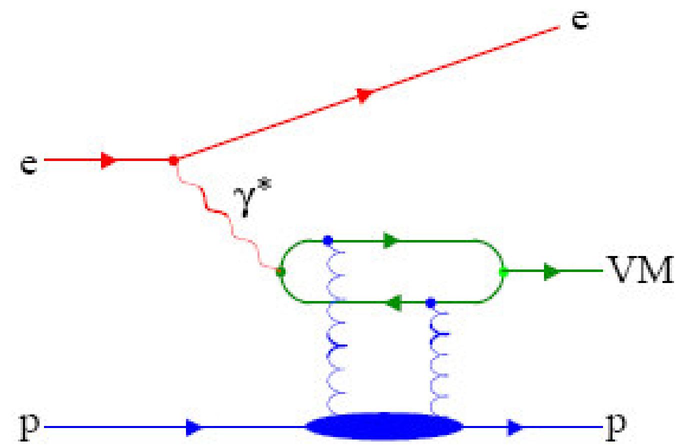
$$e + p \to e + VM\ (= \rho, \omega, \phi, J/\psi, \ldots)\ (\text{or } \gamma) + p$$

Regge Theory



- Soft $I\!P$omeron exchange
- $\sigma \propto (\frac{W}{W_0})^{4(\alpha_{I\!P}(t)-1)}$
- $\alpha_{I\!P}(t) = 1.08 - 0.25|t|$
- Works for light VM

pQCD Models

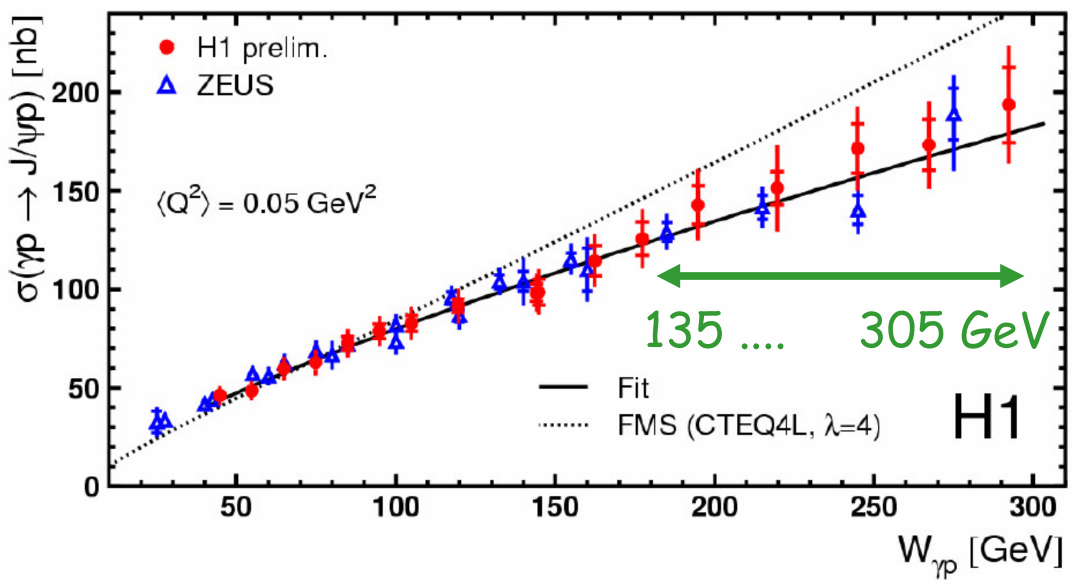


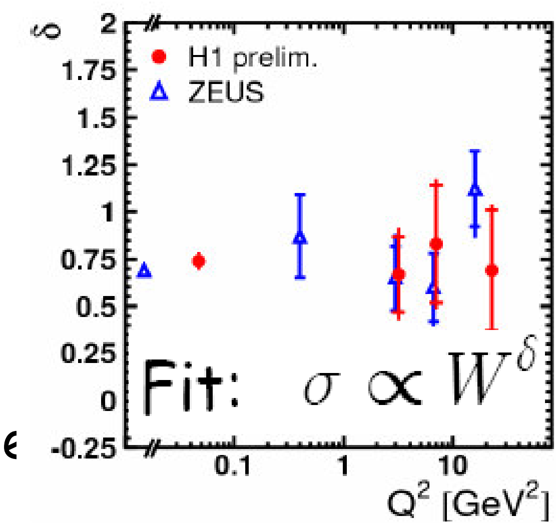
- Exchange of ≥ 2 gluons
- $\sigma \propto (xG(x, K^2))^2$
- Steep rise of $xG(x, K^2)$
- Requires hard scale: Q^2, m_q, t

Elastic J/Ψ Production

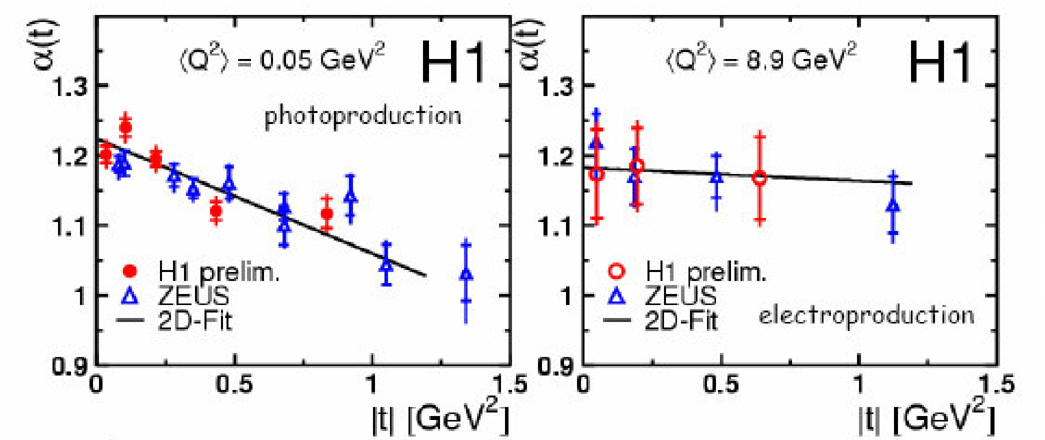
C. Kiesling

New Photoproduction data at high W





- Steep rise with W
- δ condtant with Q2



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

Photoproduction:

$\alpha' = (0.164 \pm 0.028 \pm 0.030)$ GeV^{-2}

Electroproduction:

$\alpha' = (0.019 \pm 0.139 \pm 0.076)$ GeV^{-2}

⟶ Similar trajectories

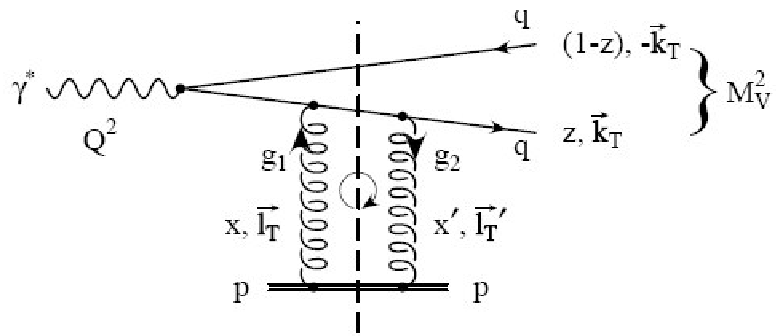
VM and the gluon at small x

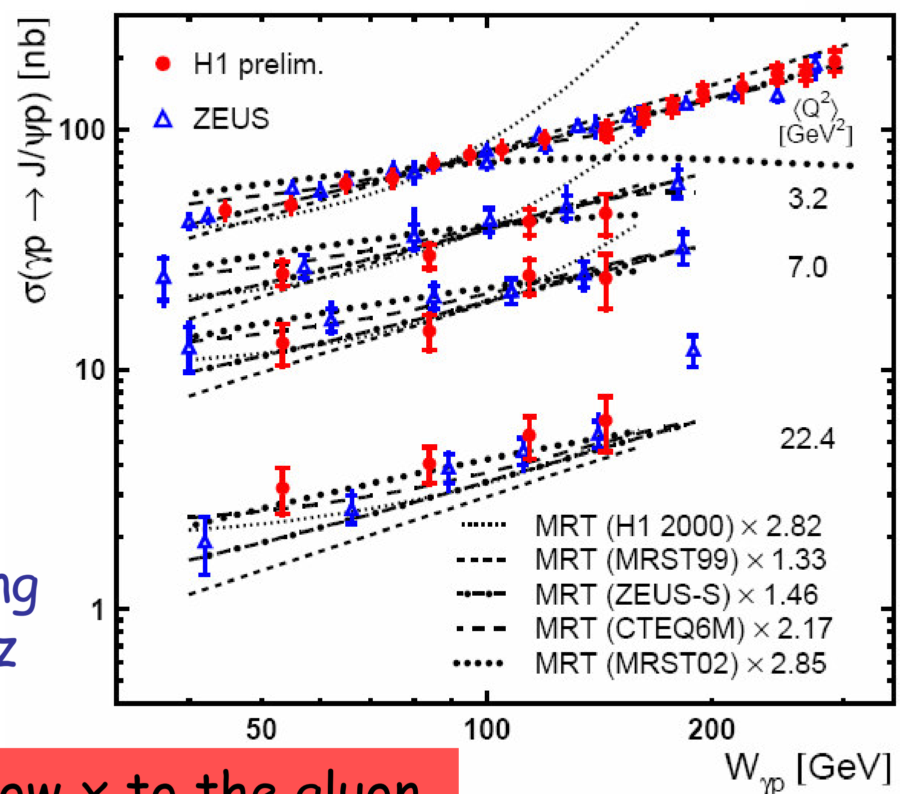
T. Teubner

k_T (ℓ_T) factorization formula with unintegrated gluon:

Photon Wave Fct

$$\mathcal{A}(\gamma^*_{L,T}\, p \to q\bar{q}\, p) = \int_0^\infty \frac{d\ell_T^2}{\ell_T^4}\, \alpha_s(\ell_T^2)\, f(x, x', \ell_T^2)\, \phi^{L,T}(Q^2, m^2, k_T^2, z, \ell_T^2)$$





Skewing effect: $x \neq x'$

⟷ Generalised PDF (GPD):

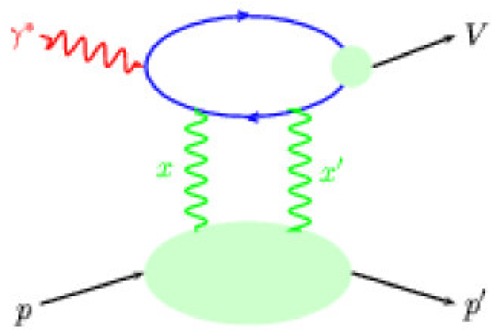
$$f(x, \ell_T^2) = \left.\frac{\partial[xg(x,q_0^2)T(q_0^2,\mu^2)]}{\partial \ln q_0^2}\right|_{q_0^2=\ell_T^2}$$ + skewing ansatz

Sensitivity at very low x to the gluon

VM at small x and GPDs

P. Kroll

Electroprodution

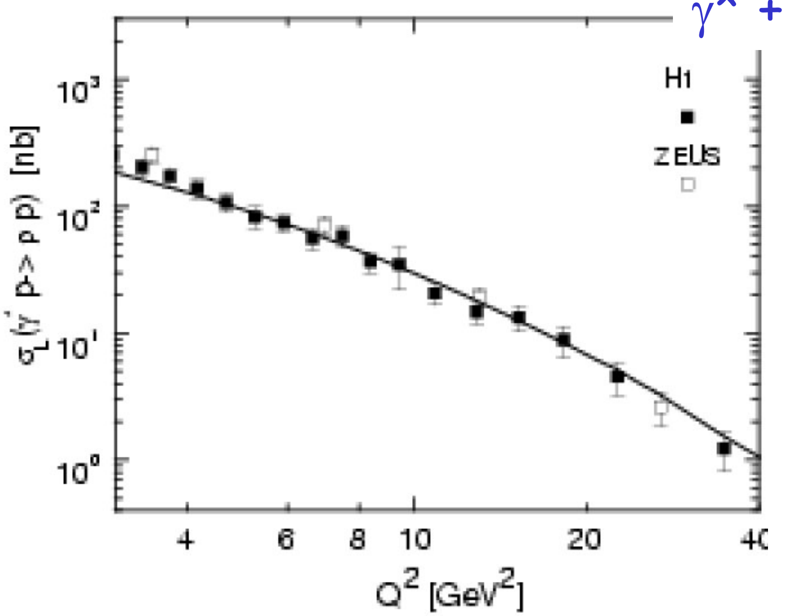


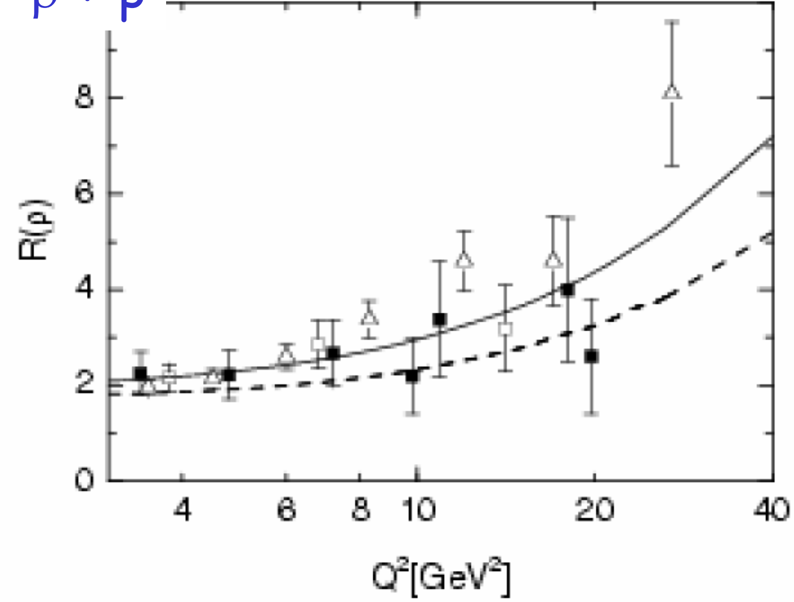
Modelling the GPD with $x \neq x'$

Popular ansatz (Radyushkin) $n = 1, 2$

$$f(\beta, \alpha, t \simeq 0) = g(\beta) \frac{\Gamma(2n+2)}{2^{2n+1}\Gamma^2(n+1)} \frac{[(1-|\beta|)^2 - \alpha^2]^n}{(1-|\beta|)^{2n+1}}$$

$\gamma^* + p \rightarrow \rho + p$

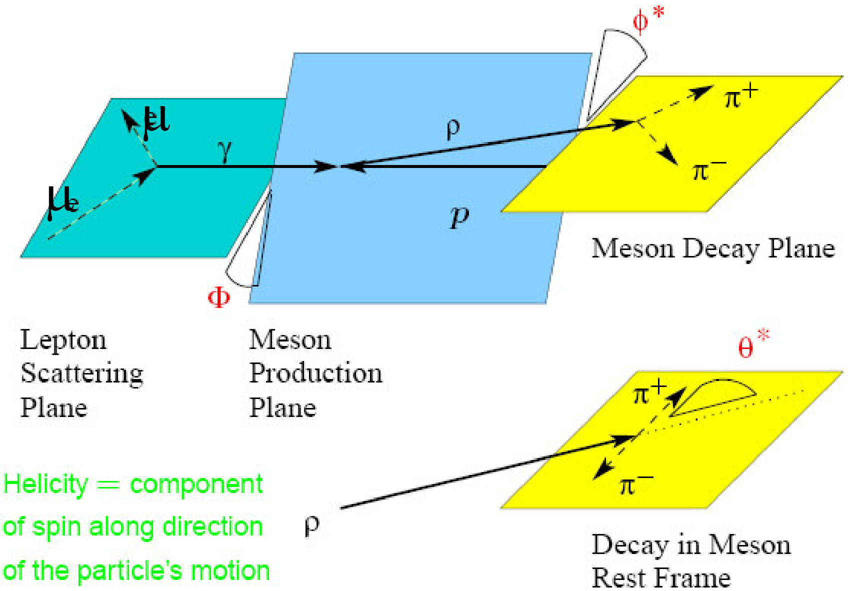




ρ^0 production at COMPASS

N. d'Hose

Helicity angles: θ^* , Φ , ϕ ⟷ 15 (23) SDME: $r^{ij}_{kl} \propto T_{\lambda'_\rho \lambda'_\gamma} T_{\lambda_\rho \lambda_\gamma}$



Helicity = component of spin along direction of the particle's motion

$T_{\lambda_\rho \lambda_\gamma}$: helicity amplitudes

No helicity flip: $T_{00} : \gamma_L \to \rho_L$

$T_{11} : \gamma_T \to \rho_T$

Single flip: $T_{01} : \gamma_T \to \rho_L$

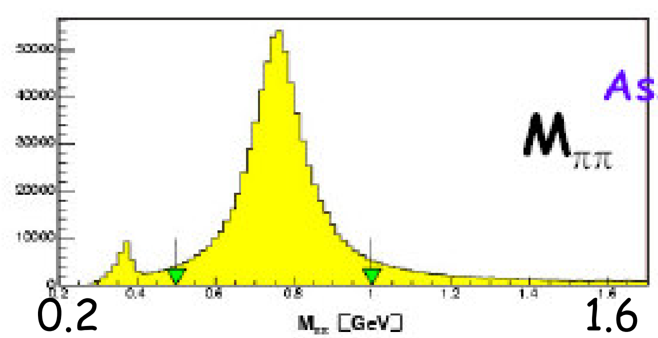
$T_{10} : \gamma_L \to \rho_T$

Double flip: $T_{1-1} : \gamma_T \to \rho_T$

} =0

S-channel helicity conservation

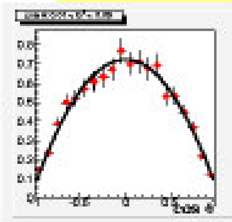
- Kinematical conditions:
  - ν > 30 GeV
  - $E_{\mu'}$ > 20 GeV
  - Q^2 > 0.01 GeV^2



ρ^0 production at COMPASS

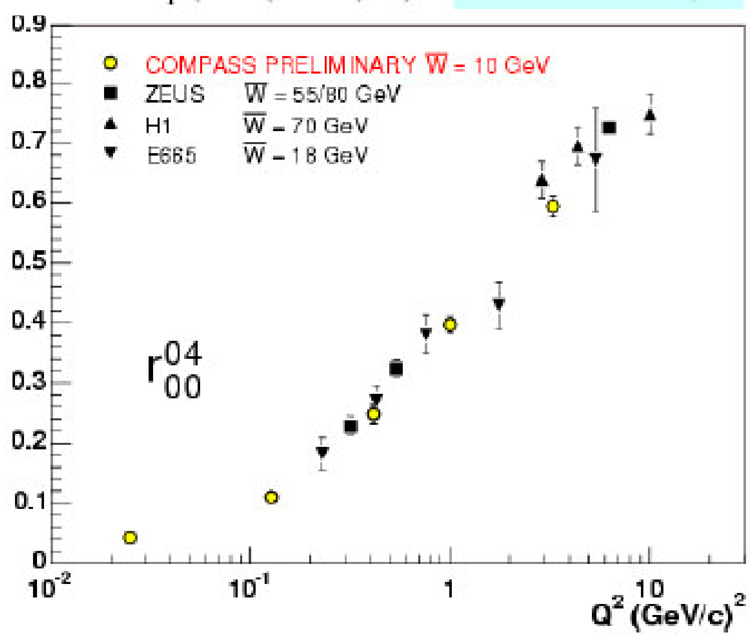
N. d'Hose

Measurement of r^{04}_{00}

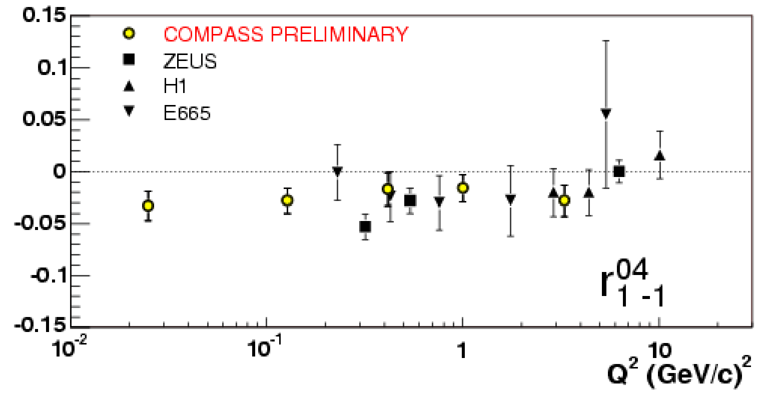


$$W(\cos\theta) = \frac{3}{4}\left|(1-r^{04}_{00}) + (3r^{04}_{00}-1)\cos^2\theta\right|$$

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



Measurement of r^{04}_{1-1}



$$r^{04}_{1-1} = \frac{\mathrm{Re}(T_{11}T^*_{-11}) - (\varepsilon+\delta)|T_{10}|^2}{N_T(1+(\varepsilon+\delta)R)} \overset{\text{SCHC}}{=} 0$$

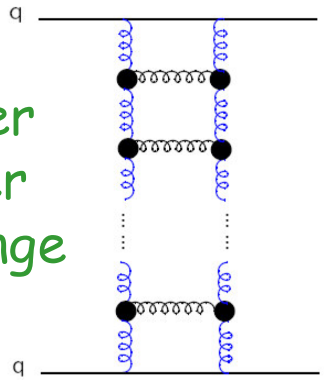
Weak SCHC violation

(but no systematic errors yet)

ρ^0 and J/ψ at high $|t|$

C. Gwilliam   D. Szuba

Higher Order exchange

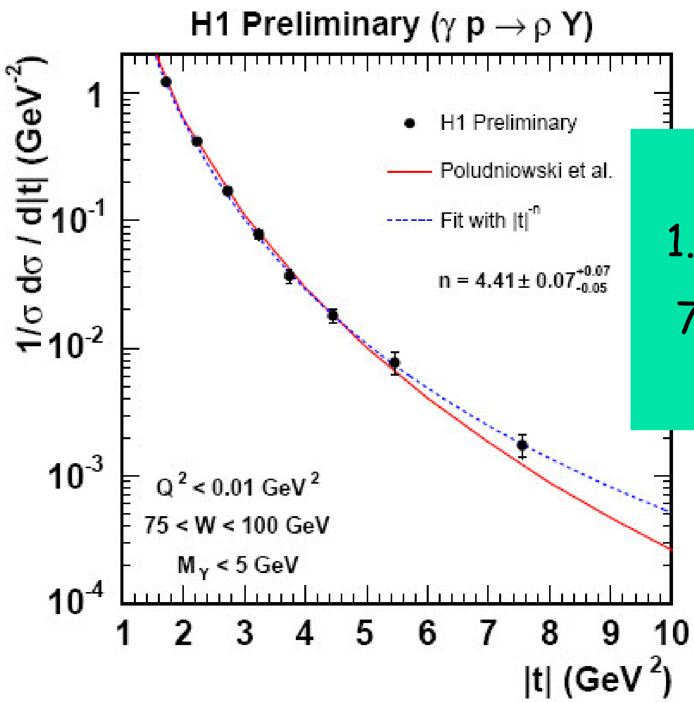


Sums perturbative series in α_s

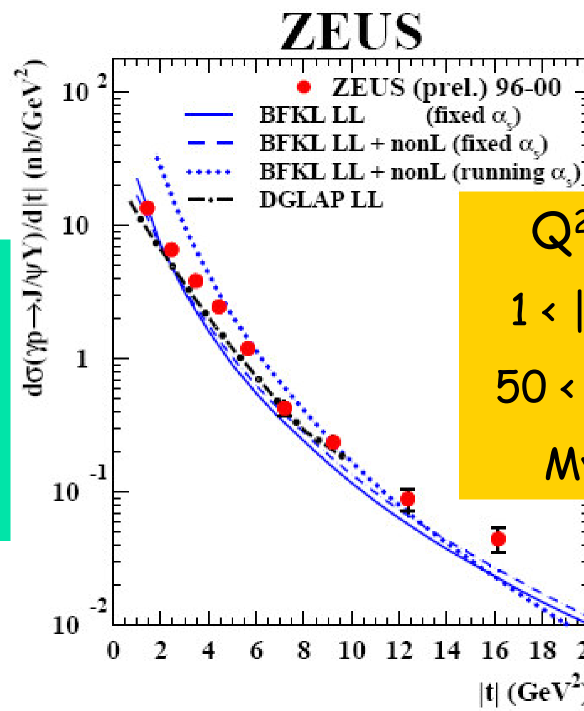
$\Rightarrow$ Effective gluon ladder ("QCD Pomeron")

Can be described by BFKL evolution at low x

Poludinowski *et al.*
[hep-ph/0306232]
[hep-ph/0311017]



$Q^2 < 0.01$ GeV^2
$1.5 < |t| < 10$ GeV^2
$75 < W < 95$ GeV
$M_Y < 5$ GeV



$Q^2 \sim 0$ GeV^2
$1 < |t| < 20$ GeV^2
$50 < W < 150$ GeV
$M_Y < 30$ GeV

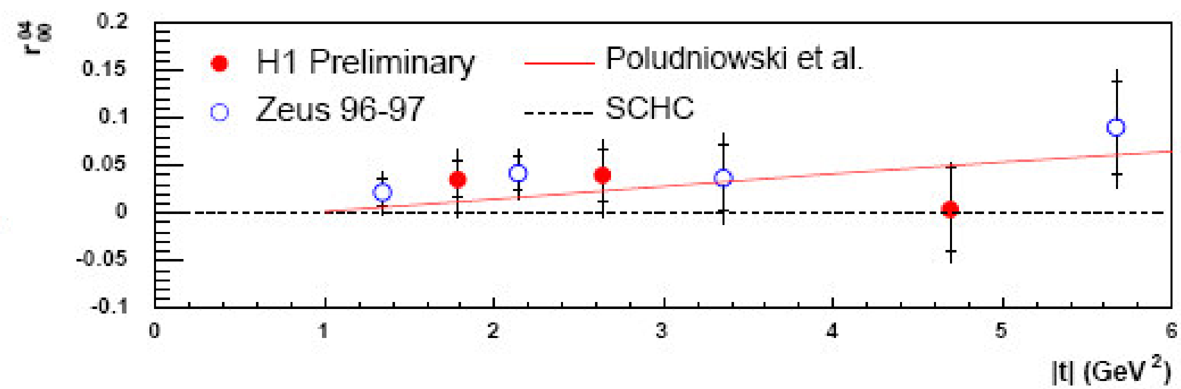
BFKL based model describes t dependence

ρ^0 at high |t|: Helicity Angles

C. Gwilliam

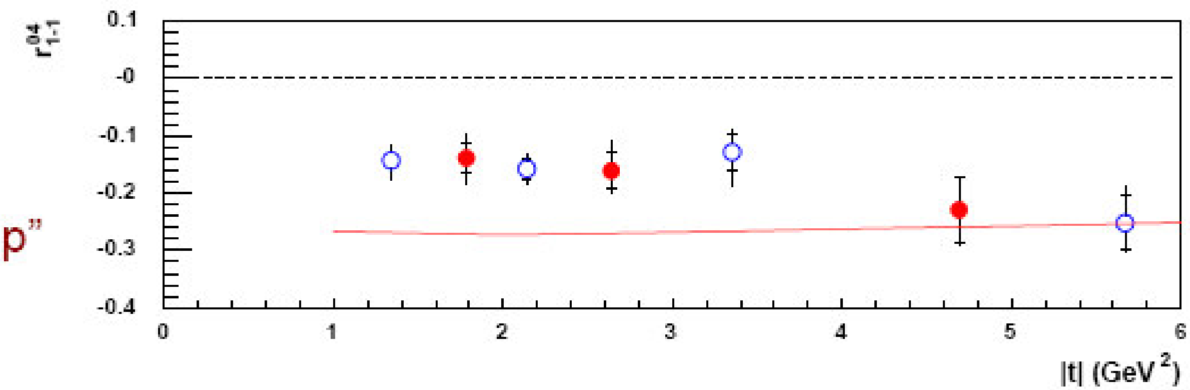
$$r^{04}_{00} = \frac{\langle |M_{+0}|^2 \rangle}{\langle |M_{++}|^2 + |M_{+0}|^2 + |M_{+-}|^2 \rangle}$$

- $r^{04}_{00} \neq 0 \Rightarrow$ Helicity "Single Flip"



$$r^{04}_{1-1} = \frac{1}{2} \frac{\langle M_{++}M^*_{+-} + M_{+-}M^*_{++} \rangle}{\langle |M_{++}|^2 + |M_{+0}|^2 + |M_{+-}|^2 \rangle}$$

- $r^{04}_{1-1} \neq 0 \Rightarrow$ Helicity "Double Flip"



→ r^{04}_{00} consistent with 0

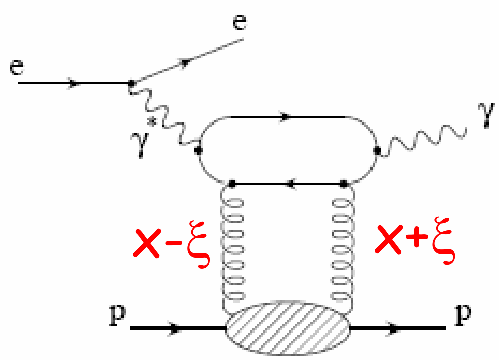
→ r^{04}_{1-1} violate SCHC

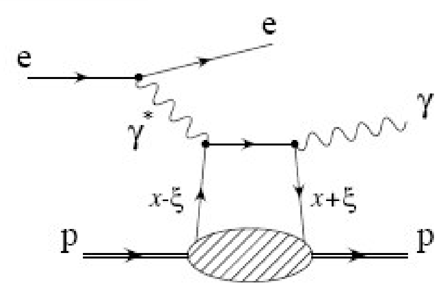
→ BFKL model qualitatively describes the data but ...

DVCS cross section at HERA

S. Glazov

$$e + p \to e + p + \gamma$$





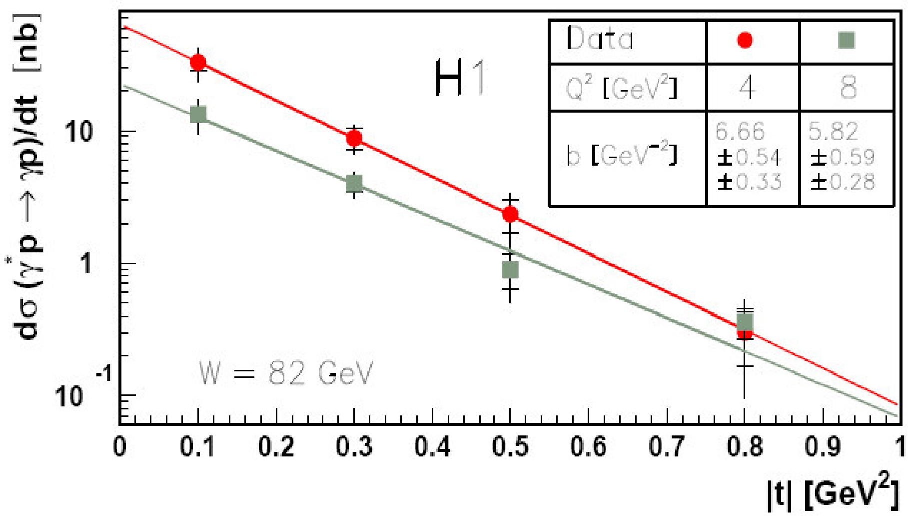
Generalised PDF:

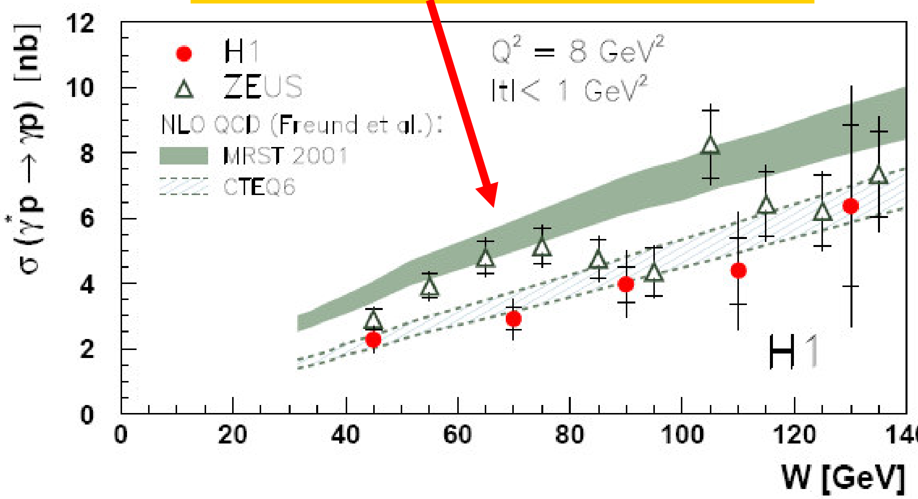
$Hq,g\,(x,\xi,t)$ → ($\xi=0$, $t=0$) → $q(x),g(x)$

$\tilde{H}q,g\,(x,\xi,t)$ → $\Delta q(x),\Delta g(x)$

+ E and $\tilde{E}$: no PDF equivalent

First t measurement → Fix model normalisation





Sensitivity to GPD parametrisation ?

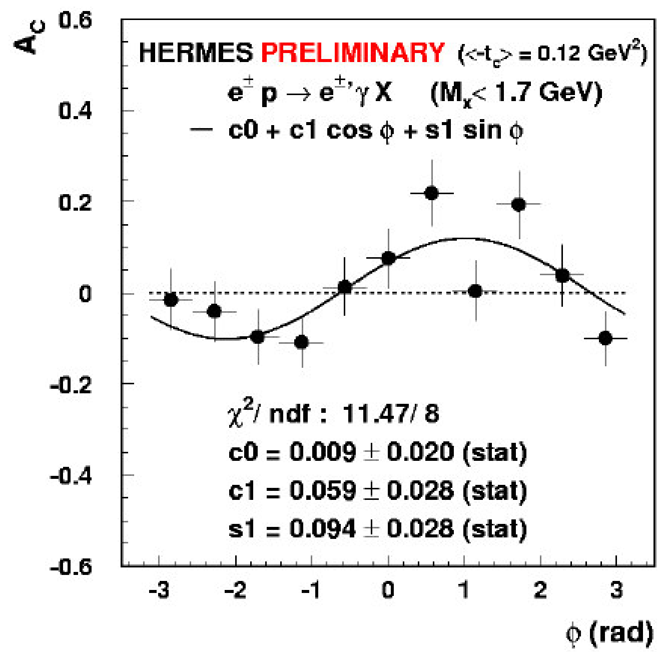
DVCS Measurements at HERMES

M. Kopytin

Beam Charge Assymetry

Positive and negative beam Charge
Unpolarized target

$\Delta\sigma_C \sim \cos(\phi)\, \mathrm{Re}\, H$



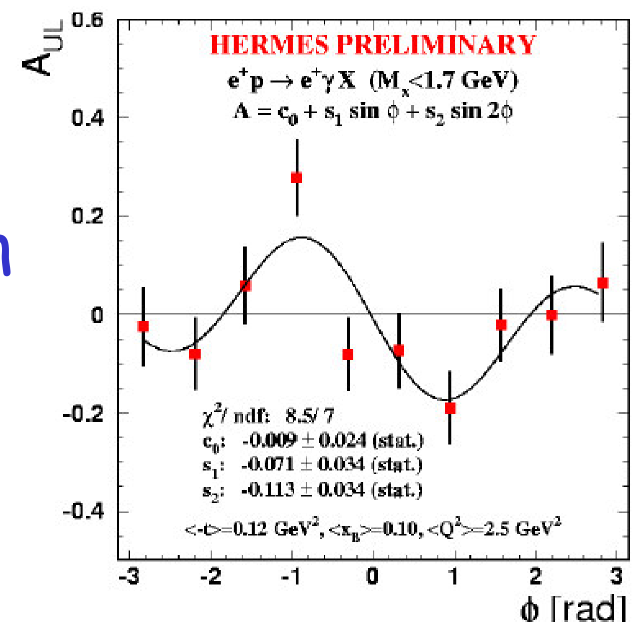
$$A_C^{\cos\phi} = 0.059 \pm 0.028$$

Proton

Longitudinal Target Spin Assymetry

Longitudinally polarized target
Unpolarized beam

$\Delta\sigma_{UL} \sim \sin(\phi)\, \mathrm{Im}\, H$



$A_{UL}^{\sin\phi}$ -0.071±0.034
$A_{UL}^{\sin 2\phi}$ -0.113±0.034

Twist 3 ?
$\mathrm{Im}(H^3, \tilde{H}^3)$

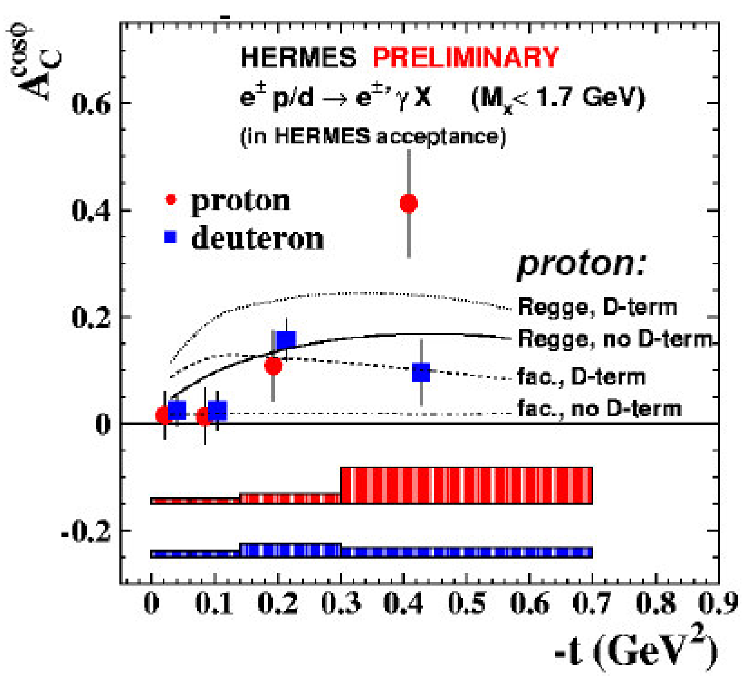
DVCS Measurements at HERMES

M. Kopytin

Beam Charge Assymetry

Positive and negative beam Charge
Unpolarized target

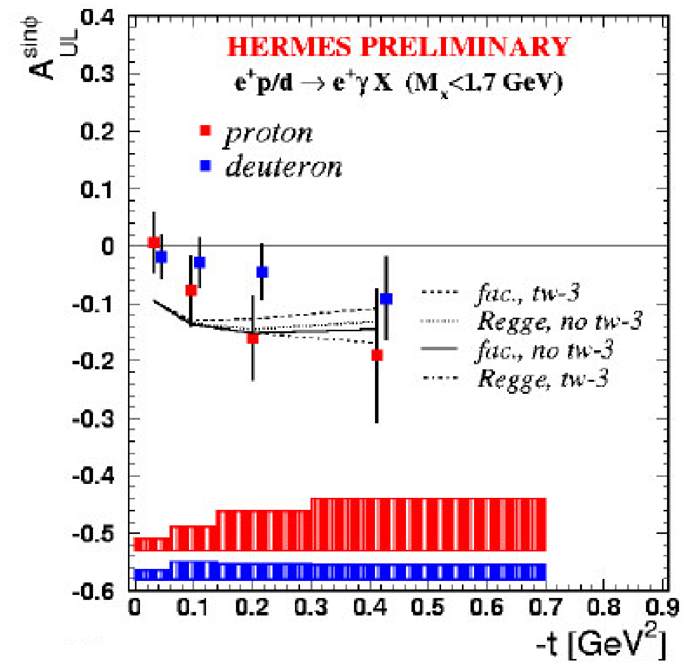
$\Delta\sigma_C \sim \cos(\phi)\,\mathrm{Re}\,H$



Longitudinal Target Spin Assymetry

Longitudinally polarized target
Unpolarized beam

$\Delta\sigma_{UL} \sim \sin(\phi)\,\mathrm{Im}\,H$

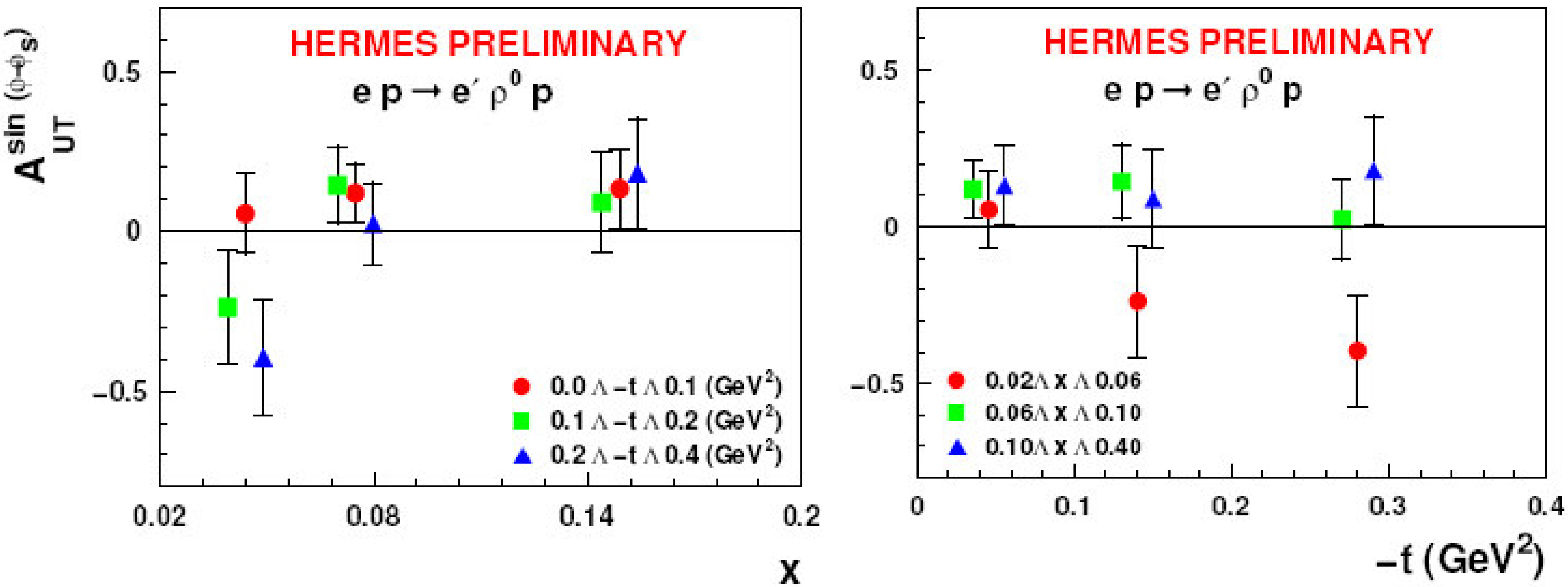


With increased statistic assymetries may constrain GPD models

Exclusive Meson Production

Target Spin Asymmetry A_{UT} for exclusive ρ^0 production

→ Sensitive to $E(x,\xi,t)$



Contributions

Vector Meson Production:

- New data on J/ψ ptoduction from H1 at HERA — C. Kiesling
- Vector mesons production at ZEUS — D. Szuba
- Diffractive production of vector mesons and the gluon at small x — T. Teubner
- High $|t|$ ρ^0 photoproduction at H1 — C. Gwilliam
- Diffractive ρ^0 production at COMPASS — N. d'Hose
- Vector meson electroproduction at small Bjorken-x and generalized parton distributions — P. Kroll

DVCS:

- Measurement of DVCS at H1 — S. Glazov
- Measurement of DVCS at HERMES — M. Kopytin
- Status and new results from DVCS at JLab — G. Gavalian

- Semi-inclusive production of pions and kaons — C. Weiss
- Exclusive meson production at HERMES — A. Vandenbroucke

Summary^2 and outlook

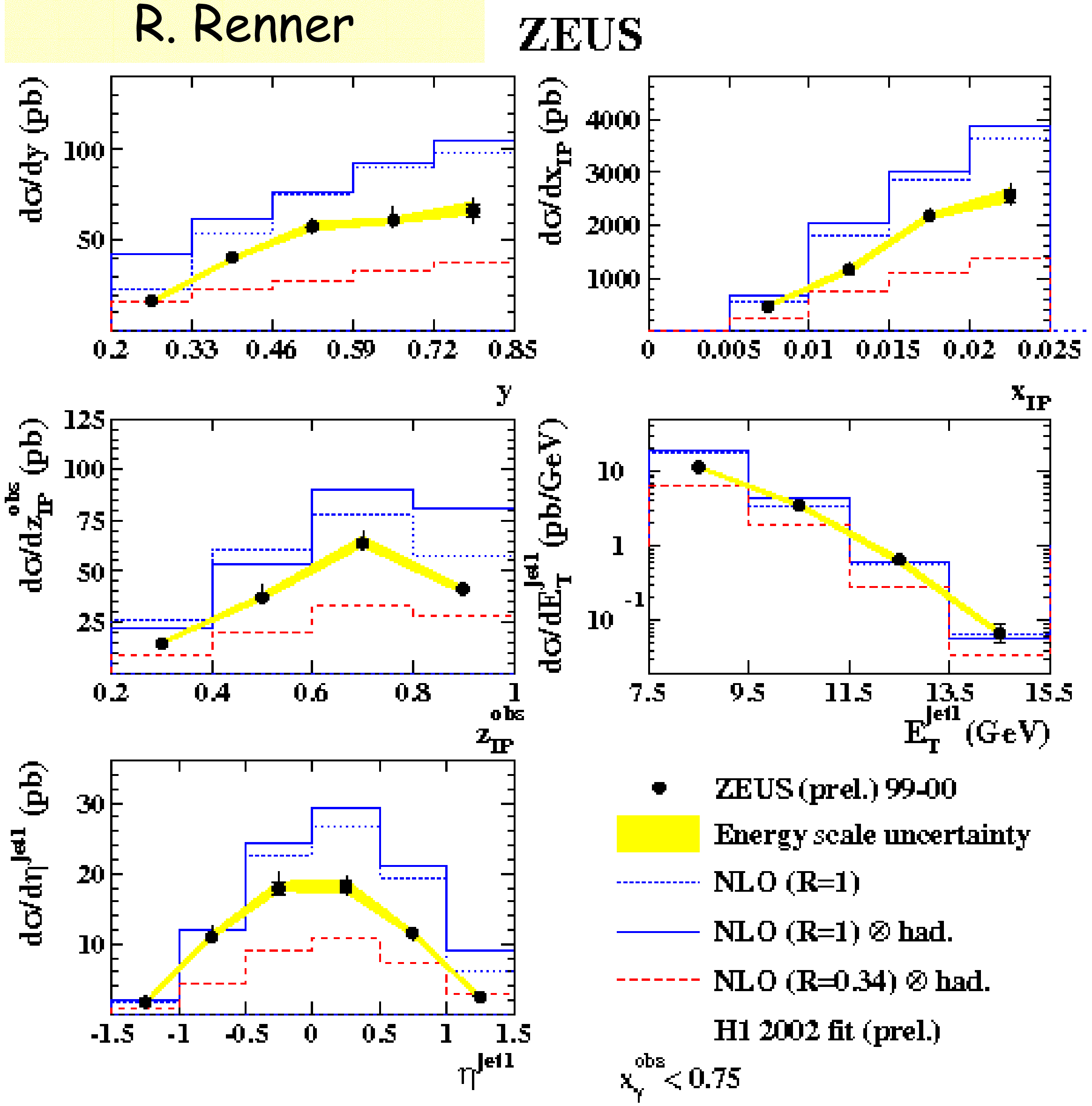
- Lot of interesting HERA and TEVATRON diffractive data available
- Consistent picture of inclusive diffractive DIS?
- DIS final states in terms of NLO diffr. Pdf's
- Factorization breaking in photoproduction?
- VM and DVCS to constrain gpd's

- Future: significantly more HERA Run-2 and TEVATRON data

BACKUP

resolved enriched ($x_\gamma < 0.75$)

R. Renner



>> NLO calculation

NLO QCD predictions

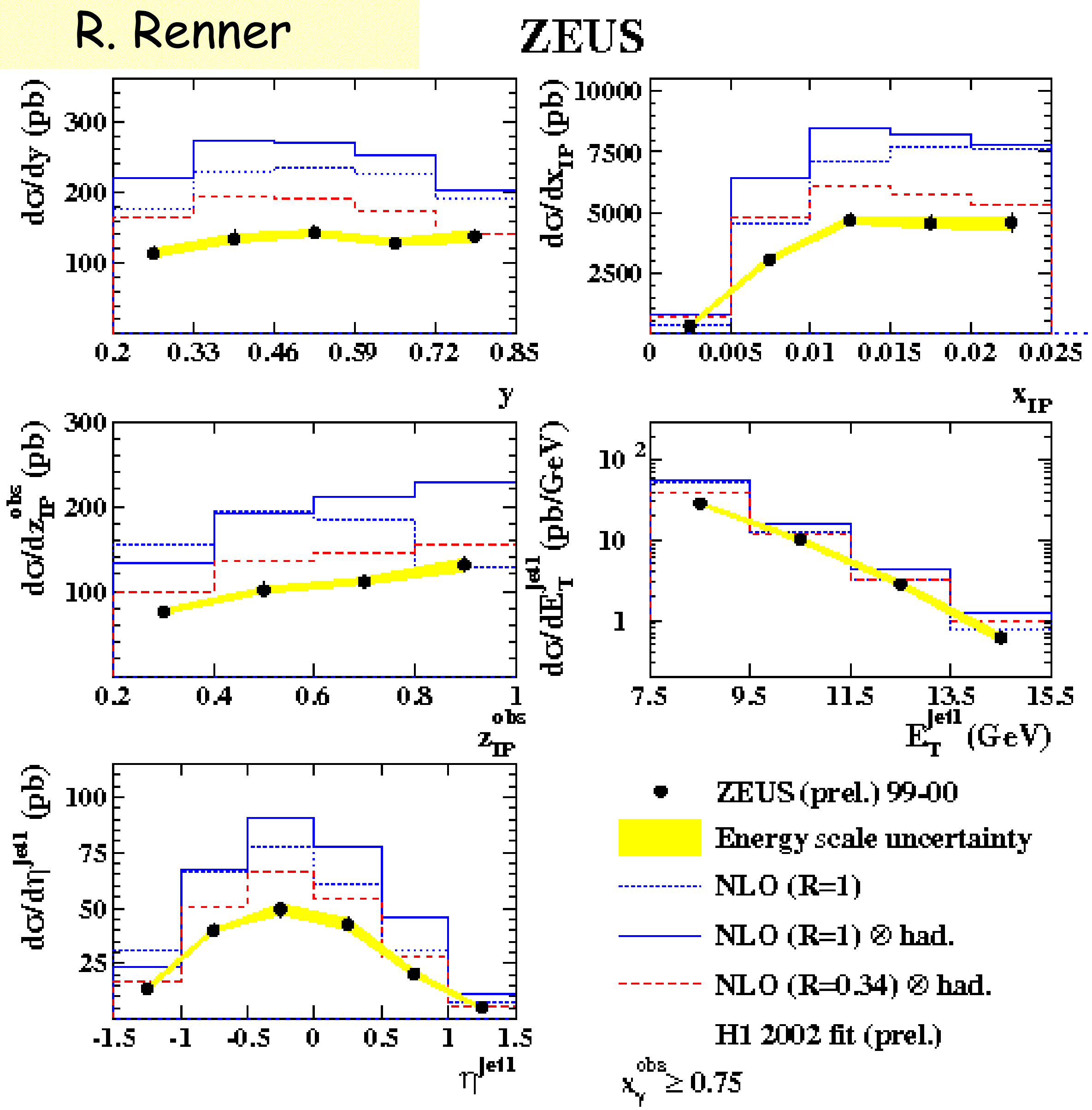
- describe the shape

- both, unsuppressed and suppressed, do not reproduce the normalization :

- too high for unsuppressed (R = 1)
- too low for suppressed (R = 0.34)

direct enriched ($x_\gamma > 0.75$)

R. Renner



NLO QCD predictions

- describe the shape

- both, unsuppressed and suppressed, do not repro-duce the normalization :

- too high for both

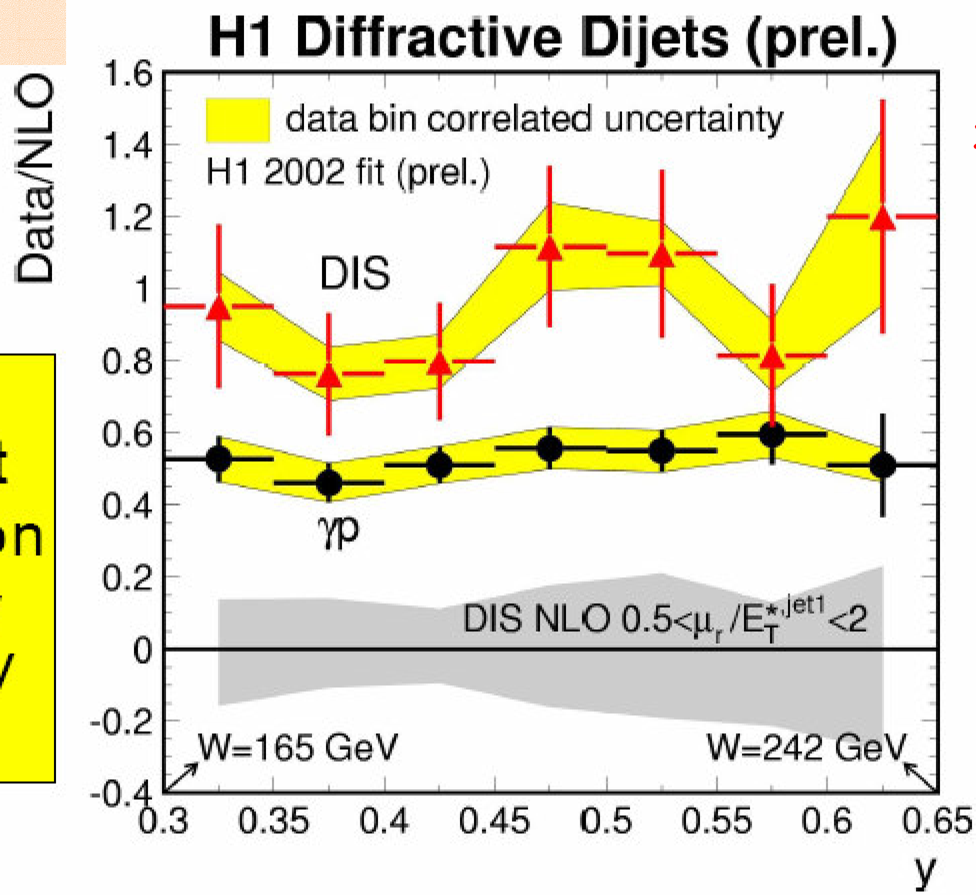
→ suggestive of
global suppression
direct + resolved

Dijet in PhP

M. Mozer

suppression depends on CMS-energy?

Tevatron: factor 7
HERA: factor 2



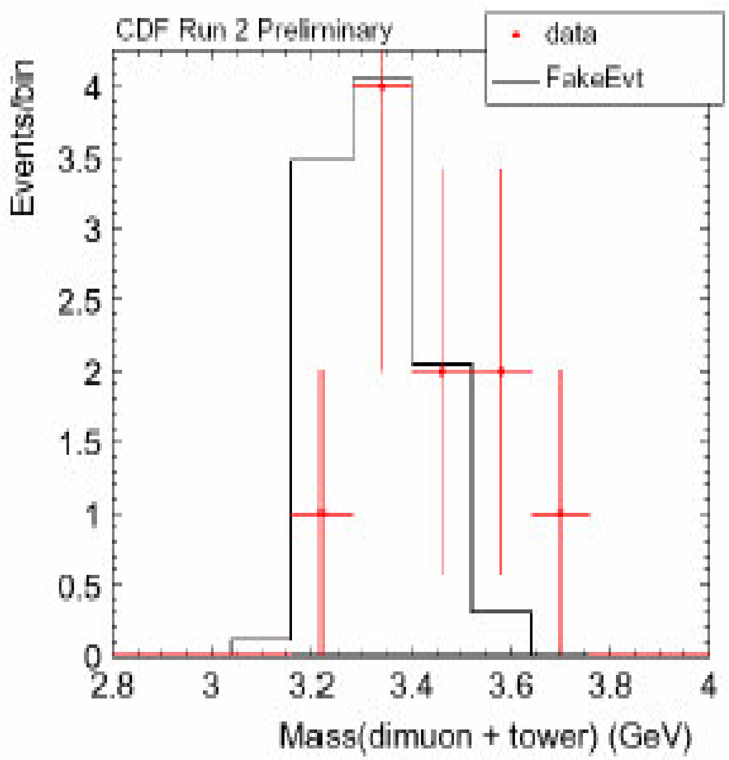
no significant dependence on CMS-energy 165-242GeV

> No suppression observed in DIS

> Overall suppression factor needed in γp (for both direct and resolved)

Both ZEUS and H1 data indicate global suppression of both direct and resolved PhP

Limits on X_c production



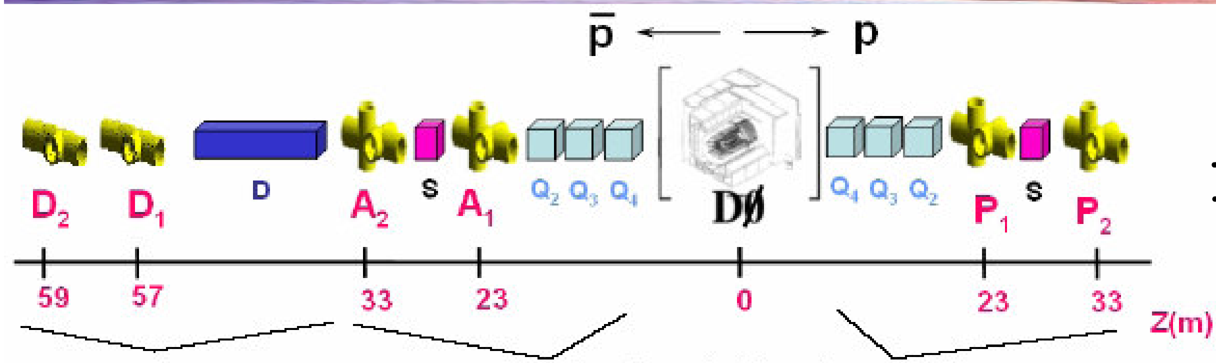
✓bkg from multiplicity fluctuations (under threshold)
✓difficult to estimate noise contribution

cross section **upper limit** for exclusive production

⇨ $\sigma_{excl}(J/\psi+\gamma) = 49 \pm 18(stat) \pm 39(syst)$ pb

~70 pb Khoze, Martin, Ryskin, Stirling
Eur. Phys. J. C 35, 211 (2004)

new trigger implemented

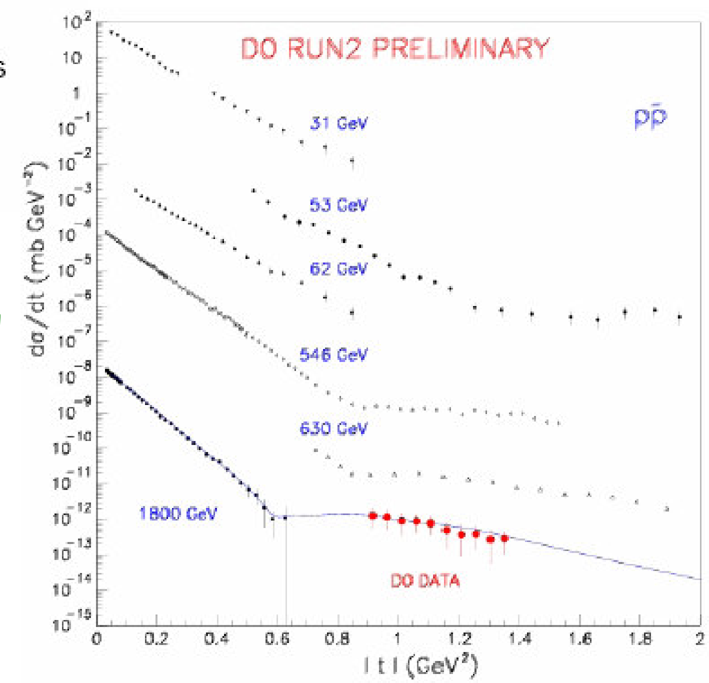


- **Dipole Spectrometer**
- inside the beam ring in the horizontal plane
- use **dipole magnet** (bends beam)

- **Quadrupole Spectrometers**
- surround the beam: up, down, in, out
- use **quadrupole magnets** (focus beam)
- also shown here: **separators** (bring beams together for collisions)

A total of 9 spectrometers composed of 18 Roman Pots

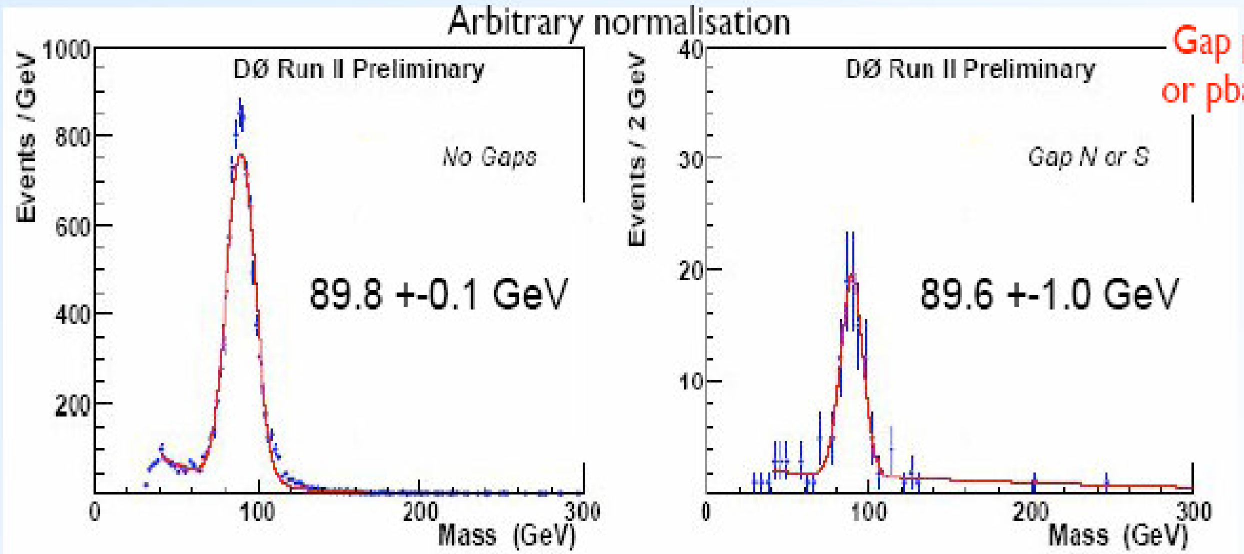
Initial measurement of Elastic t slope:



Now both CDF and D0 have roman pots and are actively pursuing broad diffractive physics program

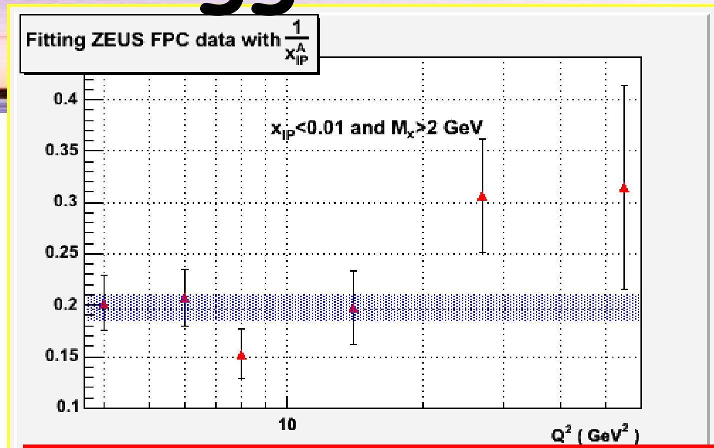
Many D0 Run-I diffractive results already using rapidity gap selection

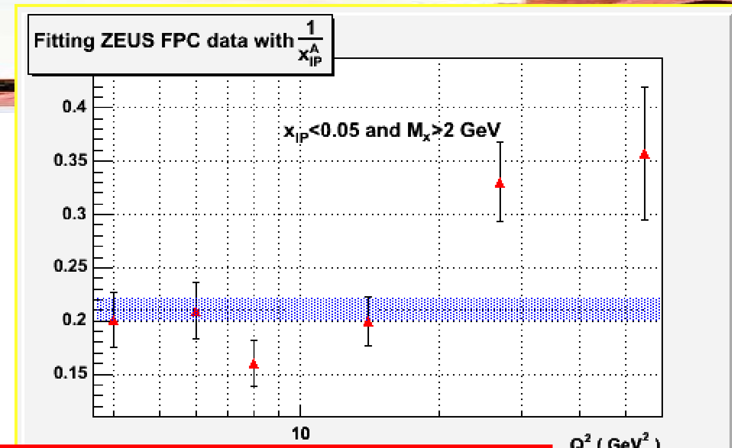
- diffractive W/Z probes quark content of Pomeron
- Search for forward gaps in $Z \rightarrow \mu^+\mu^-$ events using the Luminosity Monitor and forward calorimeter.
- Golden channel for DØ RunII:
  - Excellent coverage of muon system
  - Muon detection independent of rapidity gap signature
  - Tracking allows measurement of $\mu^+\mu^-$ invariant mass
  - A clean, well-understood inclusive Z sample



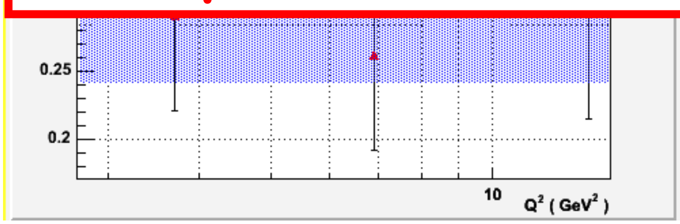
Jean-Laurent Agram   Diffraction 2004   14

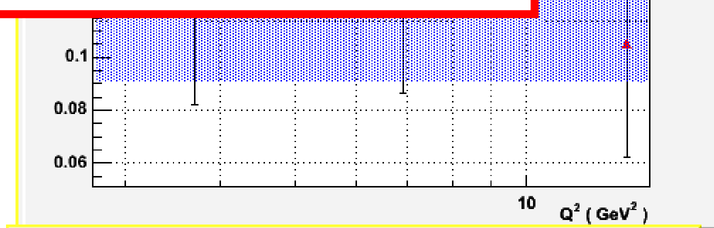
Does Regge Factorization hold?

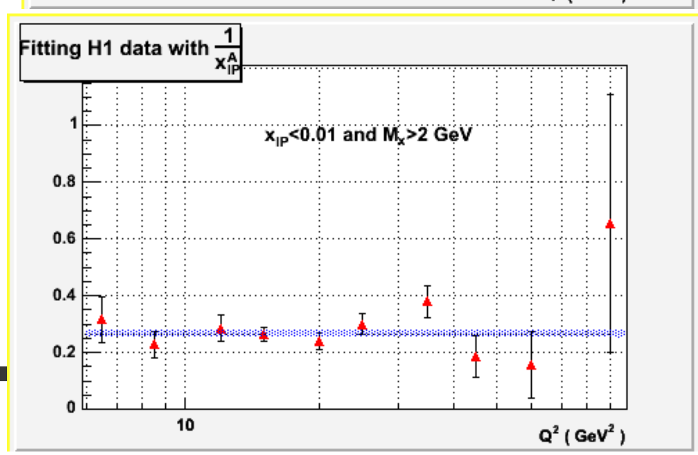


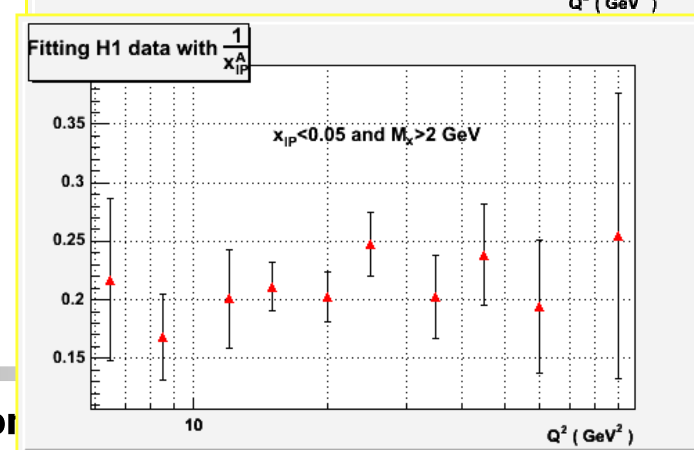


For x_{IP} < 0.01, flux seems indeed independent of Q^2 and of β

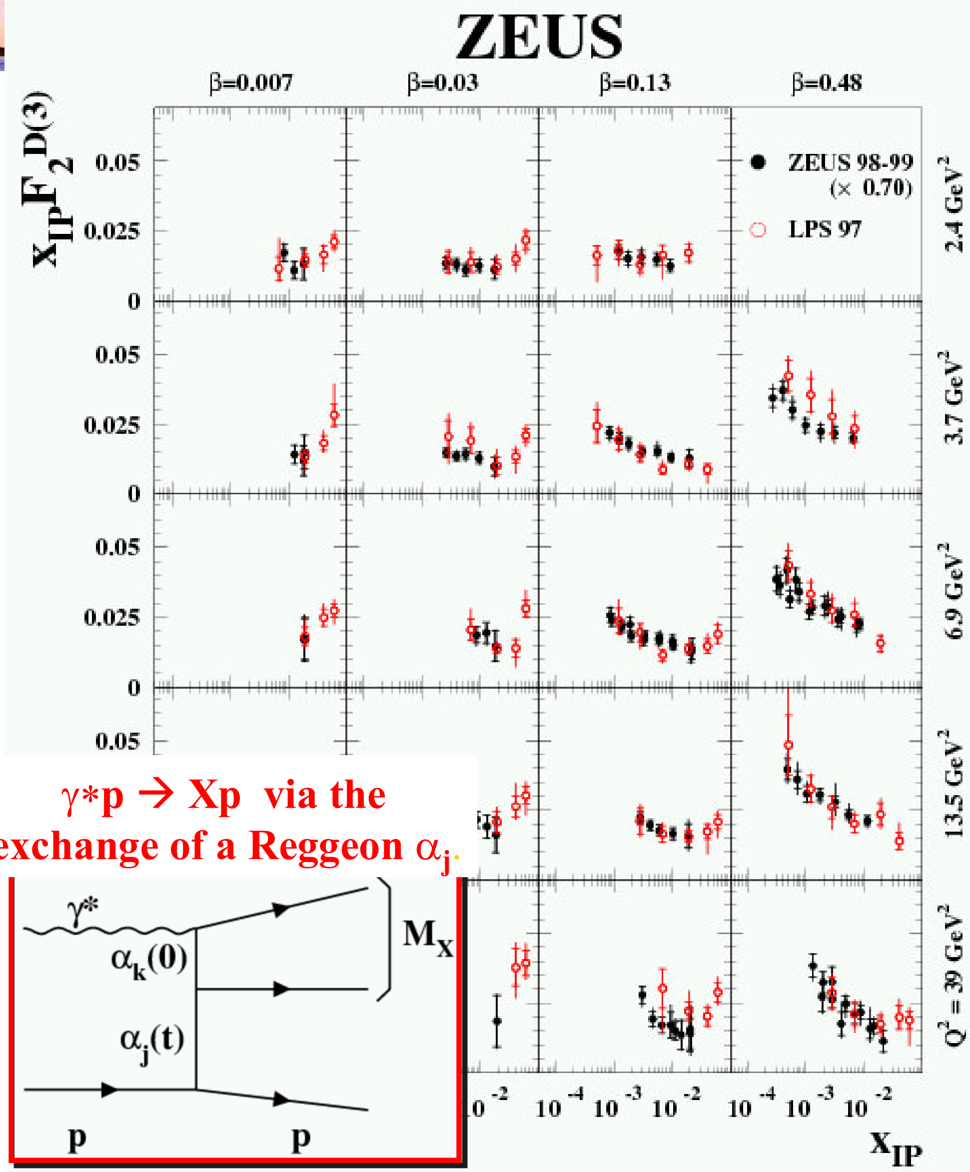




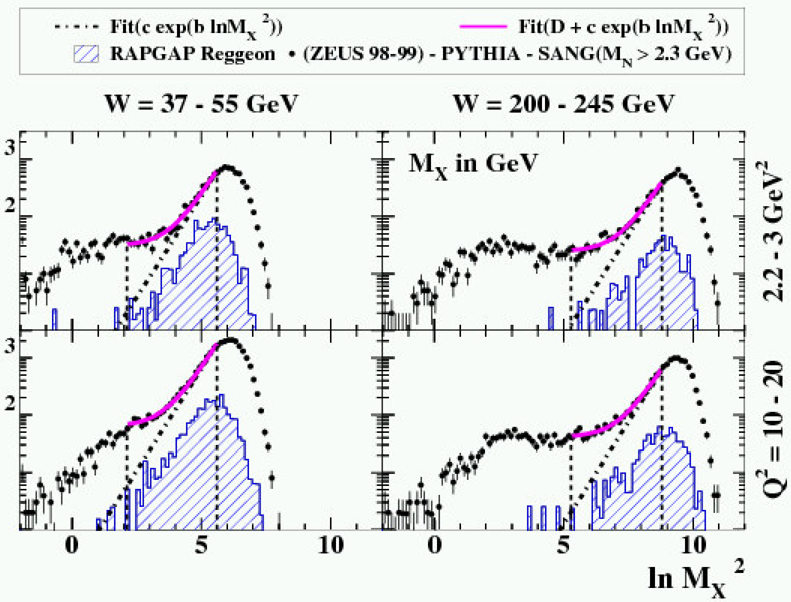




Diffractive structure function



$\gamma^* p \rightarrow Xp$ via the exchange of a Reggeon α_j.



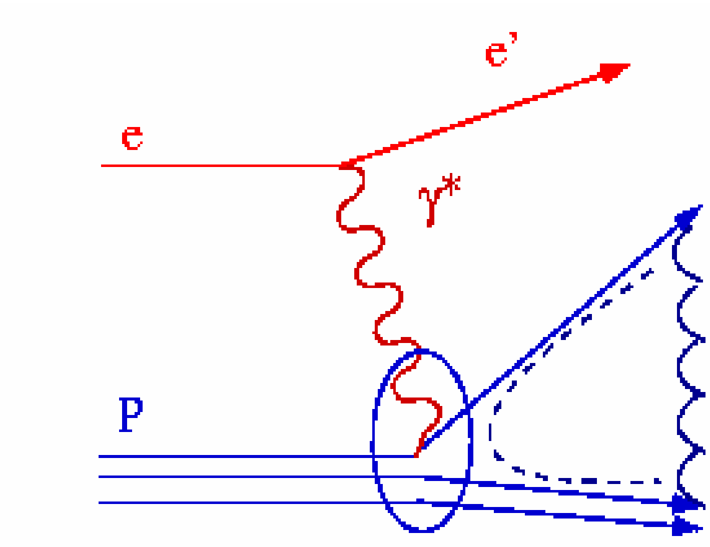
- Mx method normalized to LPS to suppress pdiss background

- Good agreement between LPS and M_X method (for M_N < 2.3 GeV) except for the region of x_{IP} > 0.01 where Reggeon contributions may dominate LPS.

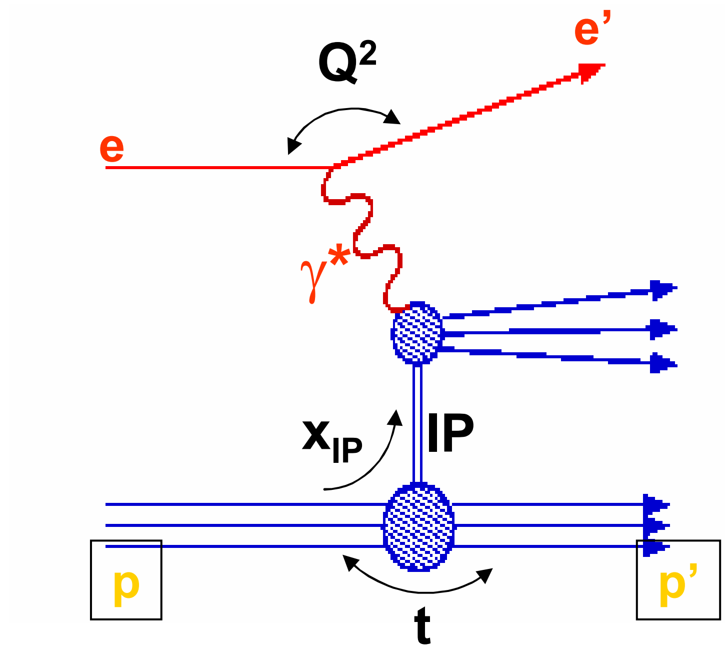
Diffractive DIS at HERA

10% of low-x DIS events are diffractive

Standard DIS



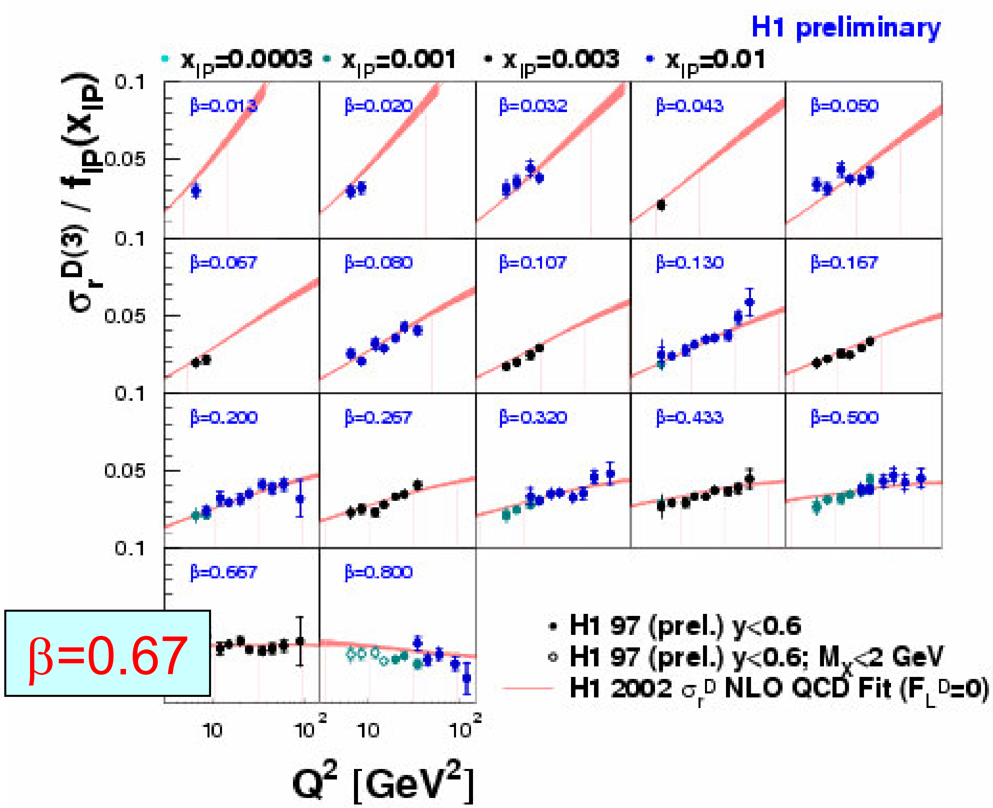
Diffractive DIS

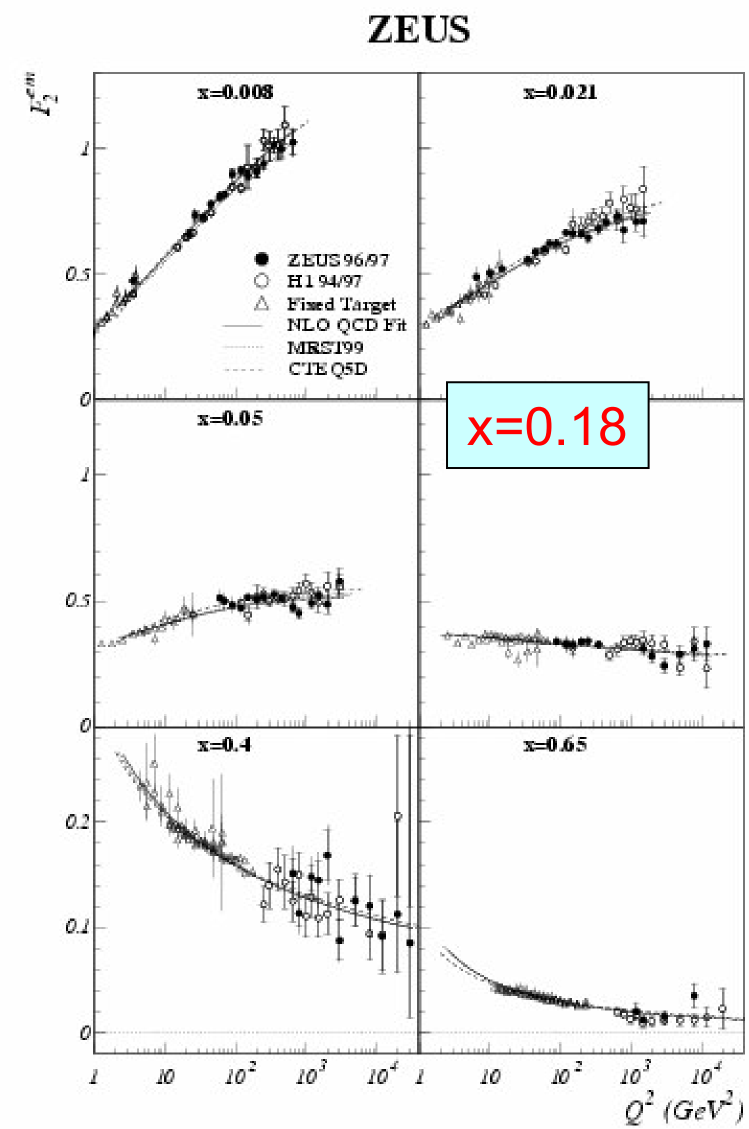


Probe structure of proton → F_2

Probe structure of color singlet exchange → F_2^D

Scaling violation of $F_2^{D(3)}$





- Positive scaling violations to highest β

$\rightarrow$ lot of gluons