Status Report

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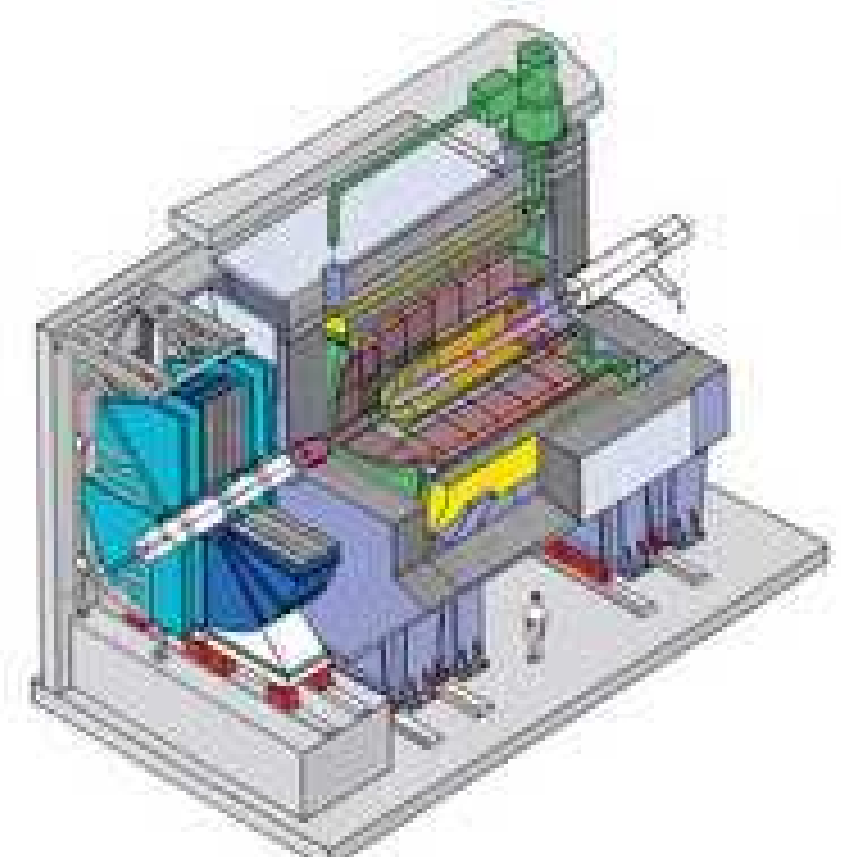
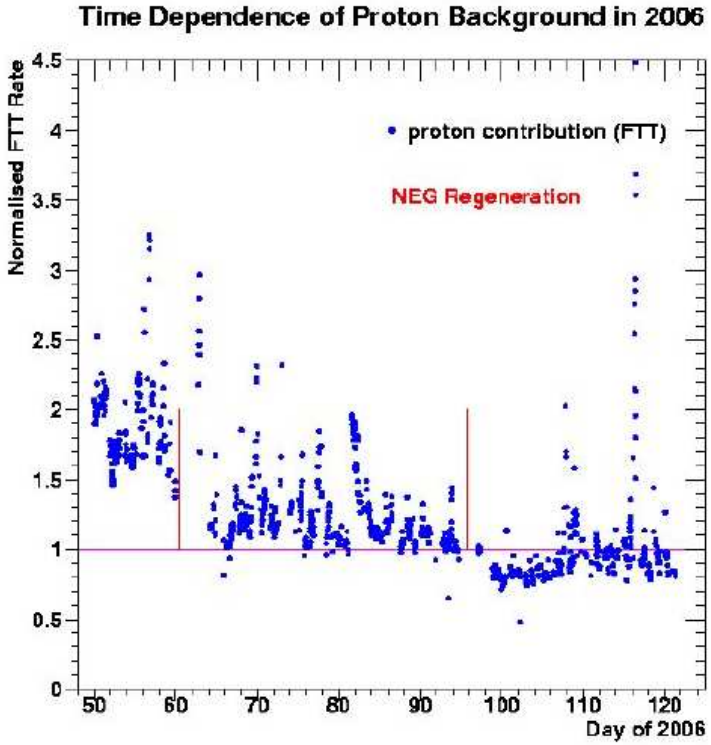
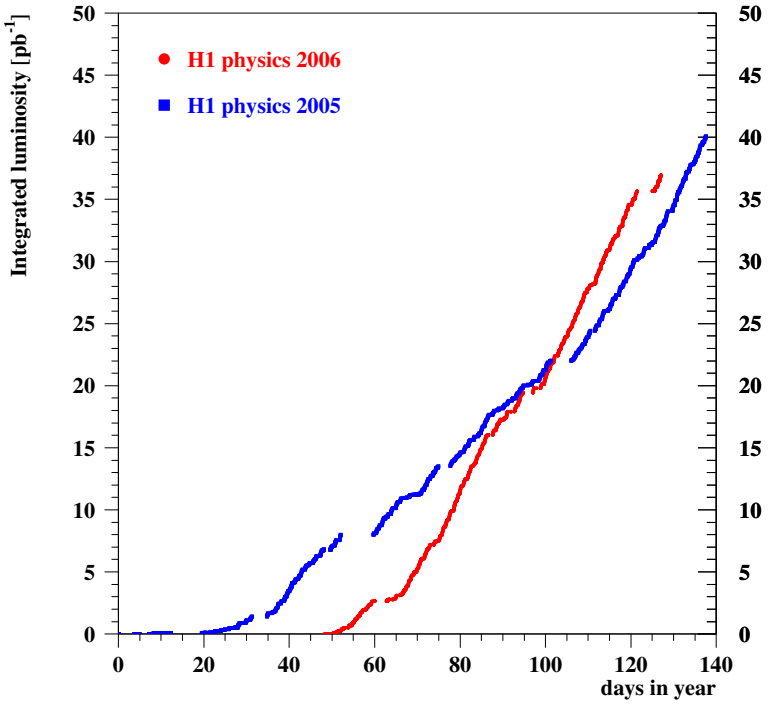
11 May 2006

- Introduction
- Data taking
- Physics highlights
- Summary and outlook



Running in 2006





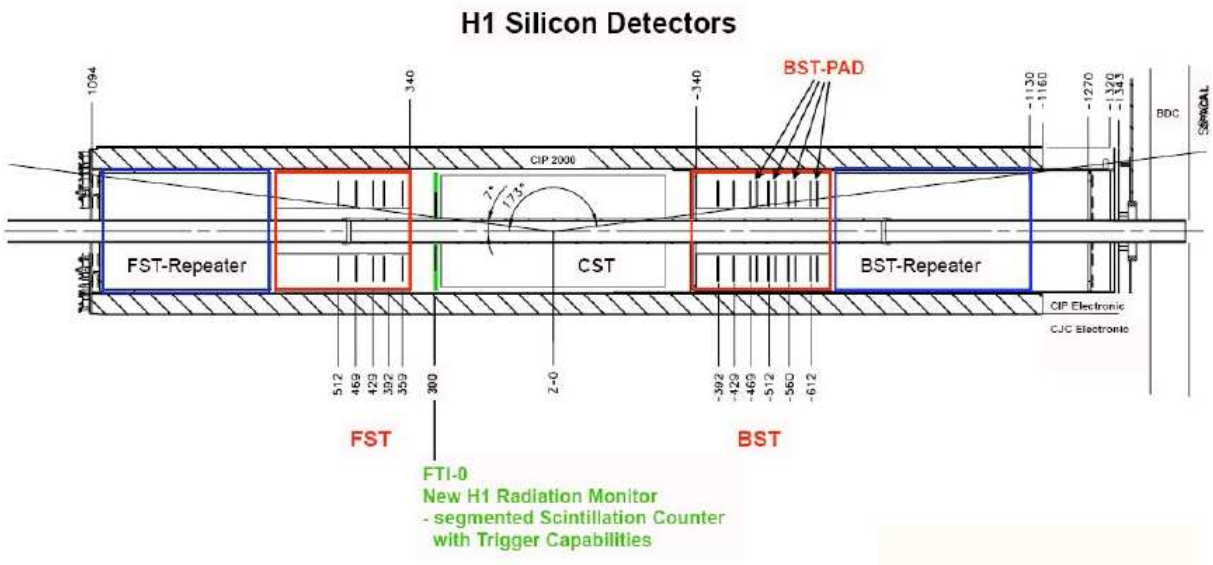
- startup was very fast and smooth !
- vacuum broken during shutdown (repair of silicon tracker)
- 2 NEG regenerations did bring vacuum to very good level
- fast increase of number of bunches

Thanks to HERA for a most succesfull restart in 06!

- 2005 data taking:
  HERA $218.2pb^{-1}$
  overall efficiency $= 54\%$
- 2006 data taking:
  HERA $60.1pb^{-1}$
  overall efficiency $= 61\%$

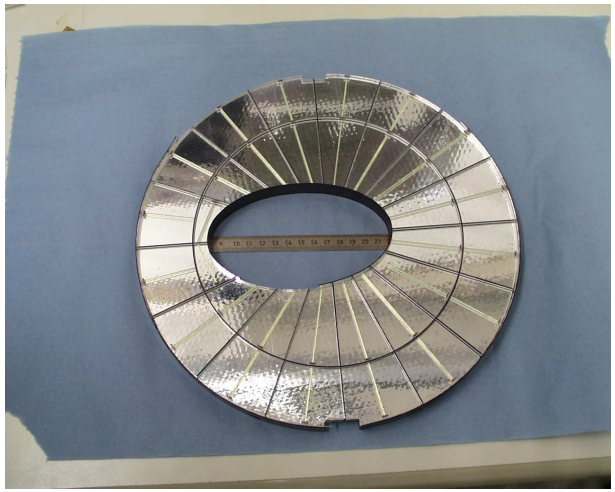
due to improved HV efficiency

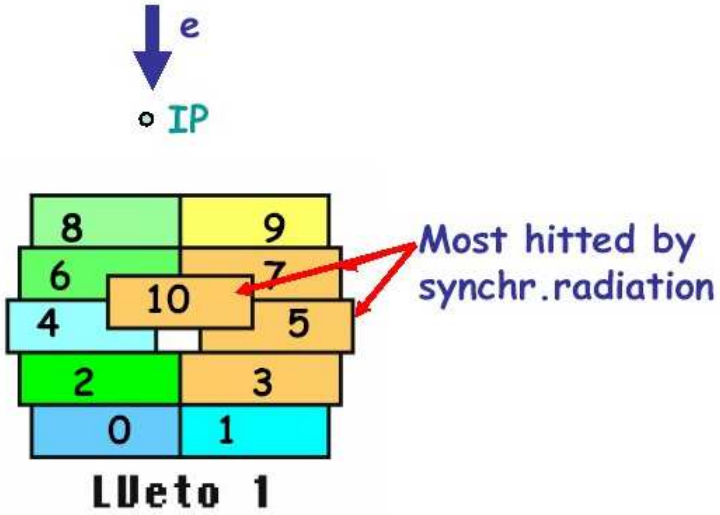
Forward/Backward Silicon Tracker reinstalled



- both detectors were out of H1 and rebuilt during 2005:
  - ▷ new modules
  - ▷ new frontend electronics
  - ▷ new DAQ
- installed in december 2005
  - ▷ detectors fully operational (S/N~ 30)
  - ▷ DAQ commissioned
  - ▷ both systems are now in running-in phase

New Radiation monitor(FTI0), Veto wall repaired





- small scintillator disk with 16 fold phi and 2 fold radial segmentation
- installed between FST and CST

used as radiation monitor

- several big counters showed low efficiency (mainly those affected by synchrotron radiation during e^- running)

$\Rightarrow$ exchanged during shutdown

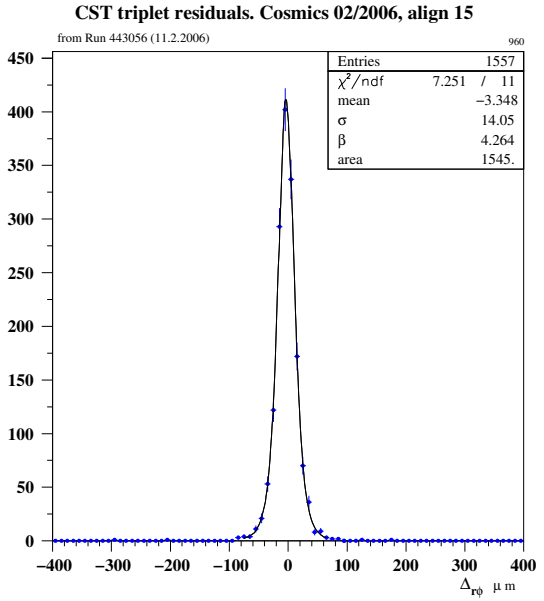
efficiency restored

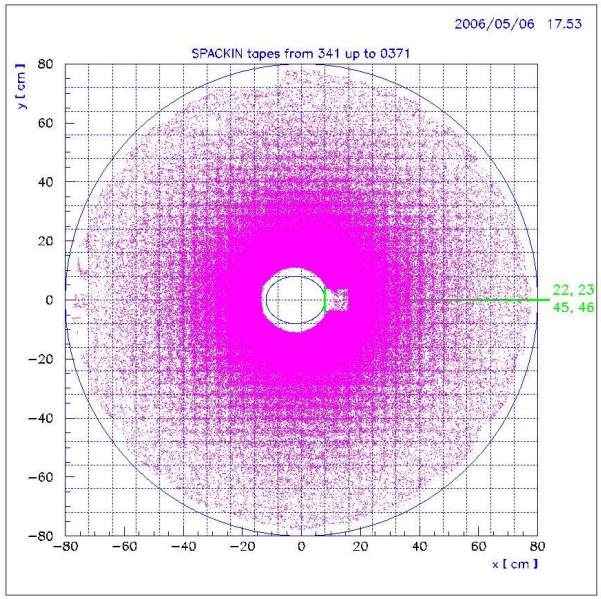
Important maintenance work: CST, SPACAL, CIP

- Central Silicon Tracker:
  (main device for HQ physics)
  maintenance work on cabling and analog electronics
  aligned using cosmics data
  ⇒ CST in very good shape

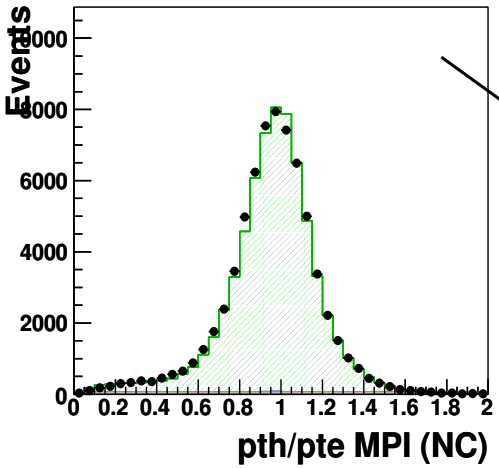
- Central Proportional Chamber (CIP):
  (used as vertex trigger)
  maintenance of front end electronics
  ⇒ CIP trigger fully operational

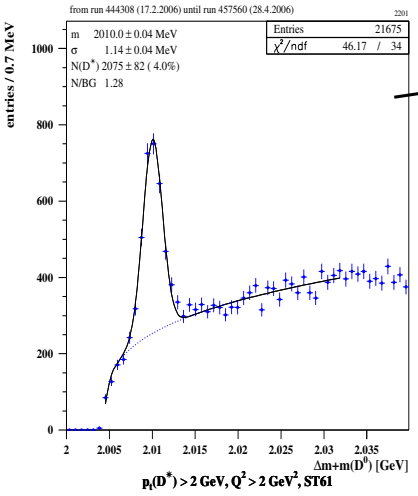
- Backward calorimeter (SPACAL):
  (low Q^2 electron id./measurement)
  photomultipliers with low gain exchanged
  ⇒ no dead region, best status of SPACAL ever

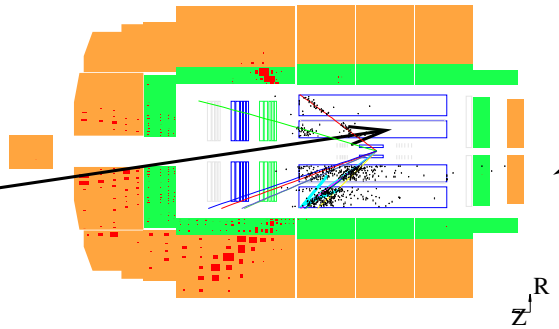


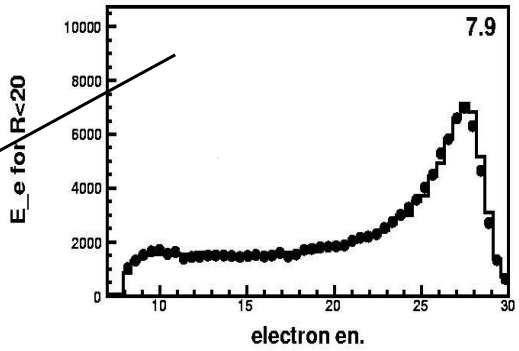


Look at collected data









Data quality regularly monitored, basic calibrations done, H1 operational

H1 physics results since last PRC, Nov. 2005

- 8 publications since last PRC:

  DESY-05-249: First Measurement of Charged Current Cross Sections at HERA with Longitudinally Polarised Positrons (first publication on HERA II data)
  DESY-06-020:Photoproduction of Dijets with High Transverse Momenta at HERA
  DESY-06-023:Diffractive Photoproduction of Rho Mesons with Large Momentum Transfer at HERA
  DESY-06-029:Tau Lepton Production in ep Collisions at HERA
  DESY-06-038:Search for Doubly-Charged Higgs Boson Production at HERA
  DESY-06-039:Measurement of Charm and Beauty Dijet Cross Sections in Photoproduction at HERA using the H1 Vertex Detector
  DESY-06-044:Search for a Narrow Baryonic Resonance Decaying to $K_s^0 p$ or $K_s^0 \bar{p}$ in Deep Inelastic Scattering at HERA
  DESY 06-048:Diffractive Deep Inelastic Scattering with a Leading Proton at HERA

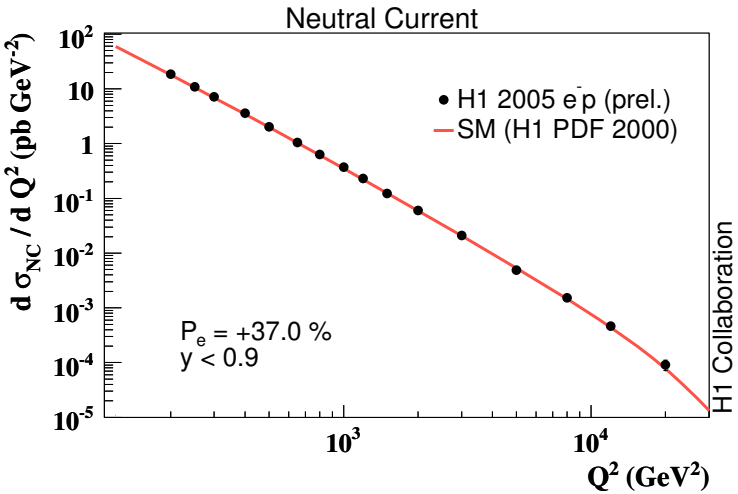
- 27 talks with new results at DIS'06

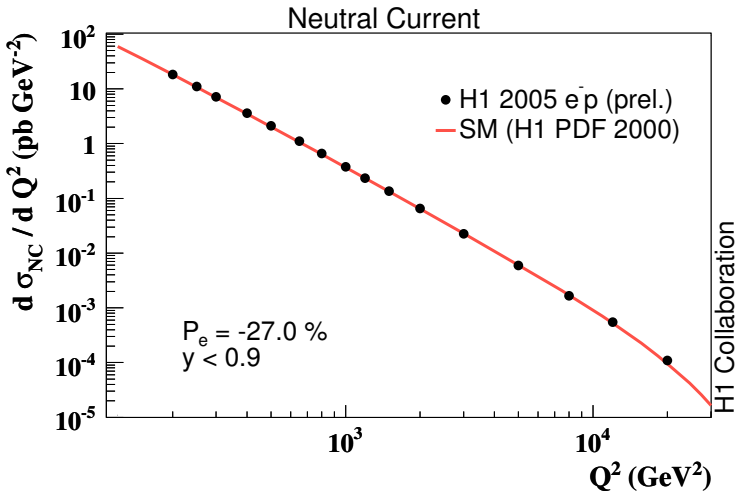
Selection from H1 talks at DIS 06:

⇒ Andrei Nikiforov	Neutral current studies at HERA II
Jacek Turnau	Measurement of Event Shape Variables in DIS at HERA
Katja Krueger	Photoproduction of dijets with High Transverse Momenta at HERA
Steve Maxfield	Inclusive Jet Production in DIS at high Q^2 at HERA
⇒ Dima Ozerov	Search for a Narrow Baryonic Resonance Decaying to K^0_S
Carsten Schmitz	Prompt Photons in DIS
⇒ Christoph Werner	Parton Dynamics in DIS multijet events at small x
Magnus Hansson	Dijets at low x and low Q^2
⇒ Dan Traynor	Scaled Charged Particles Momentum Distributions at high Q^2
Lars Finke	Production of charm and beauty dijets at HERA
Ying-Chun Zhu	Elastic J/ψ production at HERA
⇒ Biljana Antunovic	Charged Current Studies at HERA II
Paul Laycock	F2bb/F2cc at HERA
Benoit Roland	DVCS at HERA
⇒ Jan Olsson	Rho production at small t at HERA
Cark Gwilliam	Rho production at large t at HERA
⇒ Paul Newman	F2D3 and F2D4 measurements
⇒ Emmanuel Sauvan	F2D3 new analysis at medium Q^2
⇒ Olaf Behnke	Diffractive D^* and F2D(cc)
⇒ Matthias Mozer	Diffractive di-jets and combined fits
Max Klein	FI measurements and low energy running
⇒ Dave South	New H1 results on Isolated leptons and Missing Pt at HERA
⇒ Claude Valee	Multi-lepton events and search for H^{++} at HERA
Christian Hellebrant	Leptoquark searches at HERA
⇒ Stefania Xella	Tau lepton production at HERA
⇒ Christinel Diaconu	Search for excited neutrinos at HERA
Christiane Risler	Forward Jet Production in Deep Inelastic Scattering at HERA

Polarized Neutral Current Cross Section I.

$$\frac{d^2\sigma_{NC}^{e^{\pm}p}}{dxdQ^2} = \frac{2\pi\alpha^2}{xQ^4}[Y_+\tilde{F}_2 \mp Y_- x\tilde{F}_3 - y^2\tilde{F}_L],\ Y_\pm = 1 \pm (1-y)^2$$





$$\tilde{F}_2 \sim F_2 \pm P_e a_e \chi_Z F_2^{\gamma Z}$$

$$x\tilde{F}_3 \sim -a_e \chi_Z x F_3^{\gamma Z}$$

Depend on polarization at high Q^2 (mainly sensitive to γZ interference)

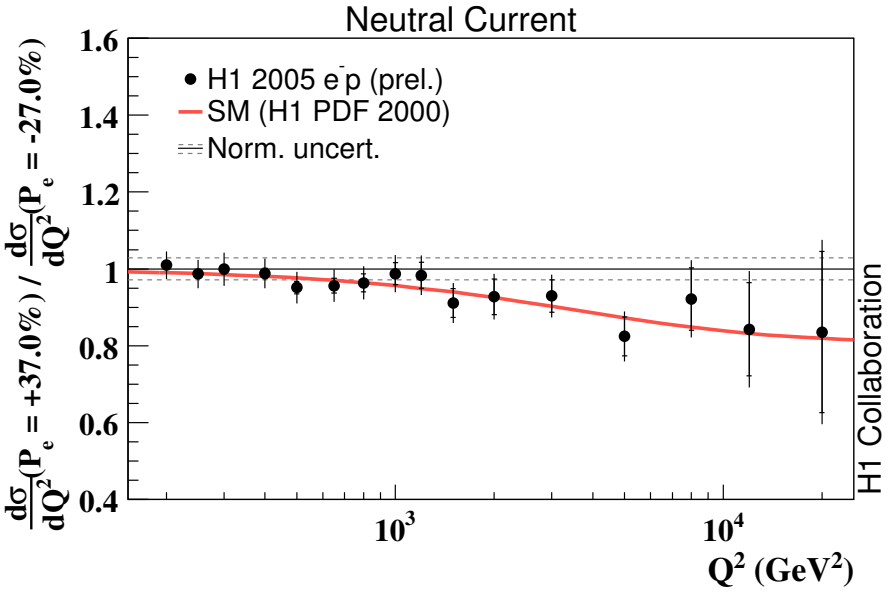
Polarized Neutral Current Cross Section II.

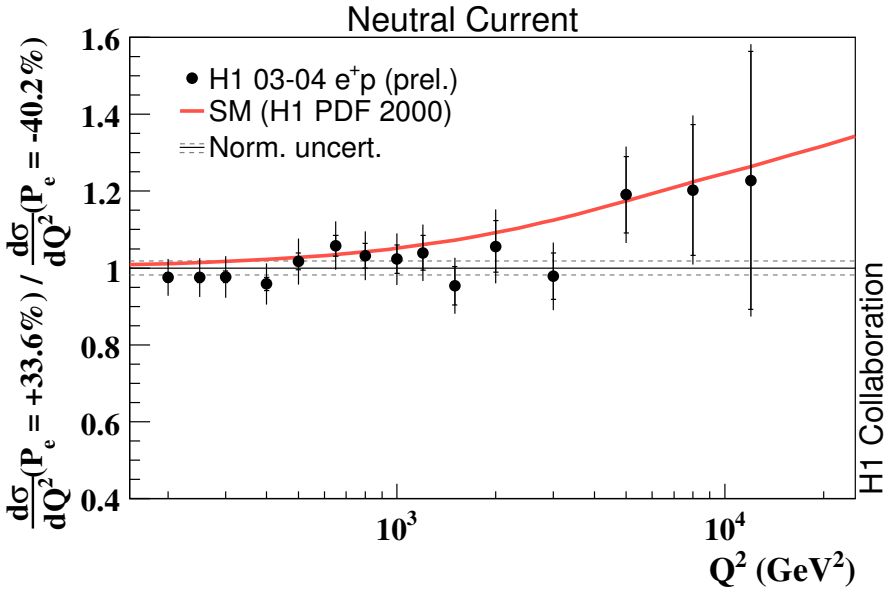
2005 $e^- p$ data

	Lumi, pb^{-1}	Polarization
RH	29.6	(+37 $\pm$ 1.3) %
LH	68.6	(-27 $\pm$ 1.8) %

2003-04 $e^+ p$ data

	Lumi, pb^{-1}	Polarization
RH	26.6	(+33.6 $\pm$ 0.6) %
LH	20.7	(-40.2 $\pm$ 1.1) %





Polarization effects in NC are clearly visible, more data to come

Charged Currents as a function of polarization

$$\frac{d^2\sigma_{cc}^{e^{\pm}p}}{dxdQ^2} = [1 \pm P]\frac{G_F^2}{2\pi x}[\frac{M_W^2}{Q^2 + M_W^2}]^2\phi_{cc}^{\pm}$$

- Visible Phase Space:
  $P_t^{miss} > 12\text{GeV}$
  $0.03 < y_h < 0.85$
  $Q^2 > 220\text{GeV}^2$

- 2003-2004 e^+ p :

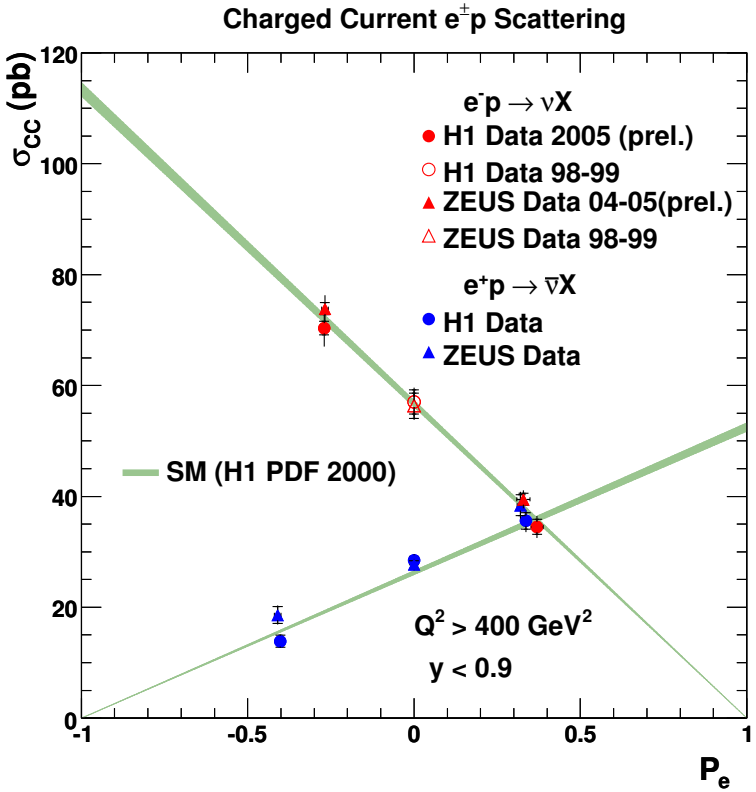
  $$\sigma_{cc}(P = -1) = -3.9 \pm 2.3(sta) \pm 0.7(sys) \pm 0.8(pol)$$

  M(W_R)$>$ 208 GeV at 95% CL

- 2005 e^- p :

  $$\sigma_{cc}(P = +1) = -0.9 \pm 2.9(sta) \pm 1.9(sys) \pm 2.9(pol)$$

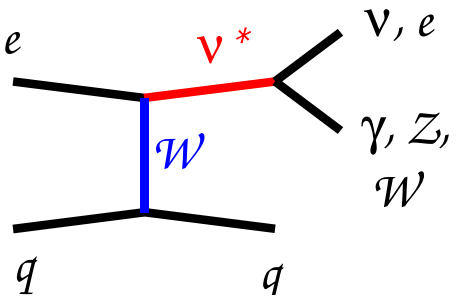
  M(W_R)$>$ 186 GeV t 95% CL



Data are in good agreement with SM prediction, no indication for r.h. currents
(Welcome new, first measurement of the polarisation with the LPOL cavity)

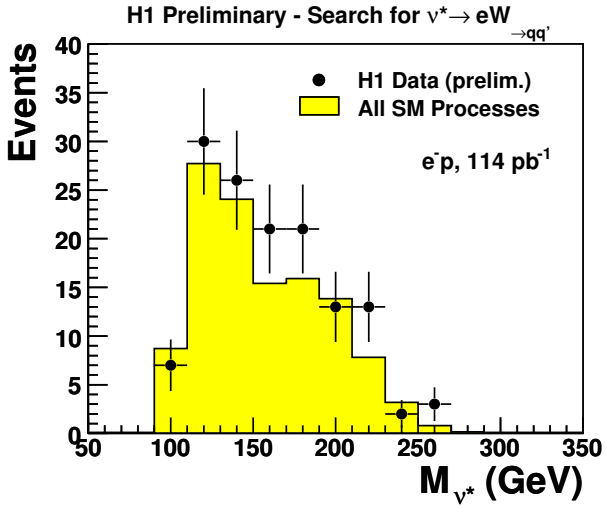
Search for excited neutrinos

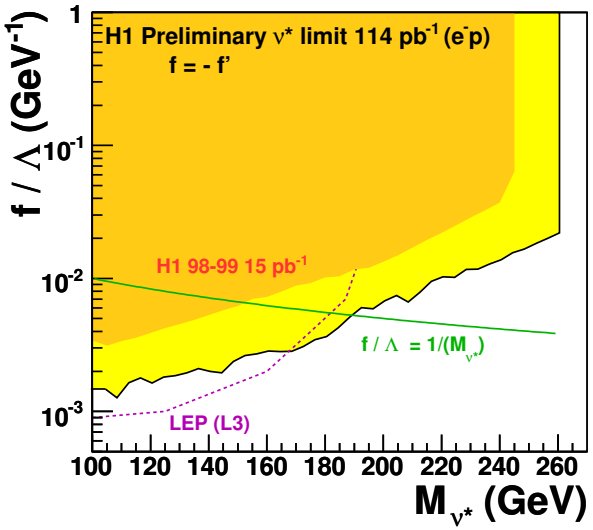
- cross section much larger in $e^- p$ ($\rightarrow$ 2005 data (114 pb^{-1}))
- HERA: expected to be produced in CC-like interaction
- signature: neutral boson-lepton resonance



- If found $\Rightarrow$ direct proof of compositness !
- model: Λ (compositness), internal dynamics in couplings f, f', f_S

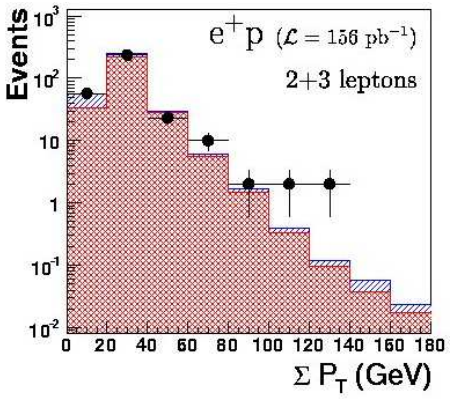
Channel	Data	SM
$\nu^* \rightarrow eW$	136	118 ± 22
$\nu^* \rightarrow \nu Z$	88	81 ± 15
$\nu^* \rightarrow \nu\gamma$	12	11.6 ± 2.5

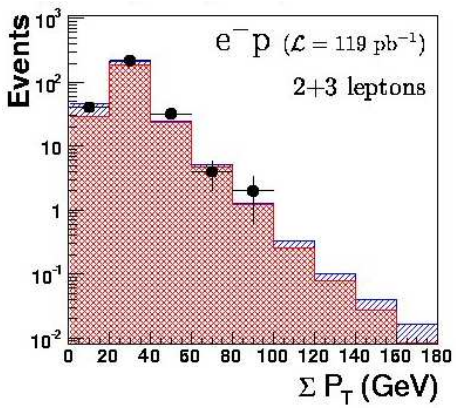


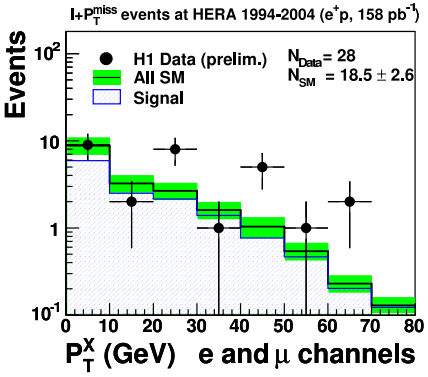


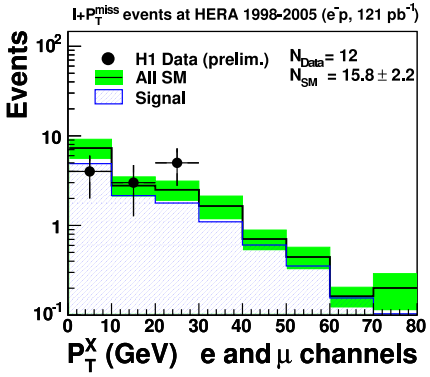
No significant deviation from SM, at high m^*_ν most stringent limits so far

Interesting lepton events (in e^+p data)

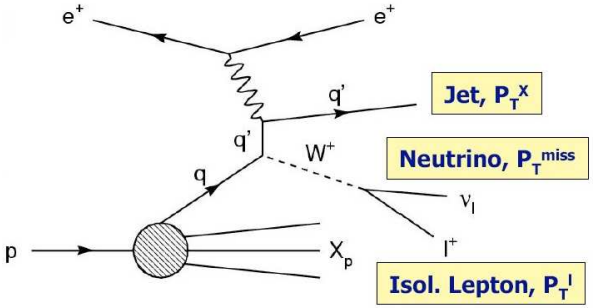






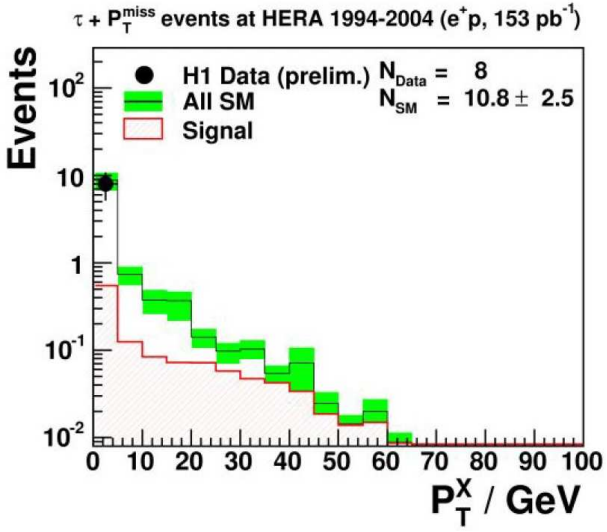


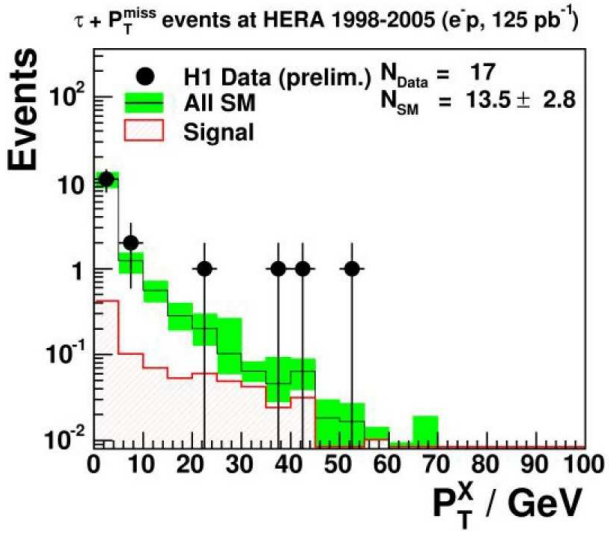
- multilepton events
  - ee
  - eee
  - $e\mu$
  - $\mu\mu$
  - $e\mu\mu$
- W-like events (isolated leptons):



Production of isolated τ and production of τ pairs

- Search performed in τ channel:





- no spectacular τ event in e^+ (not incompatible with e and μ channels , lower sensitivity)
- in e^- there are events at high P_T^X

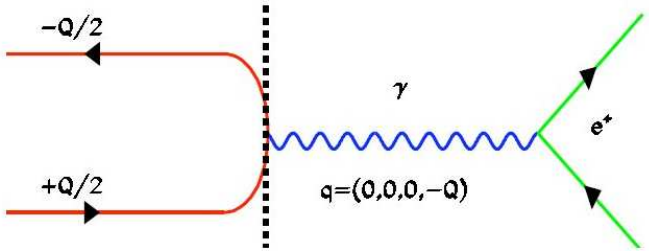
- $108pb^{-1}$ (HERA I data): cross section for τ pair production determined in the range:
  $20^o < \theta^\tau < 160^o$
  $P_T^\tau > 2GeV$
- $\sigma = 13.6 \pm 4.4 \pm 3.7pb$

! first measurement of τ at HERA, in good agreement with SM prediction

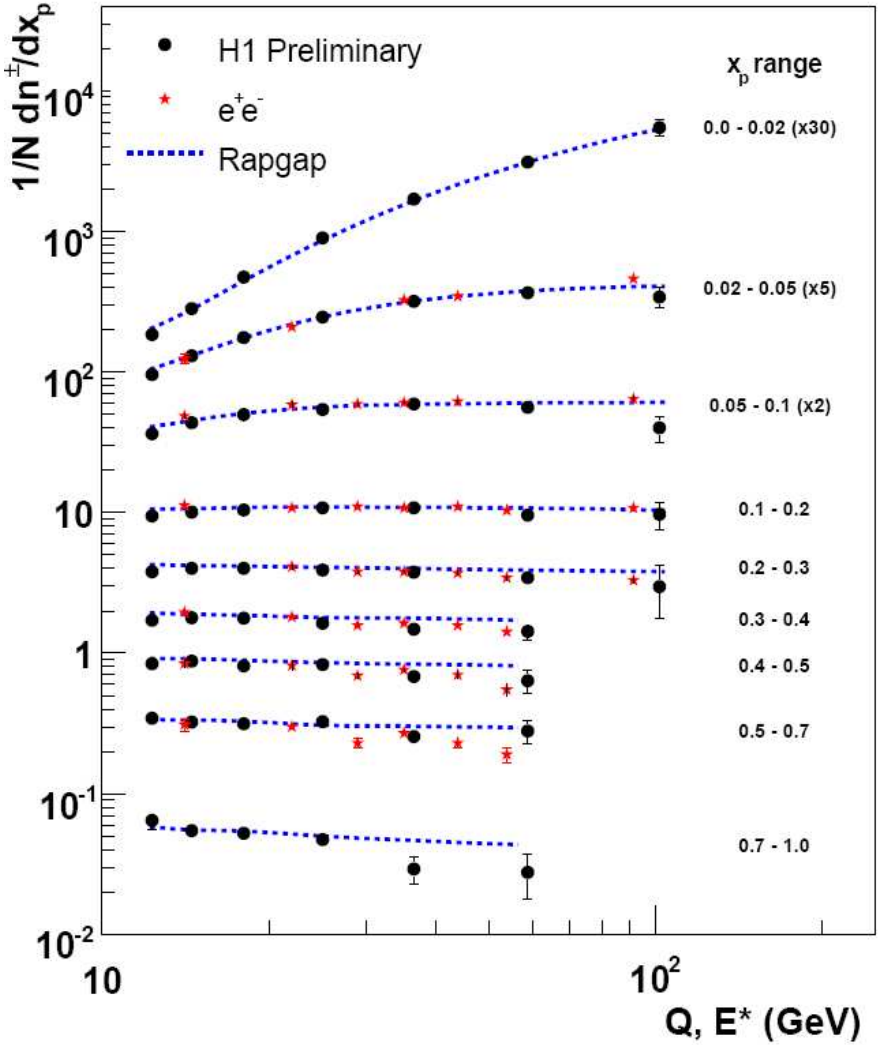
Hadronic Final State at large Q^2

! Multiplicity of charged particles in current hemisphere in Breit frame as a function of scaling variable

$$x_p = \frac{2P_h}{Q}$$



- scaling violations clearly visible
- good agreement with e^+e^- data
- well described by RAPGAP
- supports assumption on universality for light quark fragmentation

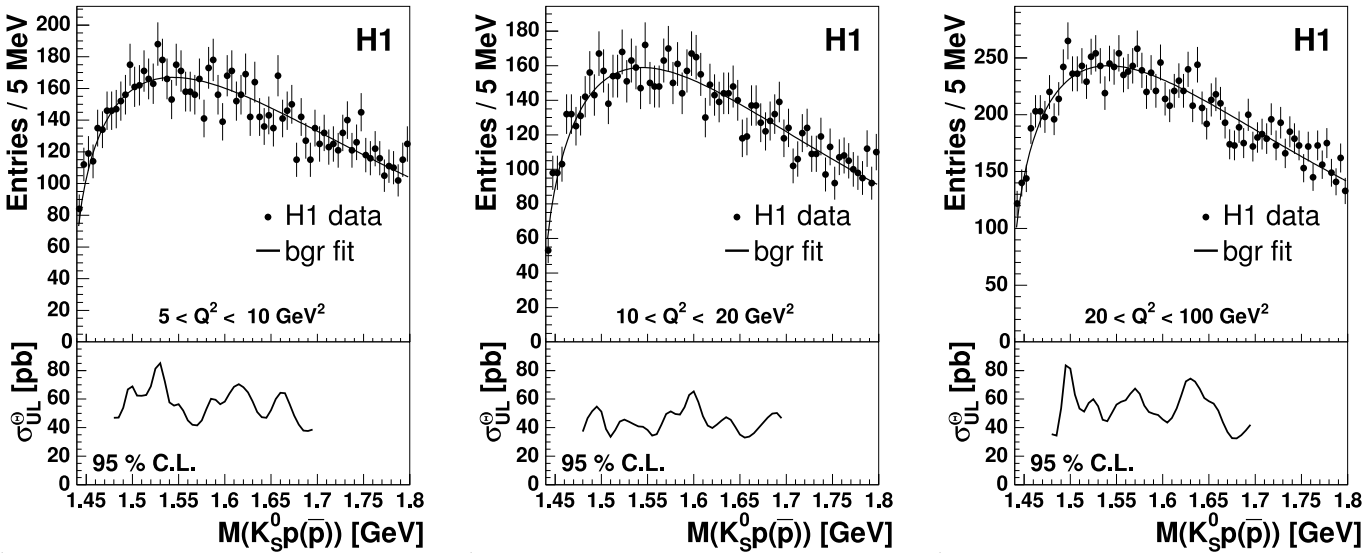


Search for a narrow resonance decaying to $K^0_S p$ ($\overline{p}$)

- search performed on HERA I data ($74 pb^{-1}$) (hep-ex/0604056)
- DIS kinematic range:
  $5 \leq Q^2 \leq 100 GeV^2$
  $0.1 \leq y < 0.6$

No visible signal

$\Rightarrow$ 95 % CL determined in the range
$p_T(K^0_S p) > 0.5 GeV$
$|\eta(K^0_S p)| < 1.5$



- data also analysed in ZEUS phase space:
  $20 \leq Q^2 \leq 100 GeV^2$
  $p(p) < 1.5 GeV$

- $\sigma(M = 1.52) < 72 pb$ (95 % CL)

not contradicting the ZEUS preliminary result

H1 does not see evidence for $K^0 p$ resonance

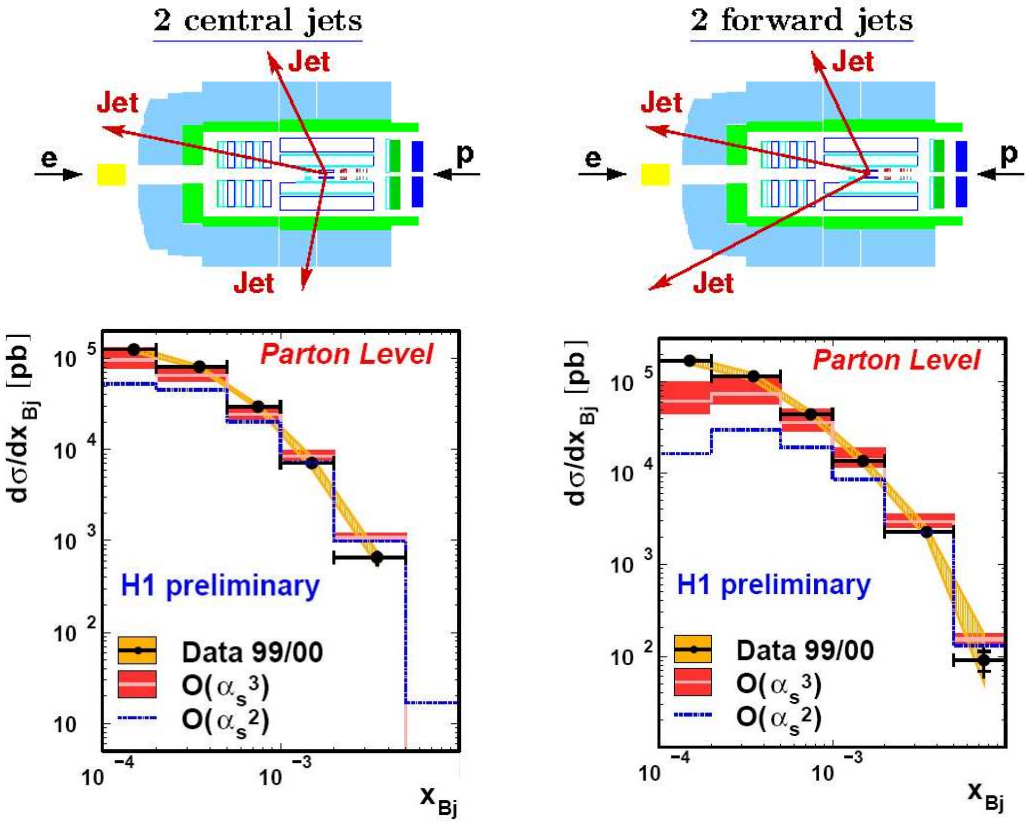
Study of 3-jet production in low x DIS

- ▷ events with ≥ 3 jets $\Rightarrow$ at least one jet from radiated gluons
- ▷ 99/00 e^+p data (44 pb^{-1})
- ▷ Phase space:

  $10^{-4} \leq x \leq 10^{-2}$
  5 $GeV^2 \leq Q^2 \leq 80$ GeV^2
  ≥ 3 jets with $p_T^* > 4$ GeV
  $p_{T1}^* + p_{T2}^* > 9$ GeV
  ≥ 1 jet in central region

$\Rightarrow$ NLO lower at low x

- main deviation observed in the sample with 2 forward jets at low x
- large difference LO $\leftrightarrow$ NLO at low x

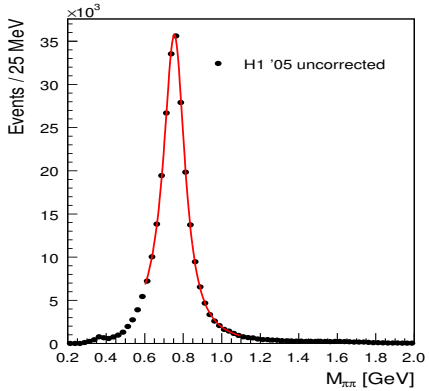


Hint on effects from k_T-unordered gluon radiation

Diffraction- Elastic ρ photoproduction at low t (FTT)

- at high W cross section dominated by pomeron exchange

$$\frac{d\sigma}{dt} \sim W^{4[\alpha(t)-1]}$$
$$\alpha(t) = \alpha_0 + \alpha' t$$

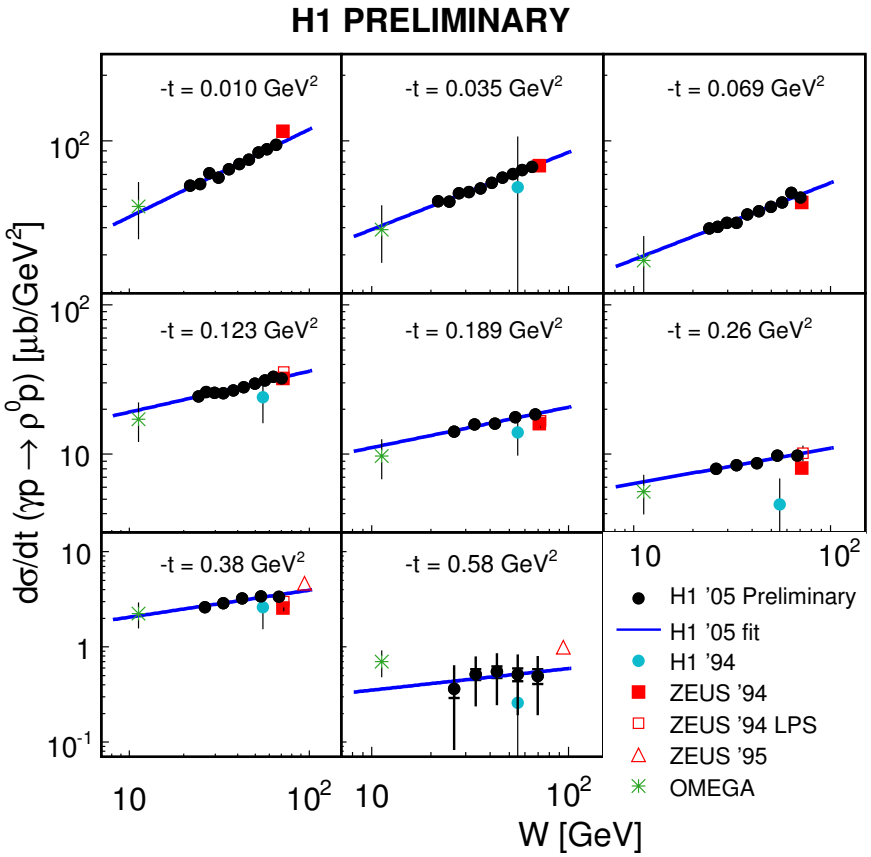


- good statistics thanks to FTT trigger

  ~ 240000 events triggered at L1

  L2 and L3 working, too

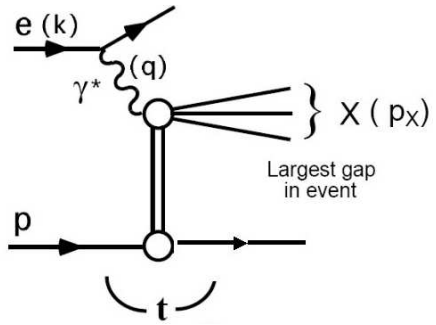
- proton dissociation component subtracted using forward detectors (FMD,FTS)
- measure pomeron trajectory using H1 data only (for the first time)



$$\alpha_{\mathrm{P}} = \left(1.093 \pm 0.03^{+0.008}_{-0.007}\right) + \left(0.116 \pm 0.027^{+0.036}_{-0.046}\right)\mathrm{GeV}^{-2}t$$

$$\alpha_{\mathrm{P}} = 1.08 + 0.25\mathrm{GeV}^{-2}t \text{ (Donnachie \& Landshoff, 1992)}$$

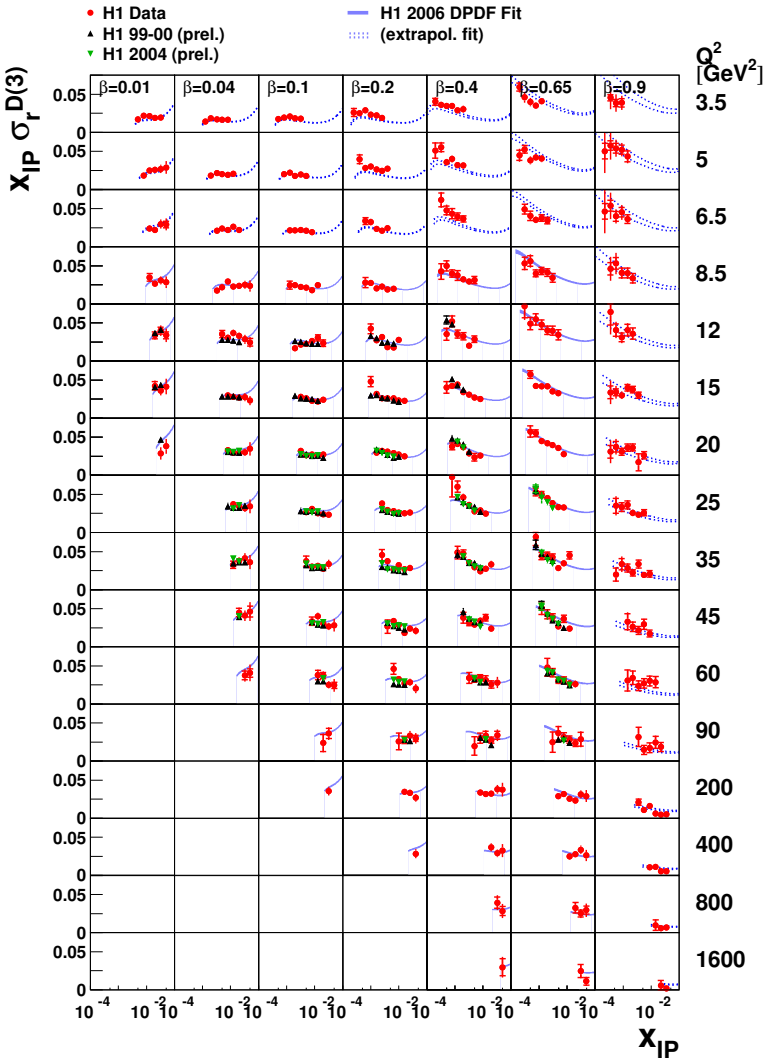
Diffractive DIS, available data sets



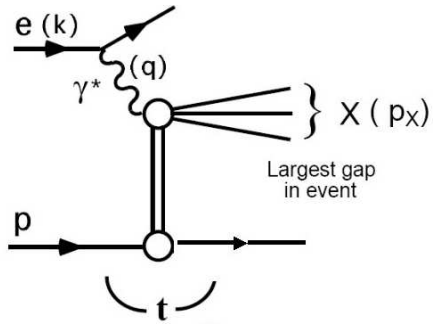
- Several Large Rapidity Gap data sets (HERA I and II):
  Final: 97-00, $3.5 < Q^2 < 1600$ GeV^2
  Preliminary: 99-00 and 04, $12 < Q^2 < 90$ GeV^2

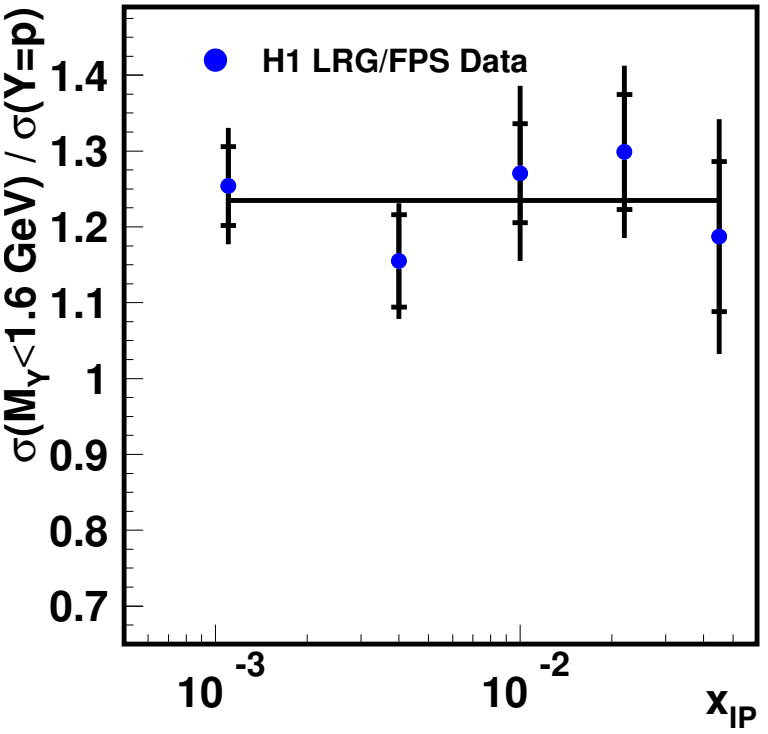
! Good consistency between LRG data sets in the phase space of new data

- new data have smaller statistical errors and confirm data being published now



Diffractive DIS, Large Rapidity Gap and Proton Tagging





- Further final data on F_2^{D4}

  proton tagged in FPS (Forward Proton Spectrometer)

  $2 < Q^2 < 50$ GeV^2

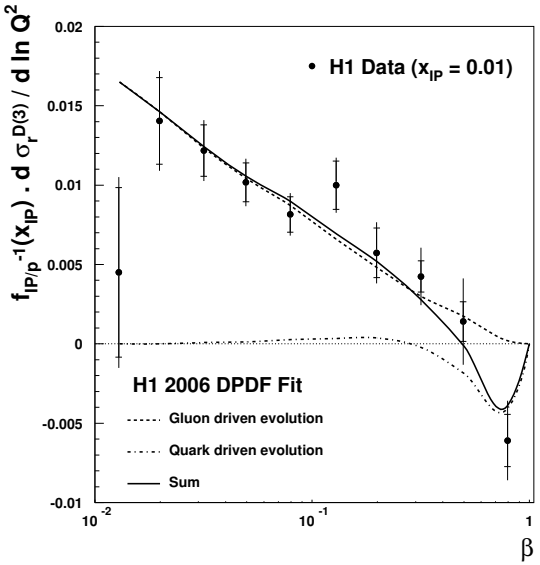
  $0.08 < t < 0.5$ GeV^2

$$\frac{\sigma(LRG)}{\sigma(tagged\ proton)} = 1.23 \pm 0.03(\text{stat}) \pm 0.16\ (\text{syst})$$

! independent of Q^2, β, x_P

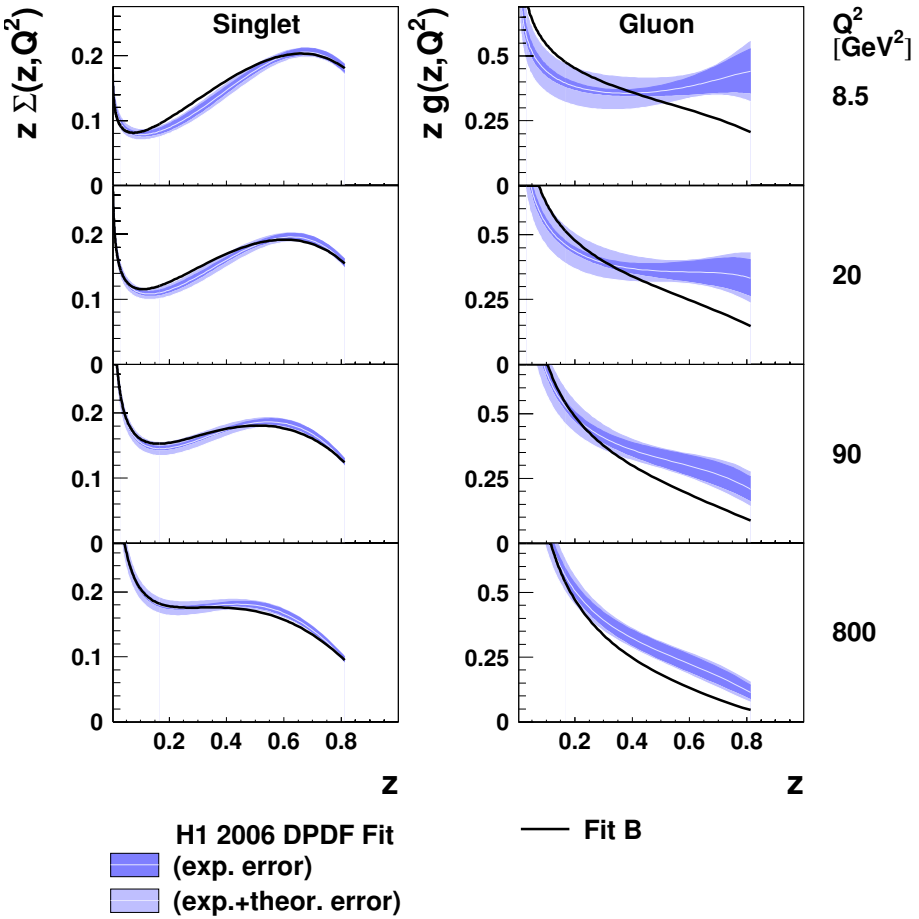
supports assumption of proton vertex factorization

Determination of diffractive parton distributions



- QCD analysis in NLO of the final H1 LRG data
  - q-density - directly related to σ
  - g-density - from scaling violations, poorly constrained at high β (z)

$\Rightarrow$ two results with similarly good description of data, but rather different gluon at high β

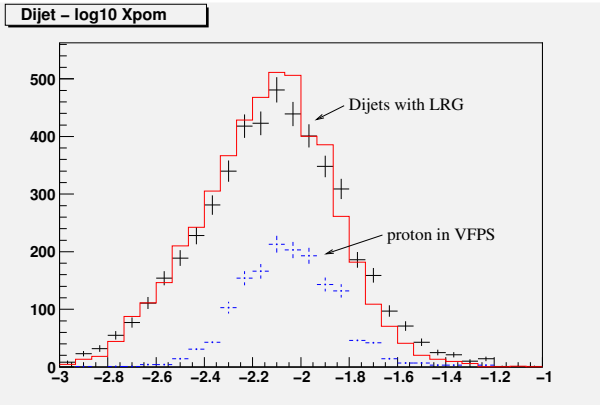


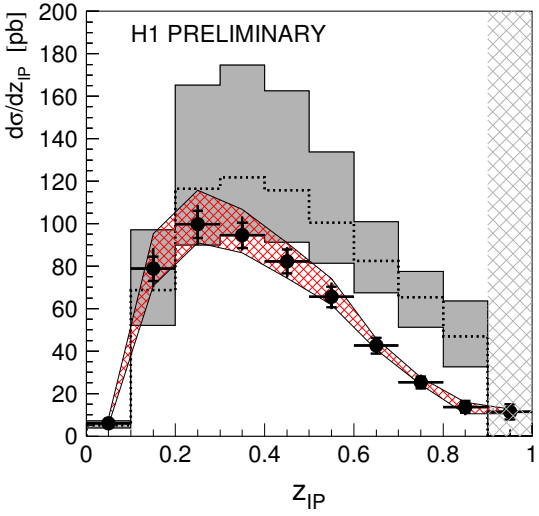
Diffraction- Diffractive dijets, factorization, common fit

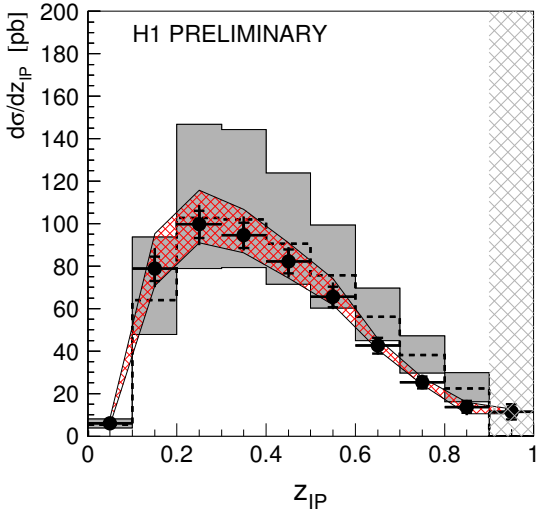
- New measurement of diffractive dijets in DIS with improved statistics ($50pb^{-1}$, 99-00 data)
- good agreement with NLO predictions using FIT B $\Rightarrow$ confirmation that factorization holds
- dijets sensitive to xg at large z

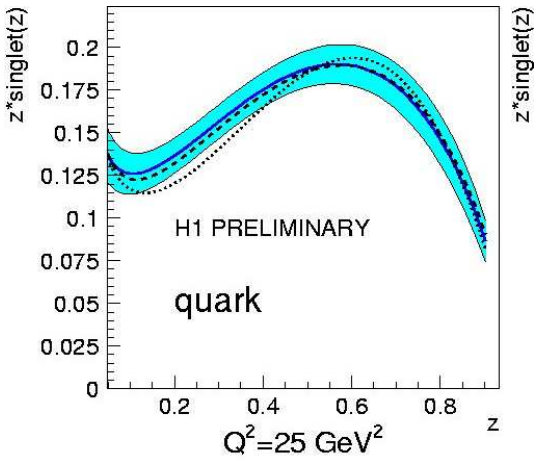
$\Rightarrow$ joint fit (inclusive diffraction+ diff. dijets) to determine dpdf's

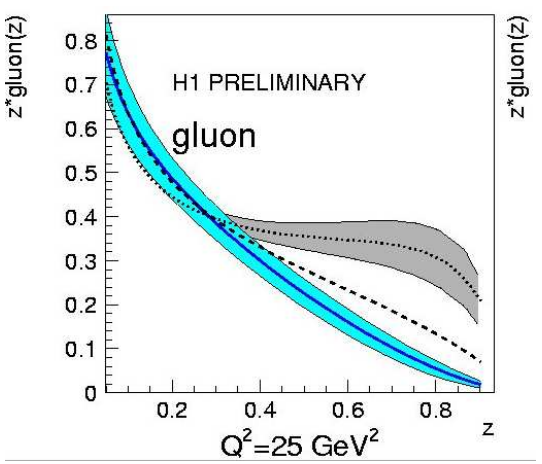
$\triangleright$ HERA II data: diffractive dijets with tagged proton in VFPS accumulating!





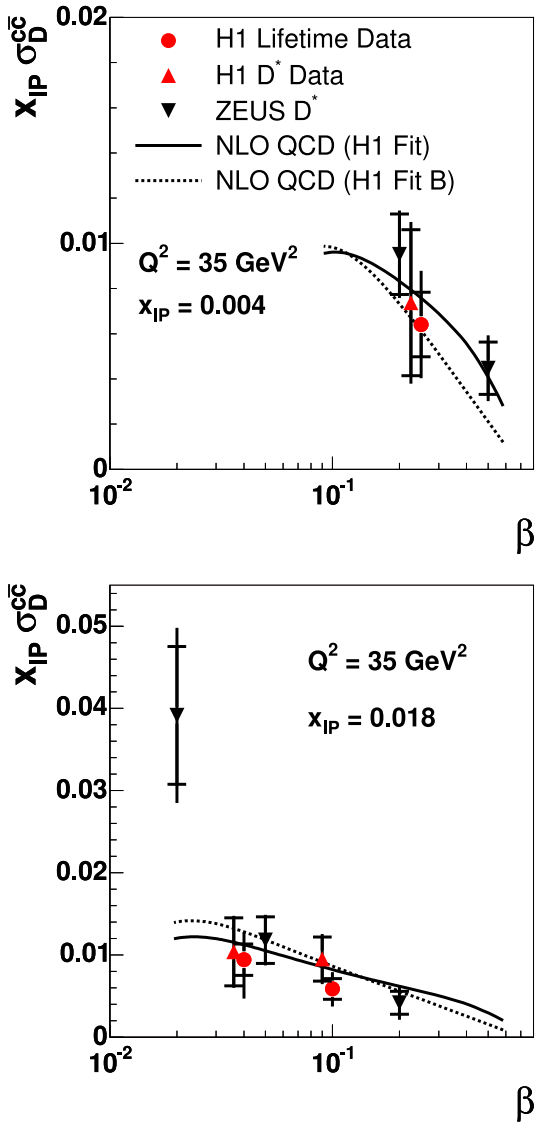






Diffraction- Factorization in DIS charm production

- New results:
  - ▷ diffractive charm in DIS using inclusive lifetime tag
  - ▷ diffractive D^* in tagged γp
- data in good agreement with NLO calculations using H1 dpdf fit
- no evidence of factorization breaking (large statistical errors)
- similar conclusion from D^* in γp

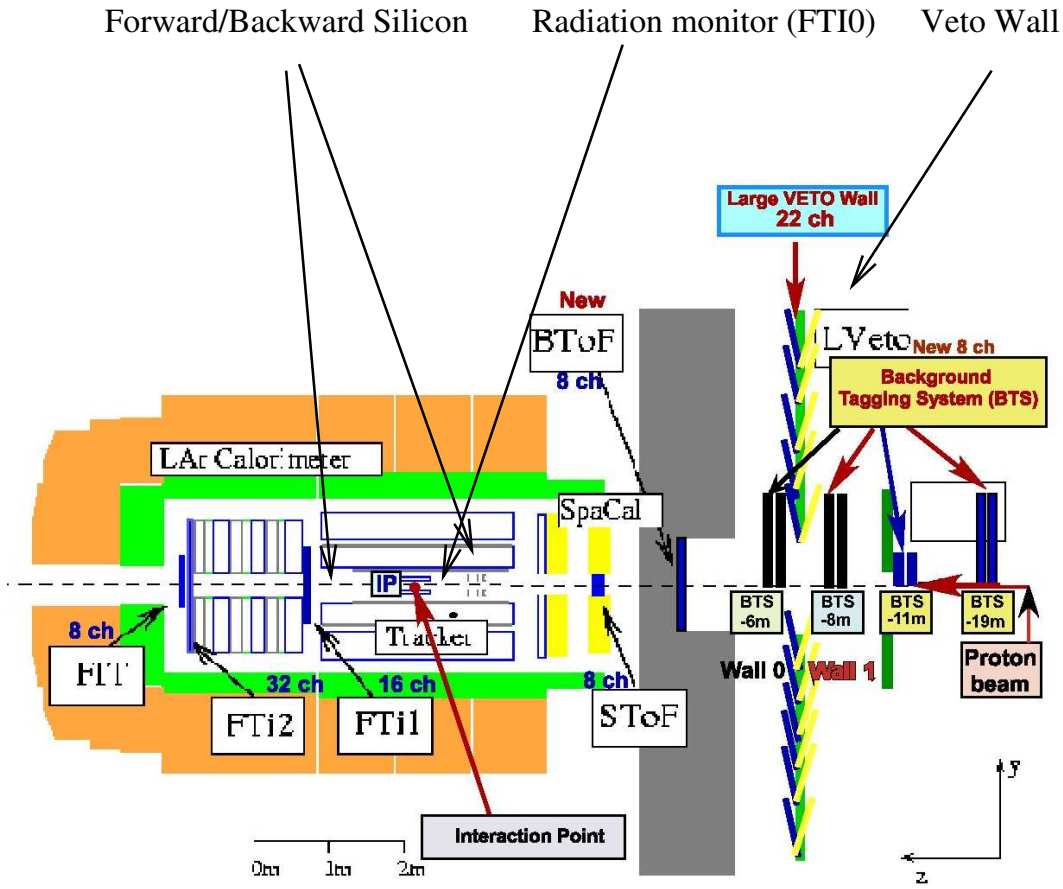


Conclusions and Outlook

- Detector:
  - ▷ in good shape
  - ▷ succesfull repair of major systems
  - ▷ upgrade projects finished
  - ▷ smooth data taking with high efficiency
- Physics results:
  - ▷ increasing flow of results from HERA II (high Q^2, searches, diffraction)
  - ▷ first physics results with upgraded detector
  - ▷ interesting high precision results from HERA I
- Outlook:
  - ▷ complete e^- data taking
  - ▷ high statistics data ($> 100 pb^{-1}$) with e^+
  - ▷ efficiently collect data for $F_L \Rightarrow 10\ pb^{-1}$ of data at lowered E_p

Backup slides

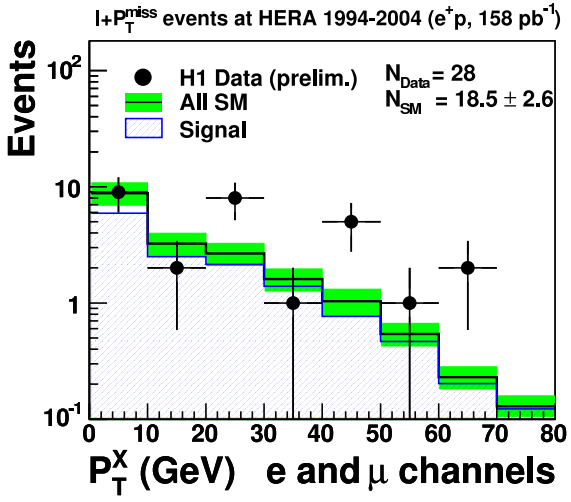
Winter Shutdown I

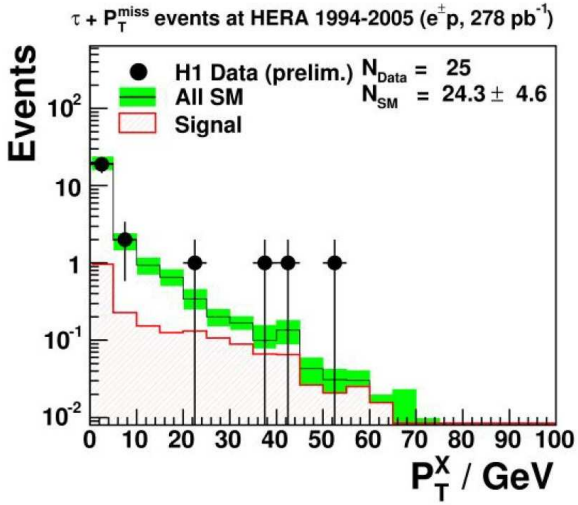


- winter shutdown used for repair work:
  - forward and backward silicon trackers
  - radiation monitor (FTI0)
  - veto wall
- maintenance work on several subsystems

Production of isolated τ pairs and other isolated leptons

- H1 reported excess of isolated leptons at high P_T^{miss} in e and μ channels
- The same techniques used to search for isolated τ's (smaller sensitivity)





Isolated leptons ($P_T^X > 25GeV$)	$e\&\mu$ channel	τ channel
Electrons 98-05 ($\sim 120pb^{-1}$)	$2/4.4 \pm 0.7$	$3/0.35^{+0.10}_{-0.08}$
Positrons 94-04 ($\sim 155pb^{-1}$)	$15/4.6 \pm 0.8$	$0/0.4 \pm 0.1$

- no spectacular τ event in e^+ (not incompatible with e and μ channels)
- in e^- events in the tail of the distribution

Search for multilepton events

- Interesting high-P_T multi-electron events observed at HERA-I

$\Rightarrow$ enlarged data set: HERA-I (118 pb^{-1}) + HERA-II e^+p (52 pb^{-1}) + HERA-II e^-p (105 pb^{-1})

$\Rightarrow$ observed topologies: ee,$\mu\mu$, $e\mu$, eee, $e\mu\mu$

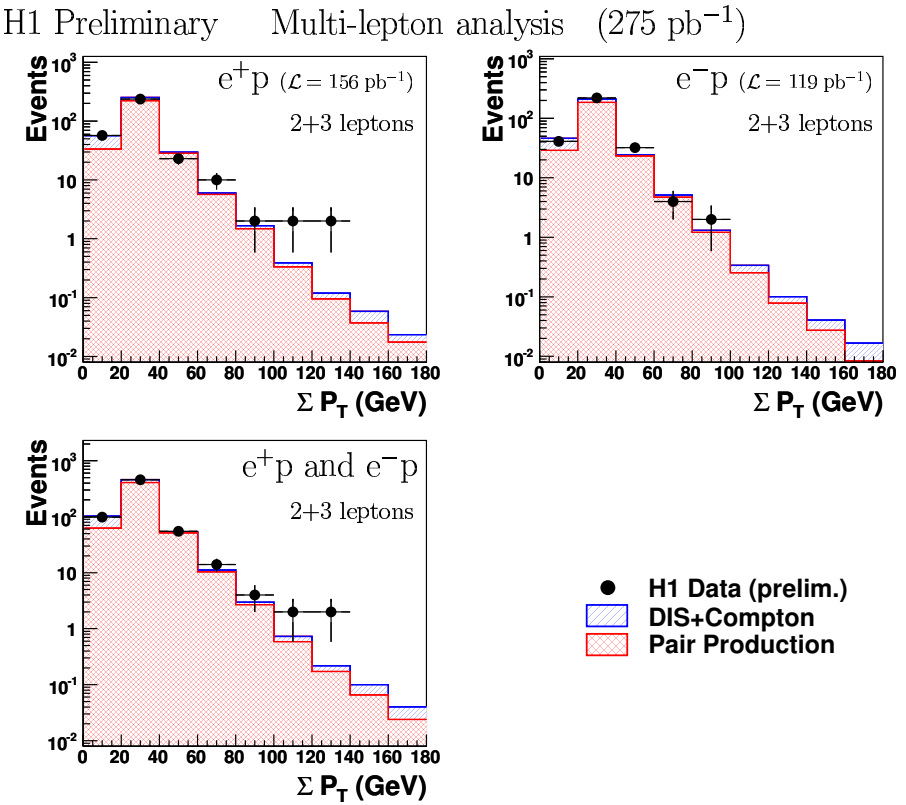
- Selection:

  ≥ 2 central leptons, $P_T^{l1} > 10GeV$,$P_T^{l2} > 5GeV$, $20^o < \theta_{l1,l2} < 150^o$

  $+$ any additional e with $E_e > 5GeV$, $5^o < \theta_e < 175^o$

  $+$ any additional μ with $P_T^{\mu} > 2GeV$, $20^o < \theta_e < 160^o$

- Two new (HERA II) spectacular events with M$>$ 100 GeV (both in e^+p)

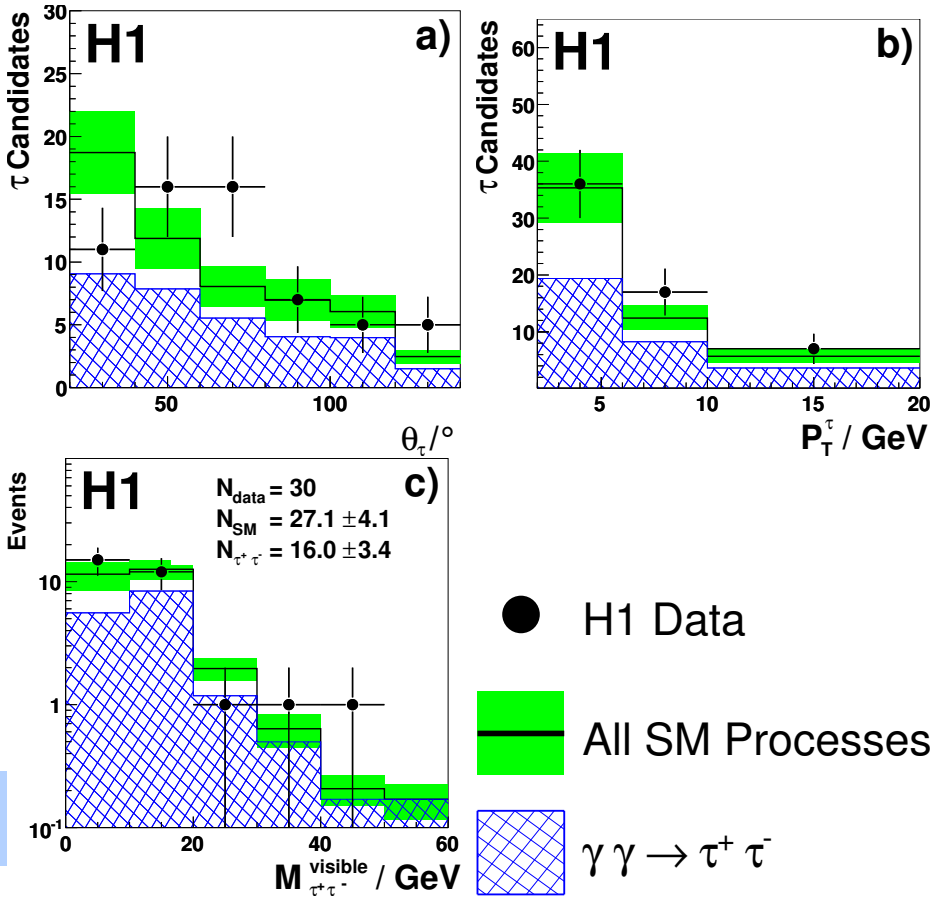


Selection	Data	SM
$e^+p \sum P_T > 100GeV$	4	0.6 $\pm$ 0.1
$e^-p \sum P_T > 100GeV$	0	0.5 $\pm$ 0.1
all $\sum P_T > 100GeV$	4	1.1 $\pm$ 0.2

Production of isolated τ leptons and τ pairs

- search for τ lepton pairs
- neural network $\longrightarrow$ separate τ from hadronic jets
- channels: $e\mu, e\tau_{jet}, \mu\tau_{jet}, \tau_{jet}\tau_{jet}$
- $108pb^{-1}$ (HERA I data) analyzed in kinematic range:
  $20^o < \theta^\tau < 160^o$
  $P_T^\tau > 2GeV$
- $\sigma = 13.6 \pm 4.4 \pm 3.7pb$

! first measurement of τ at HERA



data are in good agreement with SM

Outlook - Low proton energy run

- $\sigma_r = F_2 - \frac{y^2}{(1+(1-y)^2)} F_L$

▷ F2 determimes the sea quarks

▷ FL the gluon distribution at low x

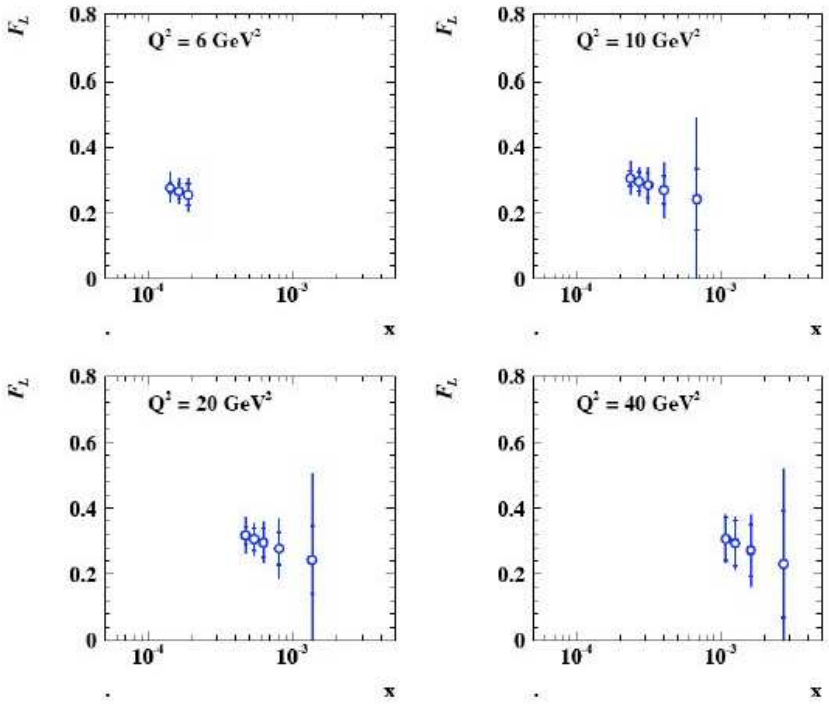
! Both are needed to constrain the evolution dynamics

- ameasurement of FL requires to vary $y = Q^2/(sx)$ and keep Q2,x fixed
- The sensitivity is proportional to y^2, $y \simeq 1 - E_{e'}/E_e$

⇒ scattered electron has to be identified at low energies, large background due to untagged photoproduction

- Simulation:

  10 $pb-1$ at 460 GeV
  30 $pb-1$ at 920 GeV
  photoproduction background statistically subtracted
  systematic and statistical errors are of comparable size



The low energy run has been part of H1's programme as presented in the EoI to the PRC in November 05. It should be realised during the phase of positron running which is envisaged to begin in June 06.