Sneak Preview of new H1 results for ICHEP06

DESY Seminar, July 24, 2006

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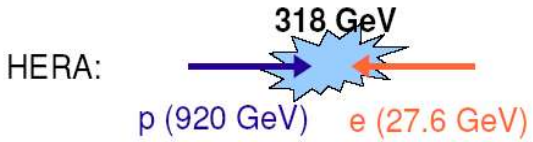
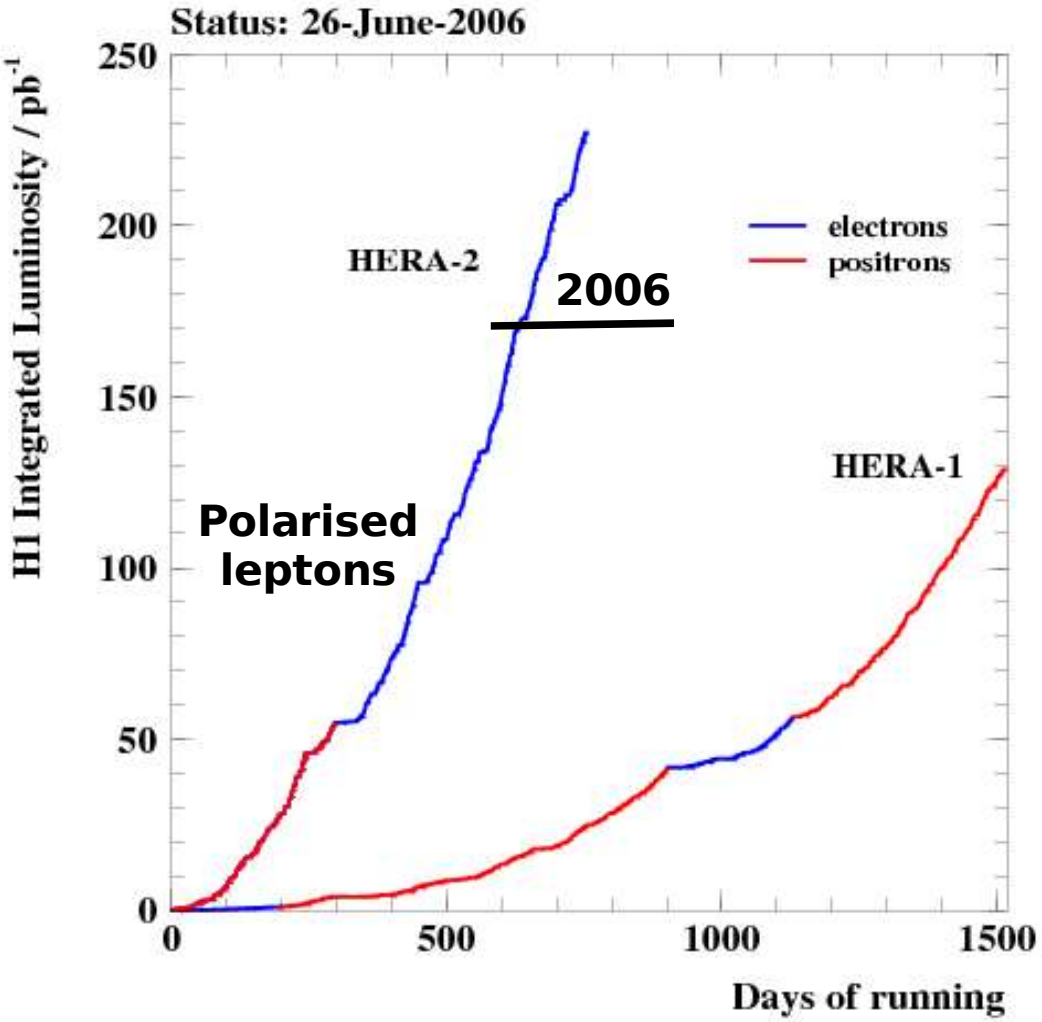
H1 data sets





HERA I: ~130 pb^{-1}

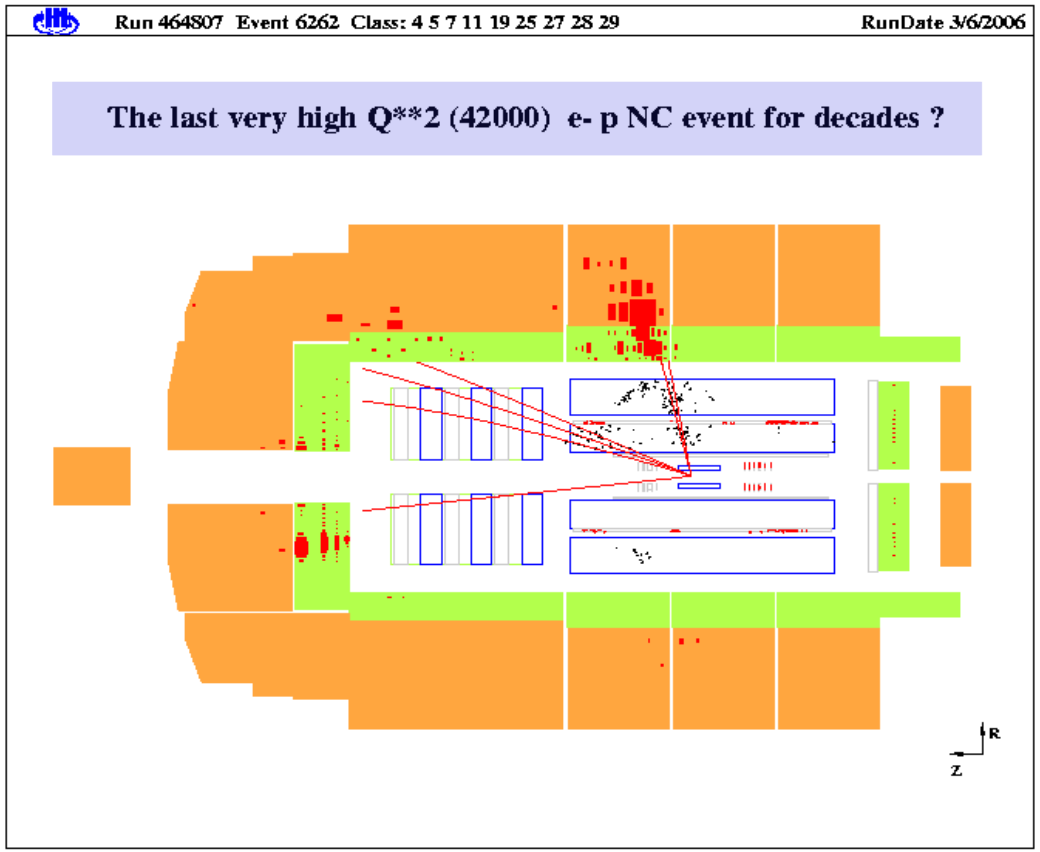
➔ 17 New Measurements since HEP2005

HERA II (since 2003): ~230 pb^{-1}

➔ 12 New Measurements since HEP2005

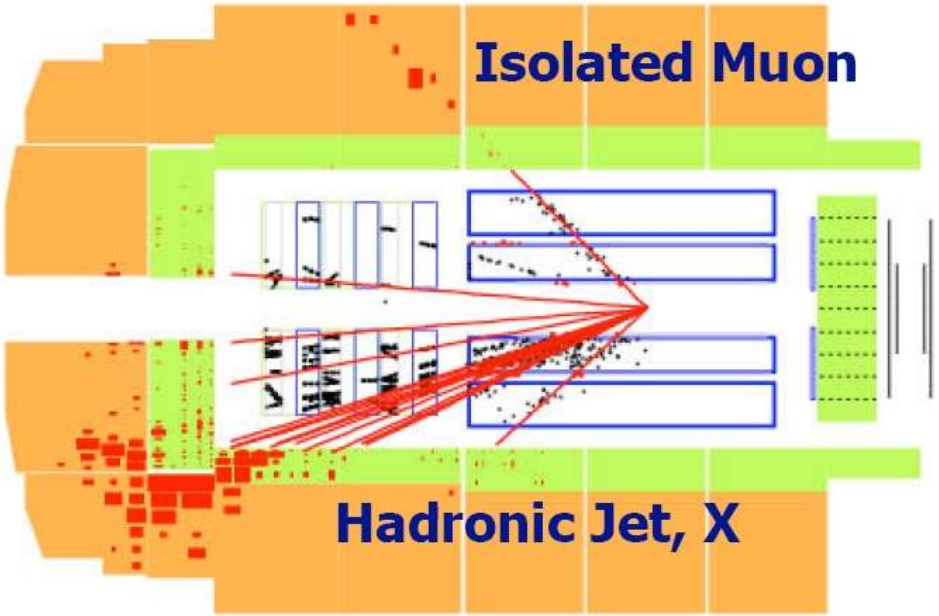
H1 data taking in 2006

- ➔ Best performance ever
- ➔ e.g. further improved HF efficiency
- ➔ Ready to collect many many more pb^{-1}

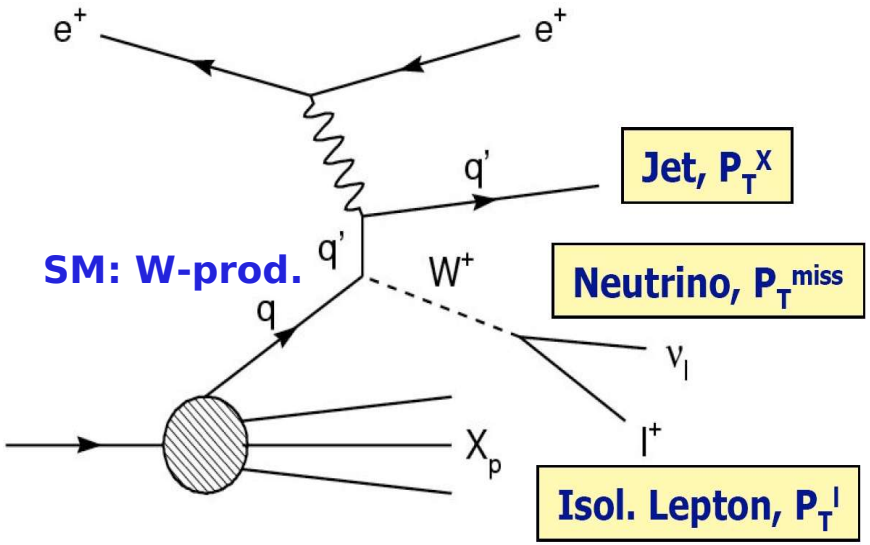


Is the SM ok?

➔Most prominent excess seen in HERA I : Isolated leptons



HERA I μ + P_T^{miss} event

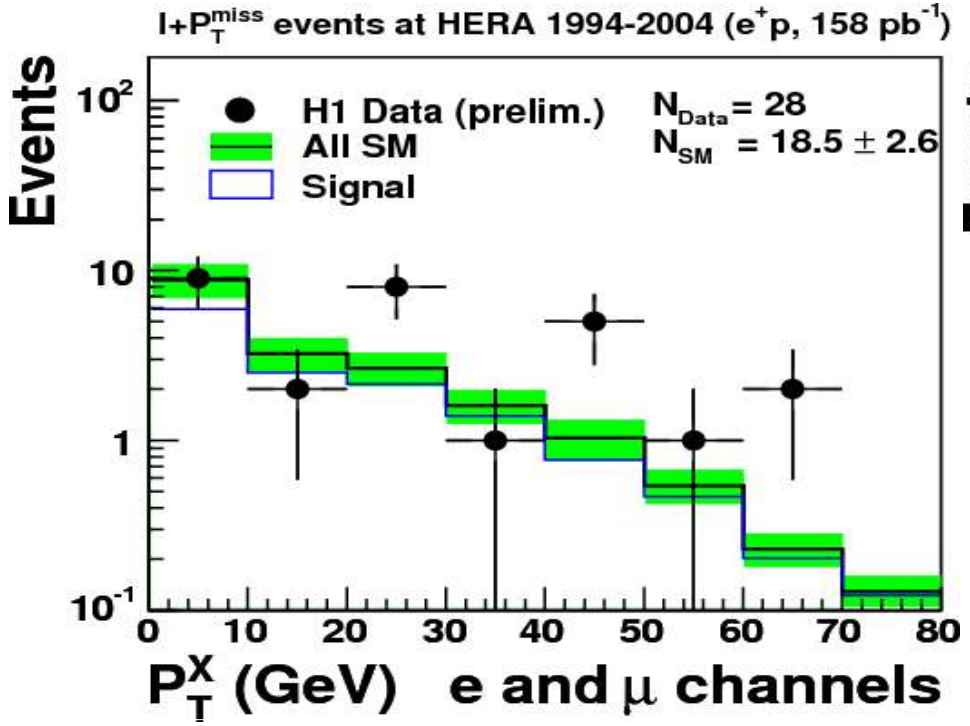


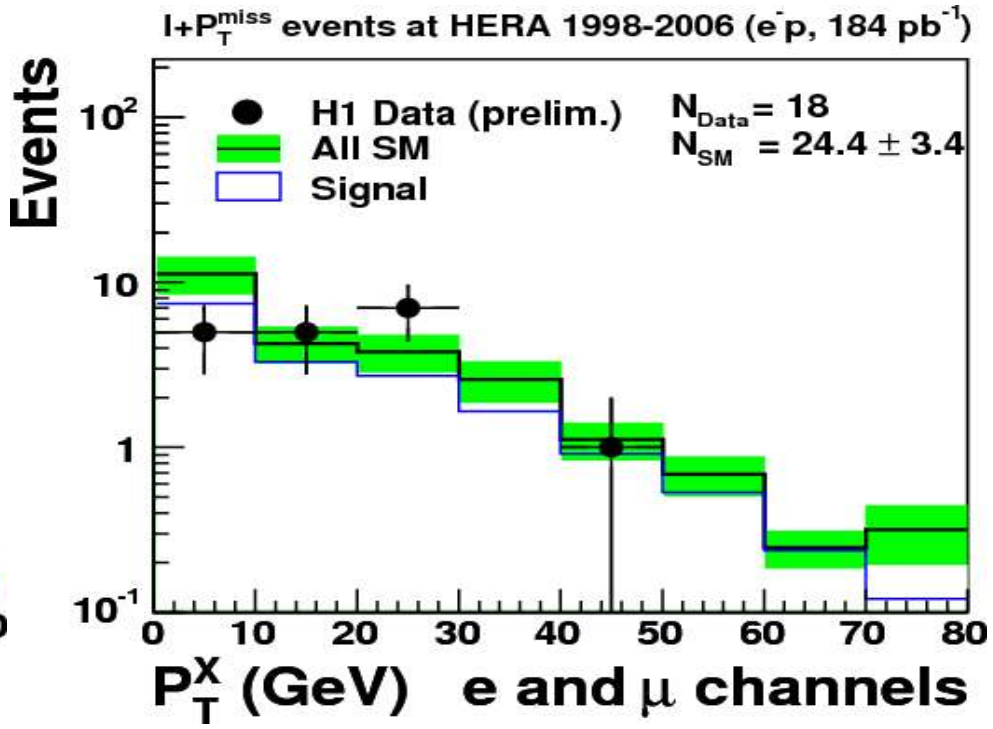
➔ Excess observed for p_T^X>25 GeV

Isolated leptons: all HERA I+II data

➔ Including brand-new 2006 data (65 pb^{-1})

➔ Further e and μ events observed in HERA II





p_T^X>25 GeV: 15 (obs.) / 4.6±0.8 (exp.)

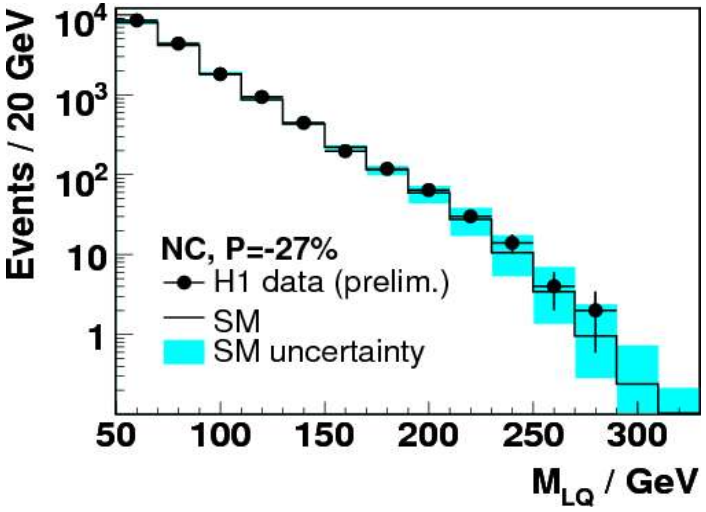
➔ Clarify excess in e^+p with the coming data

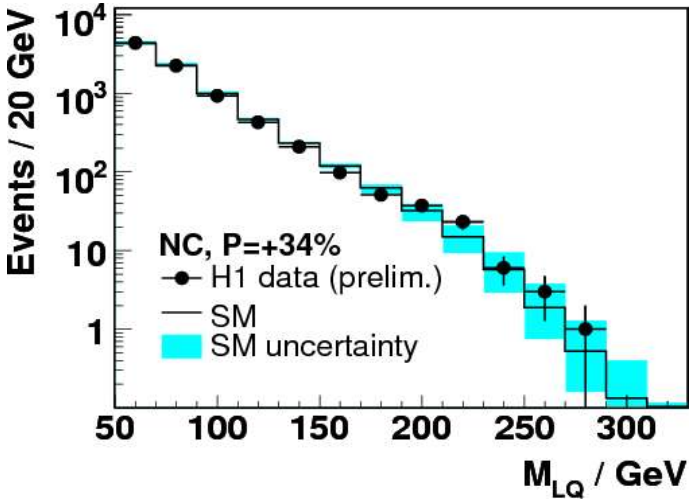
➔ No indications for excess in e^-p data

Search for Leptoquarks

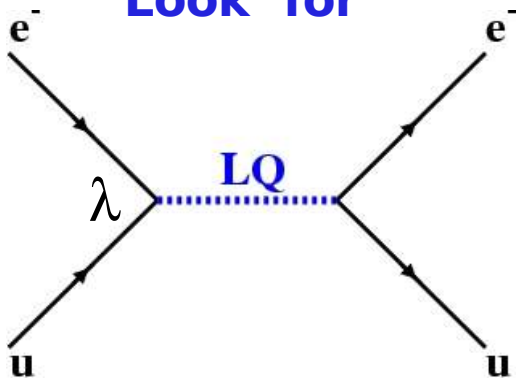
➔ Use ~92 pb^{-1} e-p data from 2005

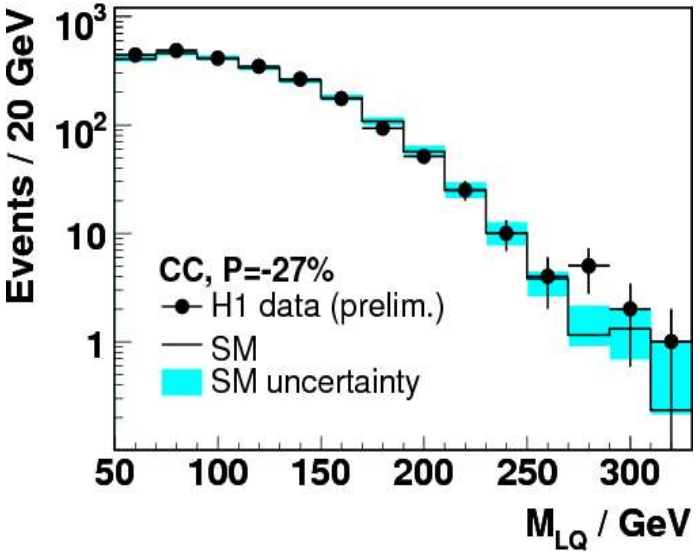
➔ e-p especially sensitve to LQ's with Fermion number = 2

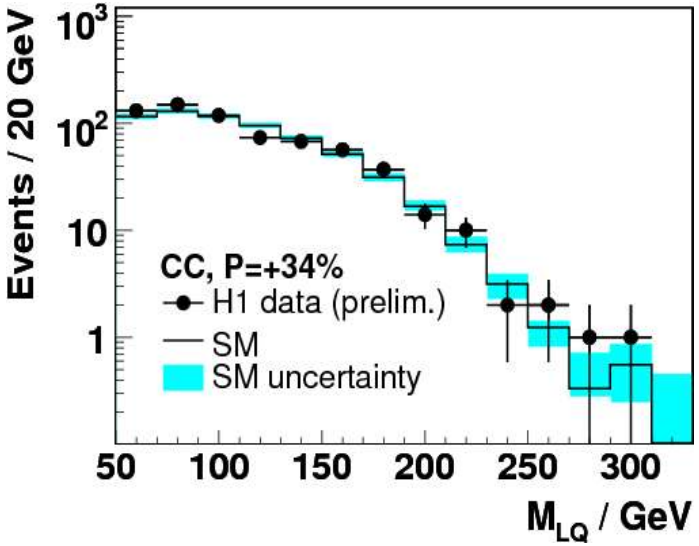


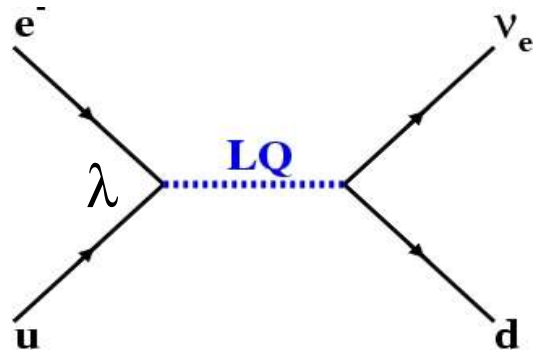


Look for





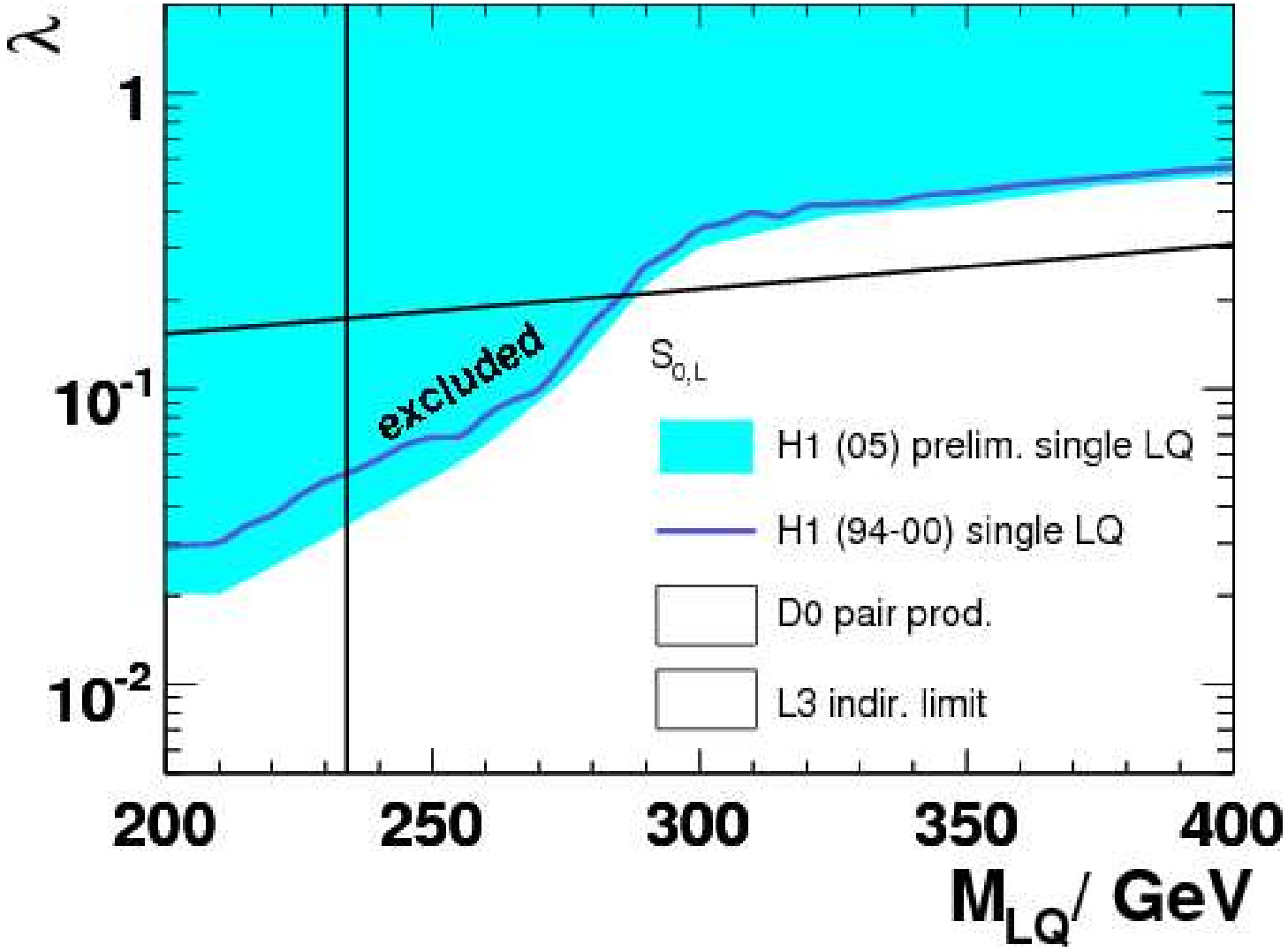




➔ No indications for a LQ signal

Leptoquarks: exclusion limit

- ➔ On coupling λ as function of M_{LQ}
- ➔ Shown here for scalar leptoquark (in framework of BRW model)



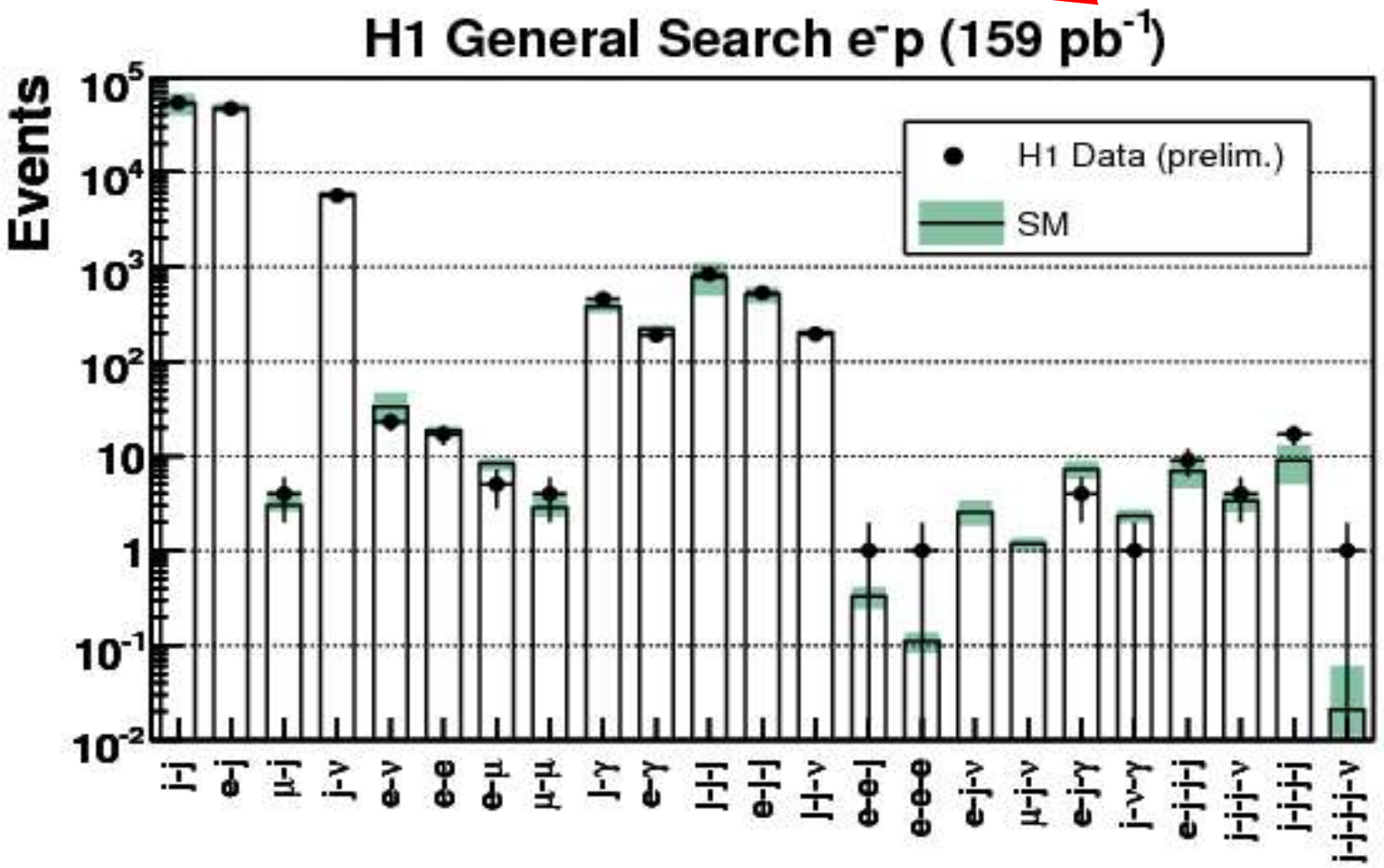
➔ Improved Limits, also for vector LQs

Generic search in e-p data

➔ **Search for deviations from SM using all suitable final states (Jets, Leptons)**

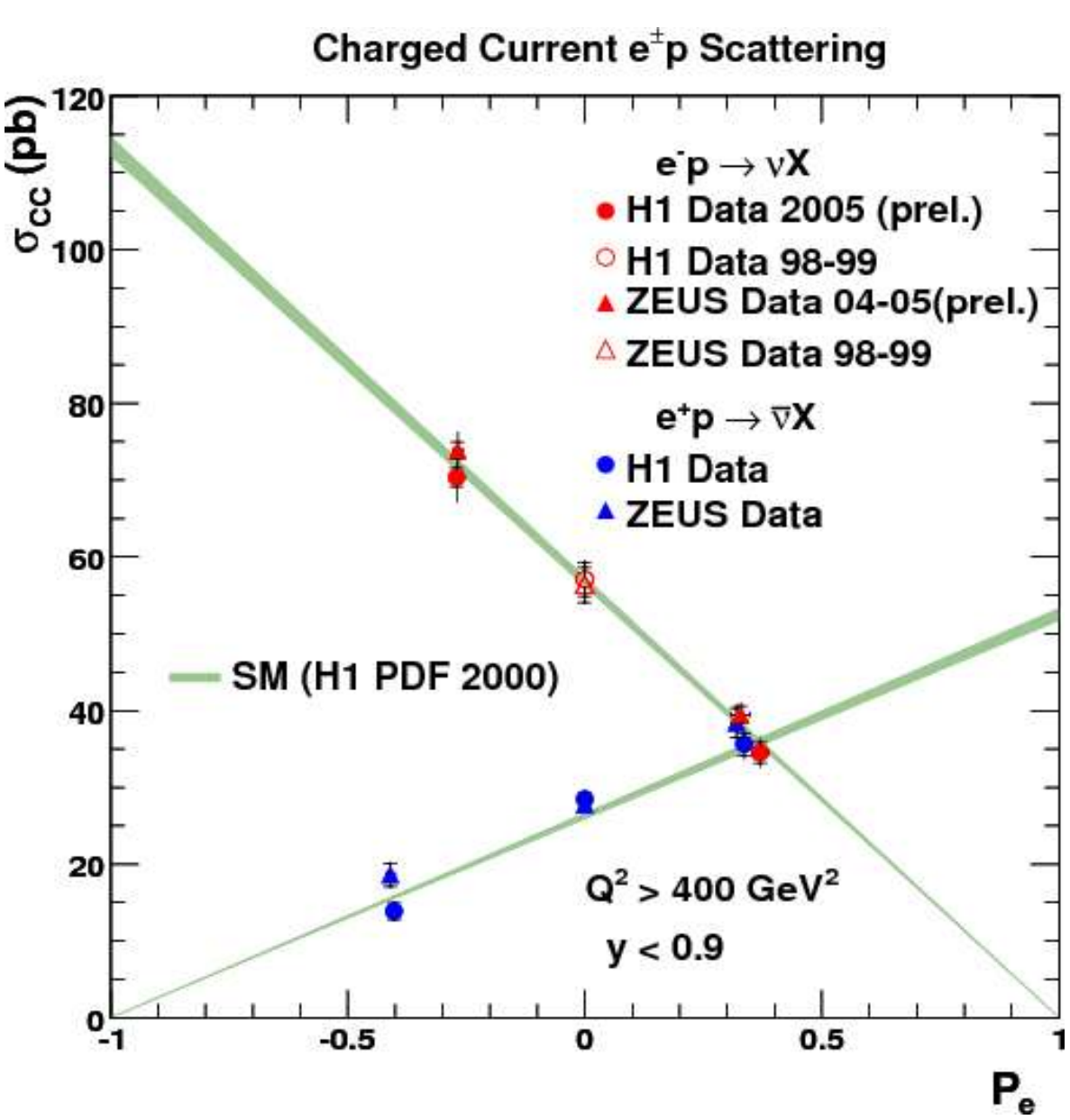
➔ **Employ standardised particle finders**

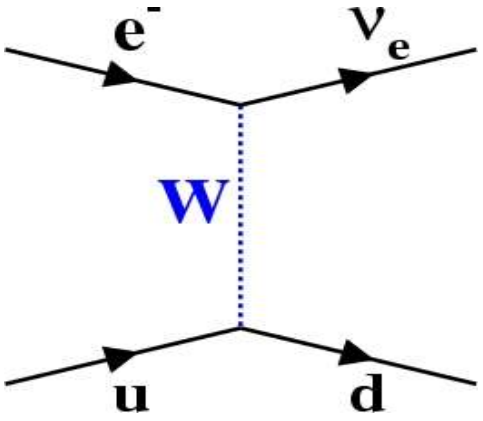
'05 and '06 e- p data



➔ **SM ok !**

Electroweak tests: Charged current vs P_e



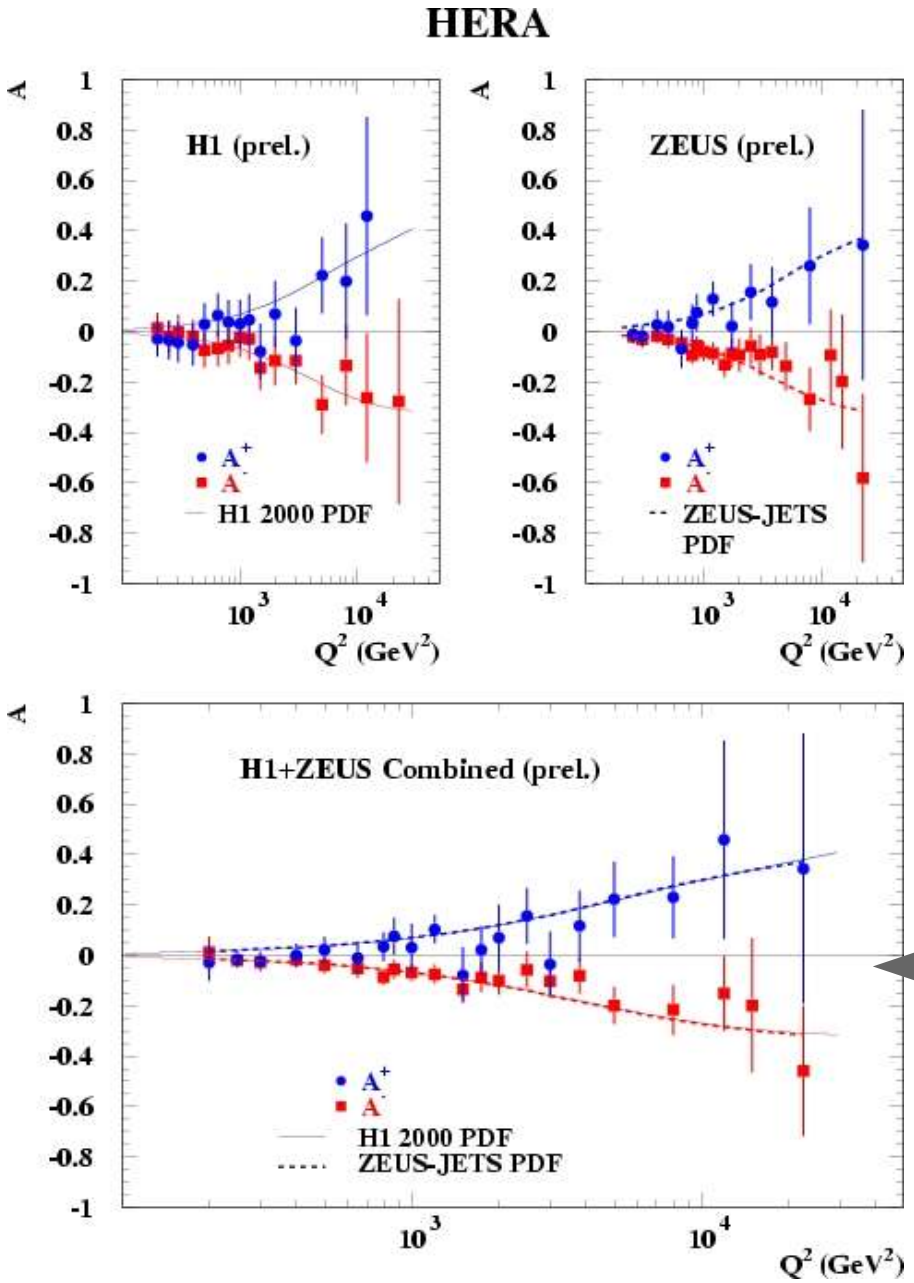


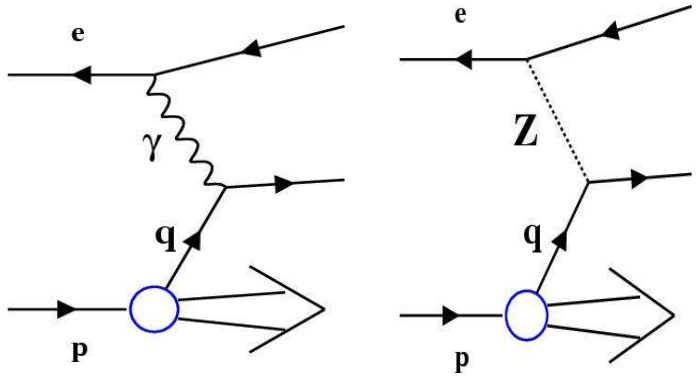
$$\sigma^{e^{\pm}p}_{\text{polCC}}(Q^2,x) = \frac{1 \pm P_e}{2} \cdot \sigma^{e^{\pm}p}_{\text{LHCC}}(Q^2,x)$$

➔ **Textbook plot! Absence of RH charged currents**

➔ **M(W_R)>~180-208 GeV with current precision**

Electroweak tests: Neutral currents vs P_e





➔ **Use prelim. H1 and ZEUS e±p data from 2003-2005**

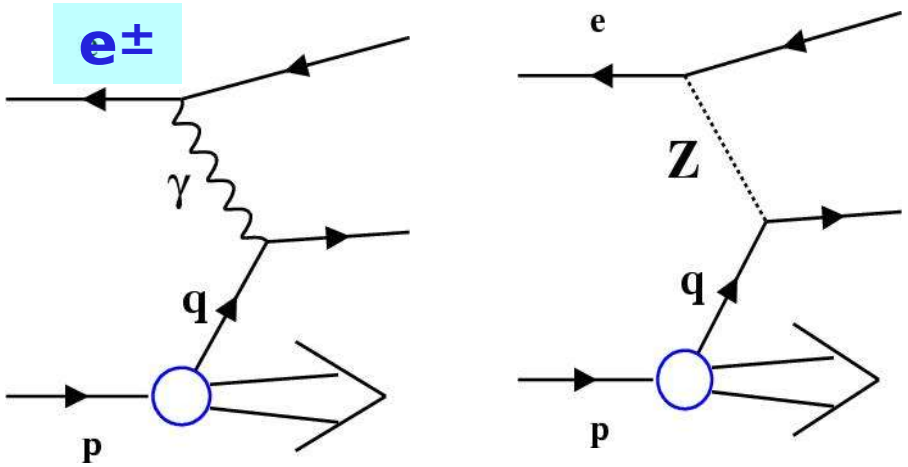
$$A^{\pm} = \frac{2}{P_R - P_L} \cdot \frac{\sigma^{\pm}(P_R) - \sigma^{\pm}(P_L)}{\sigma^{\pm}(P_R) + \sigma^{\pm}(P_L)} \simeq \mp k a_e \frac{F_2^{\gamma Z}}{F_2}$$

~ Parity violating $a_e v_q$ terms

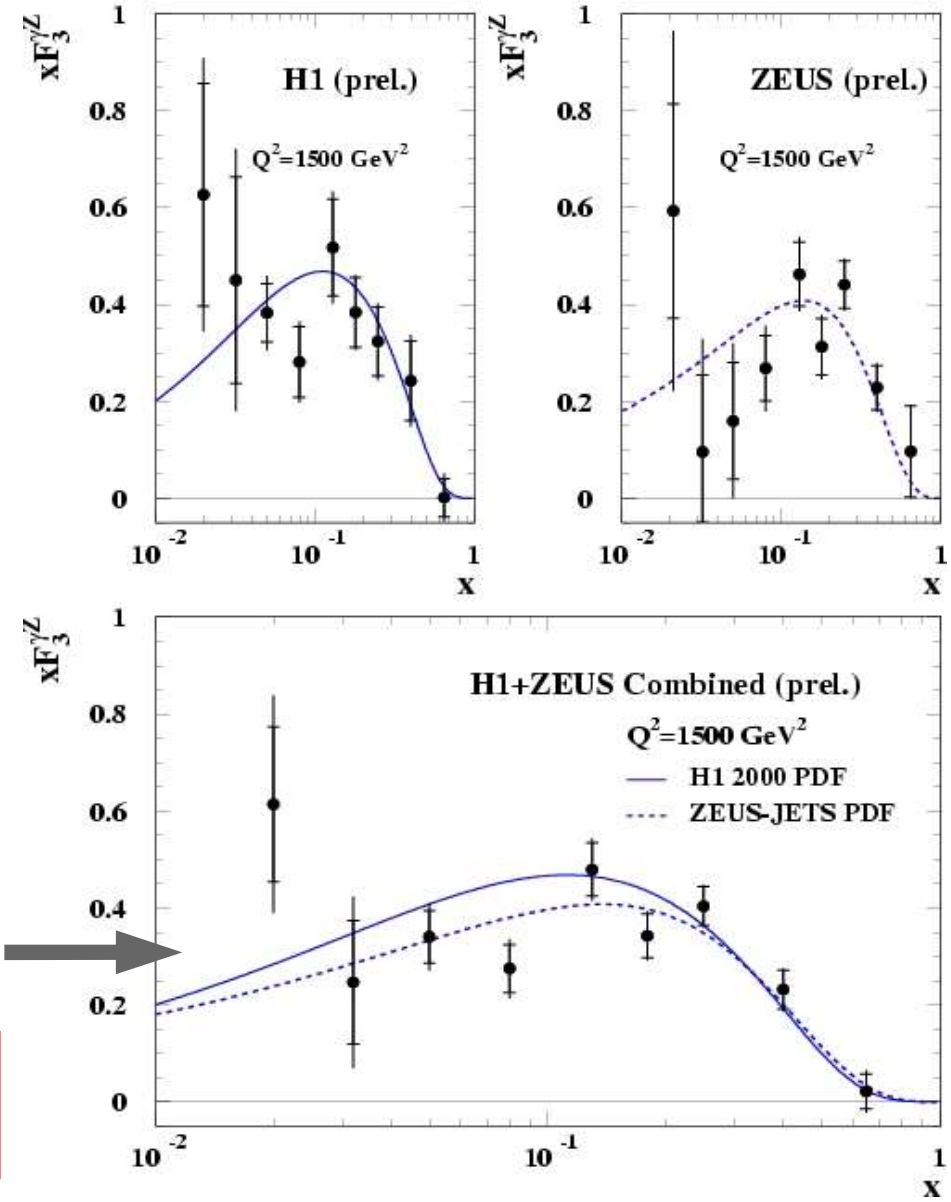
H1 & ZEUS combined data

➔ **First observation of parity viol. in NC e±p data at R<10^{-18} m**

Neutral Currents vs lepton charge: xF_3



HERA I + II



γ-Z interference flips sign when $e^+ \rightarrow e^-$

➔ Add all e^+p (and e^-p) data, correct for residual pol. $\rightarrow \sigma^+, \sigma^-$

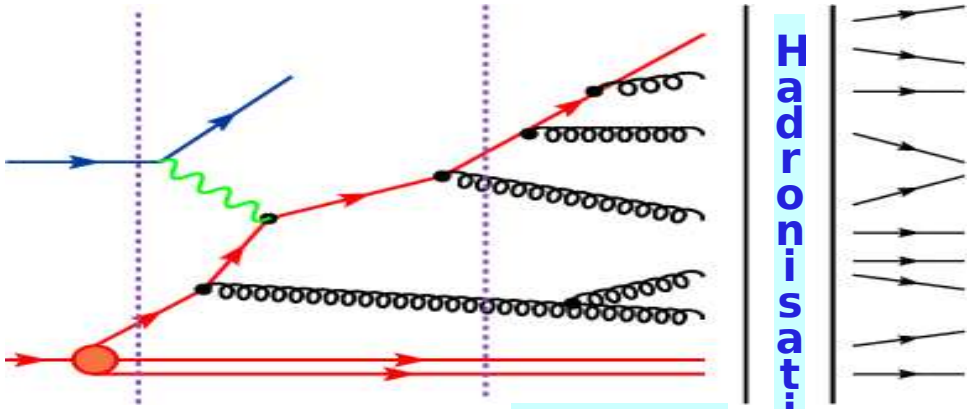
$$xF_3^{\gamma Z} = \frac{Y_+}{2ka_eY_-} \cdot (\sigma^+ - \sigma^-) \simeq \frac{x}{3}[2u_v + d_v]$$

H1 & ZEUS combined data

➔ Add to the knowledge of valence quarks at lower x

QCD tests: Event shapes

DESY 05-225



Hard radiation | **Parton shower**

➔ **Topology of produced hadrons:**

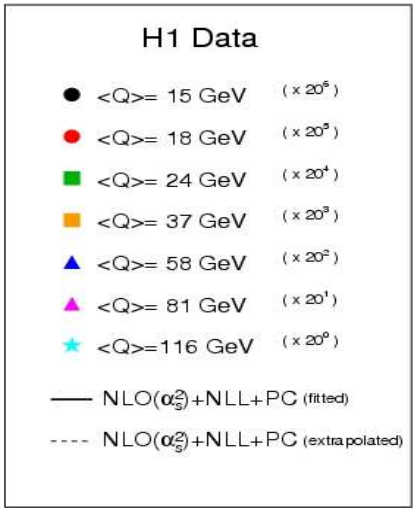
Example: Thrust

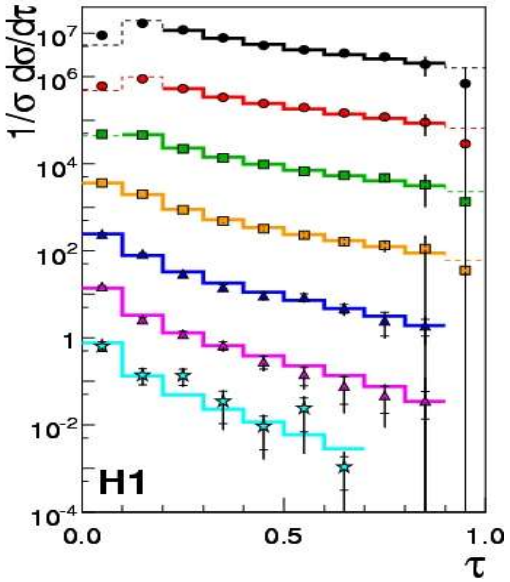
$$T = \frac{\sum_h |\vec{p}_{z,h}|}{\sum_h |\vec{p}_h|}$$

Calcu-lation: **NLO O(α_s^2) +NLL +PC(α_0)**

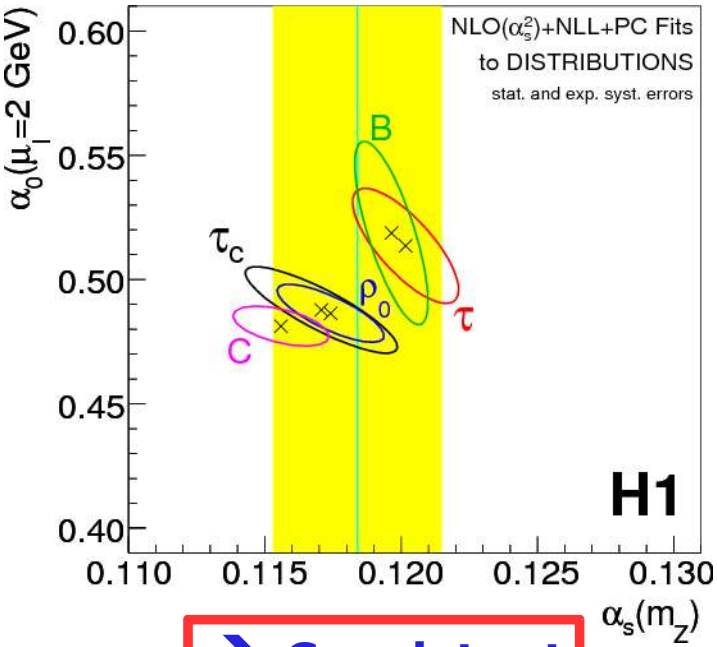
Results for

$$\tau = 1 - T$$



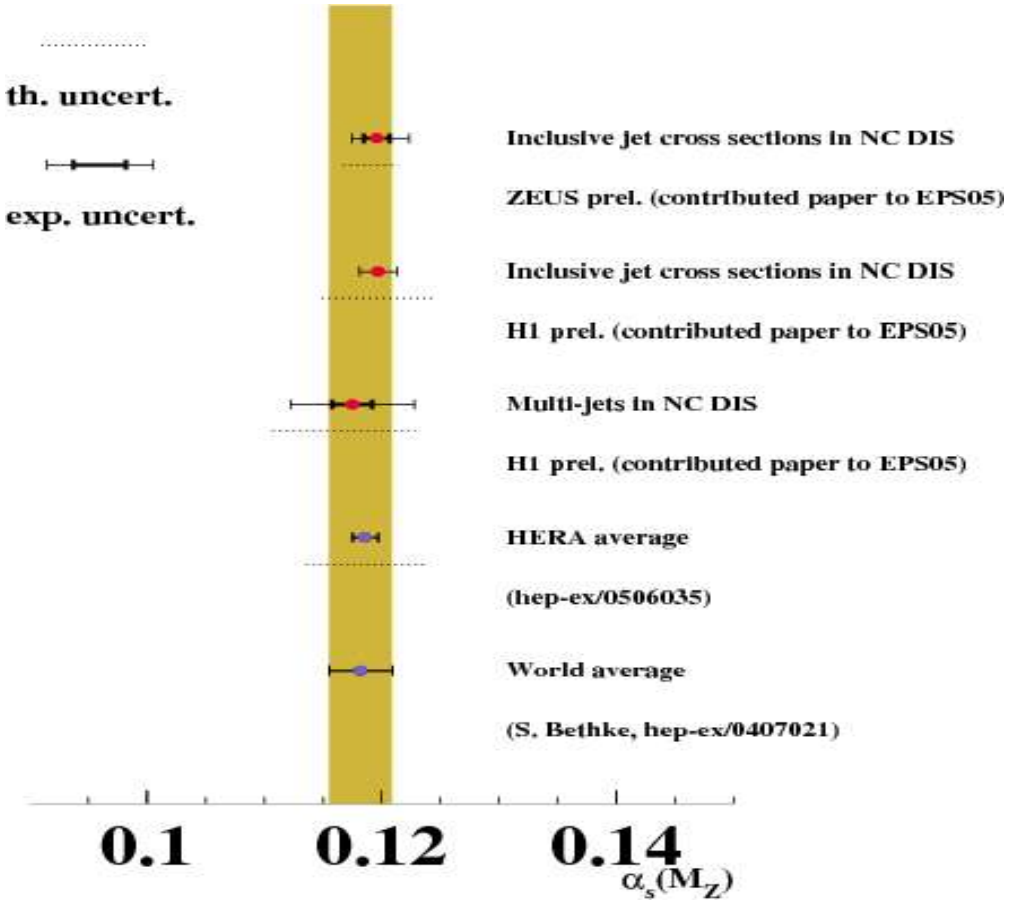


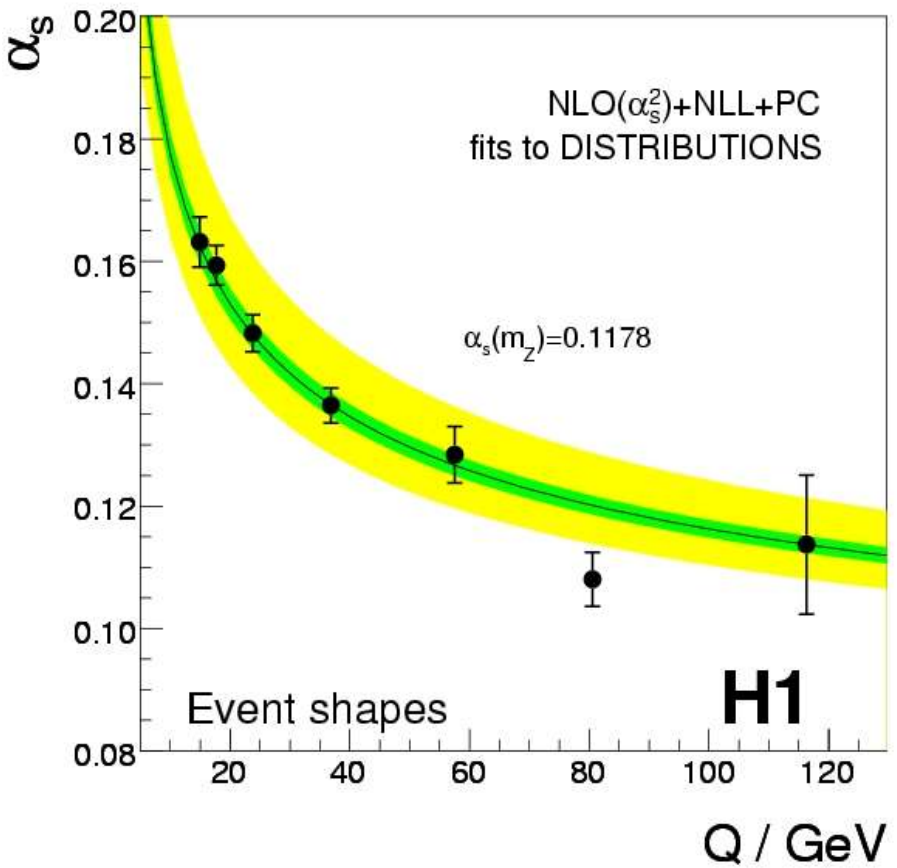
Fitted α_s vs α_0



➔ **Consistent description**

α_s from HERA





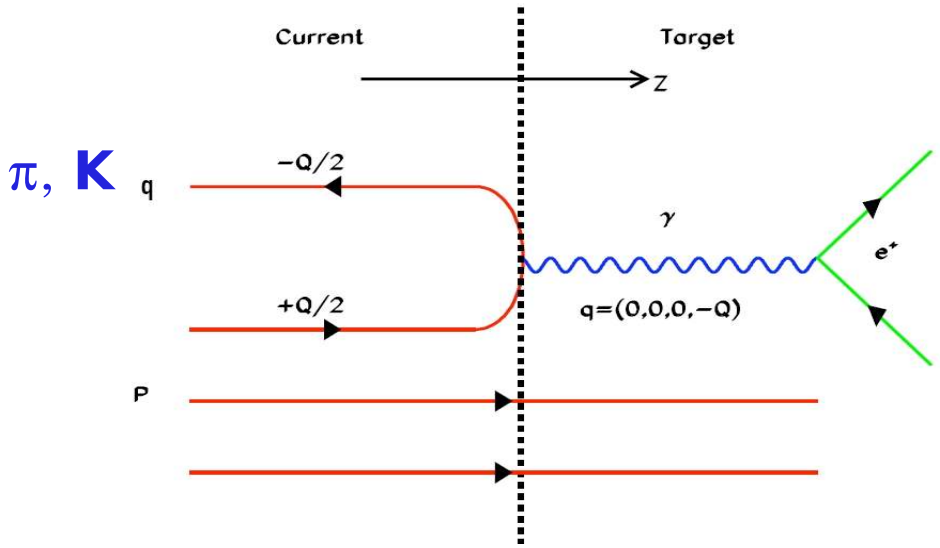
➔ **Accurate results from HERA, theory 'errors' dominate**

➔ **Observe running α_s from jets and event shapes in a single experiment**

➔ **New Bethke world average $\alpha_s(M_z)$ = 0.1189±0.0010 (hep-ex/0606035) includes the HERA average with jets**

Charged particle momenta

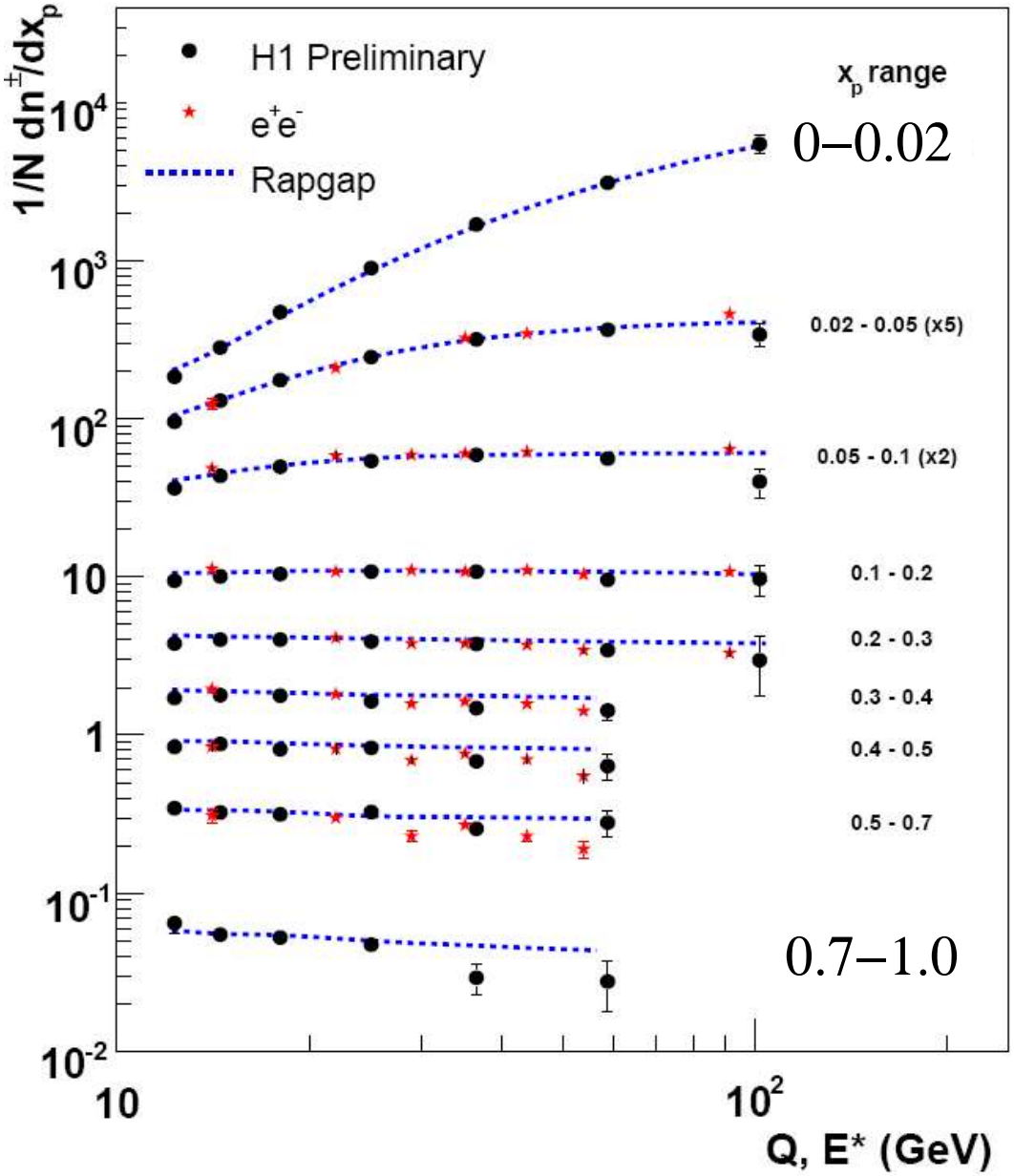
➔ For tracks in the current region of the Breit frame: $x_p = p/(Q/2)$



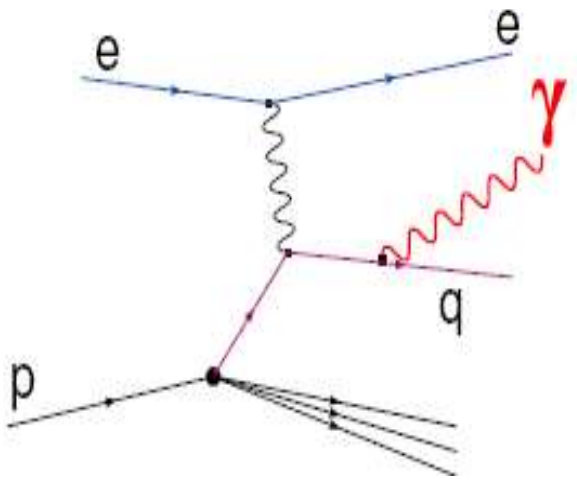
➔ Clear scaling violations observed

➔ Good agreement with ee data

45 pb^{-1} ('00)



Prompt γ in DIS:

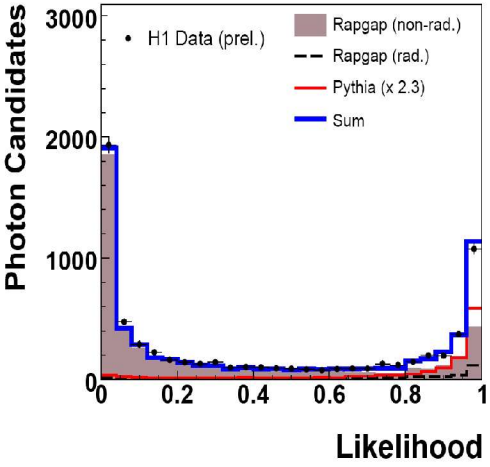


➔ $Q^2 > 4$ GeV, $E_T > 3$ GeV, $-1.2 < \eta < 1.8$

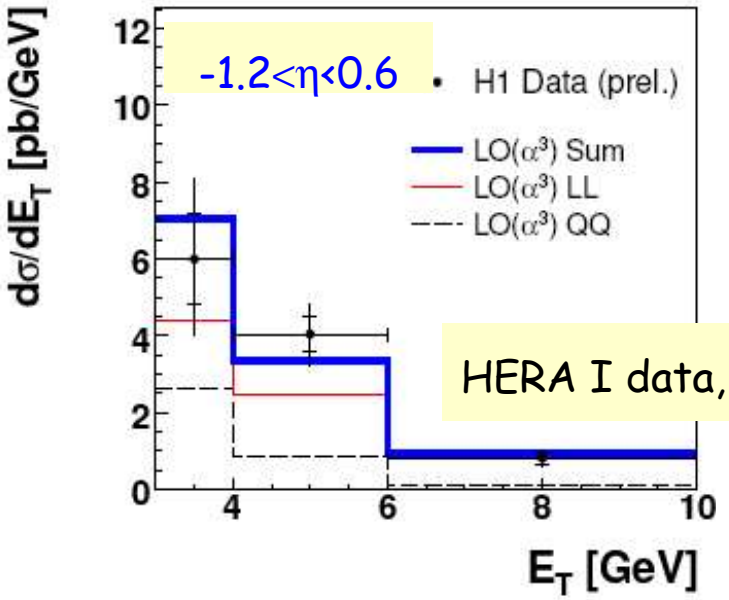
Extended range (σ x 10) w.r.t. previous HERA measurement

➔ **Select Isolated γ with $z = E_\gamma / E_{jet} > 0.9$**

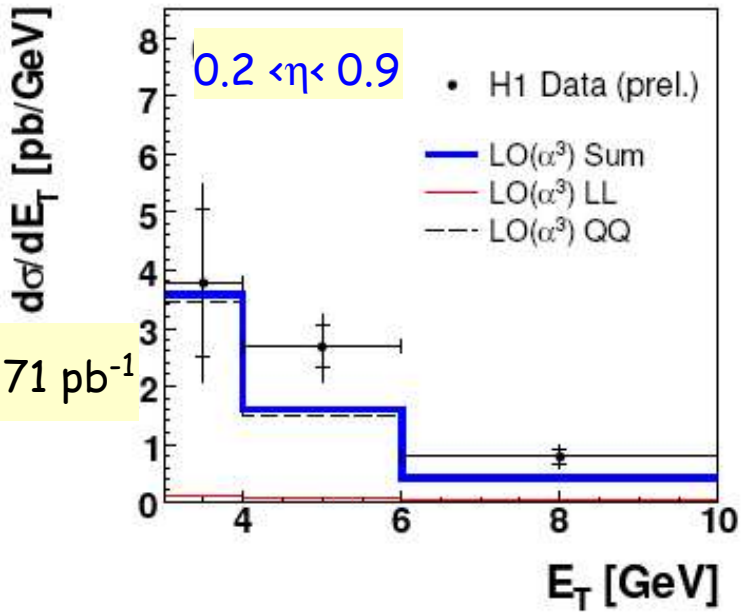
➔ **Separation from π^0 via shower shape**



$e\,\gamma^* \rightarrow e\,\gamma$ dominates



$q\,\gamma^* \rightarrow q\,\gamma$ dominates



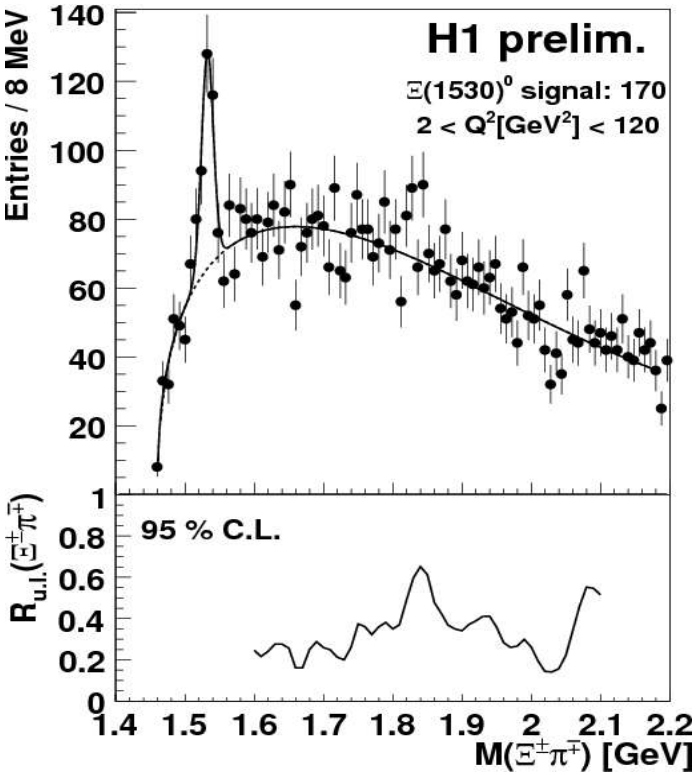
HERA I data, 71 pb^{-1}

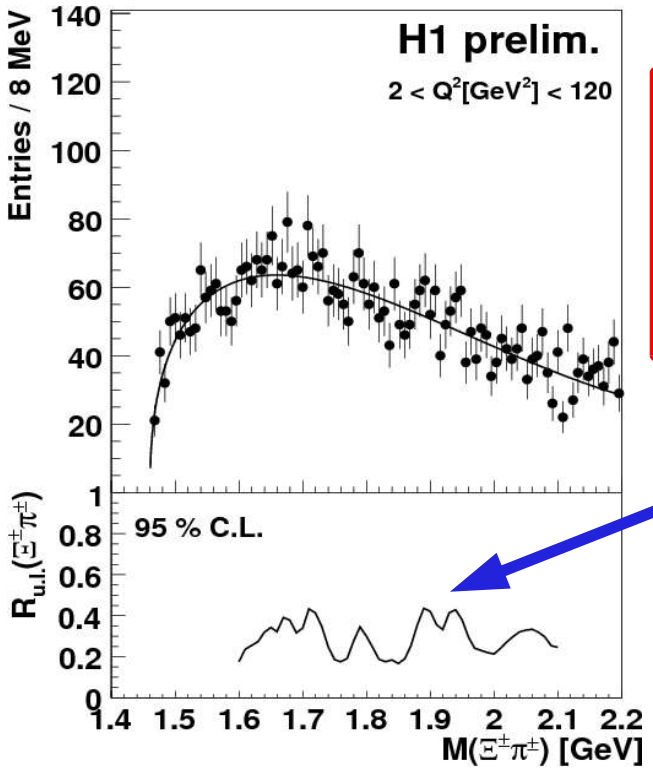
➔ **Good descripton by recent O(α^3) QED calculation**

Fragmentation: Look for exotic states

- ➔ Many recent observations/non observations of possible pentaquark states all over the world...
- ➔ H1: Evidence for charmed pq at 3100 MeV (DESY-04-038), contradicted by ZEUS (DESY-04-164)
- ➔ ZEUS: Evidence for $\theta_s(1520)$ (DESY-04-056), not confirmed by H1 (DESY-06-044)

➔ **Brand-new: Search for $\Xi_{5q}^{0} \rightarrow \Xi^{-}\pi^{+}$ and $\Xi_{5q}^{--} \rightarrow \Xi^{-}\pi^{-}$, where NA49 reported observation at a mass of 1862 MeV**





➔ Well known $\Xi^0(1530)$ resonance seen

➔ No evidence for exotic 5q states

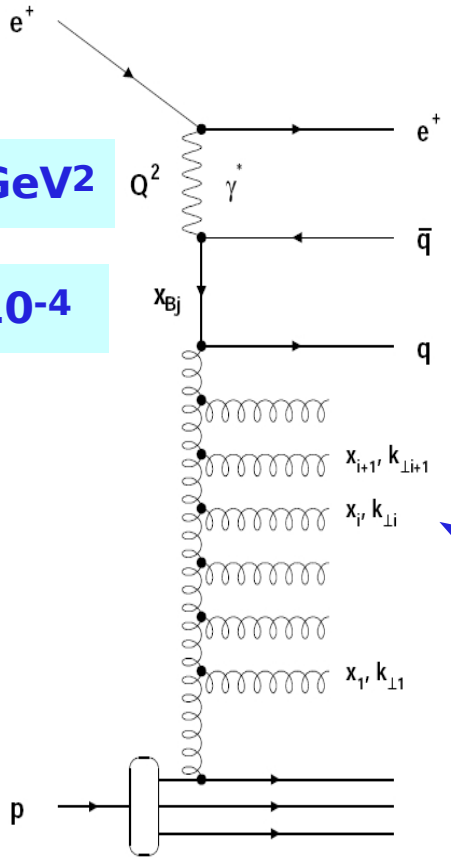
Upper limits relative to $\Xi^0(1530)$:

➔ Agrees with ZEUS (DESY-05-018)

3-jets at low Q^2 and x

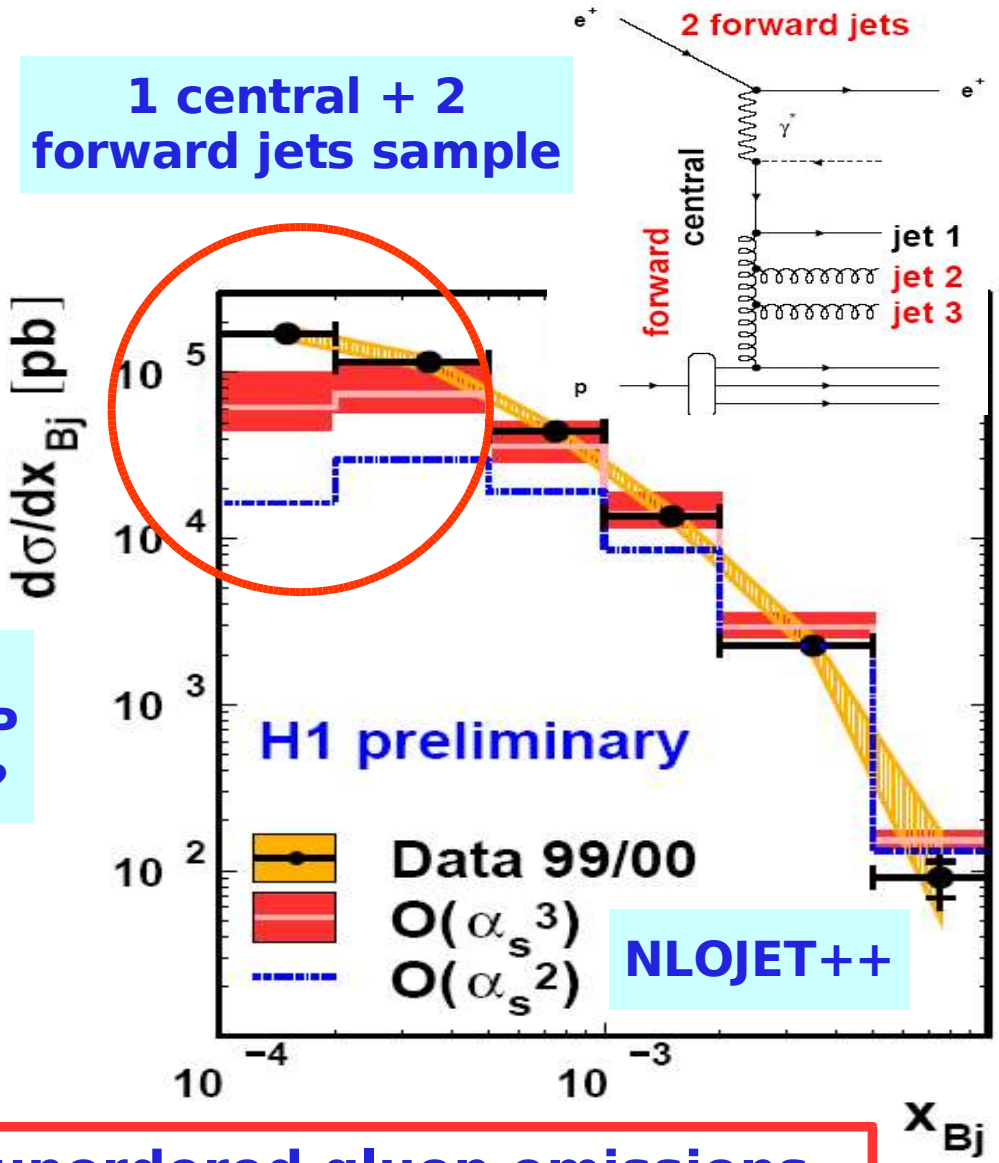
Q^2>5 GeV^2

x>10^{-4}



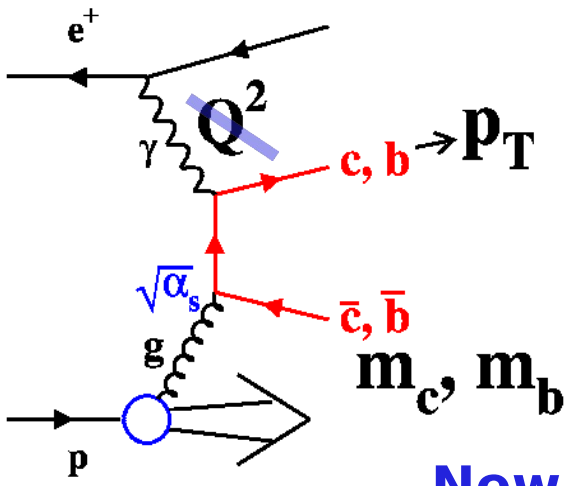
Deviations from DGLAP evolution??

1 central + 2 forward jets sample



➔Strong hints for k_T unordered gluon emissions, neglected in DGLAP

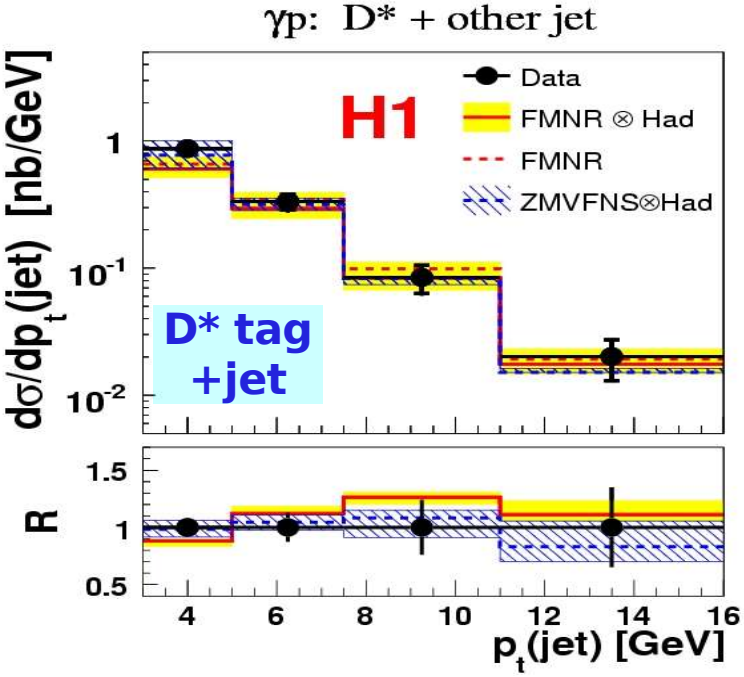
Heavy flavour in γp: $Q^2 \sim 0$



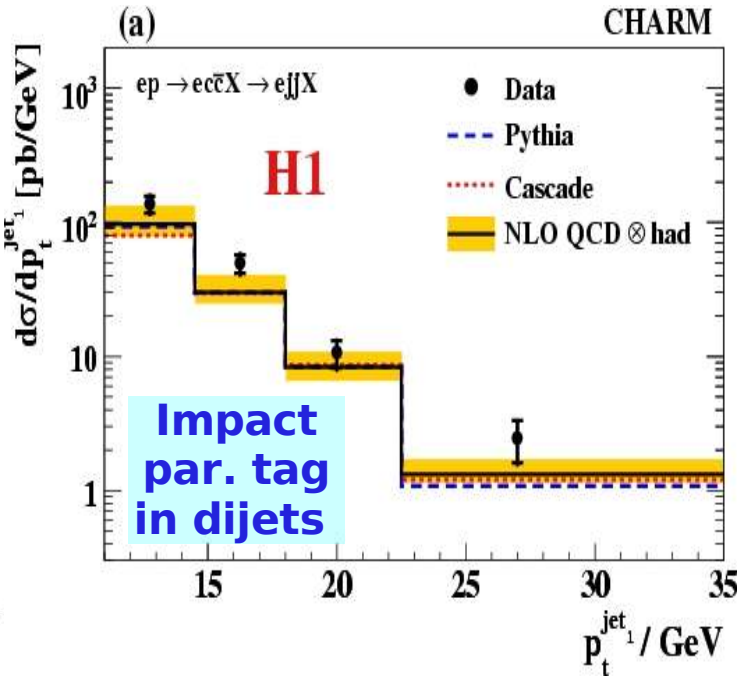
➔ **Hard Scales for pert. QCD : $m_{c,b}$, p_T**

New H1 charm results:

DESY 06-110



DESY 06-039



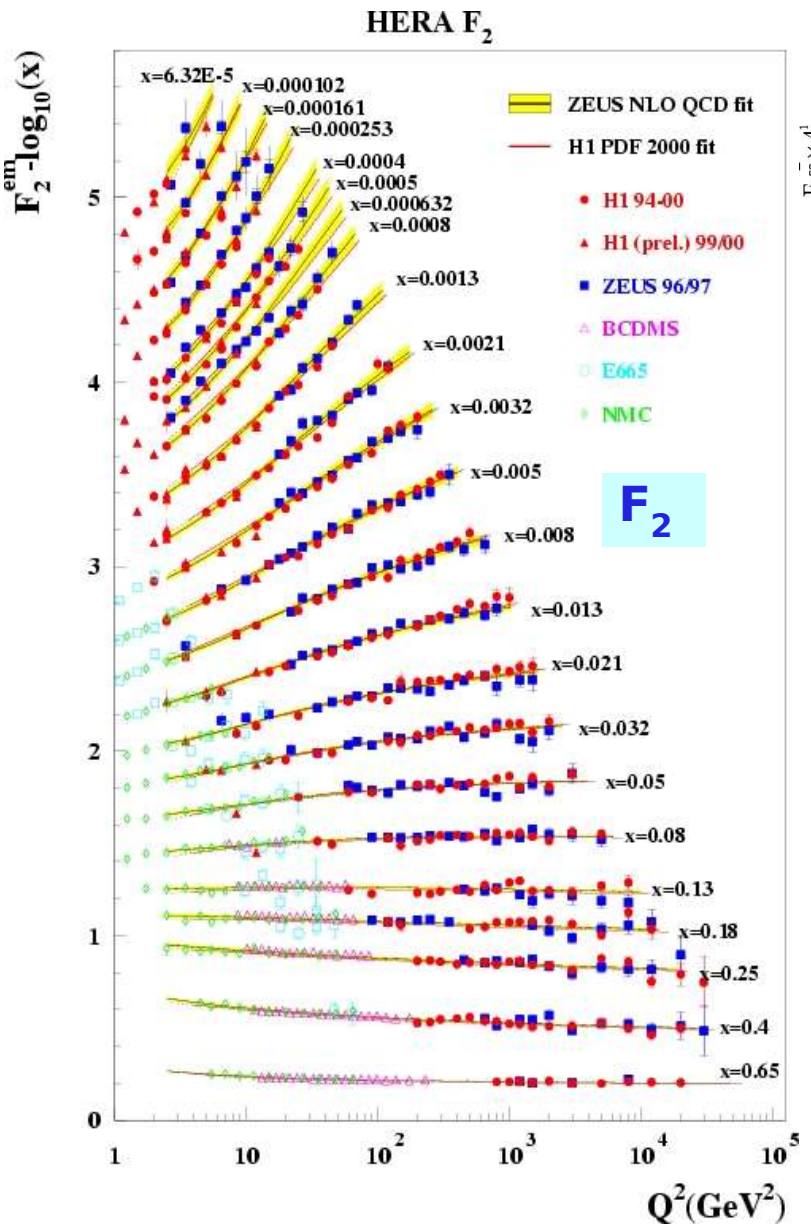
➔ **$3 < p_T(c) < 35$ GeV**

➔ **Cross-Section falls ~3-4 orders of magnitude**

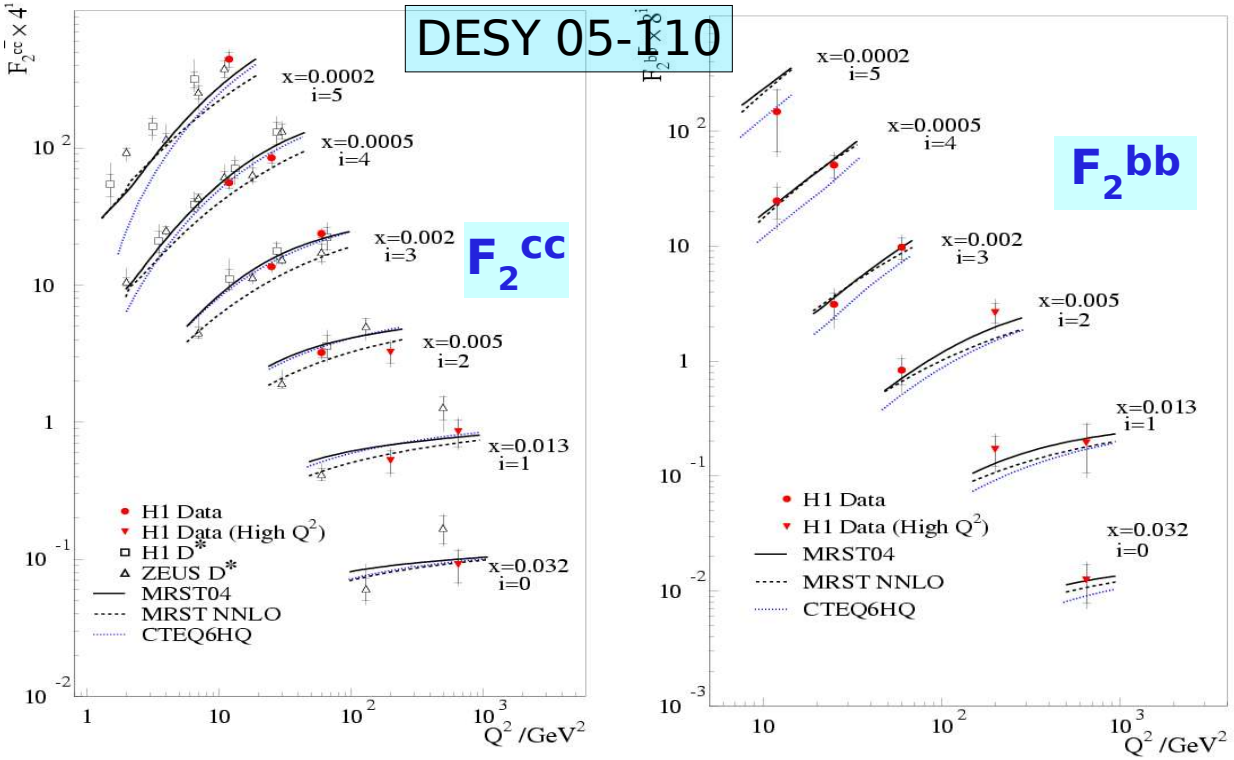
➔ **Reasonable description by NLO**

➔ **Problems in describing D*-jet correlations (not shown here)**

Charm and Beauty in DIS: F_2^{cc} and F_2^{bb}



➔ F_2^{cc} and F_2^{bb} = contributions to F_2 from events containing charm and beauty quarks



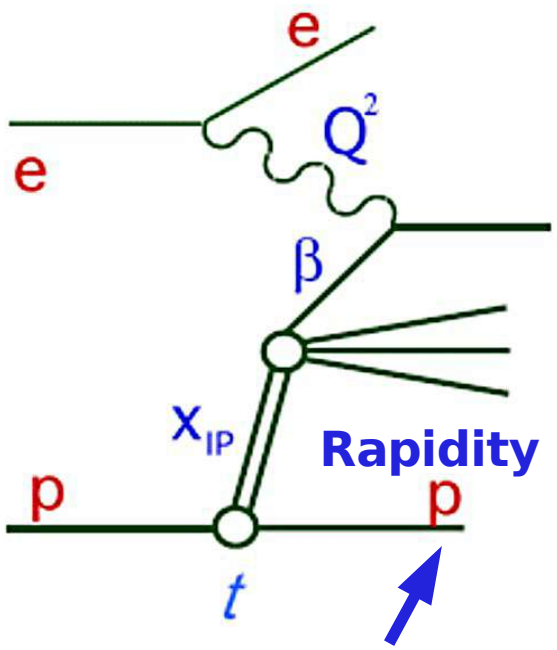
➔Charm contributes up to ~30%, beauty up to few% at higher Q^2

➔First NNLO calculations available

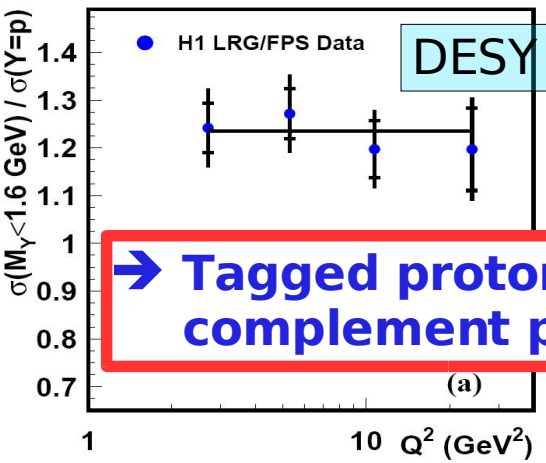
➔Interest of b density in proton for LHC

Diffractive structure functions

A few% of hard ep collisions are diffractive



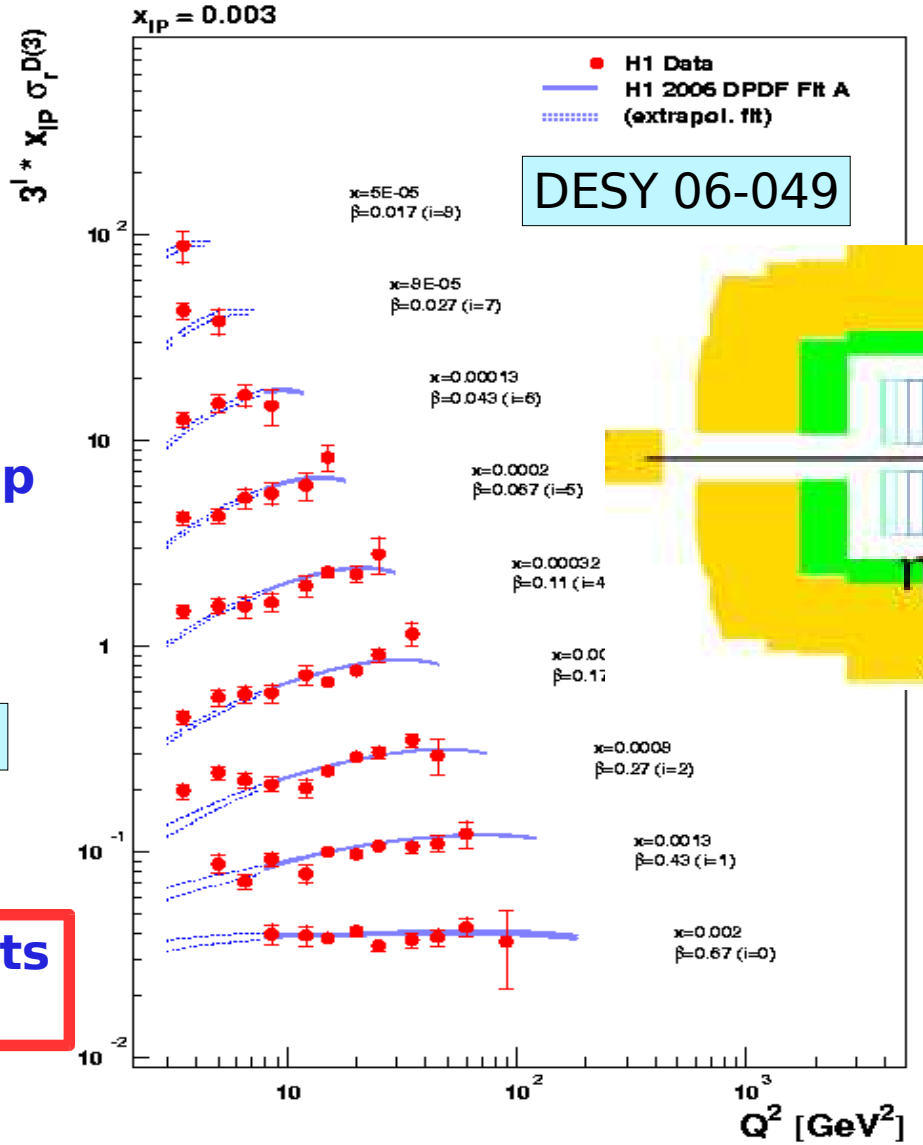
Rapidity gap

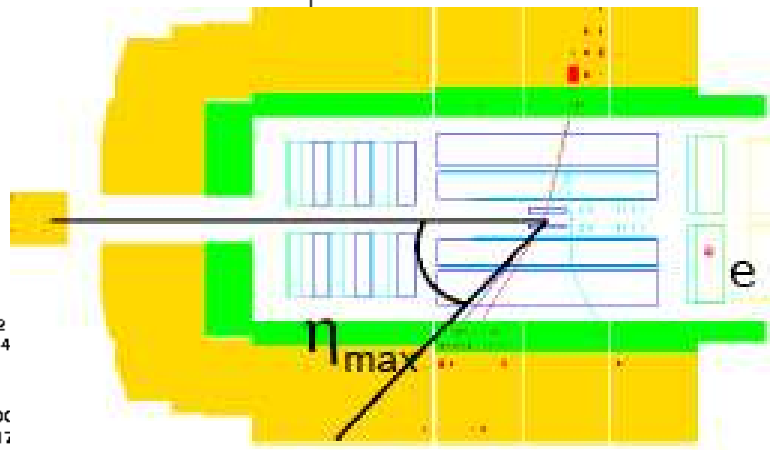


DESY 06-048

➔ **Tagged proton results complement picture**

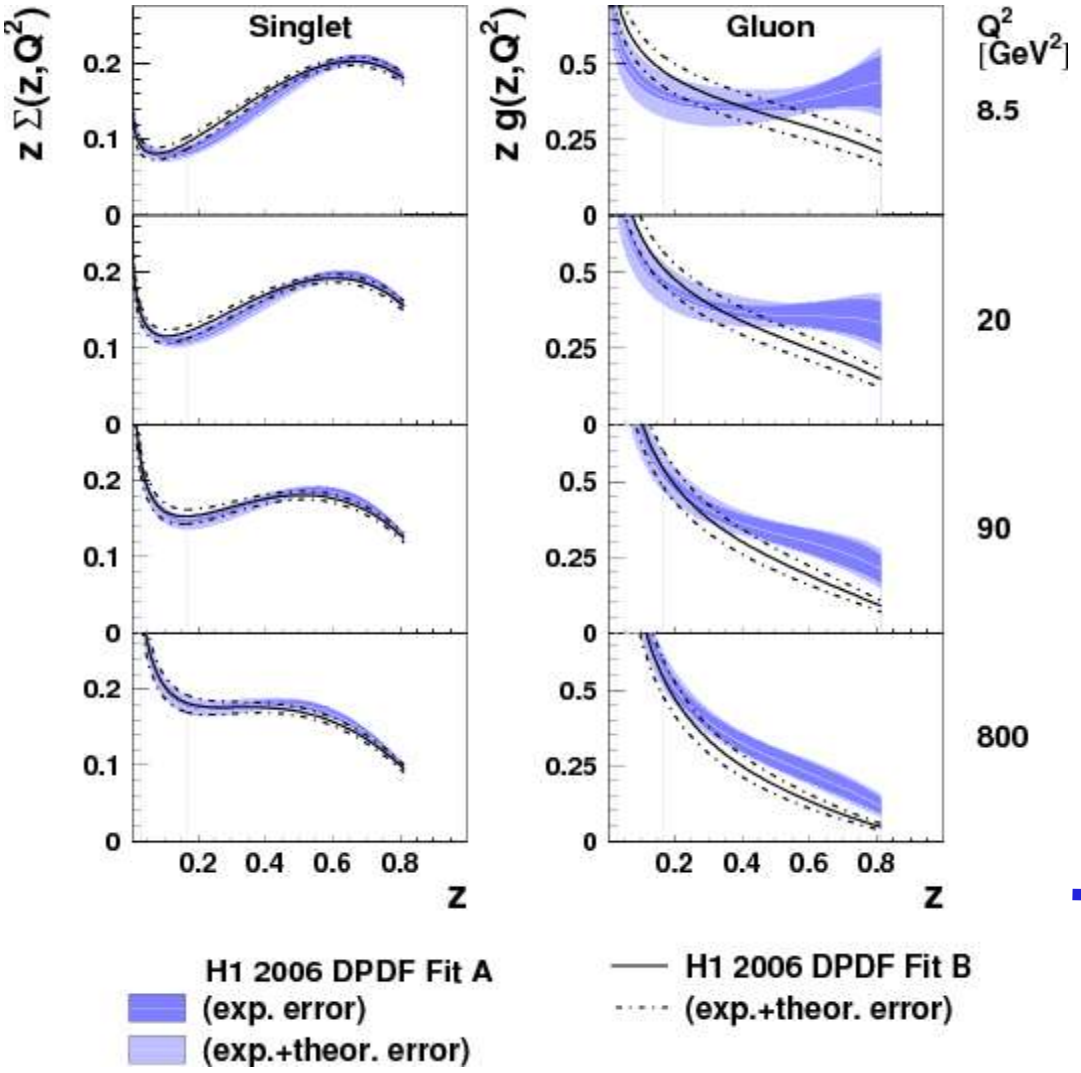
Final inclusive diffractive HERA I data from H1





➔ **Determine q(β) and g(β)**

Diffractive parton densities

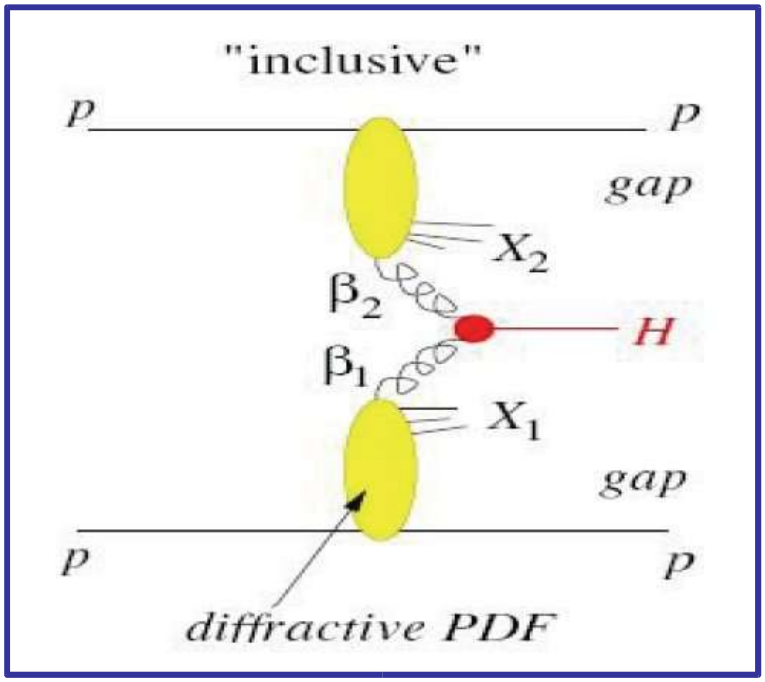


➔ Precise q(β)

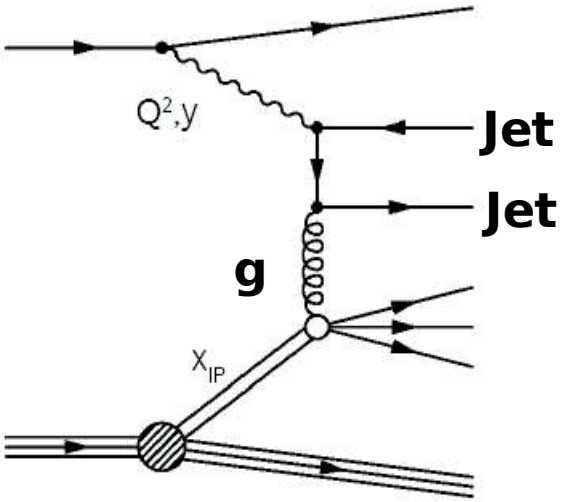
➔ Rather poorly constrained g(β): similar good fit of data with different parametrisation (FIT B)

➔ Gluon carries ~70% of the momentum of the colourless exchange

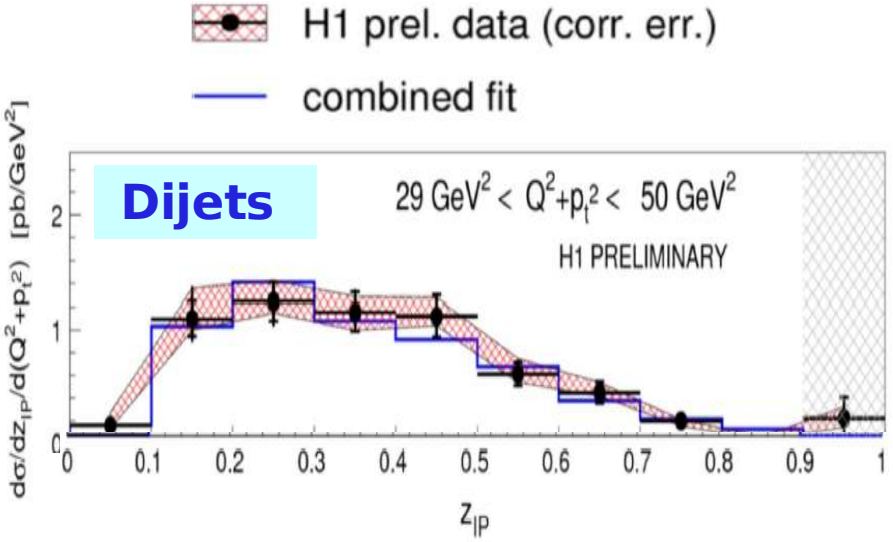
LHC

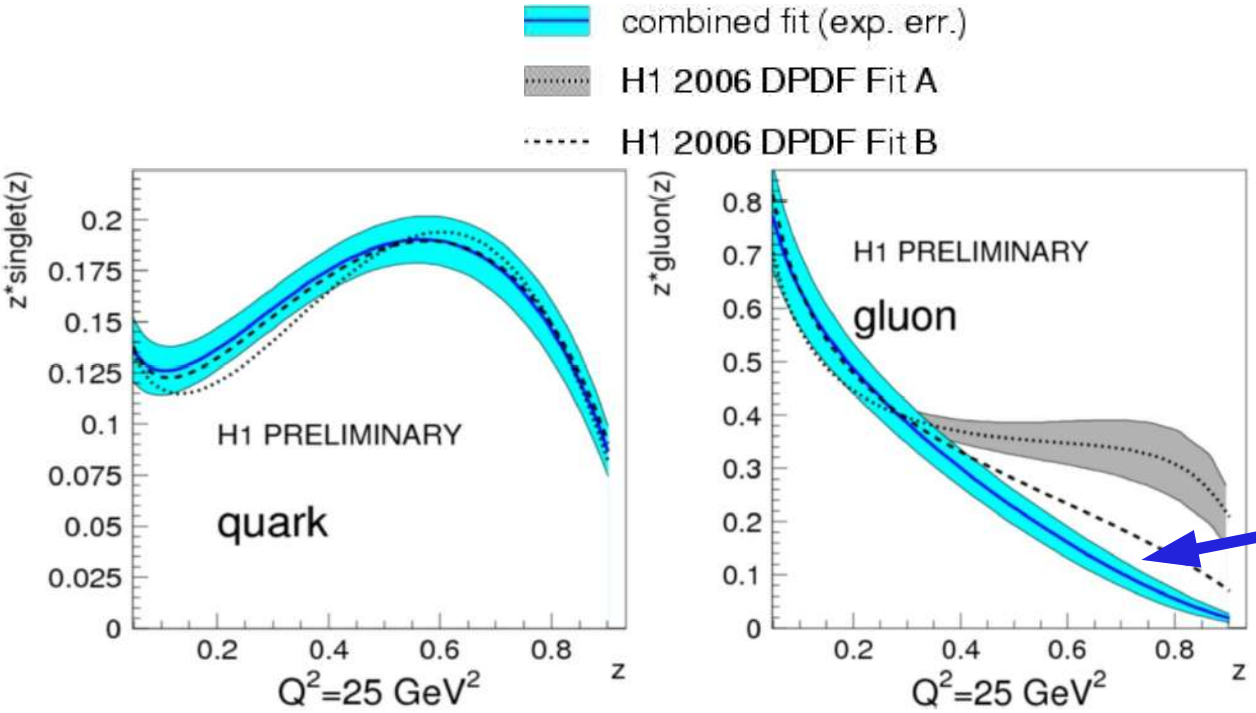


Using Dijets in addition



Combined fit of F_2^D and dijet data

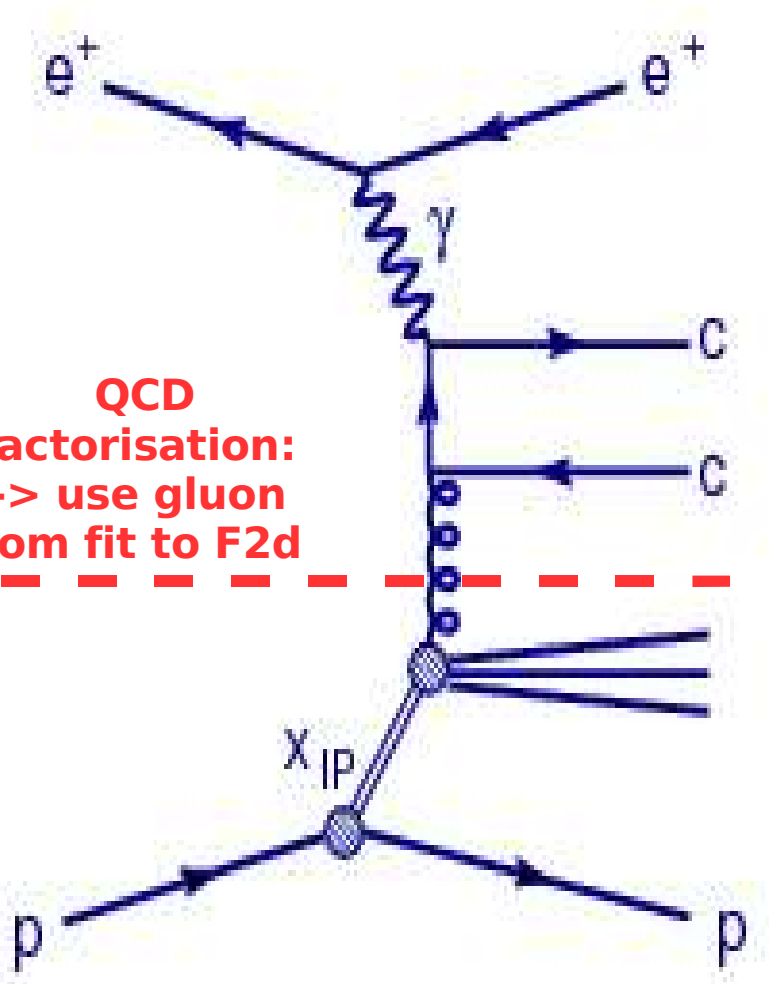




➔ Both datasets well described by combined fit

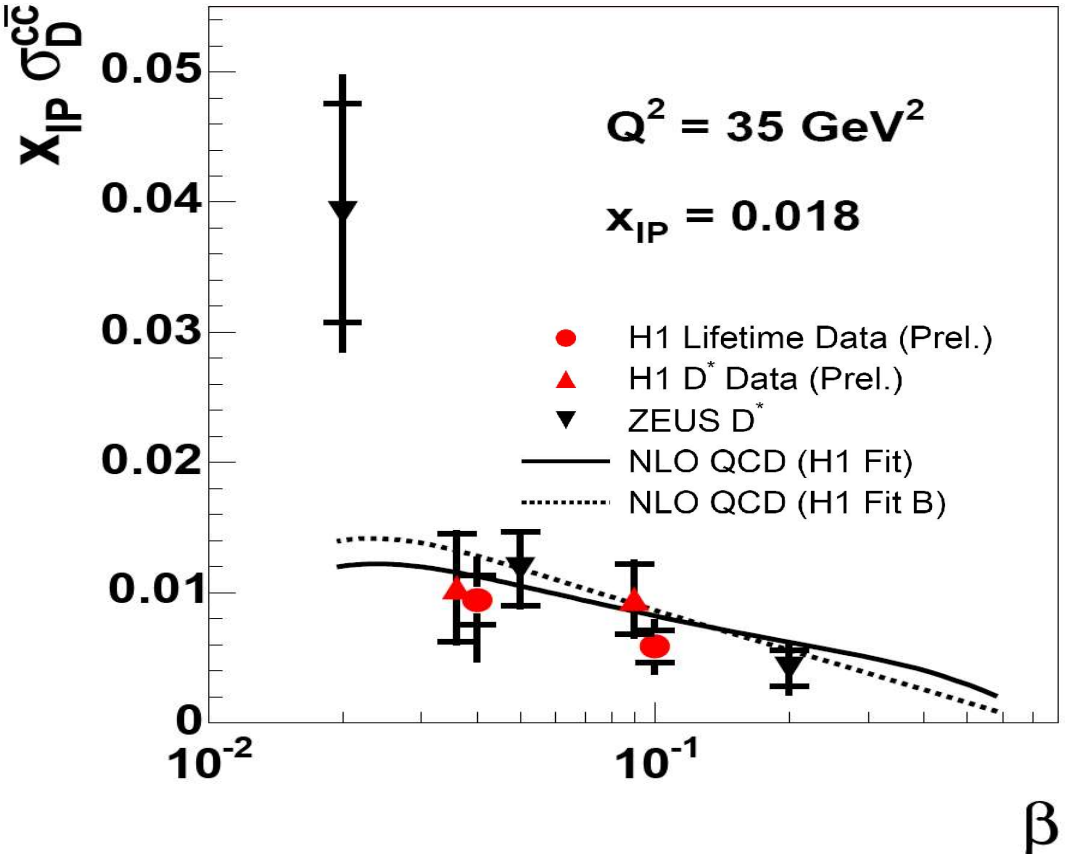
Obtain a better constraint on high z gluon

Diffractive charm production in DIS



QCD factorisation: -> use gluon from fit to F2d

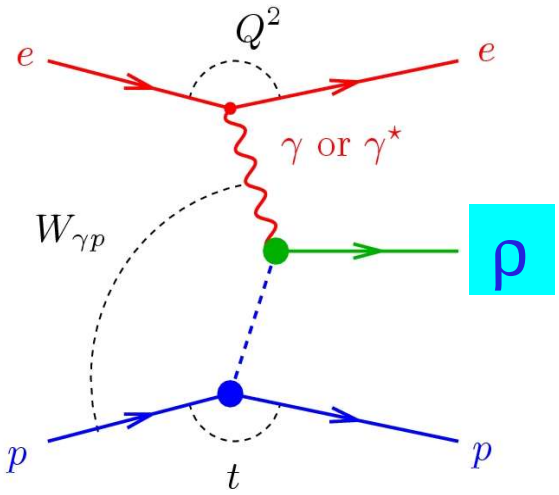
➔ New measurement: based on long charm lifetime (track impact parameters)



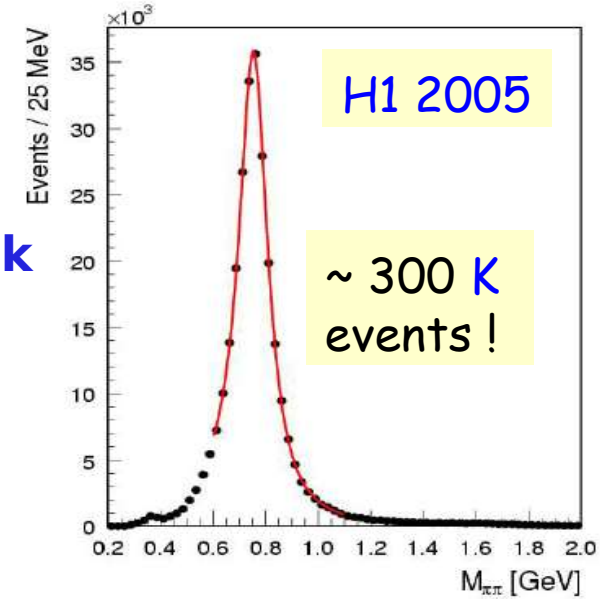
➔ Consistent with QCD fact.

➔ Charm events contribute ~20% to hard diffraction

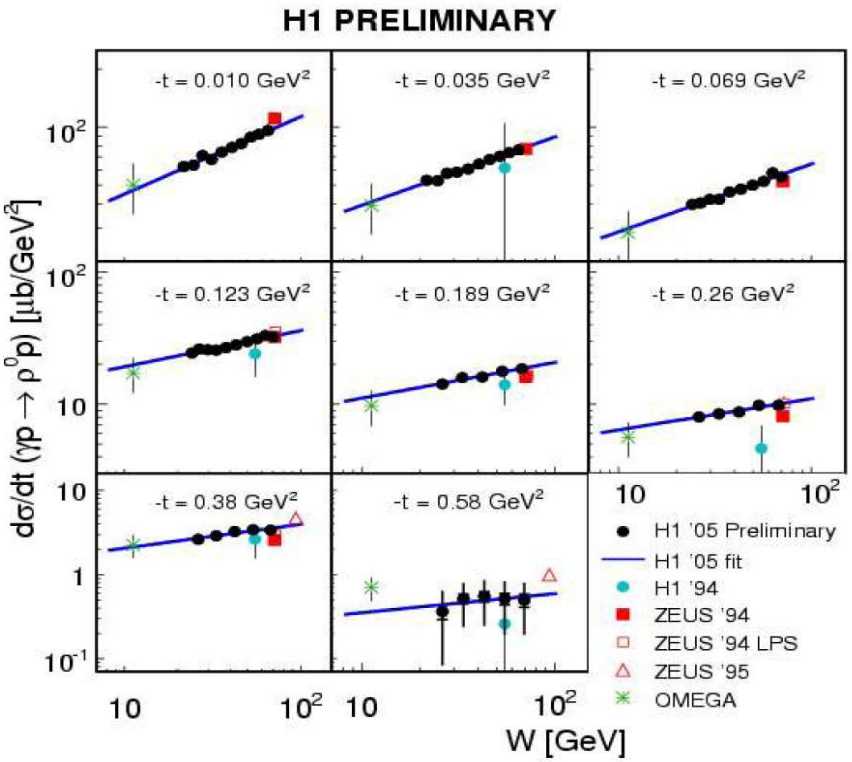
Diffractive ρ photoproduction



➔ **Q^2~0: *Soft* process: pQCD not applicable, Regge theory should work**



➔ **Exploit H1 fast Track Trigger for ρ->π+π−**



➔ **Determine Pomeron Trajectory α(t) within a single experiment**

$$\frac{d\sigma^{elas}}{dt} \propto W^{4(\alpha(t)-1)}$$

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

➔ **α' ≈0.16, lower than for the "standard soft Pomeron"**

Conclusions

➔ **H1 collected ~160 pb^{-1} e-p data in 2005-06 HERA II:**

- **~10x Lumi collected in HERA I e-p data**

➔ **Rich harvest of new physics results from H1 for ICHEP06:**

- 12 new HERA II results (Searches, electroweak, diffraction)

- 19 new HERA I results (Mainly precision QCD tests)

➔ **H1 is well prepared for the final high lumi e+p HERA II data:**

*** Clarify isolated leptons**

*** QCD: HERA Is the world leading facility and will provide the best knowledge for decades (e.g. α_s)**

*** F_L low energy run – integral part of the QCD program**