H1 Highlights for ICHEP2004

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48 papers submitted to ICHEP2004 (results of the last 2 years)

New Results: for the First Time at Major Conference

The first HERA II results

- Polarised CC cross section
- Update for the high P_T phenomena
  - general search
  - isolated leptons
  - multi-leptons

Searches

- for bosonic stop decays in Rp viol. SUSY
- for events with tau leptons
- for Doubly Charged Higgs Bosons
- for Lepton Flavour Violation

Low Q^2 and low x

- F_2 at low Q^2 using ISR events
- Forward jets at low x in DIS

Beauty

- Beauty in DIS from b->μx
- Beauty in γp using lifetime tagging
- F_2^{bb}, F_2^{cc} at high Q^2

Diffraction

- Diffractive dijets: DIS vs. γp
- Diffractive CC
- Diffractive D* in DIS

Hadron production

- Anti-deuteron production
- A narrow anti-charmed baryon state

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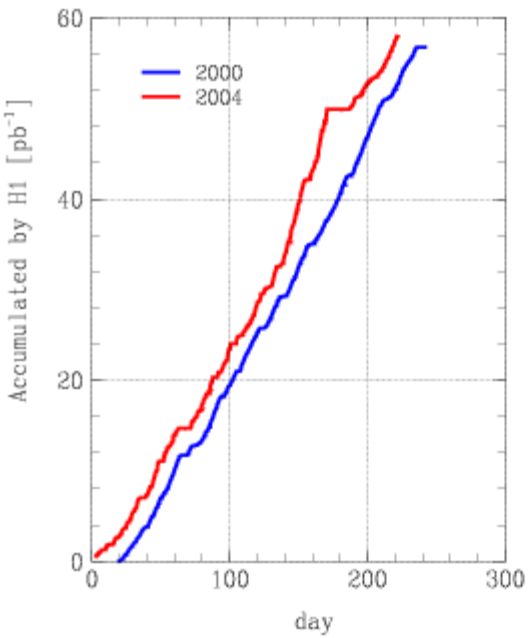
Polarised NC and CC at HERA II



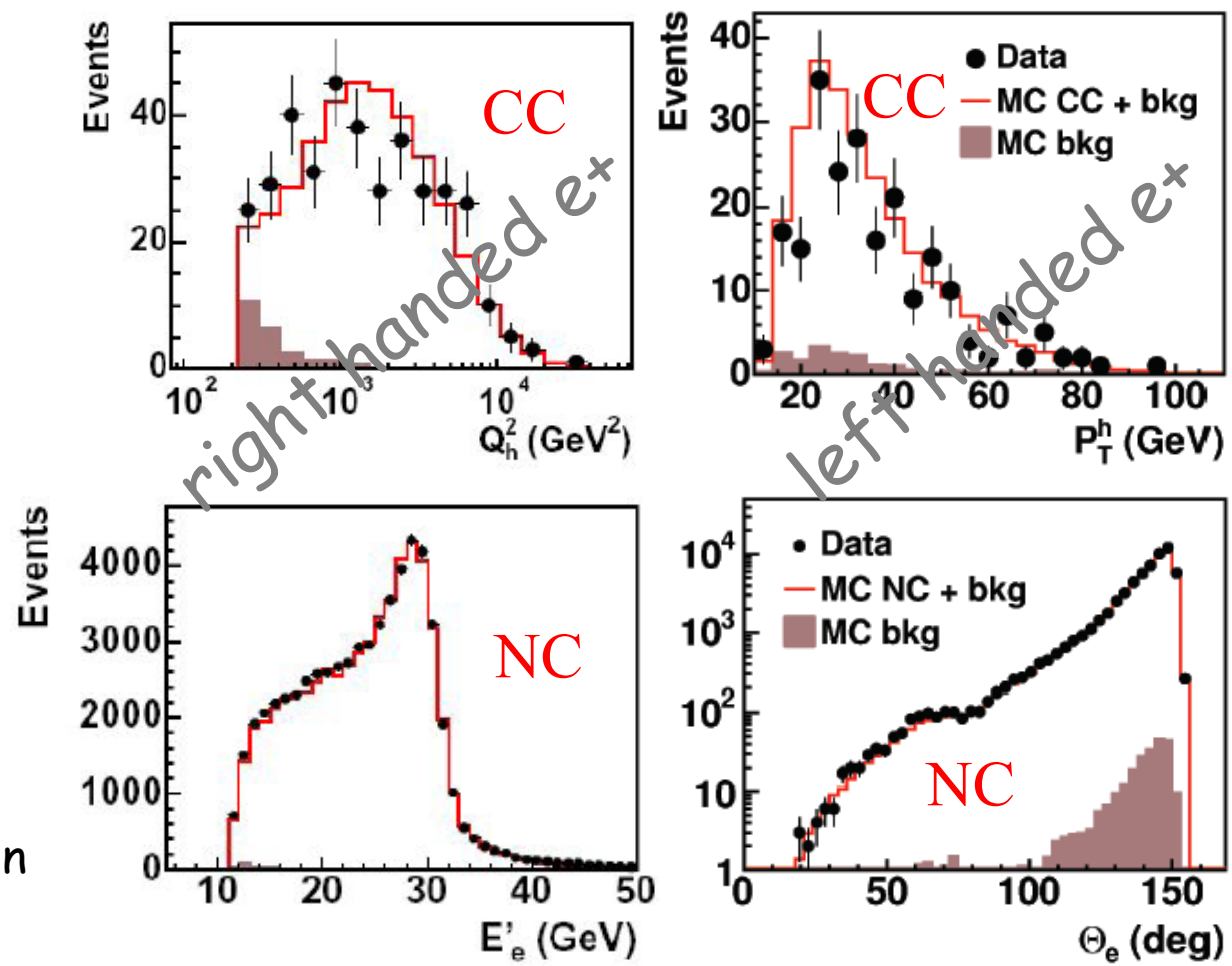
HERA II e^+p

$\mathcal{L}$ = 55 pb^{-1} (HV on)

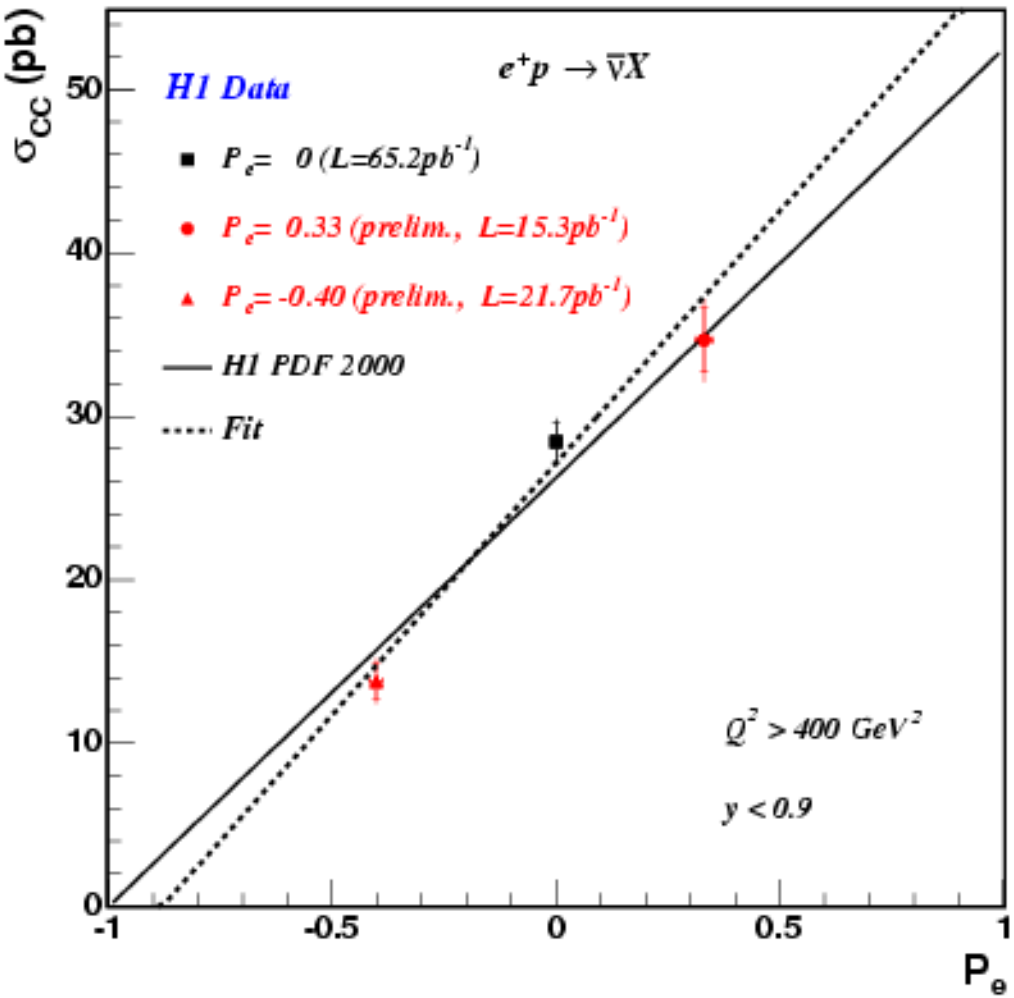
Longitudinal polarisation

P_e ~ 40%

(both positive and negative)



Polarised e^+p CC cross sections at HERA II



$P_e = 33 \pm 2\%$

$\sigma_{CC}^{tot} = 34.7 \pm 1.9(stat) \pm 1.7(syst)\, pb$

$P_e = -40 \pm 1.5\%$

$\sigma_{CC}^{tot} = 13.8 \pm 1.0(stat) \pm 1.4(syst)\, pb$

Polarisation dependence is firmly established

Linear fit $\sigma = \alpha + \beta(1+P_e)$

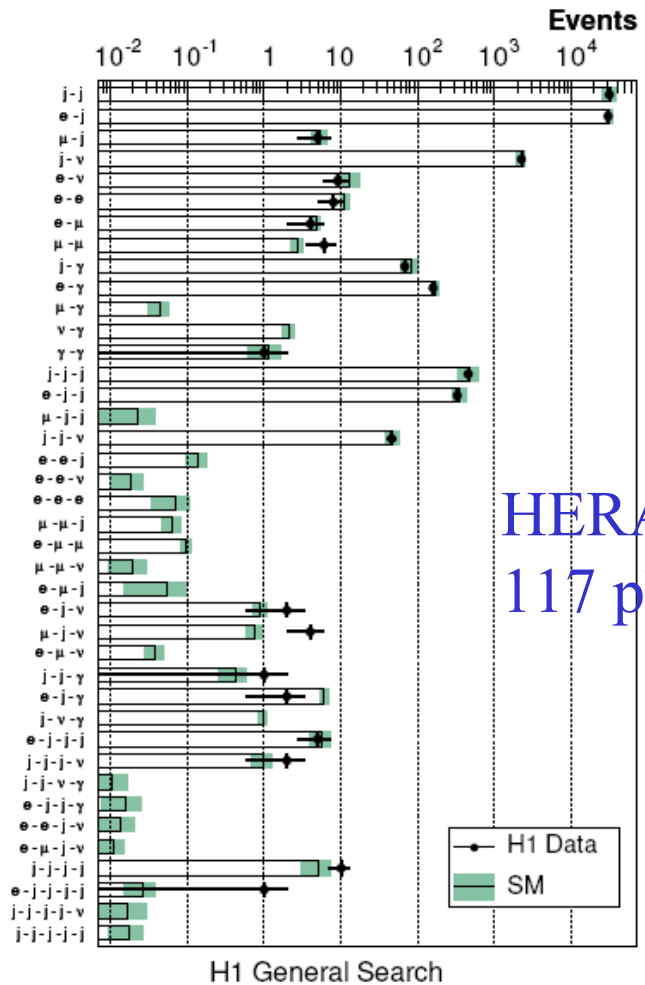
$\sigma_{CC}^{tot}(P_e = -1) = -3.7 \pm 2.4 \pm 2.7\, pb$

consistent with

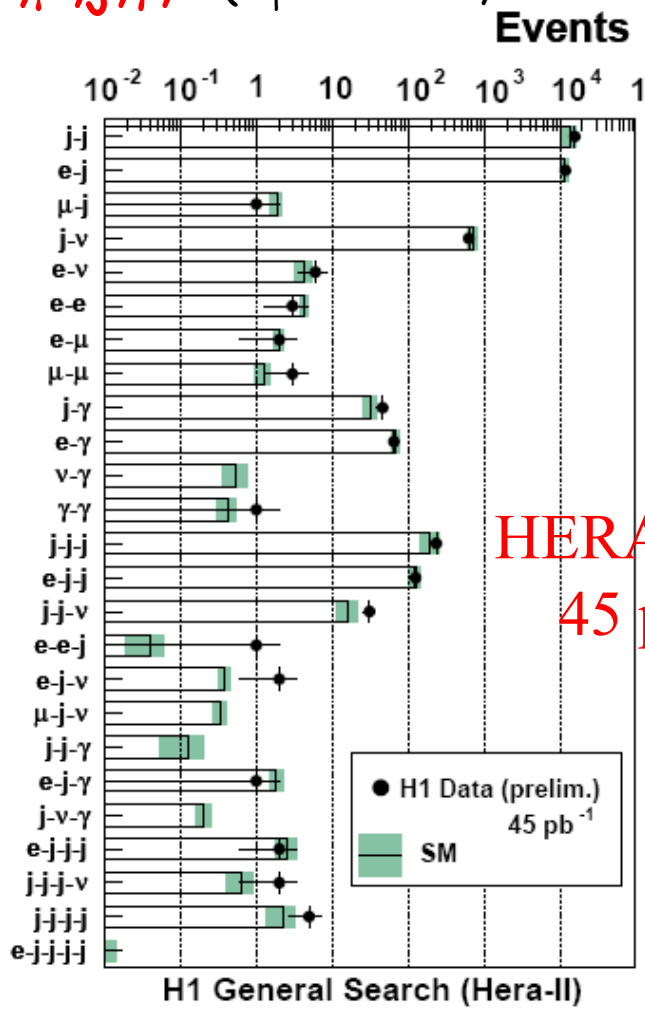
- linear $(1+P_e)$ dependence
- intercept of 0

General Search for Deviations from SM at high P_T

consider all final states with isolated e,μ,j,γ,ν (P_T>20 GeV, 10°< ϑ < 140°)



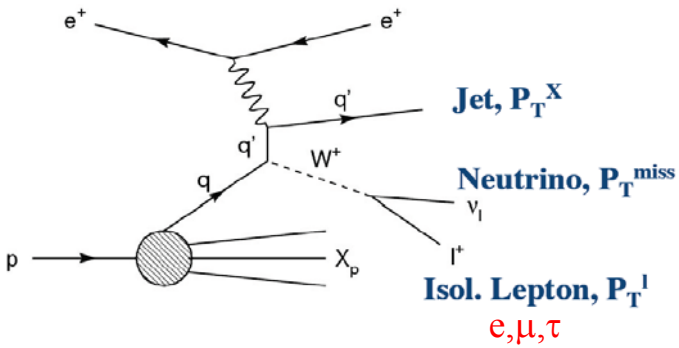
HERA I
117 pb^{-1}



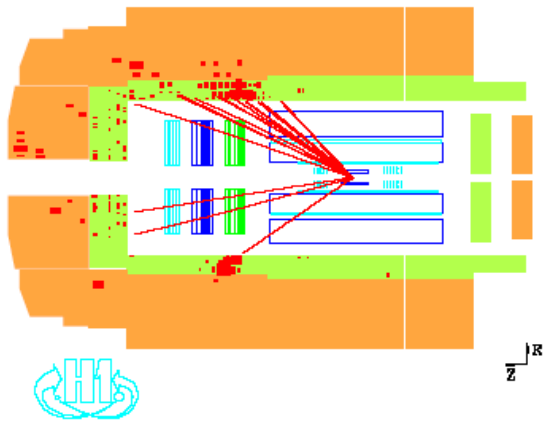
HERA II
45 pb^{-1}

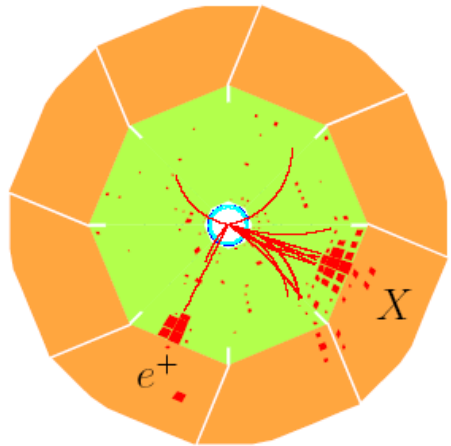
- impressive overall agreement with the Standard Model predictions

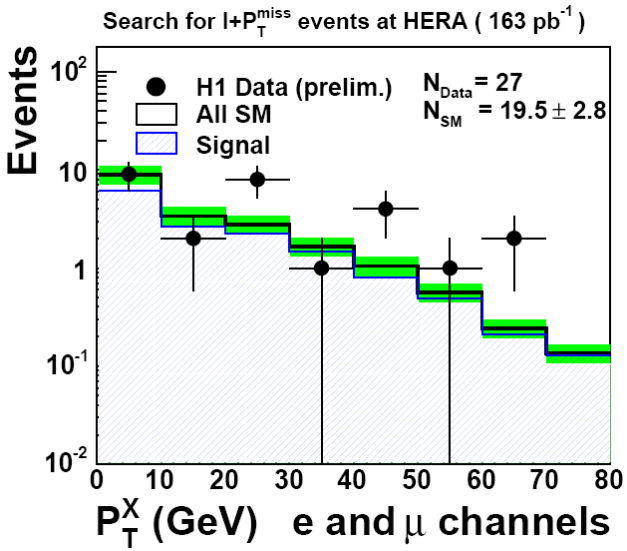
Isolated leptons with P_T^{miss} at HERA II



$P_T^e = 37$ **GeV**, $P_T^{miss} = 44$ **GeV**, $P_T^X = 29$ **GeV**

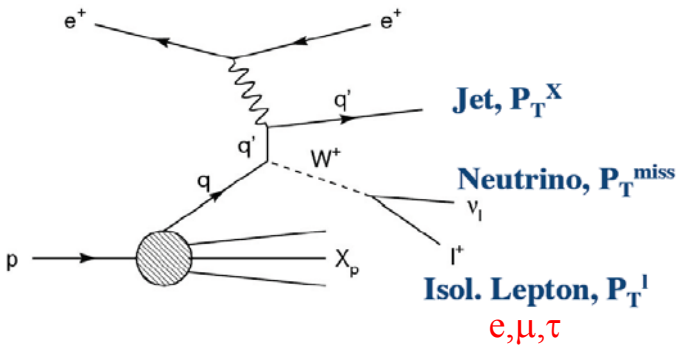






	HERA I (118 pb^{-1})			HERA II (45 pb^{-1})	
	e	μ	τ (prel)	e (prel)	μ (prel)
All P_T^X	11/11.54	8/2.94		7/3.86	1/1.16
$P_T^X > 25$ GeV	5/1.76	6/1.68		3/0.84	0/0.82

Isolated leptons with P_T^{miss} at HERA II



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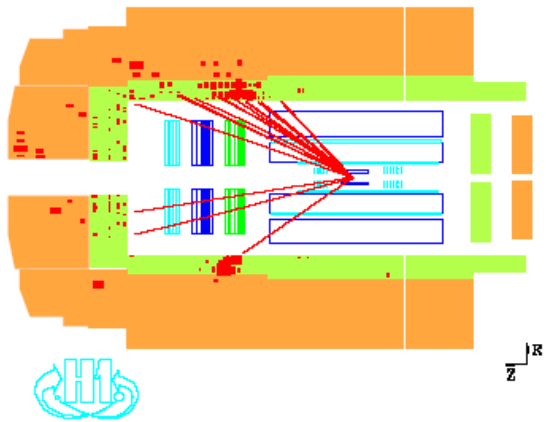
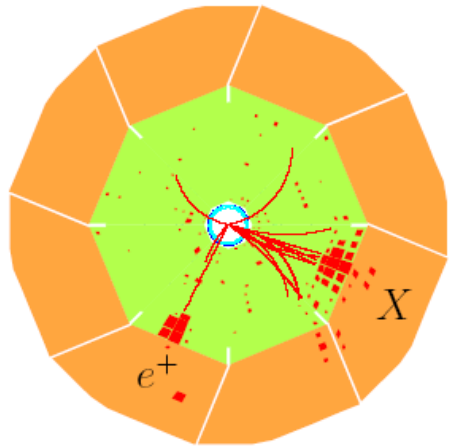
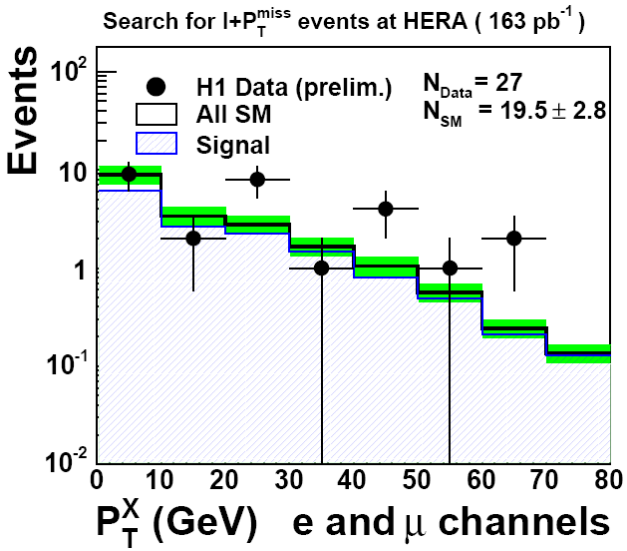


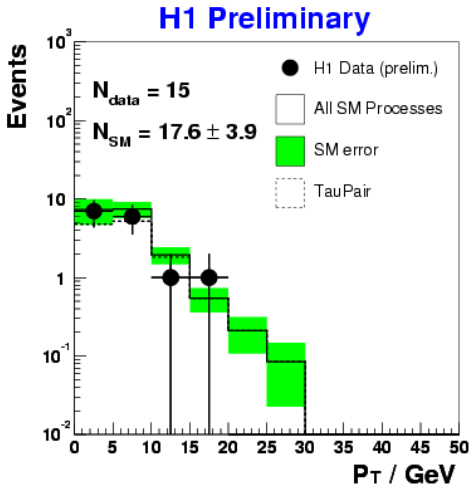


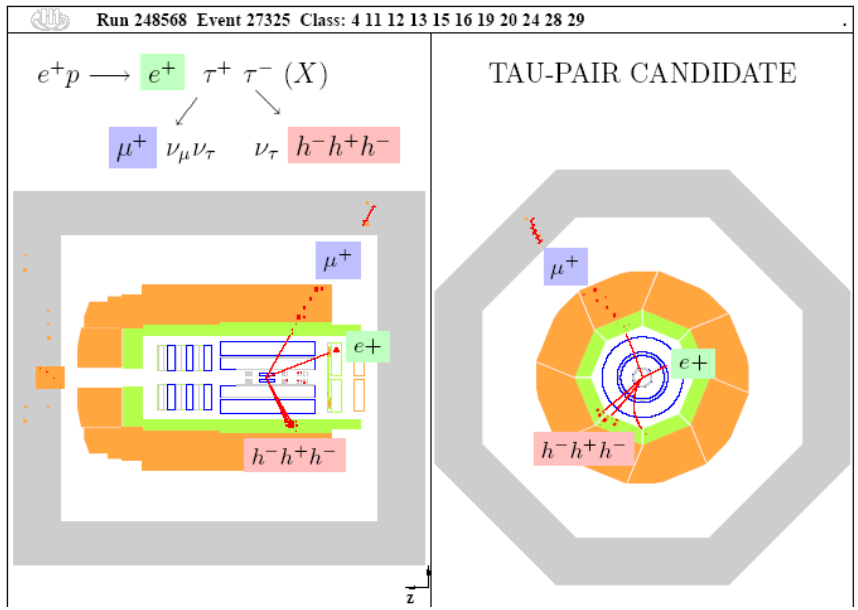


	HERA I (118 pb^{-1})			HERA I+II (163 pb^{-1})	
	e	μ	τ (prel)	e (prel)	μ (prel)
All P_T^X	11/11.54	8/2.94		18/15.4	9/4.1
$P_T^X > 25$ GeV	5/1.76	6/1.68		8/2.6	6/2.5

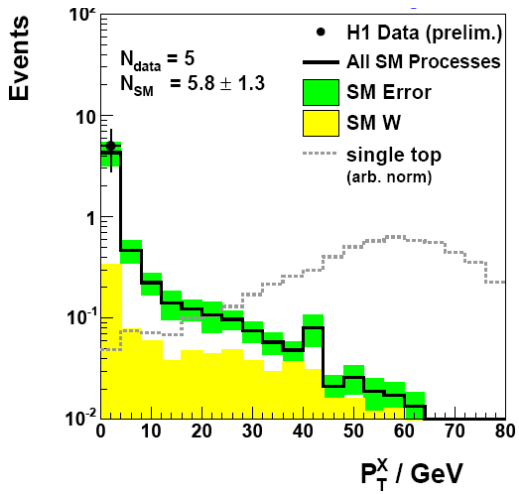
Isolated τ events with missing P_T

Elastic τ-pair production -> demonstration of the detection ability





Isolated τ and missing P_T



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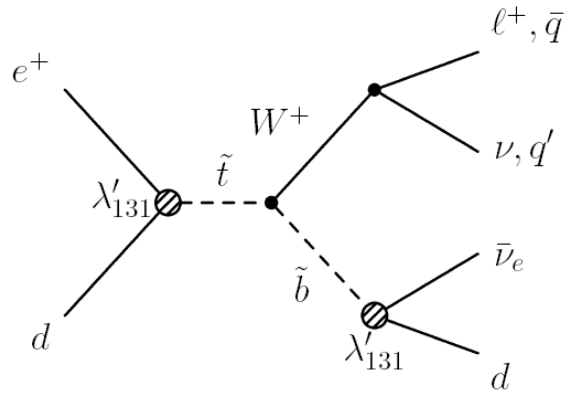
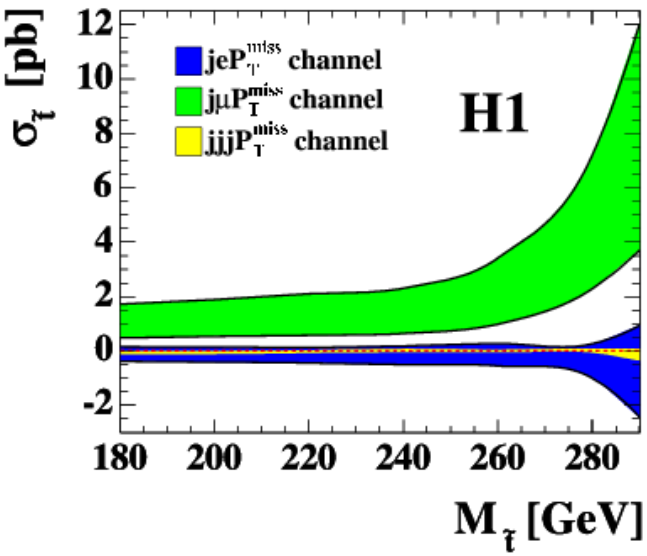
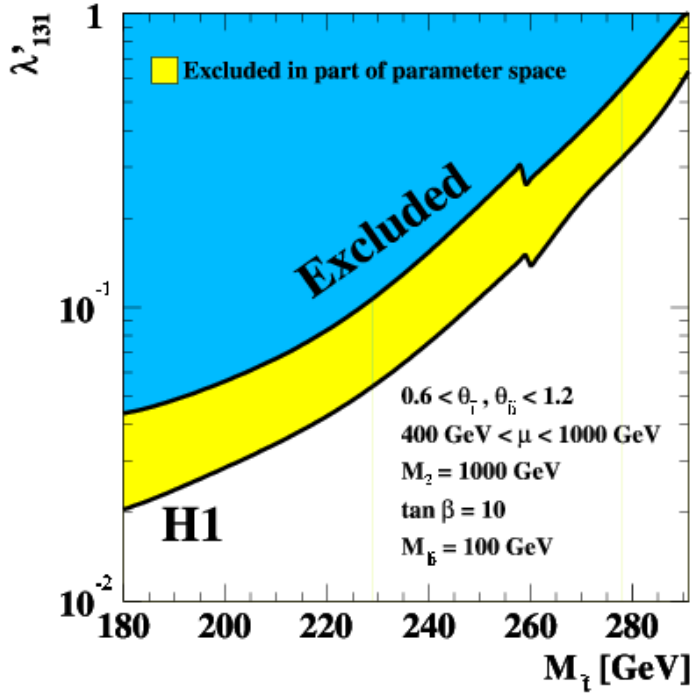
	e	μ	τ (prel)	e (prel)	μ (prel)
All P_T^X	11/11.54	8/2.94	5/5.81	18/15.4	9/4.1
$P_T^X > 25$ GeV	5/1.76	6/1.68	0/0.53	8/2.6	6/2.5

Rp viol. SUSY: Search for Bosonic Stop Decays

Possible "explanations" of isolated leptons excess
- anomalous single top production (published)
- Rp violating SUSY: $e^+ d \to \tilde{t} \to \tilde{b} W$

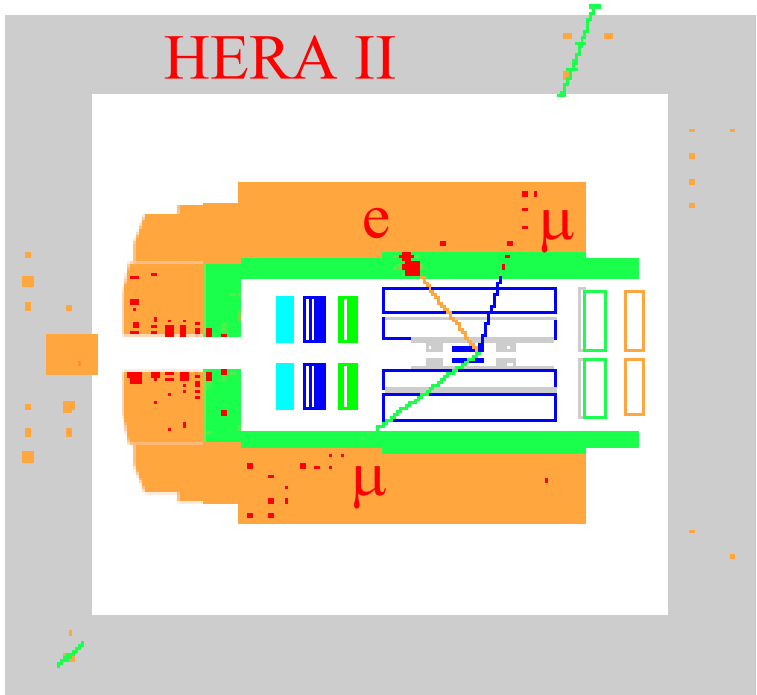






excess in $j\mu P_T^{miss}$ is not supported by other channels
-> limits

Multi-leptons at HERA I+II (163 pb^{-1})



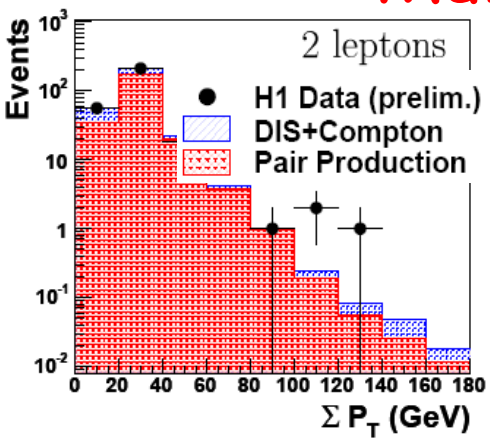
2 central leptons

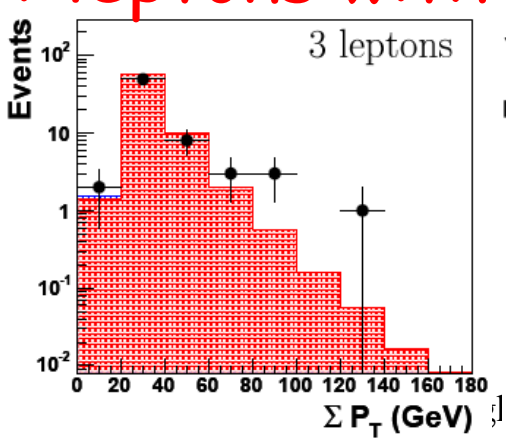
$20^o < \vartheta < 150^o$, $P_T^{l1,l2} > 10{,}5$ GeV

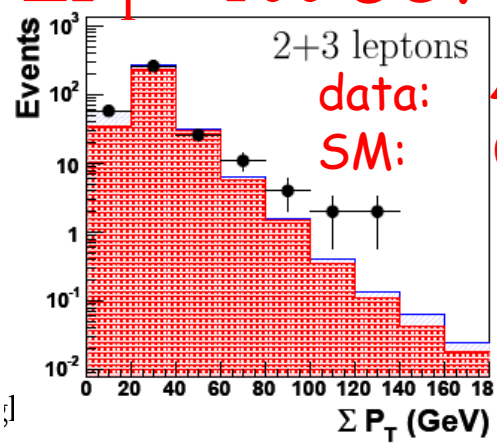
2 or 3 leptons in the finale state

Selection	Data	SM
ee M_{12} >100 GeV	3	0.44 ± 0.10
$\mu\mu$ $M_{\mu\mu}$ >100 GeV	0	0.04 ± 0.02
eμ $M_{e\mu}$ >100 GeV	0	0.31 ± 0.03
eee M_{12} >100 GeV	3	0.31 ± 0.08
e$\mu\mu$ $M_{e\mu}$ >100 GeV	1	0.04 ± 0.01
e$\mu\mu$ $M_{\mu\mu}$ >100 GeV	1	0.02 ± 0.01

Multi-leptons with $\Sigma P_T > 100$ GeV



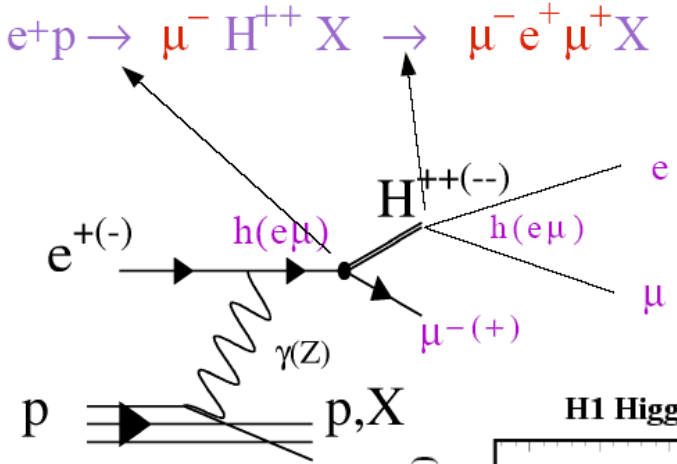




data: 4 events

SM: 0.61+-0.11

Search for Doubly Charged Higgs



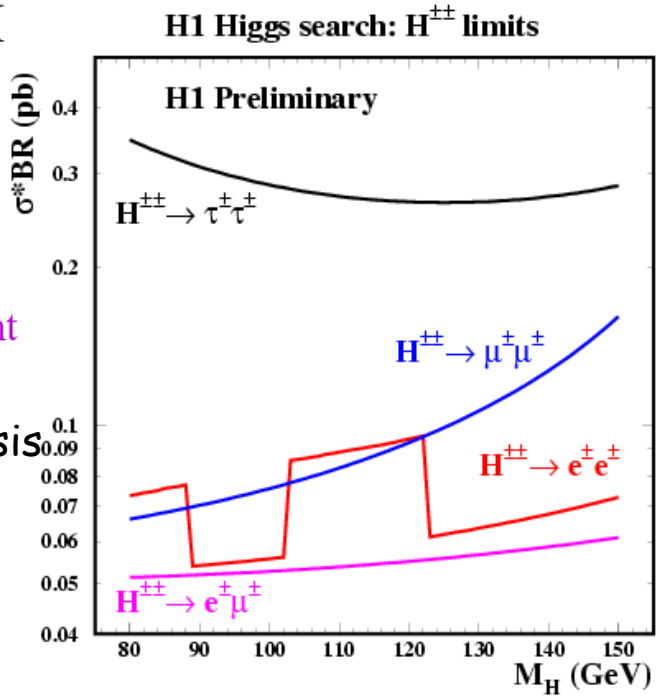
Possible interpretation of multi-lepton events

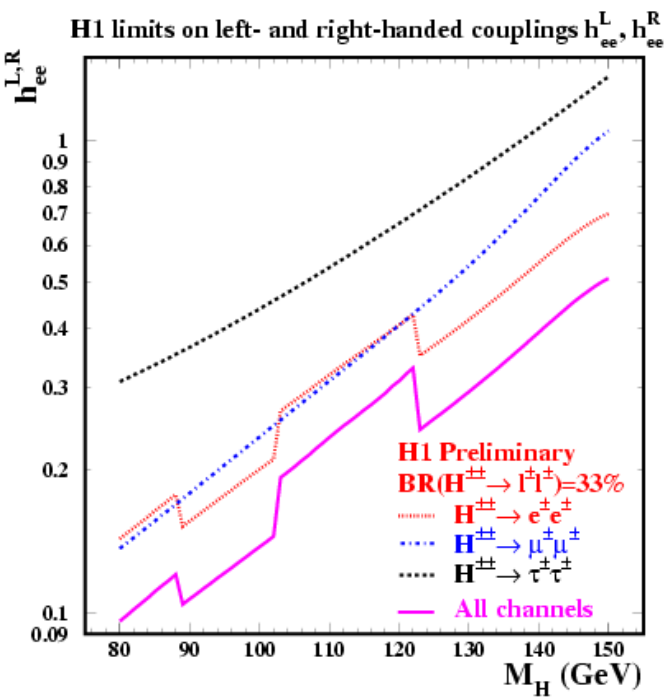
$$H^{\pm\pm} \rightarrow e^{\pm}e^{\pm}, \mu^{\pm}\mu^{\pm}, e^{\pm}\mu^{\pm}, \tau^{\pm}\tau^{\pm}$$

ττ -> eμ,ej,μj,jj

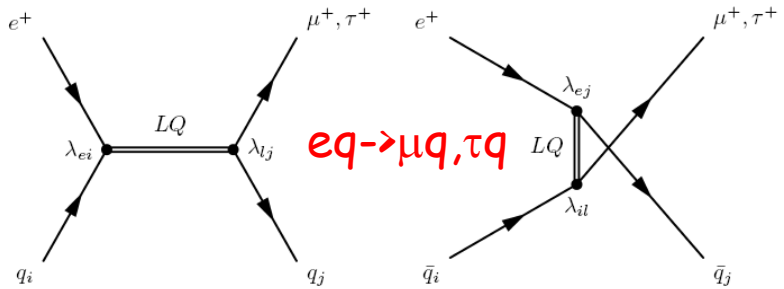
➔ Charge requirement

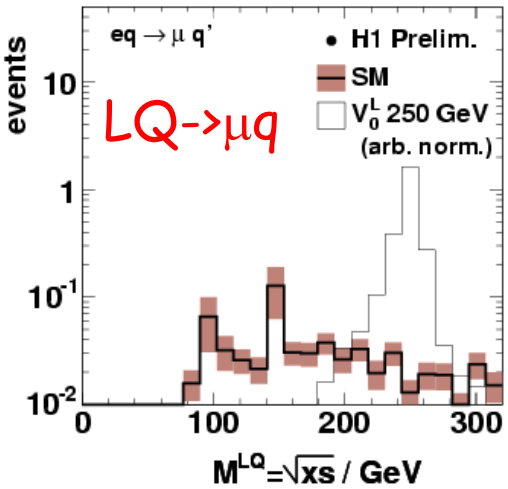
only one event survives in ee analysis

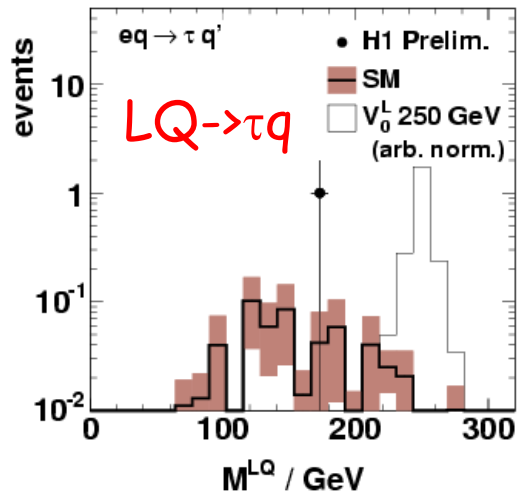




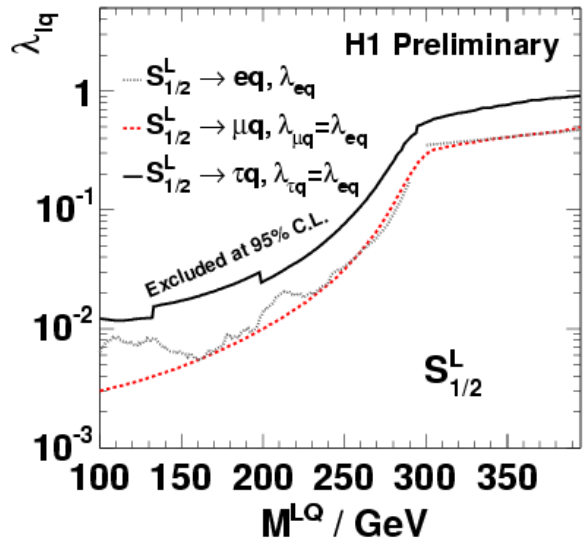
Search for Lepton Flavour Violation

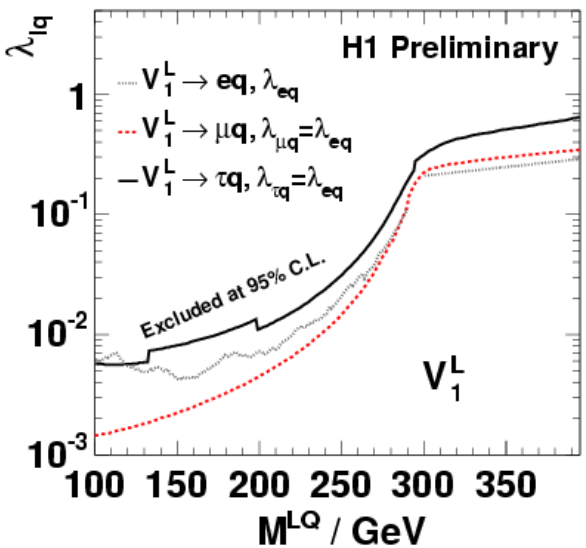




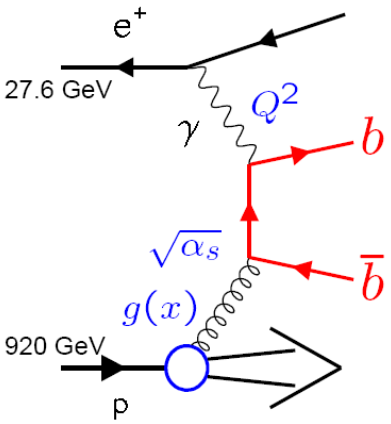


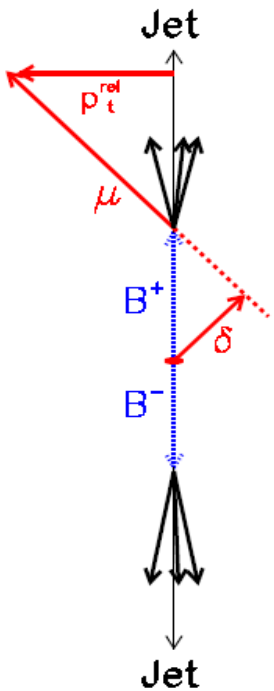
	$LQ \to \mu + q$	$LQ \to \tau + q$
Data	0	1
Total SM	0.74 ± 0.25	0.56 ± 0.16



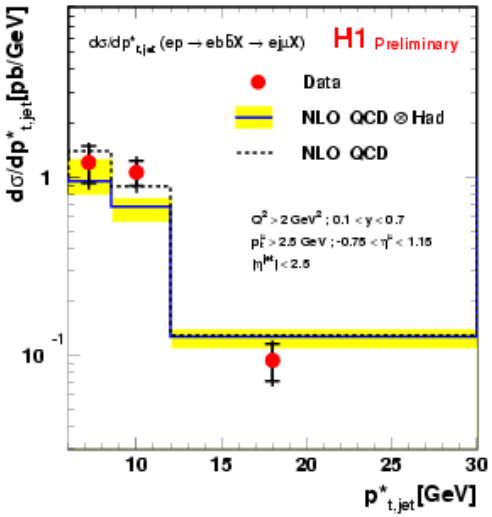


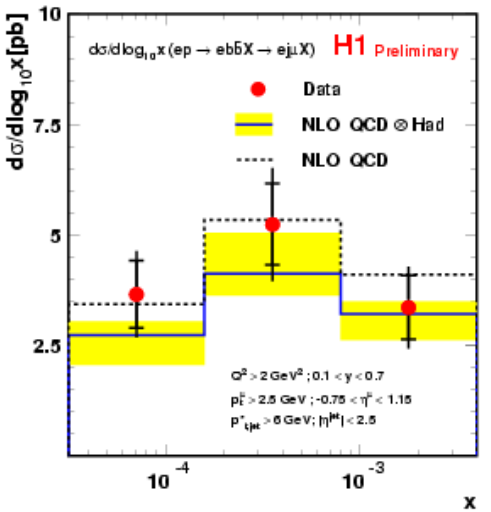
Beauty in DIS (and γp) from b->μX





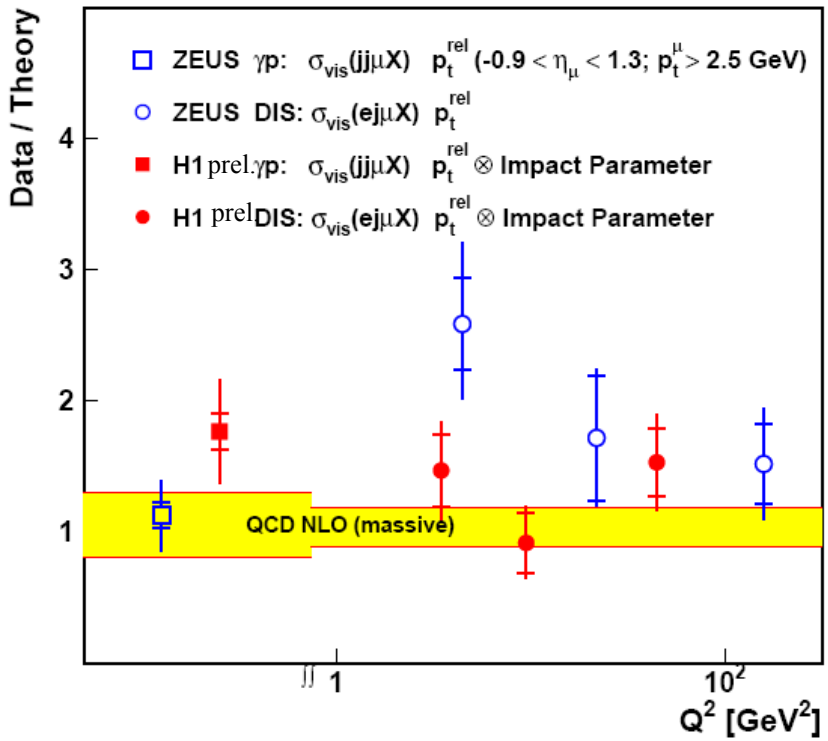
$Q^2 > 2$ GeV^2





Make use of the H1 silicon tracker: simultaneous fit to p_t^{rel} and δ

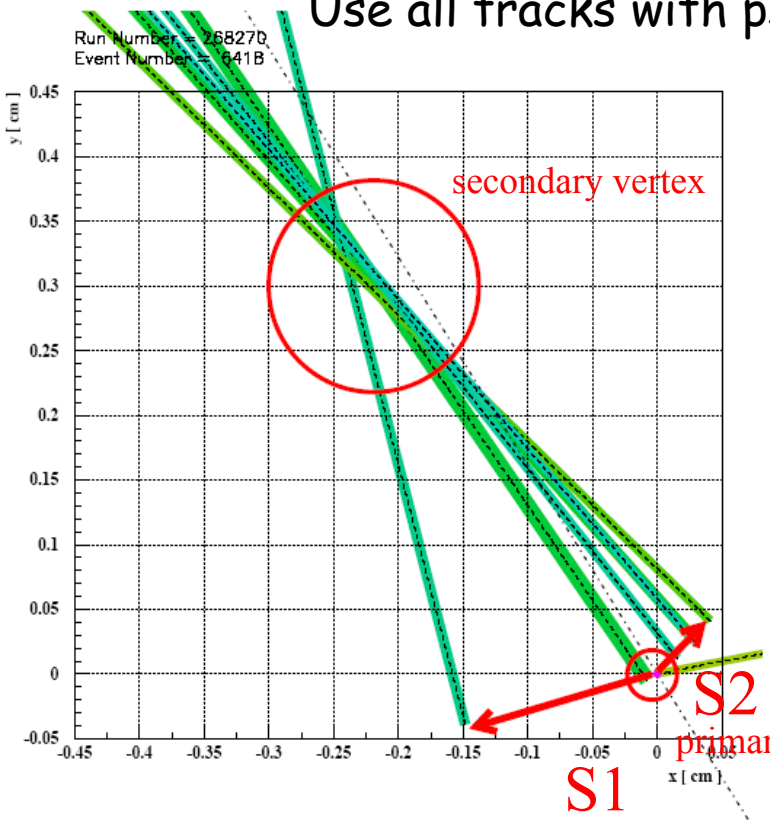
Data/NLO summary



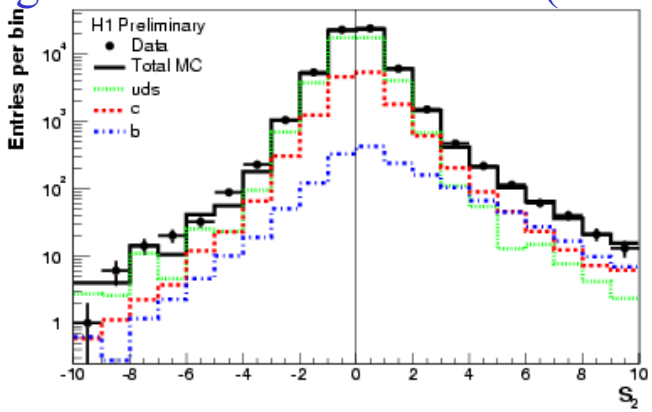
NLO is consistent both with DIS and γp data although systematically somewhat higher

Inclusive Lifetime Tagging

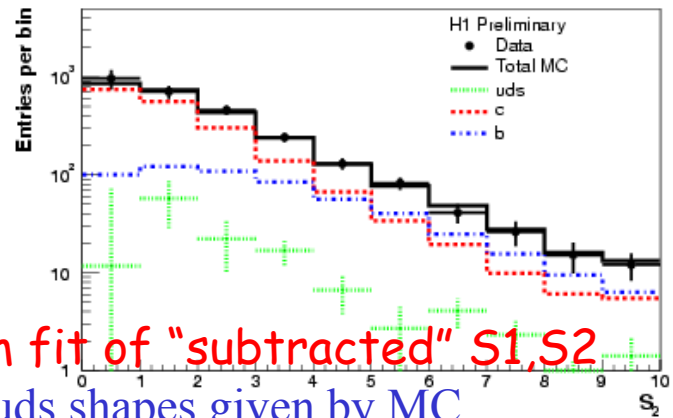
Use all tracks with p_t>500 MeV and hits in the silicon tracker
-> jet (or HFS) gives b-direction



Significance distributions S2 (and S1)



Subtract negative S2 from positive

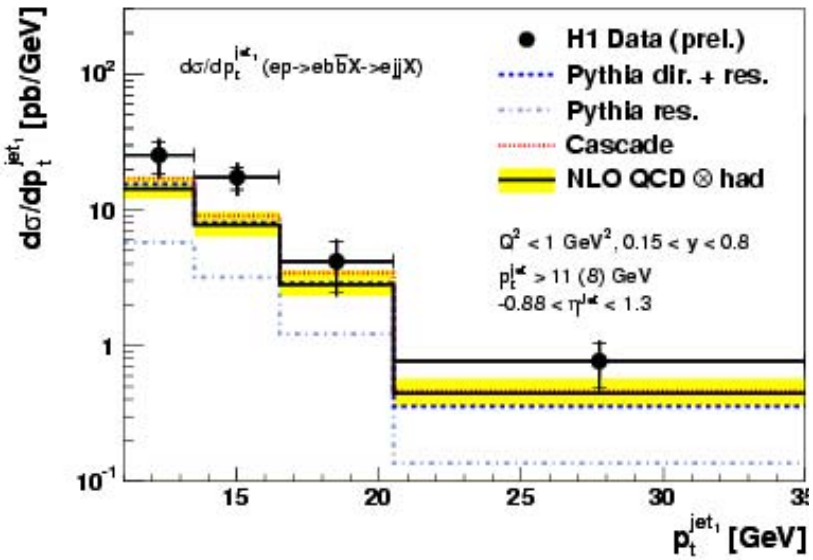


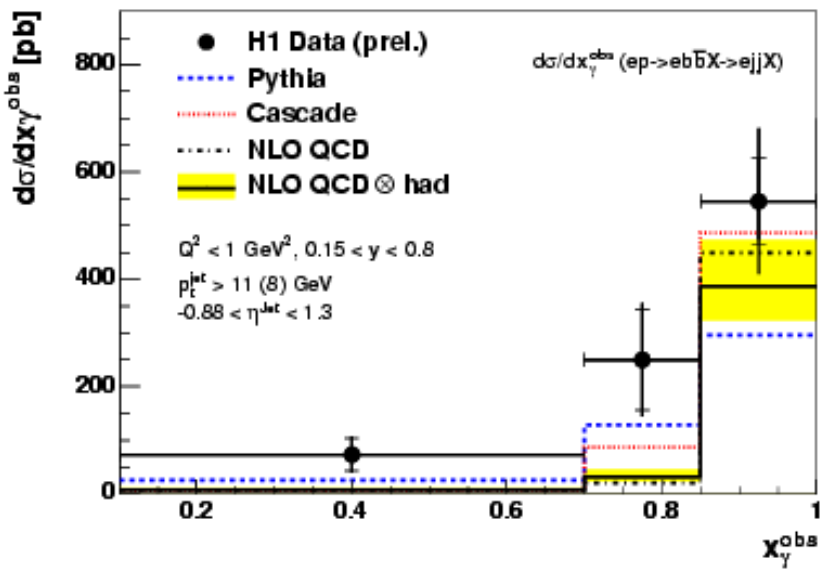
significance $S=\delta/\sigma(\delta)$
(δ=DCA in r-ϕ plane)

b,c from fit of "subtracted" S1,S2
with b,c,uds shapes given by MC

Beauty in γp using lifetime tagging

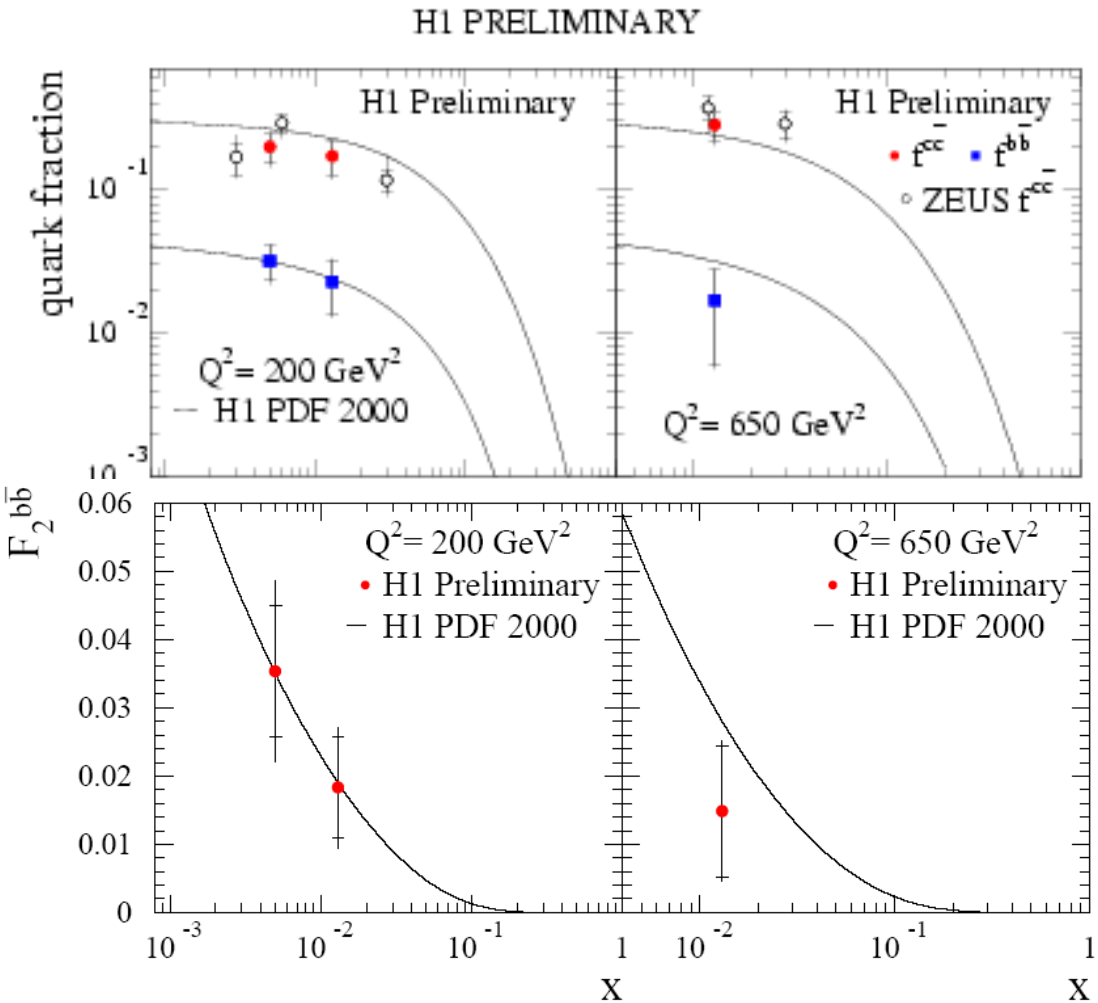
$Q^2 \sim 0$ dijets with $p_t^{jet} > 11\ (7)$ GeV and $-0.88 < \eta^{jet} < 1.3$





- Data are slightly above NLO, similar to b->μX results
- The difference tends to be larger for $x_\gamma^{obs} < 0.85$ (resolved)
- Similar conclusions for Cascade (CCFM)

F_2^{bb}, F_2^{cc} at high Q^2 using lifetime tagging



x bins for Q^2=200, 650 GeV^2 ensure that jets/tracks are within acceptance of the silicon tracker (extrapolation below 3%)

c contribution ~30%
b contribution ~3%

for Q^2 >150 GeV^2, 0.1<y<07

$$\sigma(c\bar{c}) = 431 \pm 59(stat) \pm 69(syst)\, pb$$

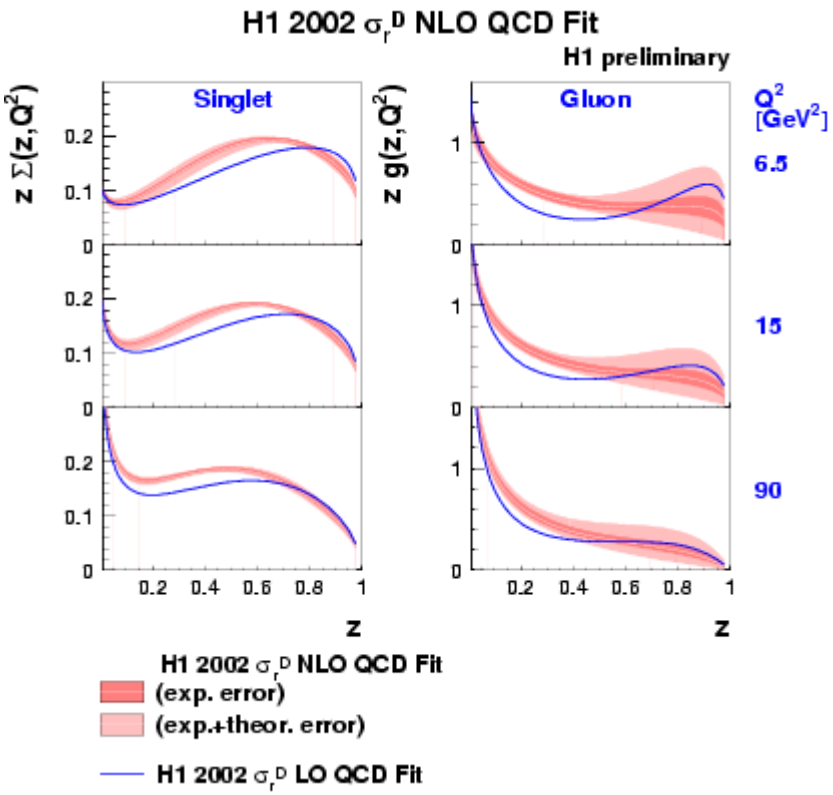
$$\sigma(b\bar{b}) = 45 \pm 11(stat) \pm 11(syst)\, pb$$

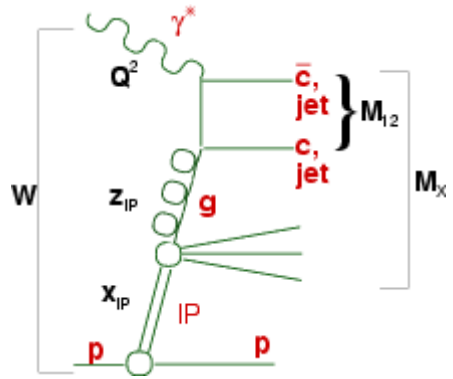
First measurement of F_2^{bb}
- consistent with NLO

Diffractive Final States and NLO QCD

(tests of QCD factorisation in diffraction)

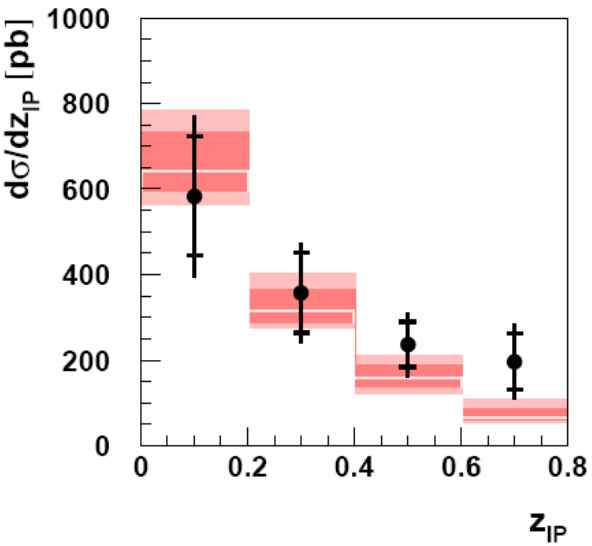
diffractive NLO PDFs from F_2^D data -> predictions for final states

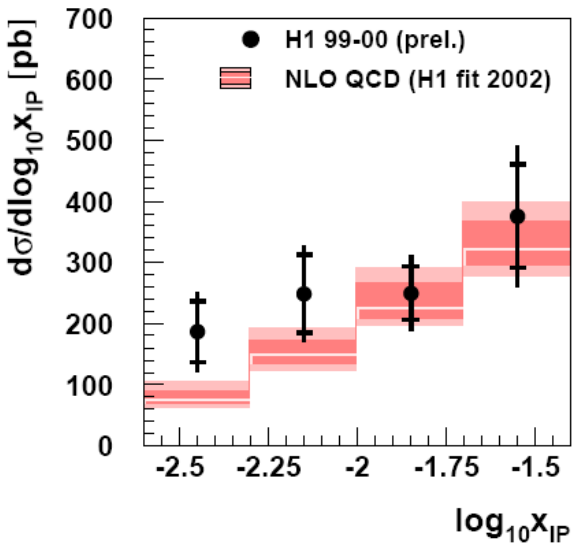




- Diffractive D* in DIS
- Diffractive dijets (DIS, γp)
- Diffractive CC

Diffractive D* in DIS



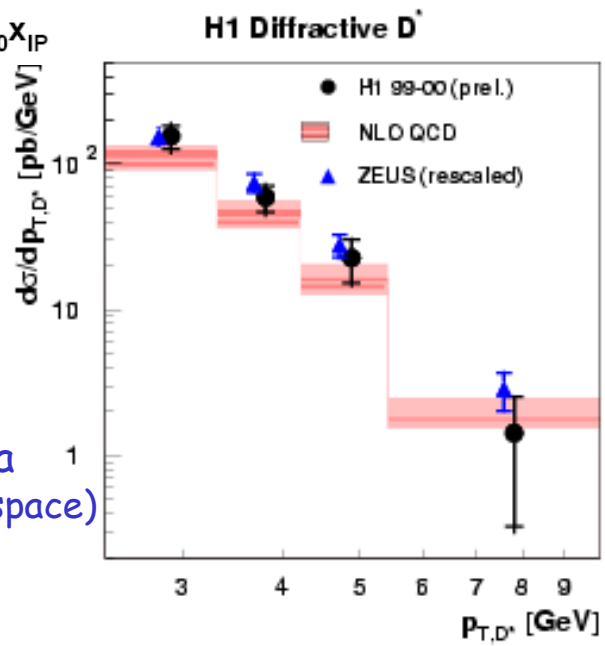


cross section for

$2<Q^2<100\ \mathrm{GeV}^2$, $0.05<y<0.7$,
$x_{IP}<0.04$, $M_Y<1.6$ GeV, $|t|<1\mathrm{GeV}^2$,
$p_T(D^*)>2$ GeV, $|\eta(D^*)|<1.5$

$$\sigma_{diff}(D^*) = 358 \pm 41 \pm 61 pb$$

NLO agrees with data indicating validity of the hard scattering factorisation theorem

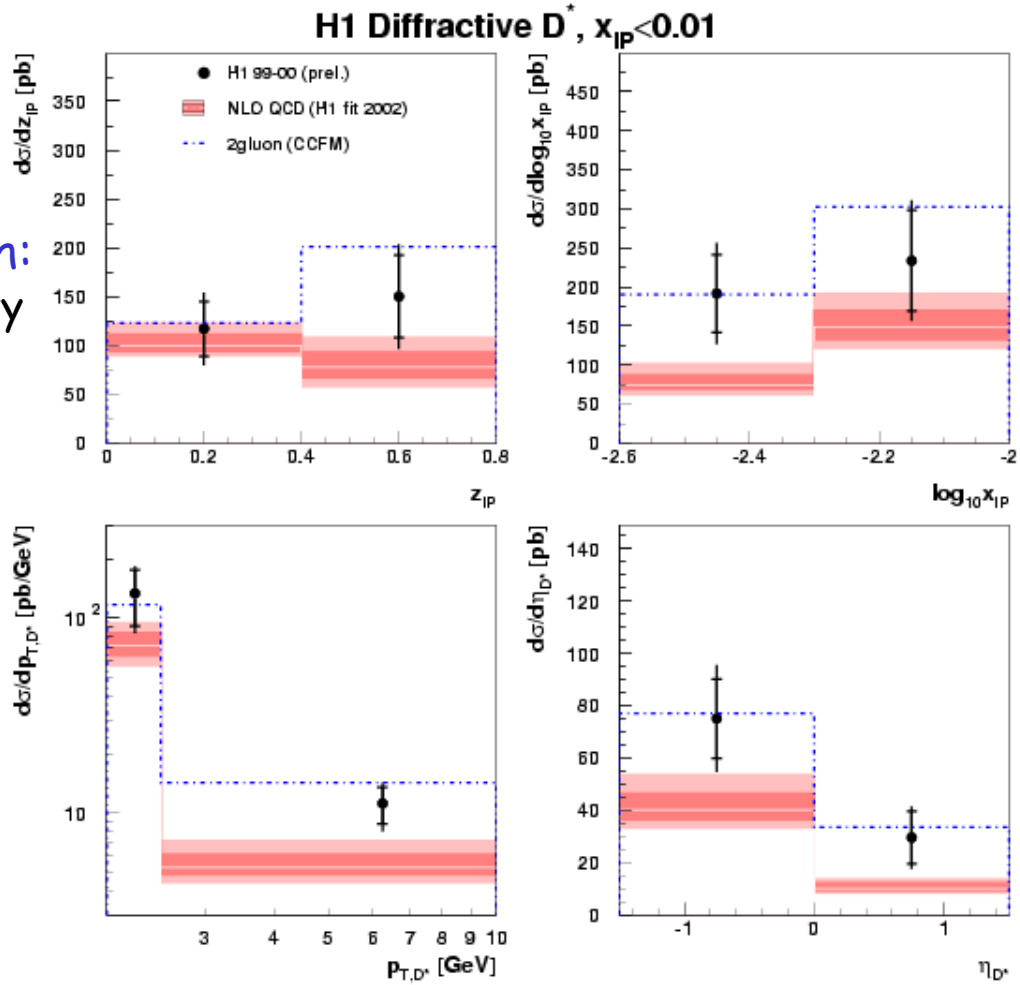


agreement of H1 and ZEUS data
(corrected for difference in phase space)

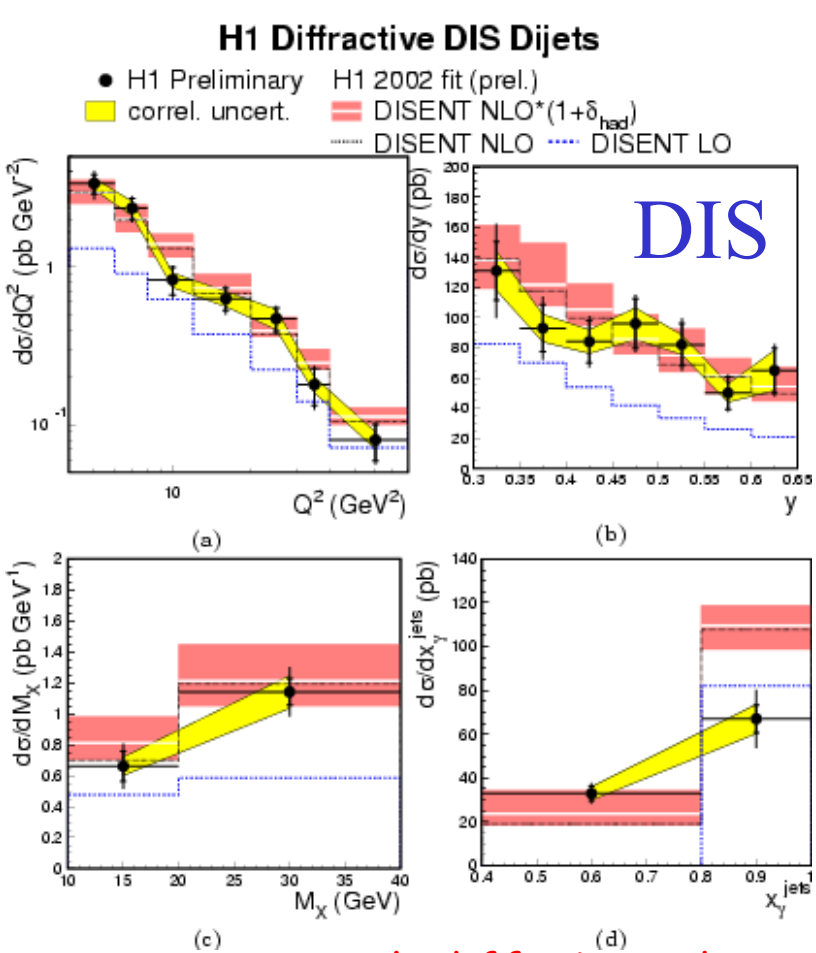
Comparison with 2-gluon approach (x_{IP}<0.01)

Perturbative 2-gluon approach:
use of un-integrated gluon density obtained from CCFM evolution to the inclusive F_2 data

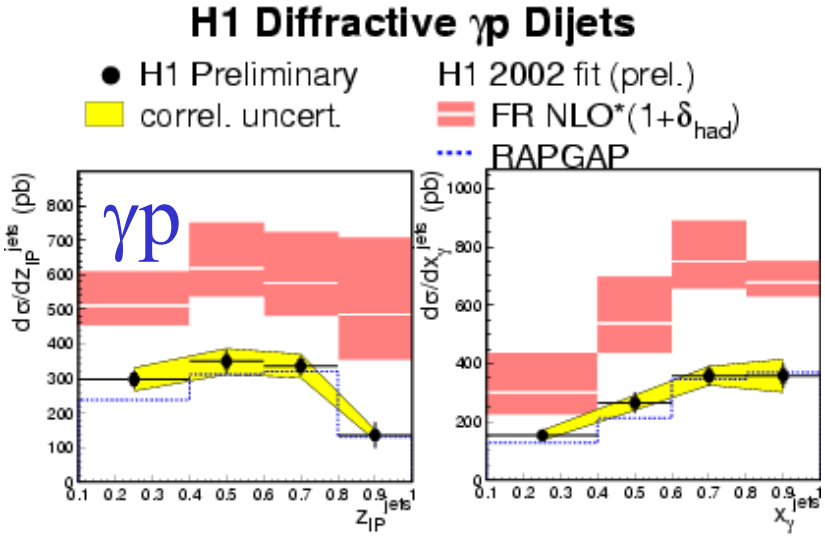
Good agreement with data in all distributions



NLO QCD for Diffractive Dijets in DIS and γp



NLO agrees with diffr. DIS data supporting QCD factorisation



Common phase space for DIS and γp

$165<W<242\,GeV$, $E_t^{*jet}>5(4)\,GeV$, $-1<\eta<2$

$x_{IP}<0.04$, $M_Y<1.6\,GeV$, $|t|<1\,GeV^2$

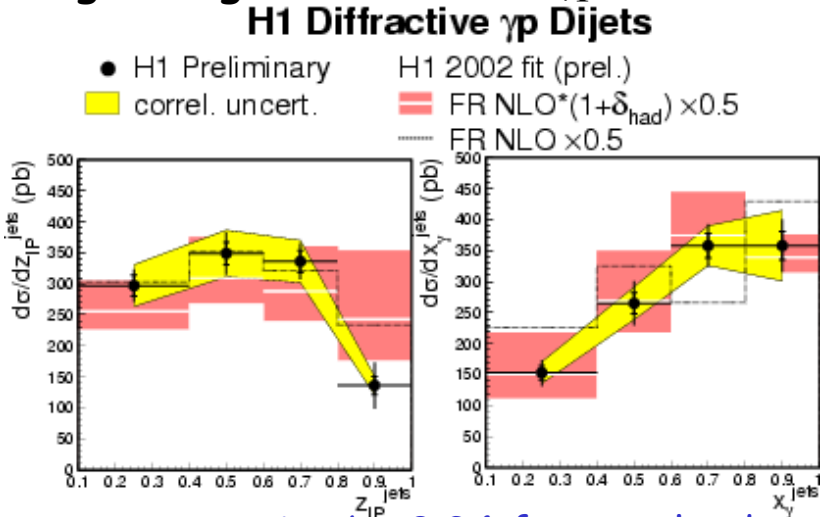
NLO is corrected for hadronisation

NLO is about 2 times higher γp data -> breaking of factorisation in γp

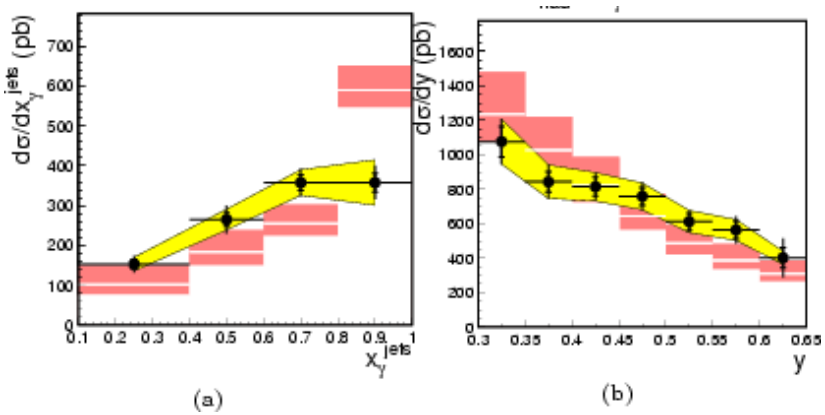
for dijets in ppar: ~7 times higher

"Rapidity Gap Survival Probability" in γp

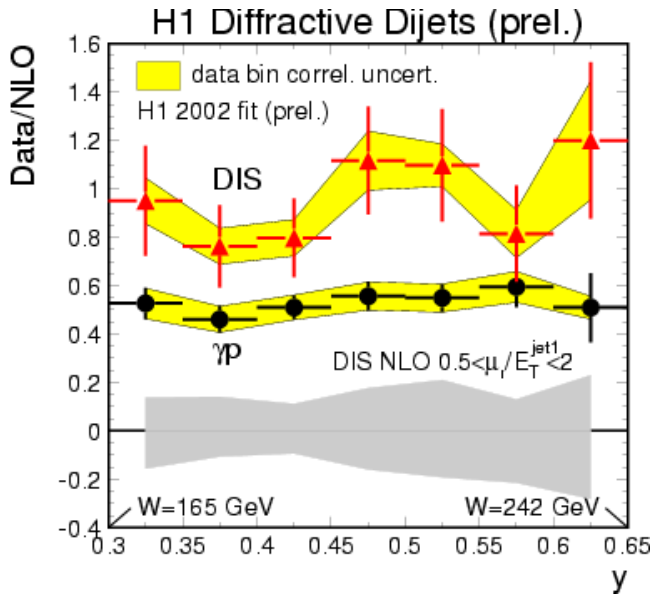
NLO multiplied by a factor of 0.5
-> good agreement with γp data



suppression by 0.34 for resolved (Kaidalov et al) is not sufficient



Data/NLO: DIS & γp

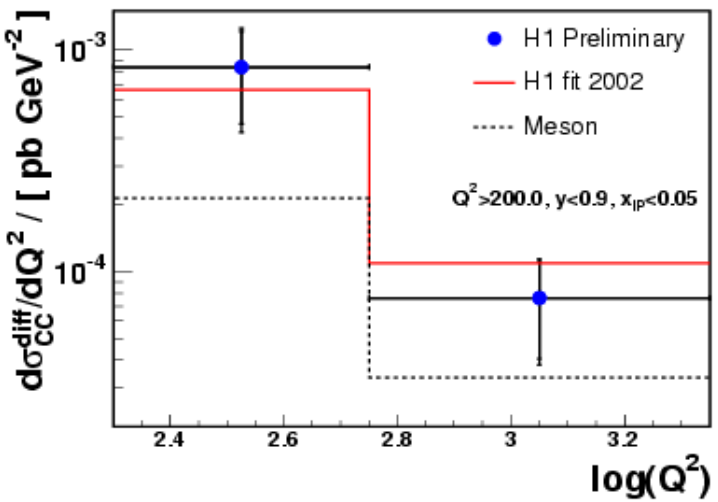


Double ratio

$$\frac{\text{data/NLO } (\gamma p)}{\text{data/NLO (DIS)}} = 0.5 \pm 0.1$$

-> no y (energy) dependence

Diffractive e^+p CC cross section

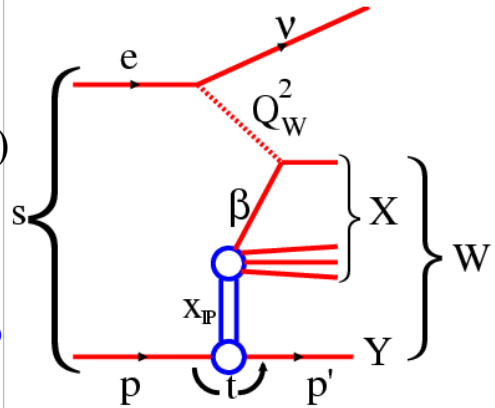


14 diffractive CC events

(Q^2 >200 GeV^2, y<0.9, x_{IP}<0.05)

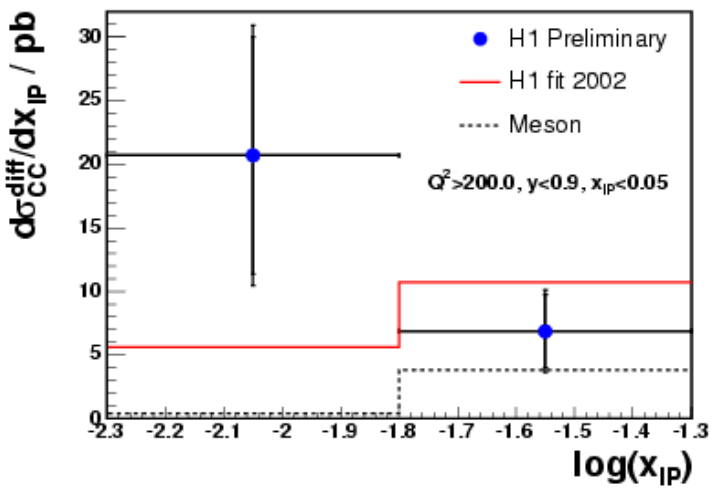
$\sigma_{CC}^{diff} = 0.42 \pm 0.13 \pm 0.09\, pb$

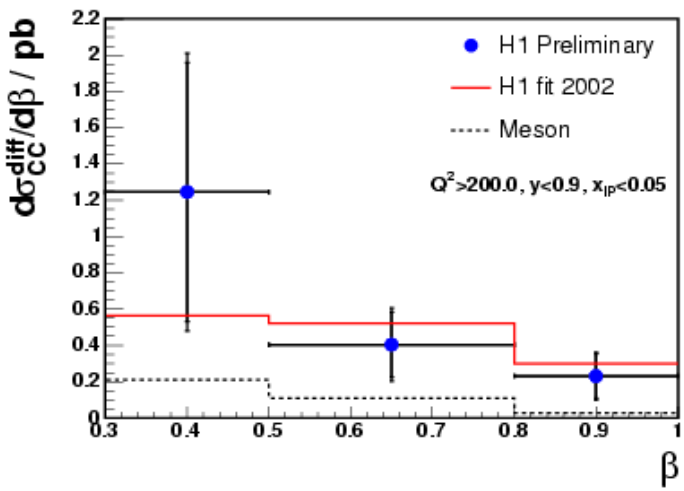
$\sigma_{CC}^{diff} / \sigma_{CC}^{tot} = 2.5 \pm 0.8 \pm 0.6\%$



-> differential distributions in Q^2, x_{IP} and β

-> good agreement with H1 DPDF fit assuming flavour democracy





Summary

Many new results for ICHEP2004:

- analysis of HERA I data is still going on, although in some areas the data now are essentially exploited
- the first physics results from HERA II polarised CC, new interesting events at high P_T,...
- many completely original and new topics double signitures, new techniques, ...

Many thanks to HERA machine group and all H1 colleagues who worked hard to get these results out