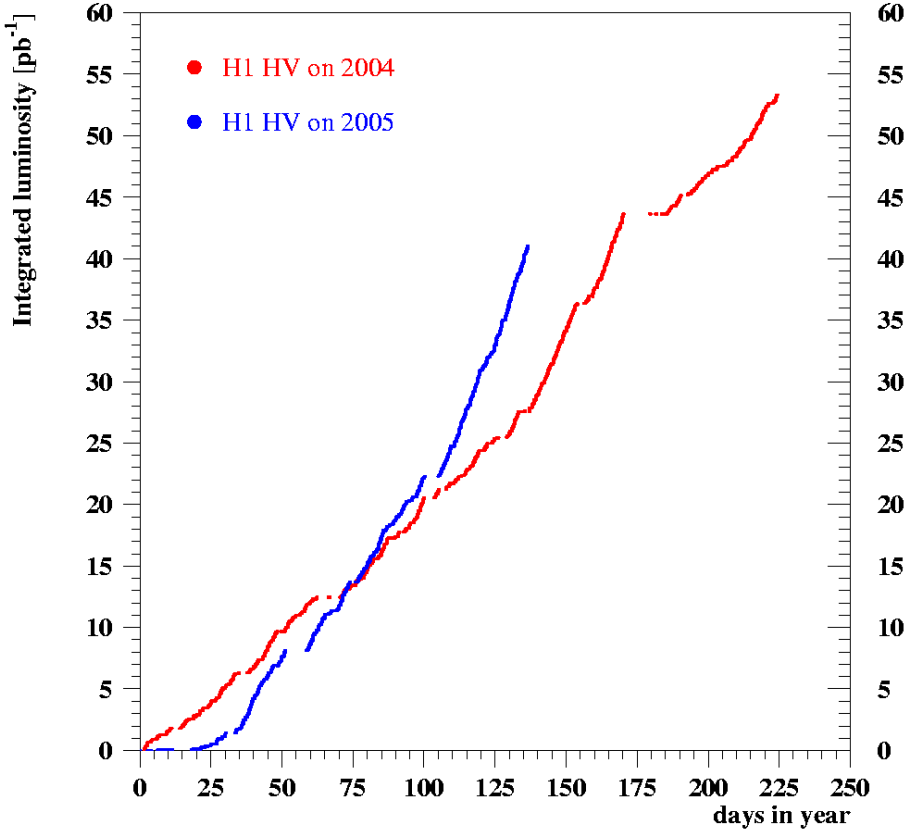
H1 Status Report

Emmanuel Sauvan, CPPM Marseille

- Analysis and detector in 2005
- New physics results for HERA-I
- Upgrade projects
- Conclusions

2005 data taking: Luminosity

- Evolution of lumi, HV ON, in 2005:



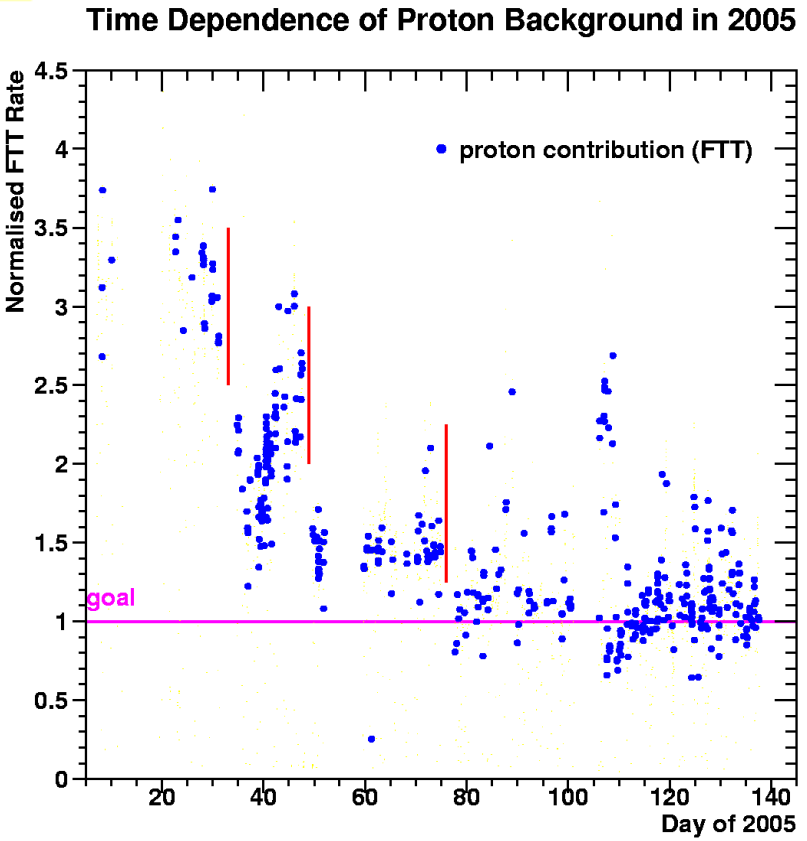
- 2005 lumi production well ahead of 2004
- Averaged HV efficiency is only 53.6%
- Improved in the last month
  - ➔ 19 pb^{-1} taken from mid-April to mid-May
  - ➔ ~72 % HV efficiency

↘ Congratulations to the machine group for successful e-p operation

↘ **40 pb^{-1} of e-p data collected for physics**

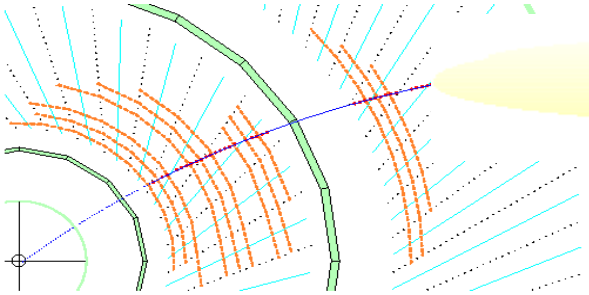
Background conditions in 2005

- Harsh background conditions: p-spikes
  - ➔ Cured by changing coils in 1 magnet
- Dominated by p-gas background
  - ➔ Steady reduction over 3 months
  - ➔ Helped by NEG pump regenerations
  - ➔ Reached best value of 2004



- Chamber current: scales with $I_e.I_p$
  - ➔ Operation was possible at 50 * 100 = 5000 mA^2

➘ **Background conditions changed recently**

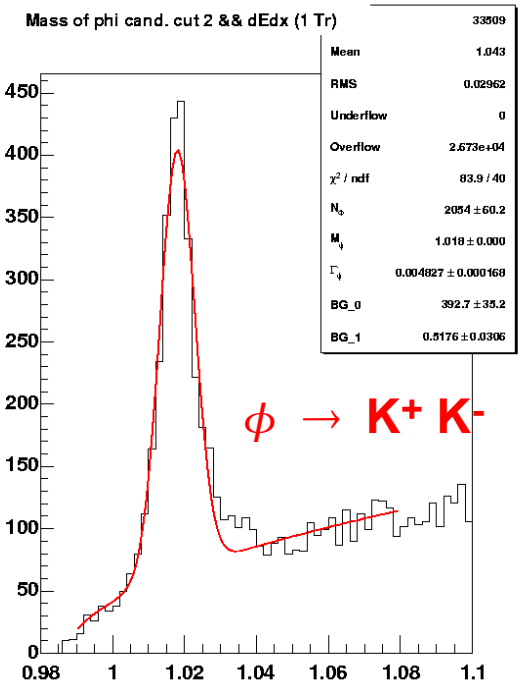


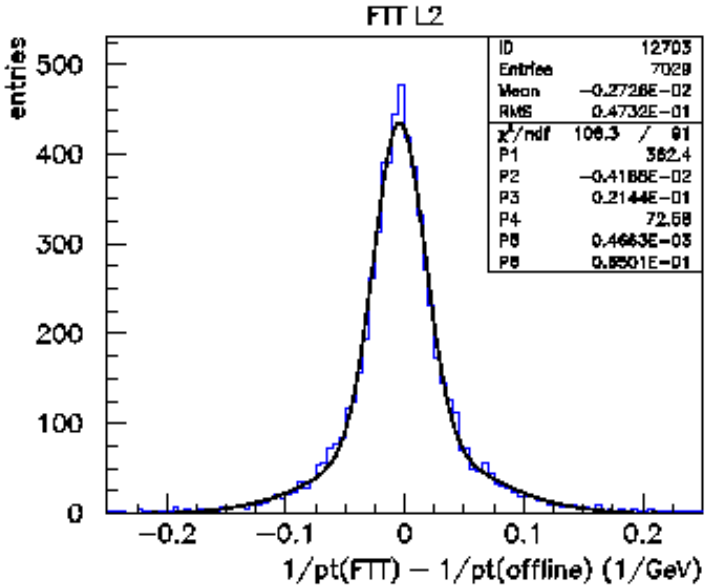
Fast Track Trigger

- Level 1 (2.3 μs): coarse r-ϕ track reconstruction
  - ➔ In production since 2005
  - ➔ 50% of H1 triggers use FTT

2000 phi candidates in 3 weeks

min. threshold of 100 MeV





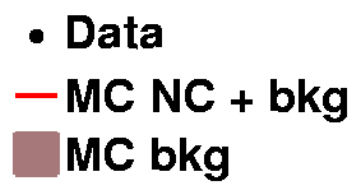
2% p_t resolution

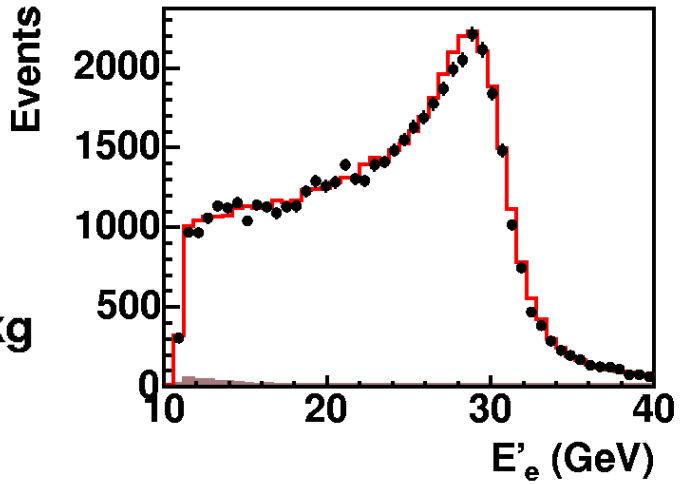
- Level 2 (20 μs): precise 3D track reconstruction
  - ➔ Commissioned, operational, first calibrations
  - ➔ Fulfills specifications
- Level 3 (100 μs): full event reconstruction
  - ➔ Being commissioned

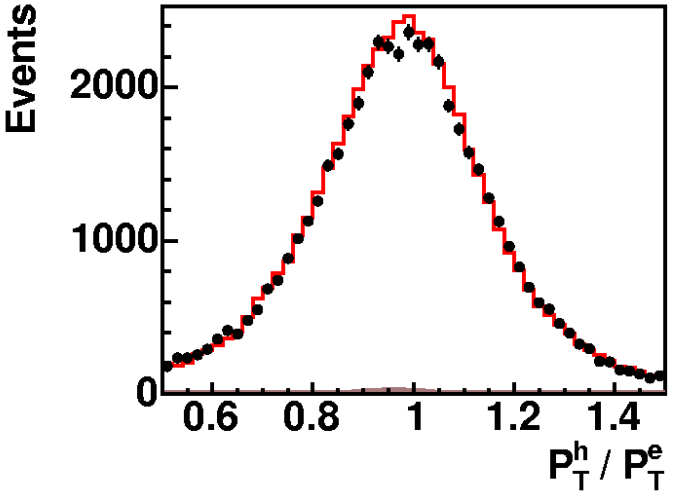
2005 data: high Q^2 data sample

- H1 detector is working well:

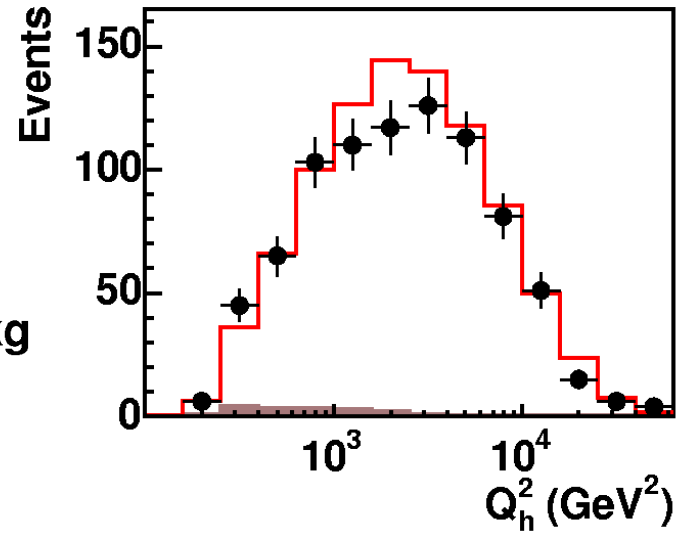
- NC: control of calorimeter energy scales

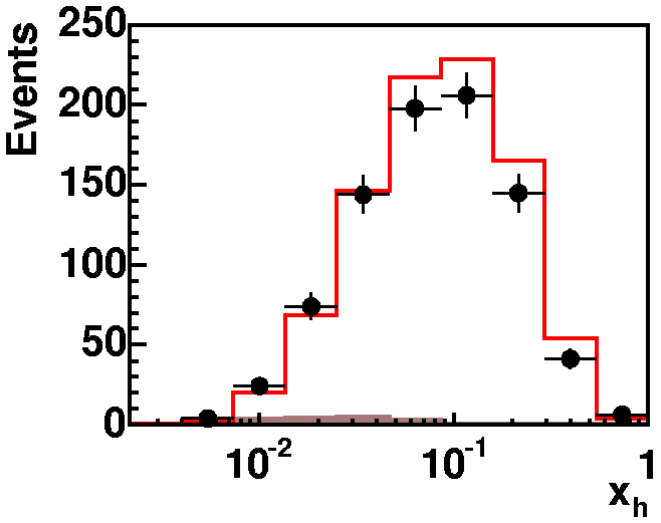






- CC analysis:

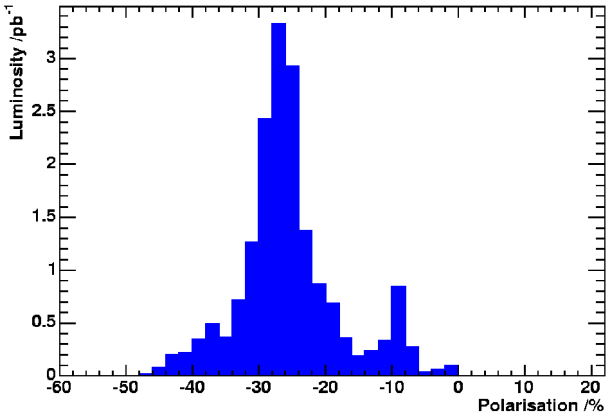


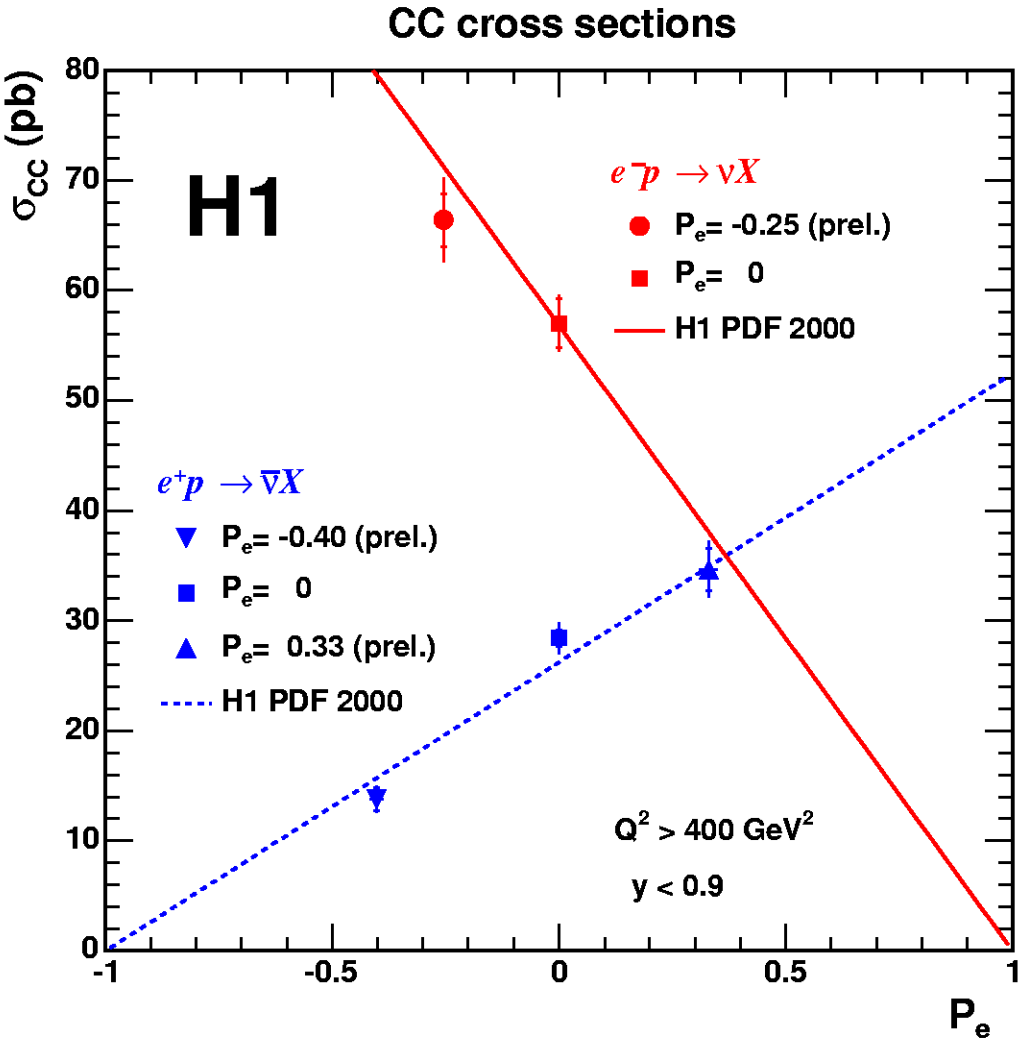


↘ Allowed a new cross-section measurement

CC cross-section as a function of polarisation

- Need a good control of the luminosity ($\mathcal{L}$=17.7 pb^{-1})
- Mean left-handed polarisation of -25%





- New measurement for DIS 2005:

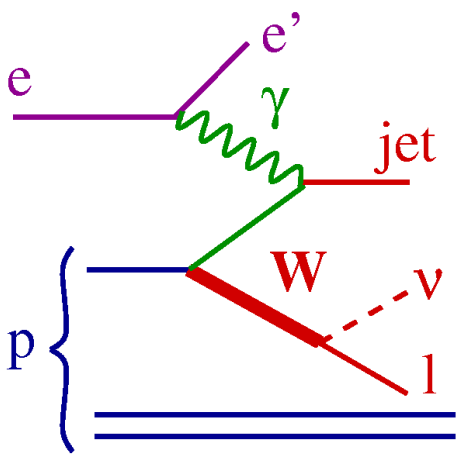
σ_{CC} (e$^-$p, P_e=-0.25) = 66.42 ± 2.39 (stat.) ± 2.99 (sys.) pb

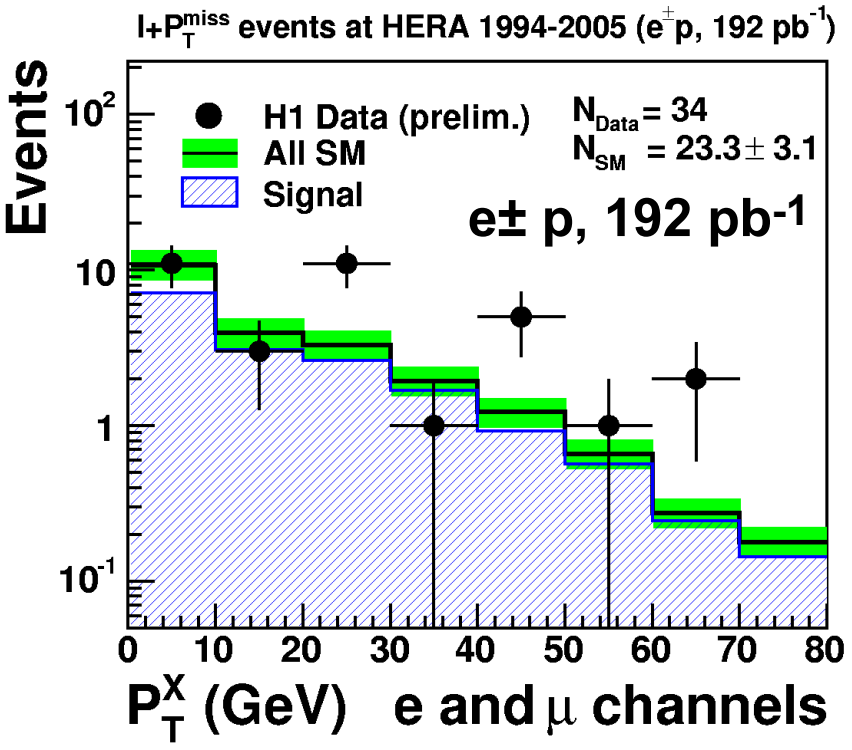
➔ Polarisation dependence as expected from SM

➔ Right-handed e-p data will be taken in the near future

Events with isolated leptons and missing P_T

- New update for DIS 2005 with 21 pb^{-1} of e-p
  - ➔ 5 new e events observed for 2.75 ± 0.4 expected
  - ➔ 1 with $P_T^X > 25$ GeV
  - ➔ No μ event yet (0.59 ± 0.09 expected)

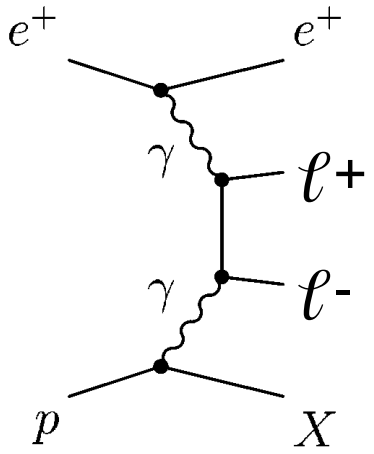




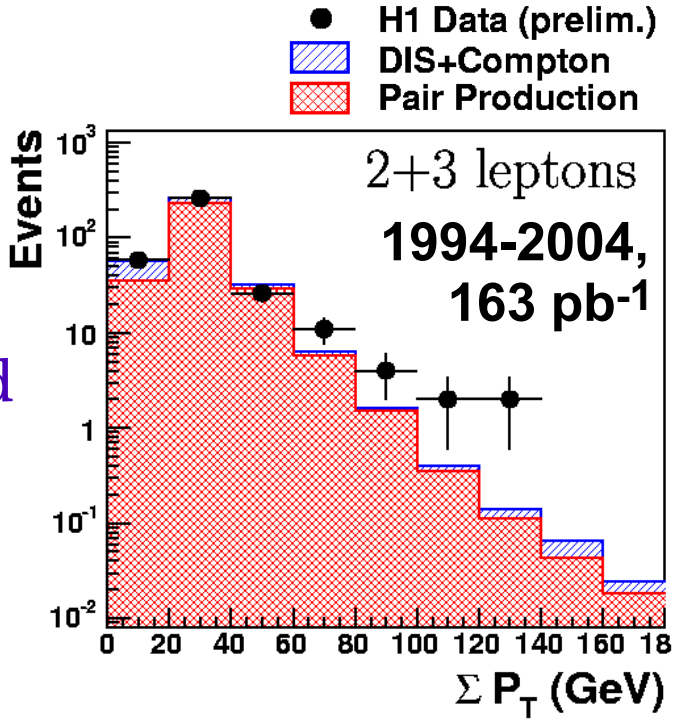
1994-2005 e± p, 192 pb^{-1}	Electron obs./exp. (W)	Muon obs./exp. (W)
All P_T^X	25/18.4 ± 2.5 (70%)	9/4.9 ± 0.8 (85%)
$P_T^X > 25$ GeV	11/2.9 ± 0.6 (81%)	6/2.9 ± 0.6 (86%)

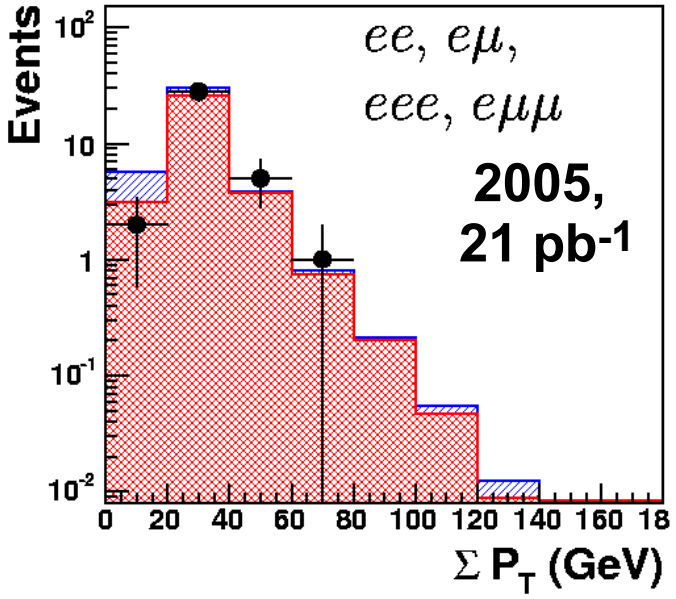
Multi-lepton events

- Multi-leptons (e, μ) topologies:



- Deviation from SM observed at high P_T
  - ➔ 4 events for 0.61 ± 0.11 expected



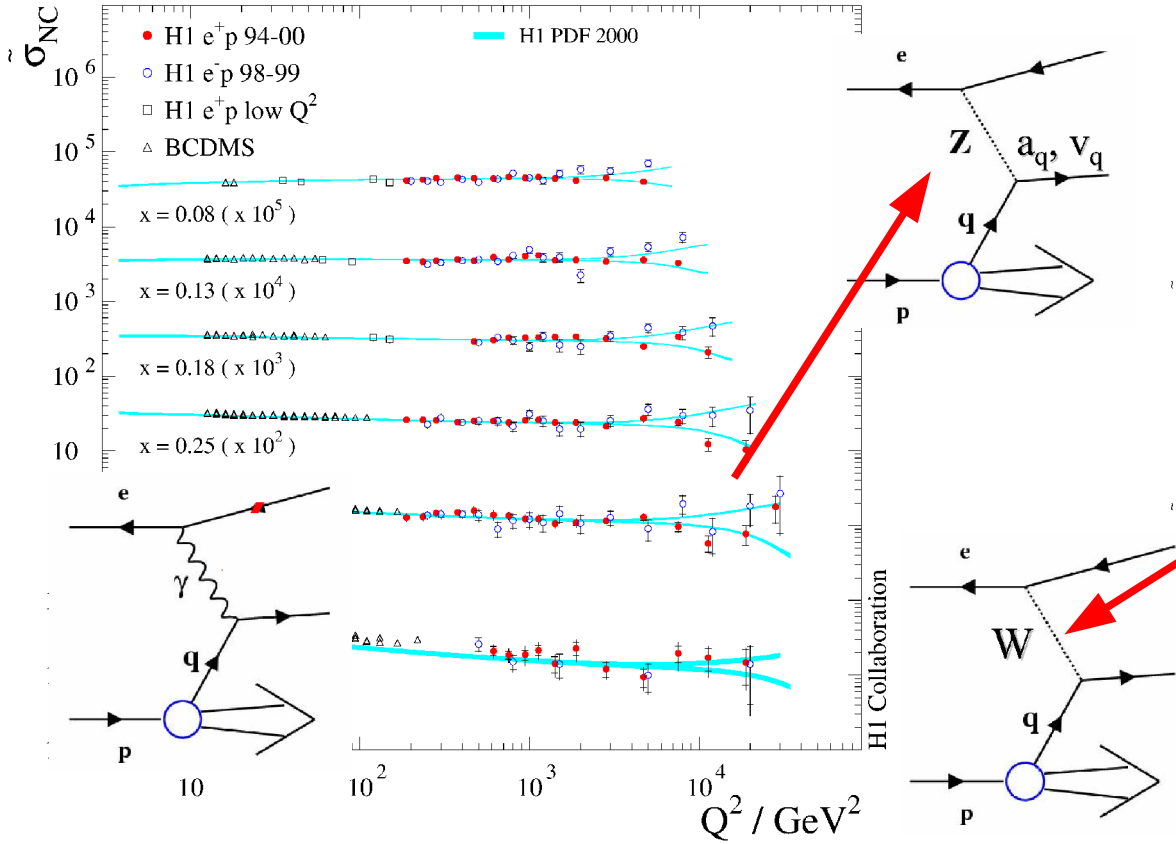


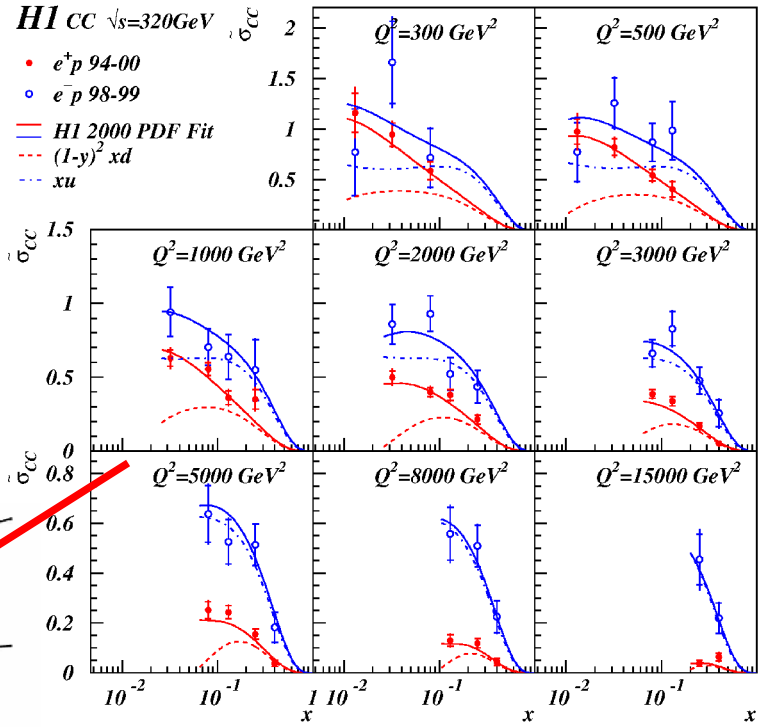
- Updated with 21 pb^{-1} of e-p
  - ➔ no new high P_T event yet

New H1 results

- DIS05: 31 talks by H1 members, 15 new results since last PRC
- Selection of new results presented:
  - ➔ CC cross-section with polarised electrons
  - ➔ Updates for the high P_T searches
  - ➔ Measurement of electroweak parameters
  - ➔ F_2^{cc} and F_2^{bb} at low Q^2
  - ➔ α_s from 3/2 jets
  - ➔ Pentaquark search: $\theta^+(1530) \rightarrow K^0_s p$
  - ➔ Charm fragmentation function in DIS
  - ➔ Jet shape studies in charm photoproduction
  - ➔ Elastic J/Ψ production

Measurement of electroweak parameters



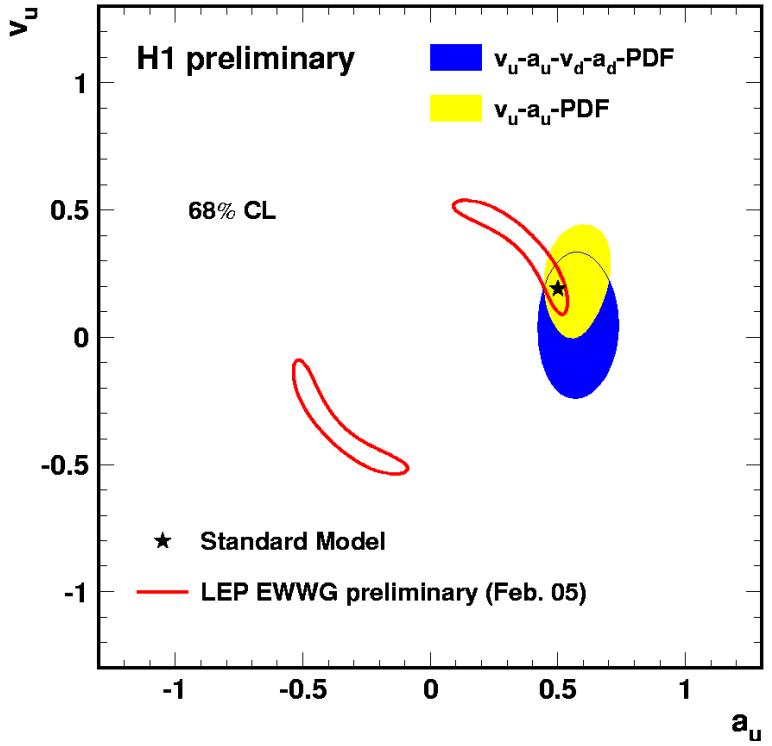


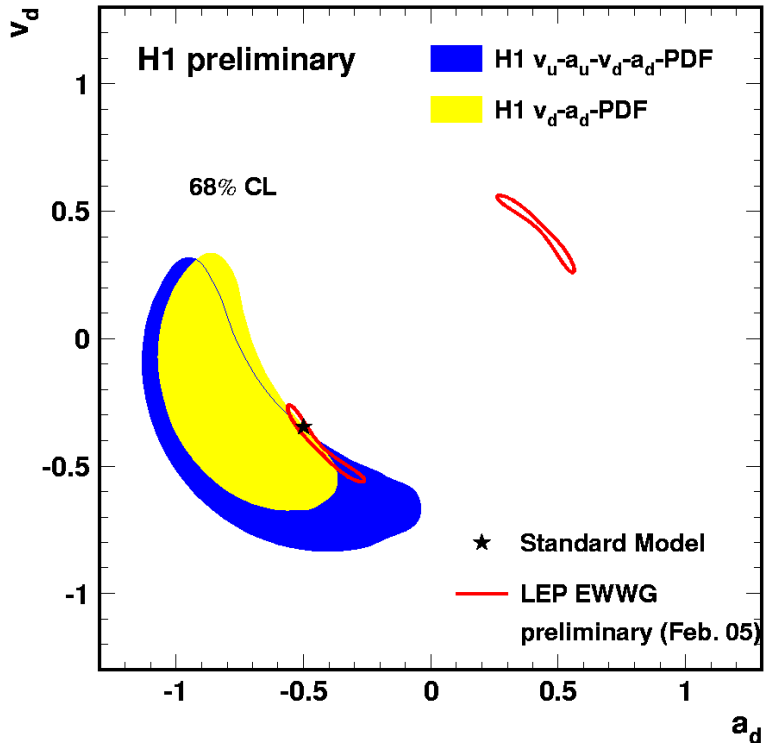
➘ **Z-q couplings**

➘ **W propagator mass**

- Perform an EW-QCD combined fit (using H1 HERA-I data)
  - ➔ Exploit the potential for EW physics of HERA-I NC/CC
  - ➔ Consistently treat uncertainty from proton structure

Light quark couplings to the Z





➘ **First HERA results on a_q, v_q**

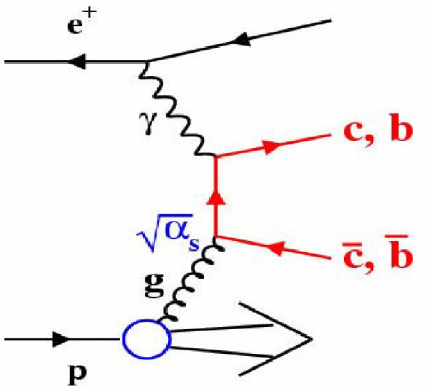
➔ Complementarity with LEP

- Further results:
  - ➔ M_{prop} = 82.87 ± 1.82 GeV (exp.) [M_W measurement in t-channel]
  - ➔ $\sin^2\theta_W$ = 0.2151 ± 0.0040 (exp.) [determined in OMS scheme]

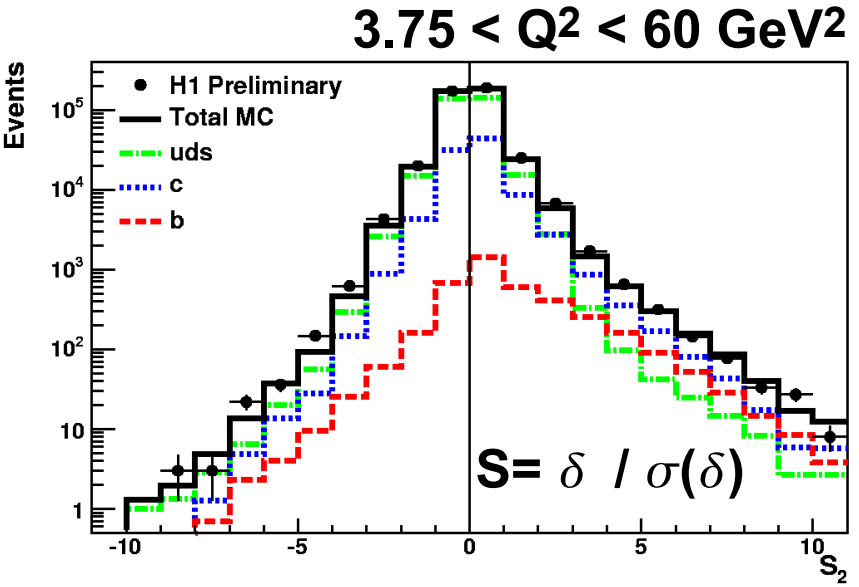
➘ **Luminosity, e^+ and e^-, polarisation will help**

New determination of F_2^{cc} and F_2^{bb} at low Q^2

- Measure c and b contributions to inclusive ep scattering
  - ➔ Only 0.8% of b at low Q^2: experimentally challenging



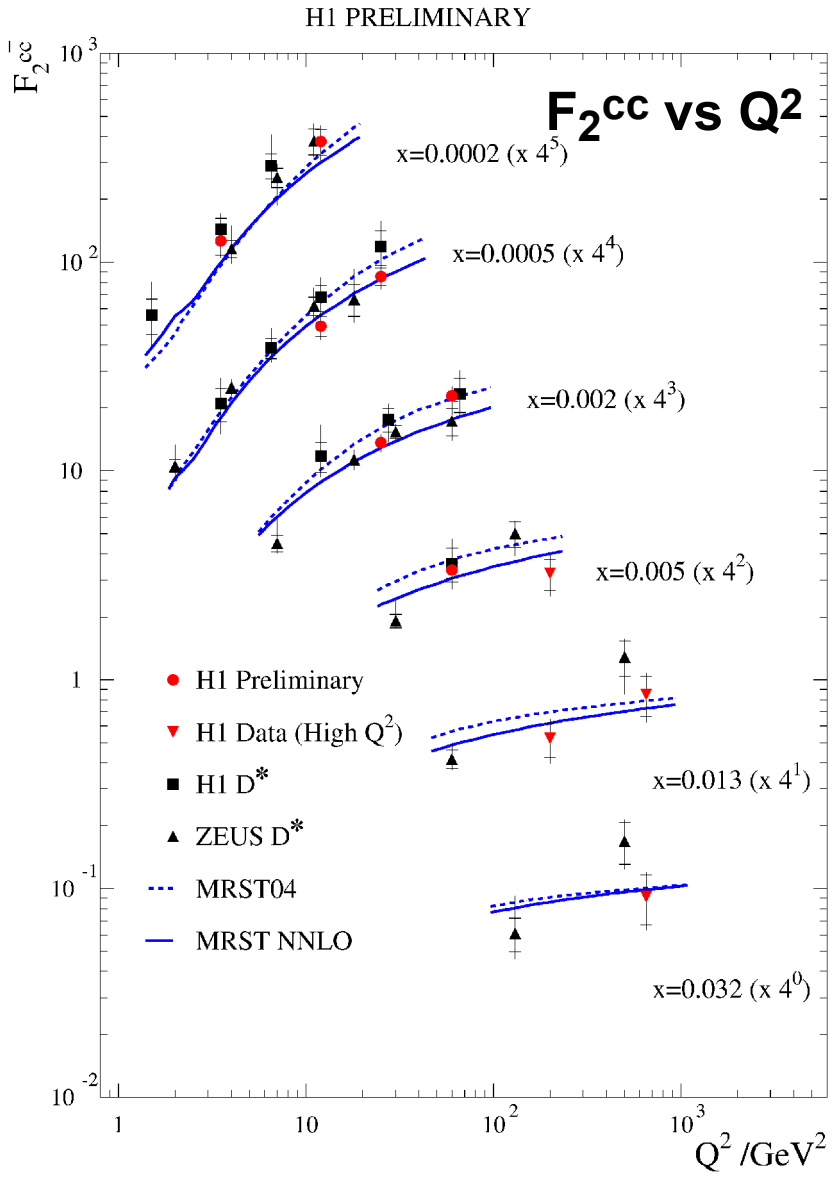
- Exploit long b and c lifetimes
  - ➔ Track impact parameters from the H1 vertex detector
  - ➔ Use an inclusive separation method
  - ➔ New precise measurements at low Q^2

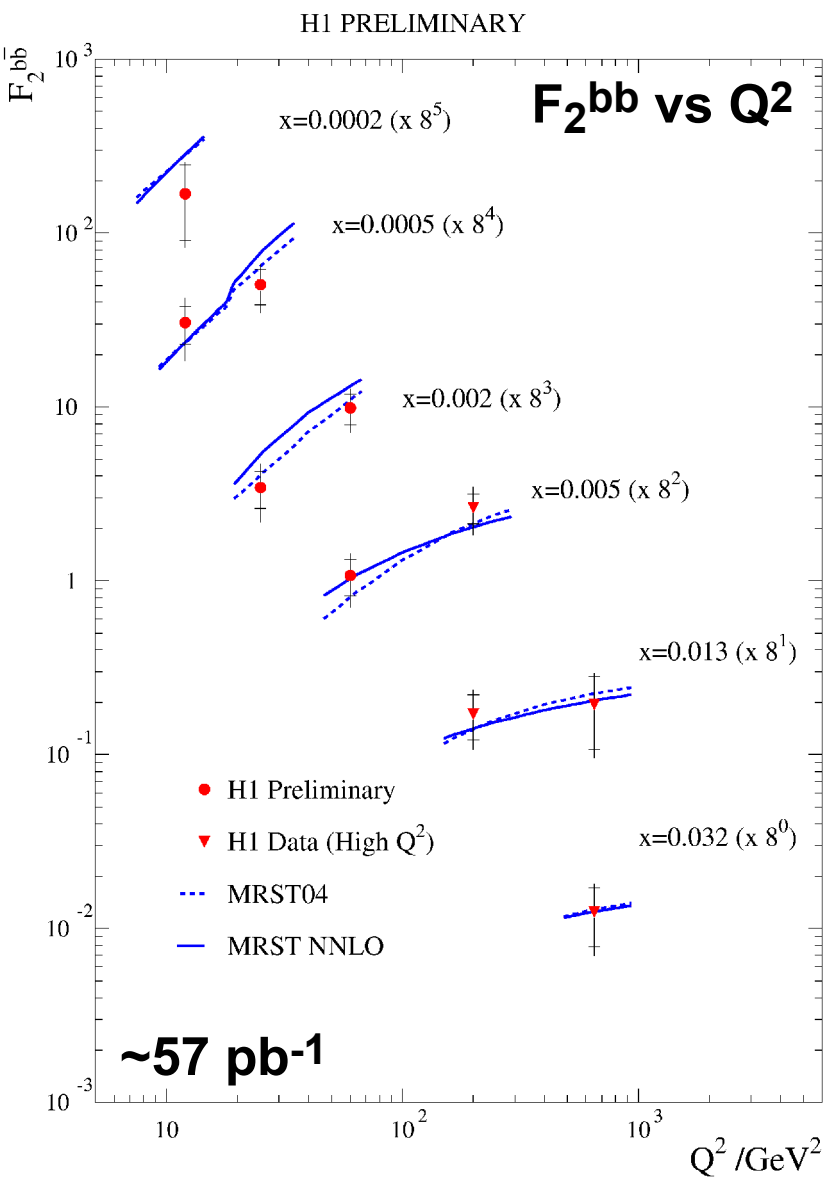


➘ **F_2^{cc}: size of model dependent extrapolations reduced**

➘ **First measurement of the proton beauty structure function at low Q^2**

New determination of F_2^{cc} and F_2^{bb} at low Q^2





➘ **Potential for precise measurements with high luminosity**

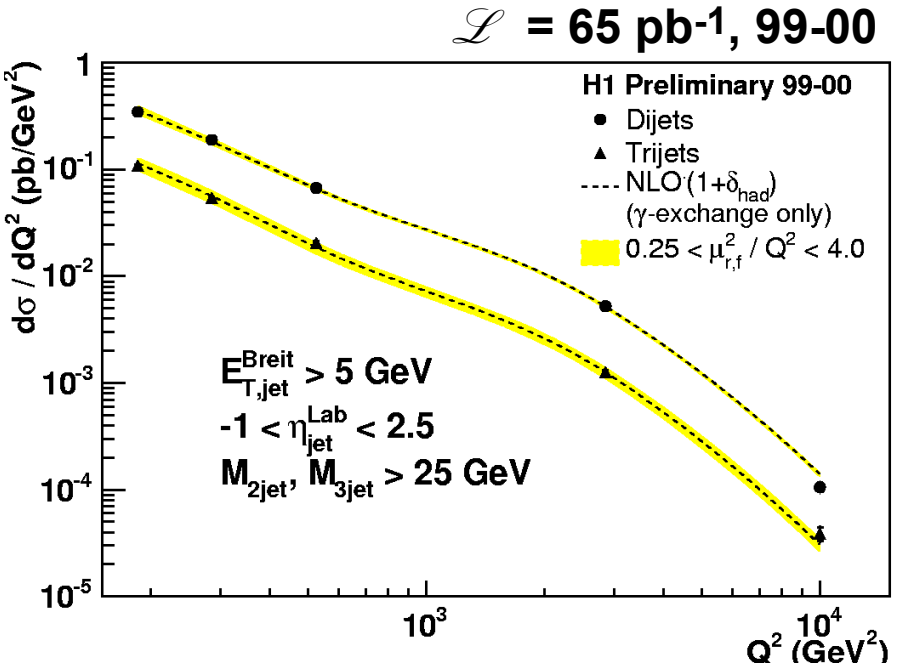
New H1 results

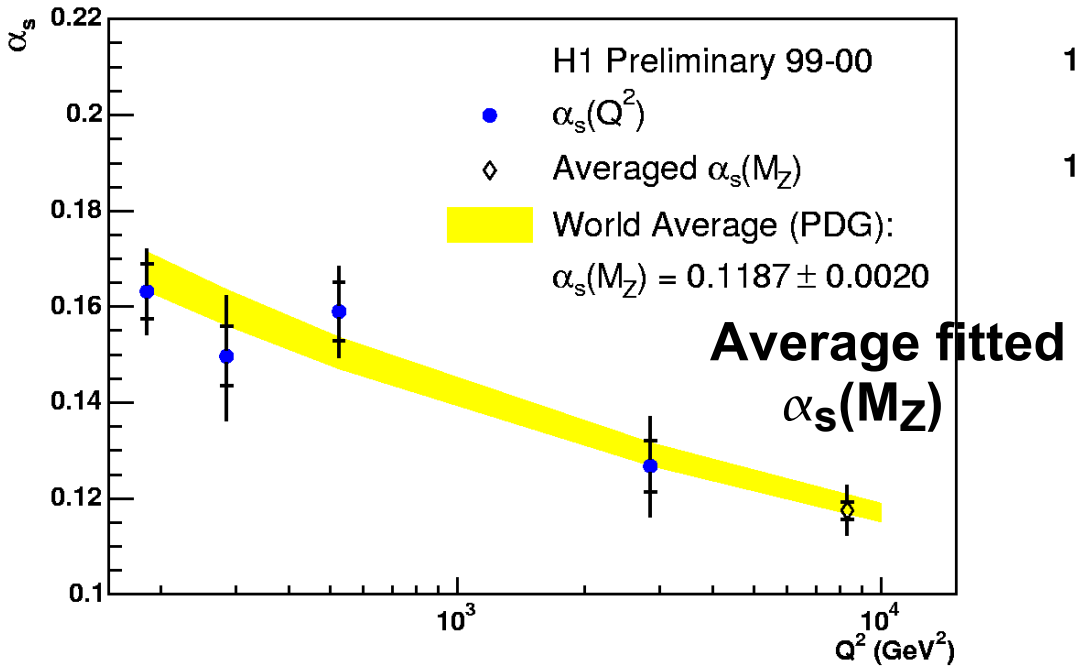
- CC cross-section with polarised electrons
- Updates for the high P_T searches

- Measurement of electroweak parameters
- F_2^{cc} and F_2^{bb} at low Q^2
- **α_s from 3/2 jets**
- Pentaquark search: $\theta^+(1530) \rightarrow K^0_s p$
- Charm fragmentation function in DIS
- Jet shape studies in charm photoproduction
- Elastic J/Ψ production

α_s from 3jets / 2jets at high Q^2

- Measure dijet and trijet cross-sections in high Q^2 NC-DIS
- Exploit the ratio $R_{3/2}$ to extract $\alpha_s(M_Z)$





➔ Competitive determination of α_s

➔ $\alpha_s(M_Z) = 0.1175 \pm 0.0017\ (stat.) \pm 0.0050\ (sys.)\ ^{+0.0054}_{-0.0068}\ (theo.)$

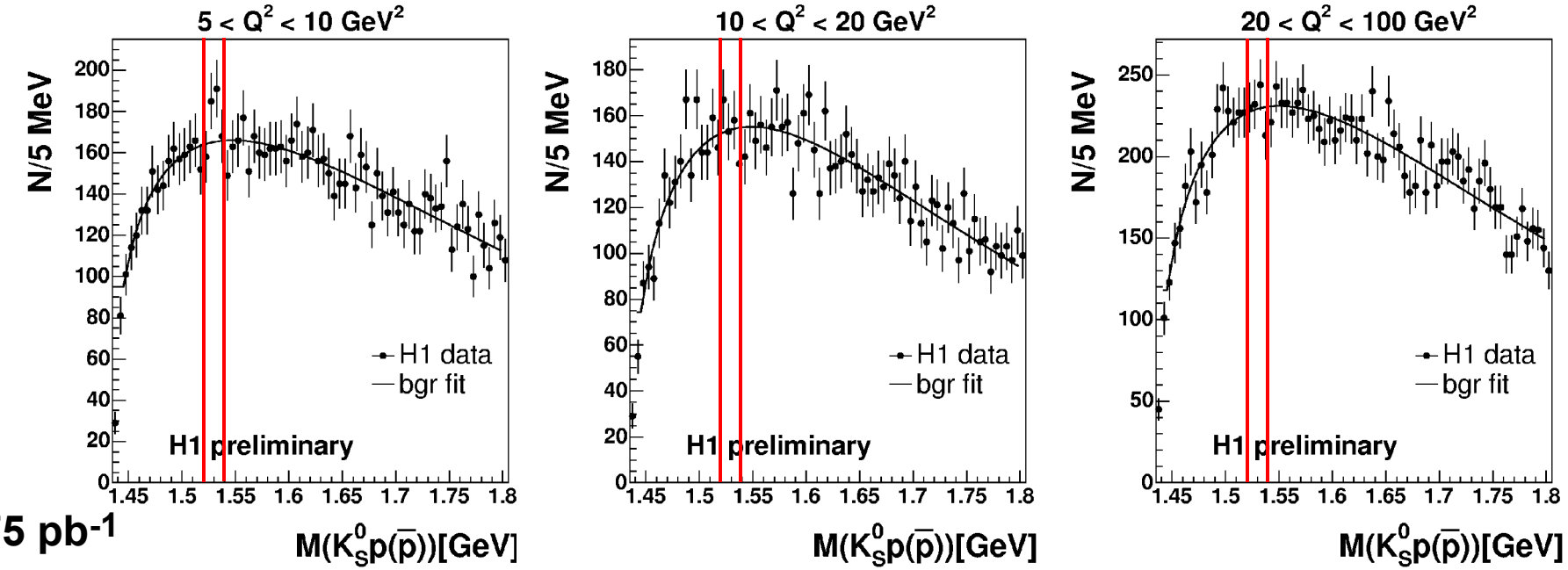
New H1 results

- CC cross-section with polarised electrons
- Updates for the high P_T searches

- Measurement of electroweak parameters
- F_2^{cc} and F_2^{bb} at low Q^2
- α_s from 3/2 jets
- **Pentaquark search: $\theta^+(1530) \rightarrow K^0_s p$**
- Charm fragmentation function in DIS
- Jet shape studies in charm photoproduction
- Elastic J/Ψ production

Pentaquarks ?

- Search for $\theta^+(1530) \rightarrow K^0_s\, p$



$\mathcal{L}$ = 75 pb^{-1}

➔ No signal observed

➔ Limits on cross-section derived

- Visible range: $P_T(K^0_s p) > 0.5$, $|\eta(K^0_s p)| < 1.5$
- 95% C.L. upper limit: ~40-120 pb, depending on exact mass

- $D^*p(3100)$ resonance: new for DIS05

➔ Detailed studies and acceptance corrected event yields

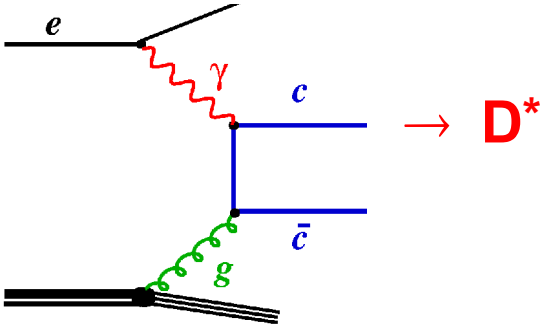
New H1 results

- CC cross-section with polarised electrons
- Updates for the high P_T searches

- Measurement of electroweak parameters
- F_2^{cc} and F_2^{bb} at low Q^2
- α_s from 3/2 jets
- Pentaquark searches: $\theta^+(1530) \rightarrow K^0_s p$
- **Charm fragmentation function in DIS**
- Jet shape studies in charm photoproduction
- Elastic J/Ψ production

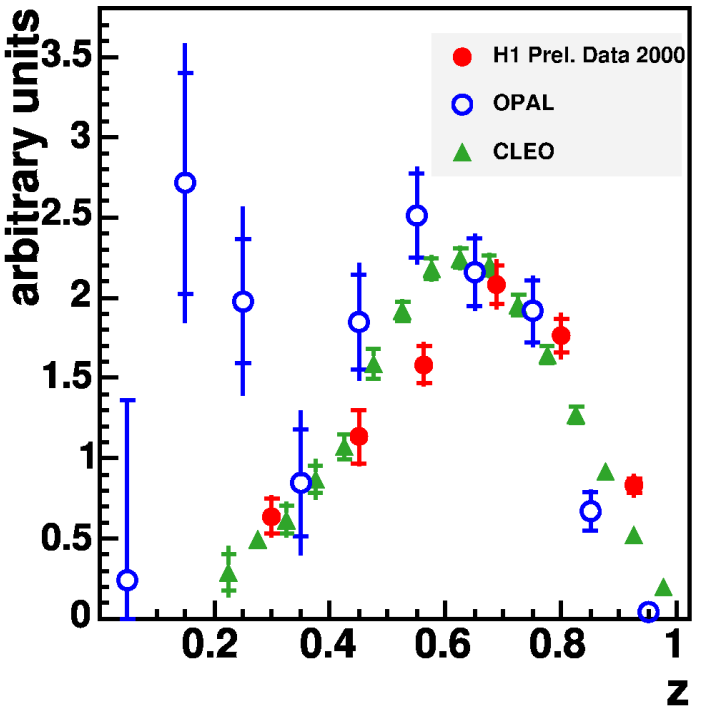
Charm fragmentation function in DIS

- Fragmentation: non perturbative process
  - ➔ Need experimental studies



- z = fraction of c quark energy carried by D*
  - ➔ Results using the hemisphere method:

- D^* selection
- Separate event in 2 hemispheres



H1 hemisphere method
$\langle\sqrt{s}\rangle \approx 10$ GeV,
$z = \frac{(E+p_L)_{D^*}}{\sum_{hem}(E+p)}$

OPAL $\sqrt{s} = 91.2$ GeV,
$z = 2E_{D^*}/\sqrt{s}$

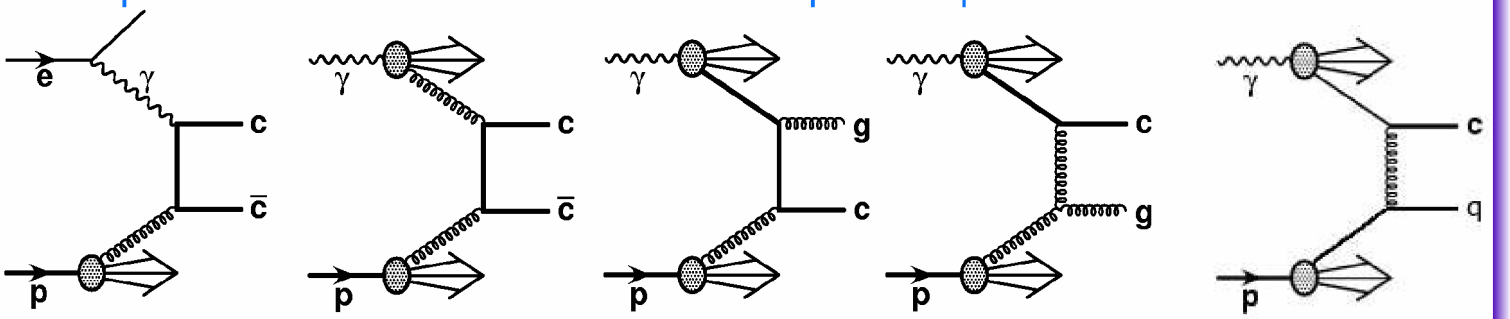
CLEO $\sqrt{s} \approx 10$ GeV,
$z = p_{D^*}/p_{max}$

➘ **Spectra of similar shape for fragmentation in e+e- and ep collisions**

Jet shape studies in charm photoproduction

- charm production mechanism:

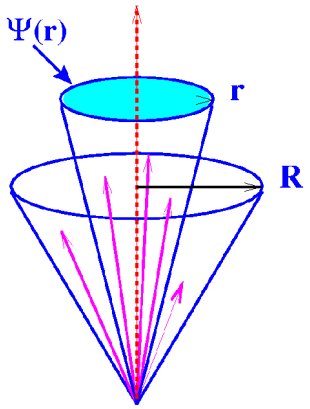
direct process: resolved photon processes:



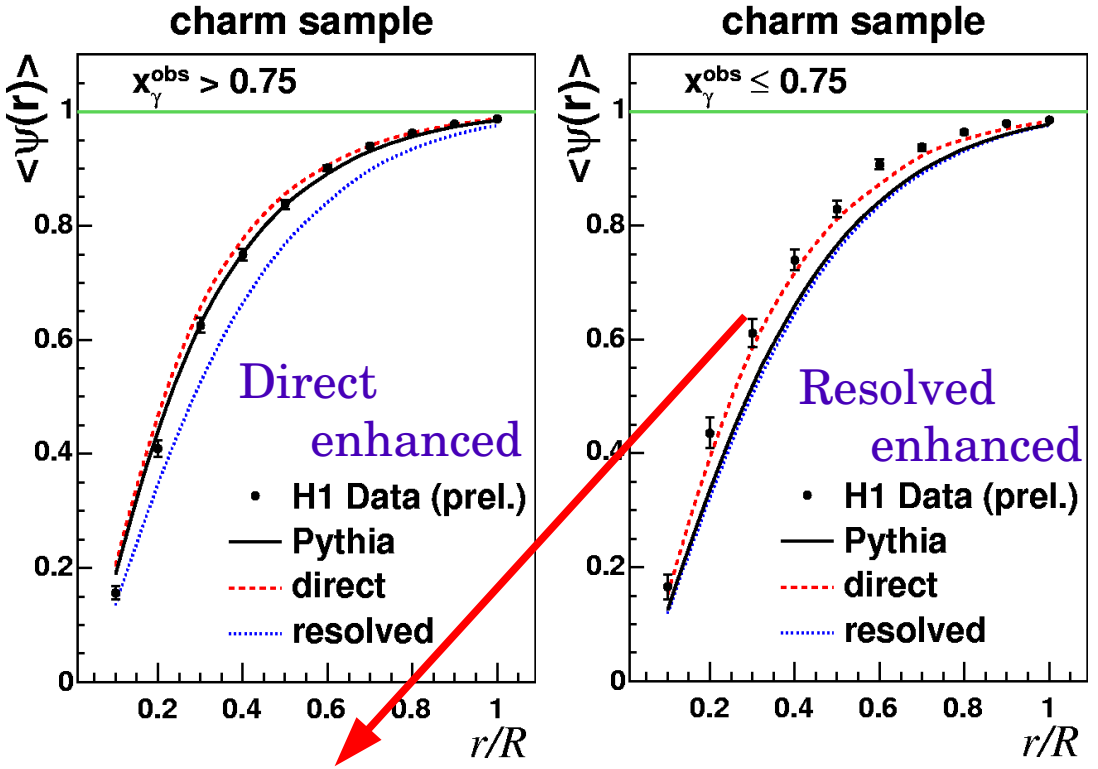
➔ Contribution of c-excitation processes ?

- Di-jet events, 1 tagged by μ
- Use jet shapes to distinguish between c and g jets

➔ g jets broader



$$\psi(r) = \frac{p_t^{cone}(r)}{p_t^{jet}(r=R)}$$



➔ Data suggest less gluon jets at low x_γ

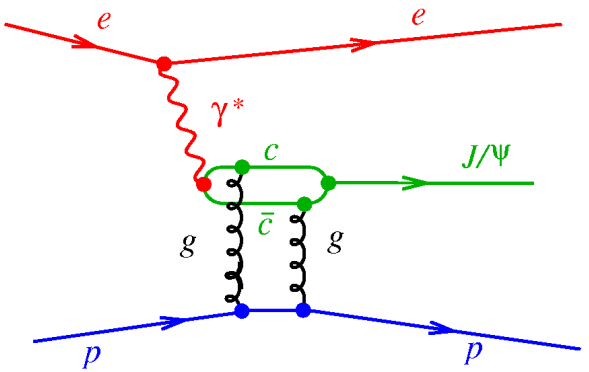
New H1 results

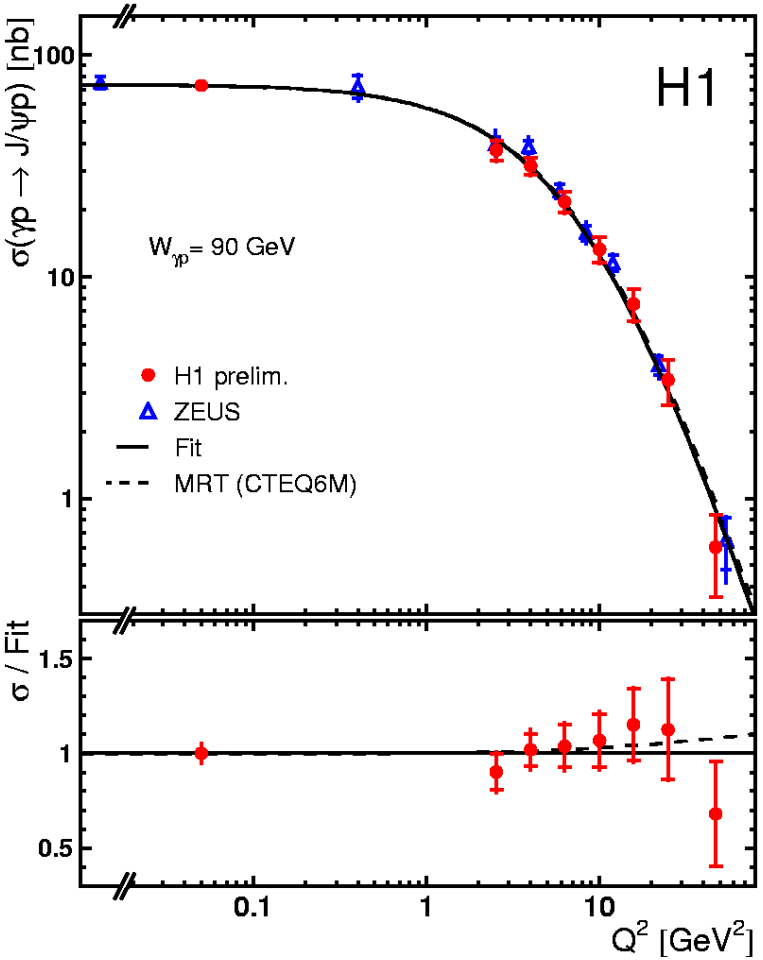
- CC cross-section with polarised electrons
- Updates for the high P_T searches

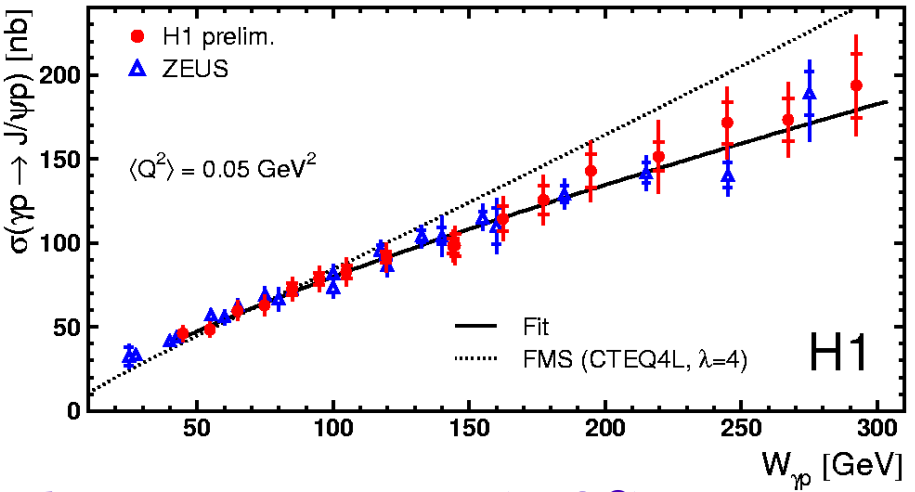
- Measurement of electroweak parameters
- F_2^{cc} and F_2^{bb} at low Q^2
- α_s from 3/2 jets
- Pentaquarks: $\theta^+(1530) \rightarrow K^0_s p$
- Charm fragmentation function in DIS
- Jet shape studies in charm photoproduction
- **Elastic J/Ψ production**

Elastic J/Ψ production

- Final HERA-I result
- Measurement extended to high W
- Photoproduction for $40 < W_{\gamma p} < 305$ GeV
  electroproduction for $2 < Q^2 < 80$ GeV^2





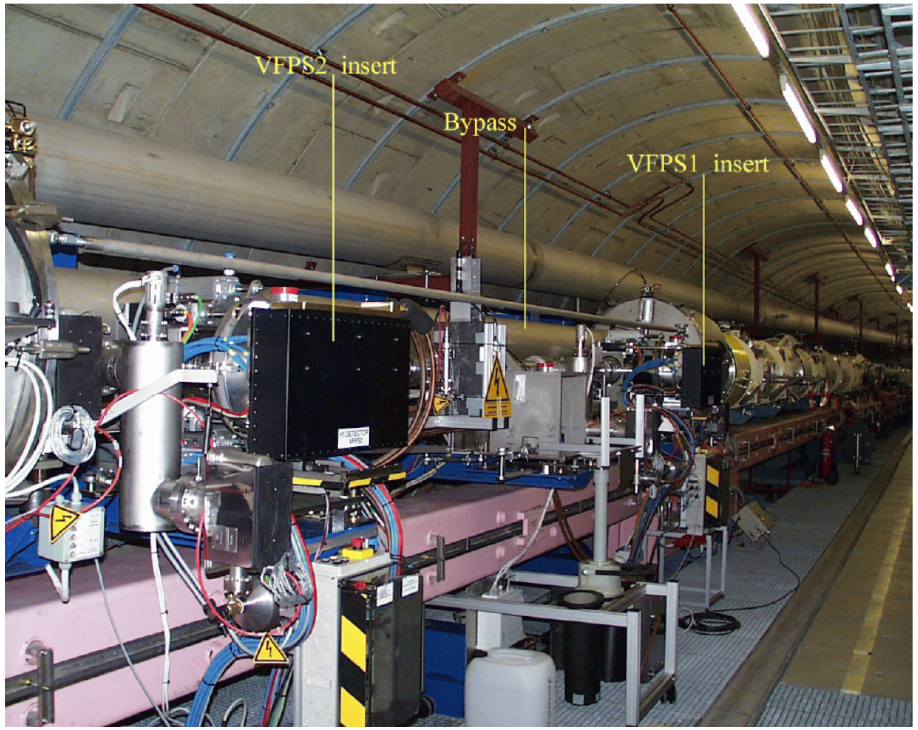


- High sensitivity to $g(x,Q^2)$

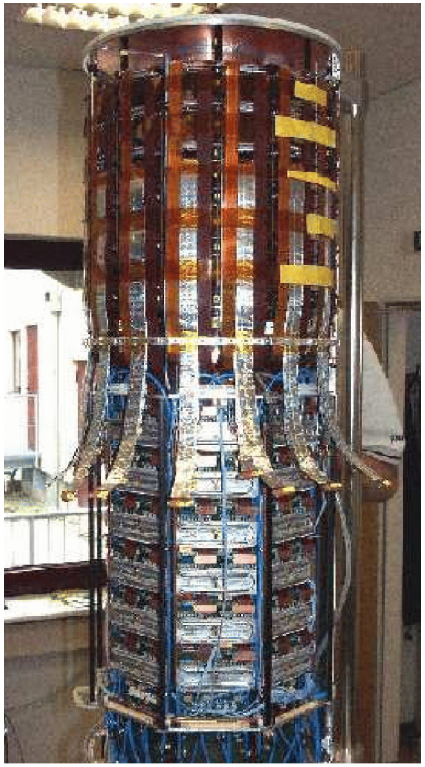
  ➔ Potential of leading to good QCD tests

- Helicity studies: no violation of s-channel helicity conservation

Status of Very Forward Proton Spectrometer



- 2 roman pot stations near z = 220m
  - ➔ For efficient triggering and measurement of leading protons $|t| < 1\ \mathrm{GeV}^2$, $x_P \sim 0.01$
- Optical fibers exchanged last shutdown (damaged by radiation)
- Is regularly operated by shift crews
- First data taken in February
- Acceptances have been checked and are ok
- Measured overall efficiency ~85%

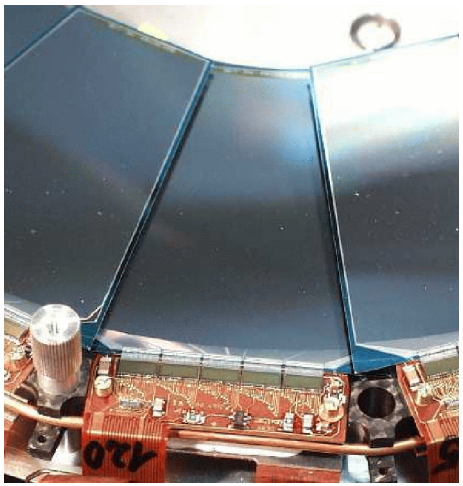


FST and BST repair status

- Successful production of radiation hard chips (98%)
- New sensors and hybrids → ok
- New radiation monitor will be installed (scintillator based)
- Humidity sensors added

BST (144 modules):

- All modules produced
- Detectors under laser test in Zeuthen.
- Cooling circuitry ready



FST (124 modules):

- FST modules production started

↘ **Goal: ready for system test in September 2005**

New H1 publications

- New papers since last PRC:
  - Measurement of F_2^{cc} and F_2^{bb} at High Q^2 using the H1 Vertex Detector at HERA
  - Search for Light Gravitinos in Events with Photons and Missing Transverse Momentum at HERA
  - A Direct Search for Stable Magnetic Monopoles Produced in Positron-Proton Collisions at HERA
  - Measurement of Dijet Cross Sections in ep Interactions with a Leading Neutron at HERA
  - Measurement of Beauty Production at HERA Using Events with Muons and Jets
  - Measurement of Charm and Beauty Photoproduction at HERA using D^* μ Correlations
  - Measurement of Deeply Virtual Compton Scattering at HERA

Conclusions

- Innovative new HERA-I analyses and publications
  - ➔ Improving precision

- 2005 running: detector in good shape and taking data
  - ➔ 40 pb^{-1} of e-p left-handed data
  - ➔ Prompt analysis of new data: CC cross-section, searches
  - ➔ e-p promising but lumi has often been limited limited by harsh background conditions

➘ **H1 collaboration looks forward to continue the exploitation of high luminosity data**