H1 status report

62st PRC Meeting, Oct. 23, 2006, DESY Zeuthen

Olaf Behnke, Heidelberg

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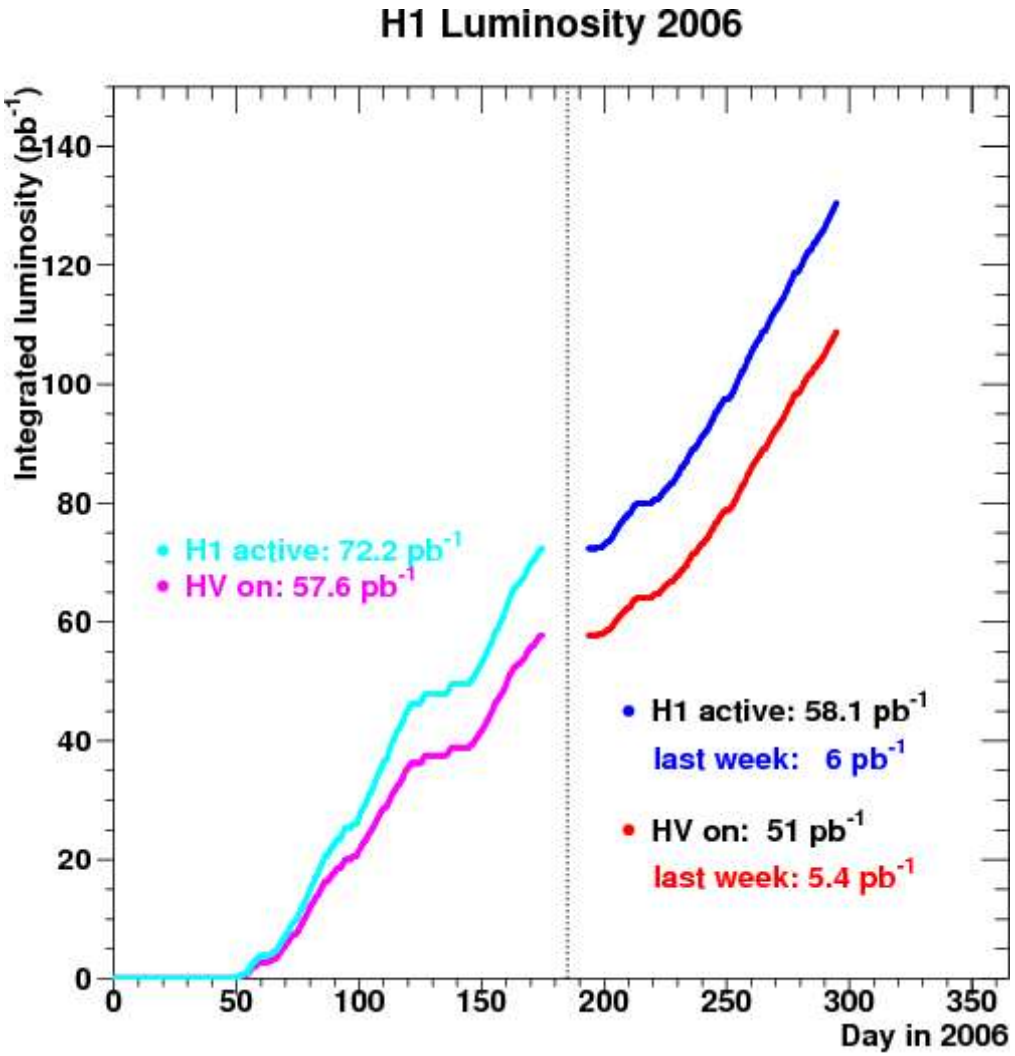
1. Recent HERA running and H1

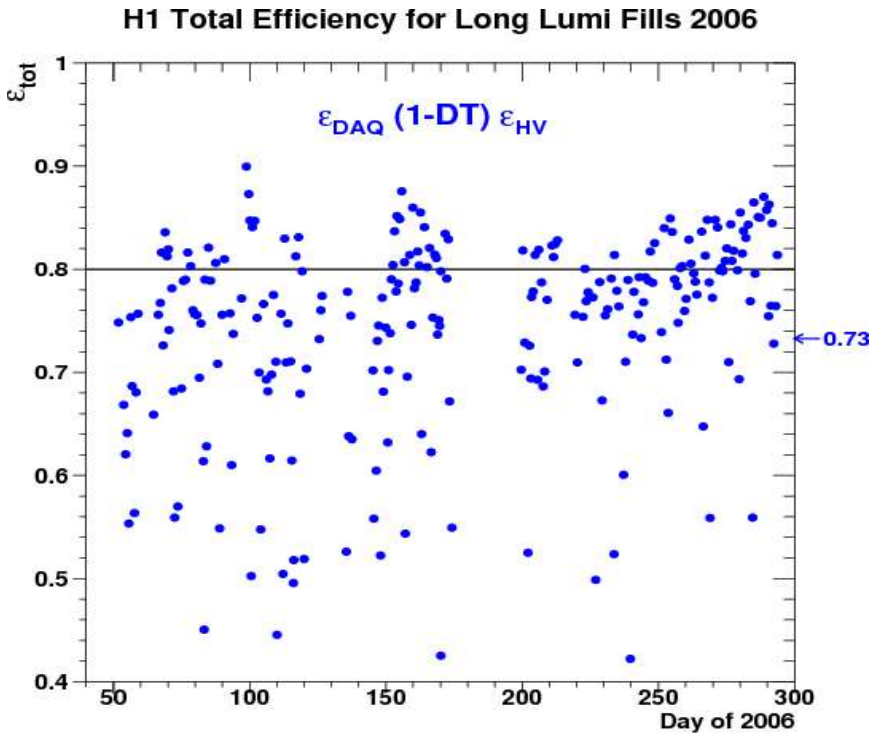


e+p running since July 06:

➔ ~51 pb^{-1} good data taken

➔ Low background (good vacuum)

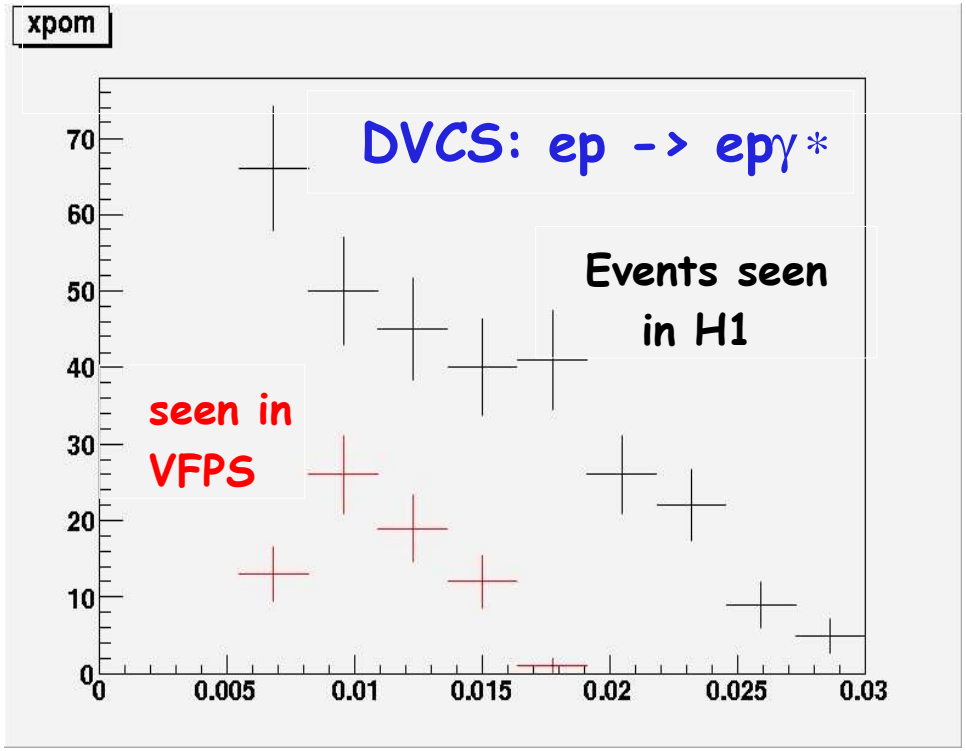
Thanks to HERA!



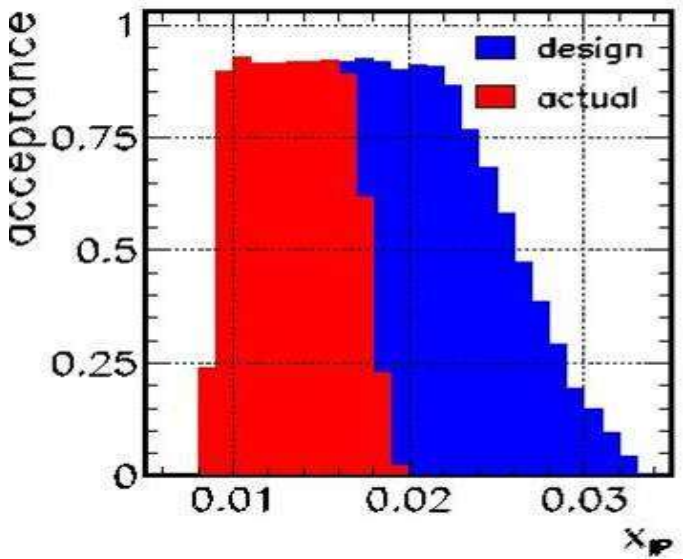
➔ Improved efficieny mainly due to less HV trips (less HERA background + improved trip electronics)

H1 detector news: Very forward proton spectrometer

- ➔ Roman pot detectors at 220 m NL
- ➔ Detect the diffracted protons
- ➔ Collected ~70% of H1 lumi in 2006

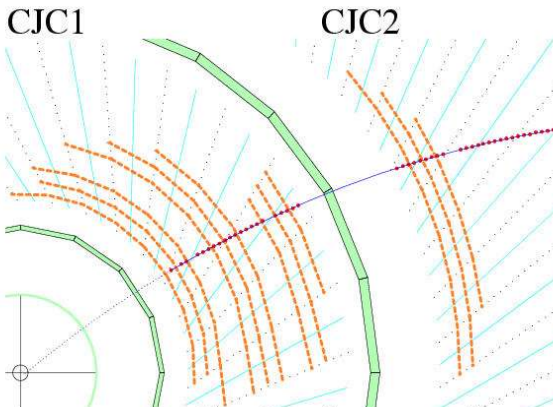


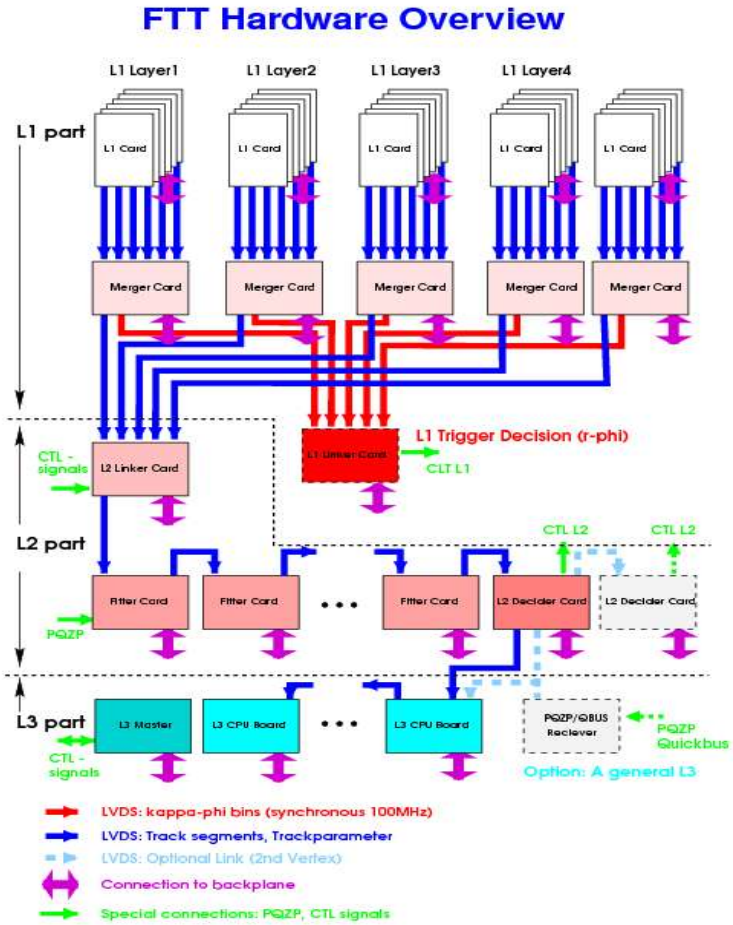
fractional proton energy-loss xp



➔ Suspect for reduced acceptance: HERA beam optics differs from design, more HERA investigations/actions needed!

Fast track trigger: Level 3 activated



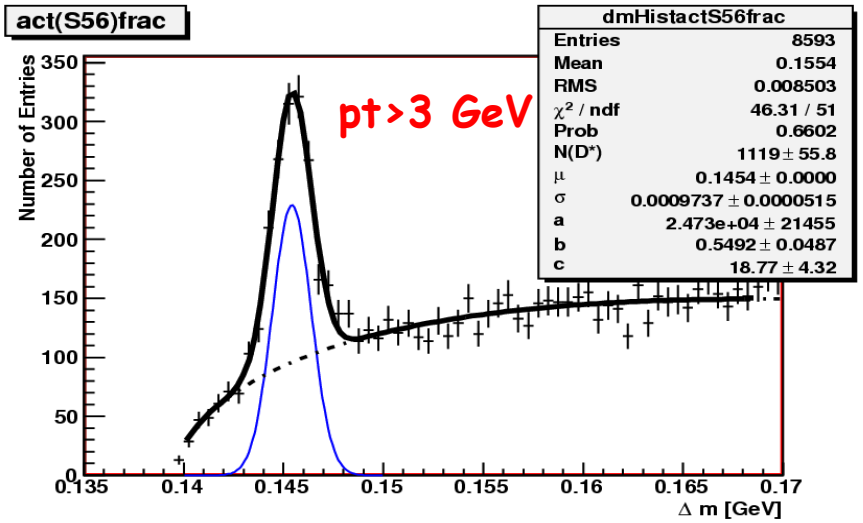


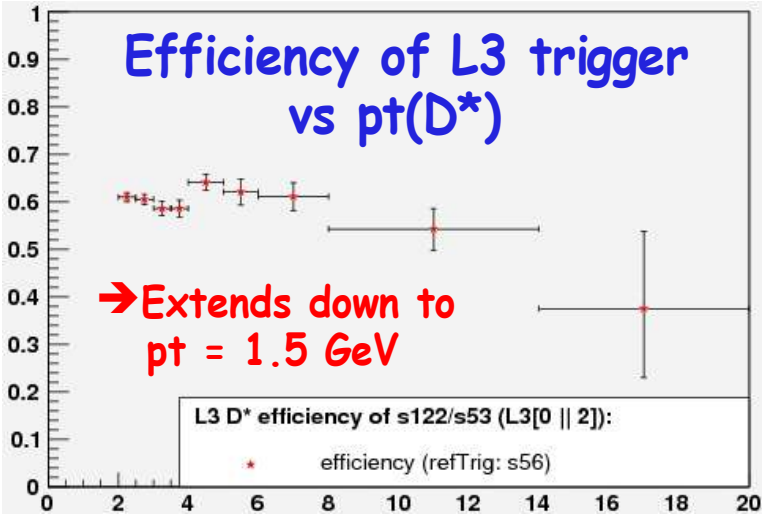
L1: Tracks

L2: Up to 48 refined tracks

L3: Invariant masses

D* signal triggered with L1 && L2 in untagged photoproduction



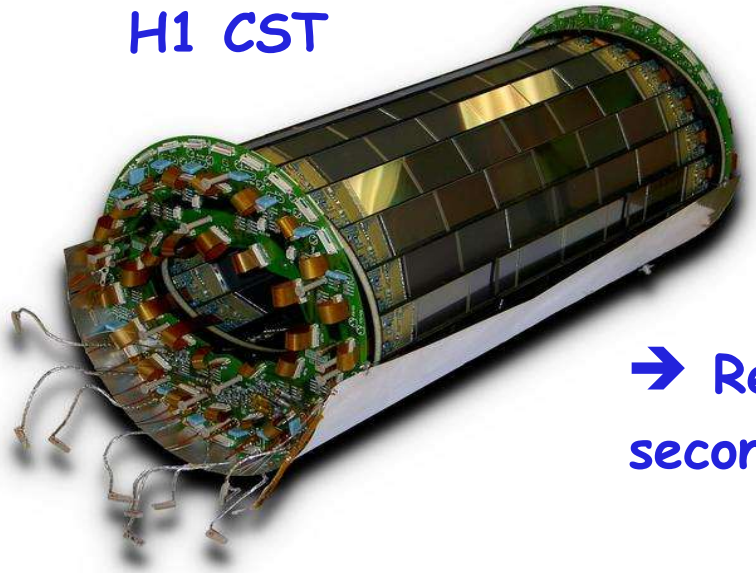


andre.Schoening@desy.de

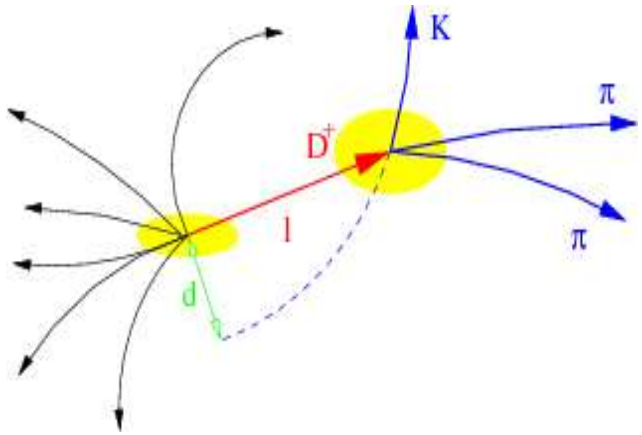
Central Silicon Tracker

➔ Performed High precision alignment, achieved effective hit resolution ~11 μm

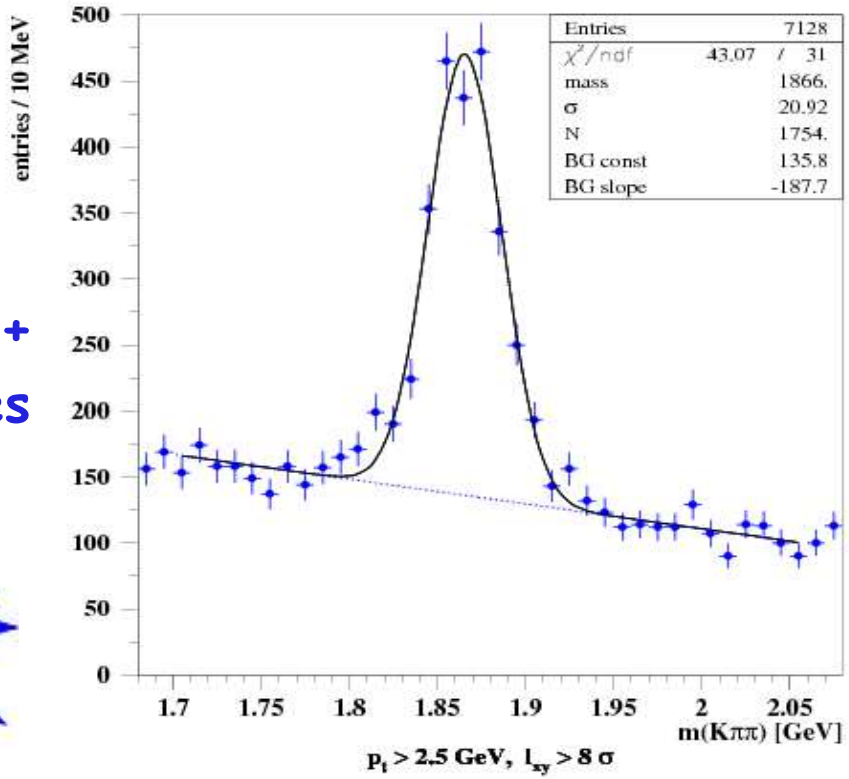
H1 CST



➔ Reconstruct D+ secondary vertices

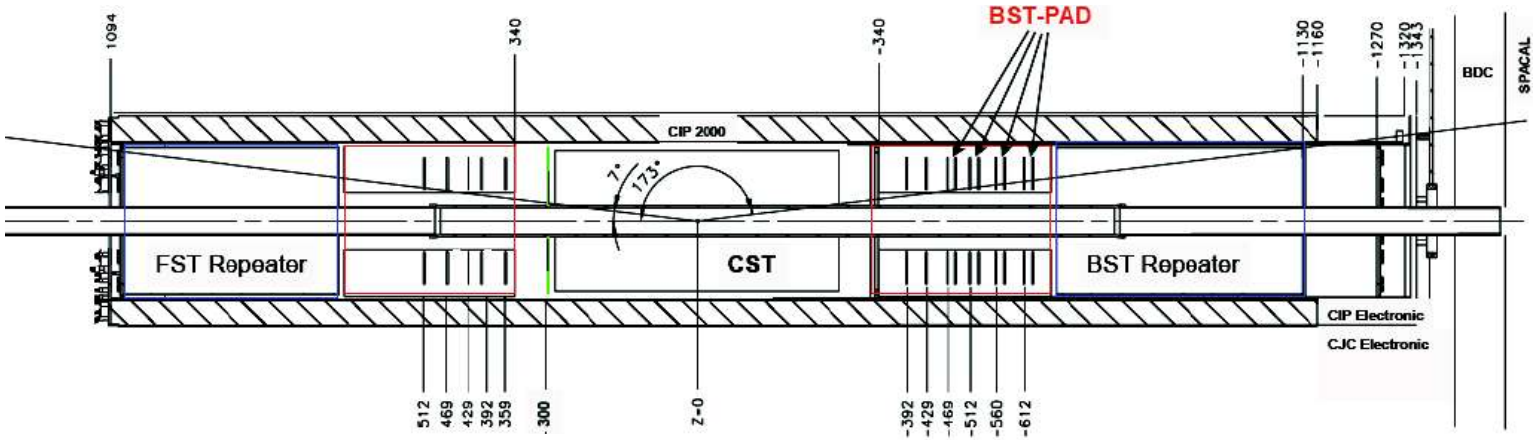


$D^+ \rightarrow K\pi\pi$ signal (2006):



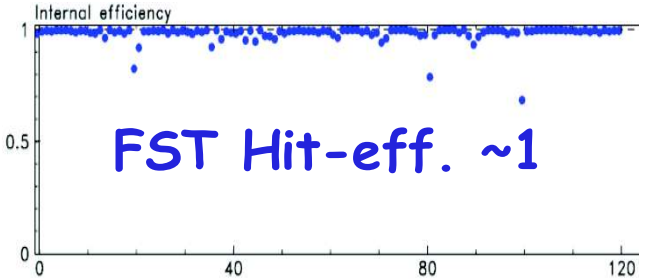
➔ Expect nice physics results!

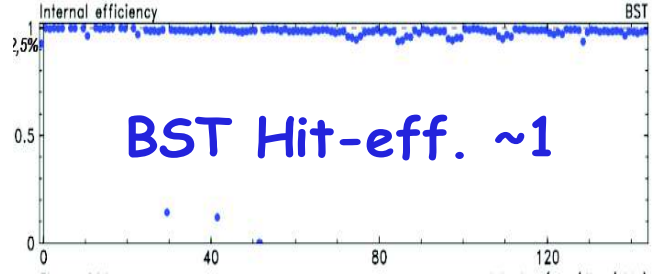
Forward and Backward Silicon Tracker



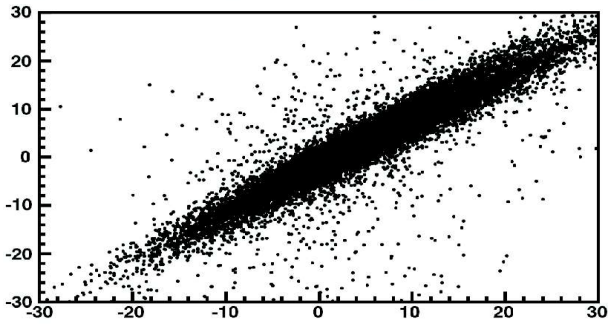
FST: **BST:**

both fully operational since may/06

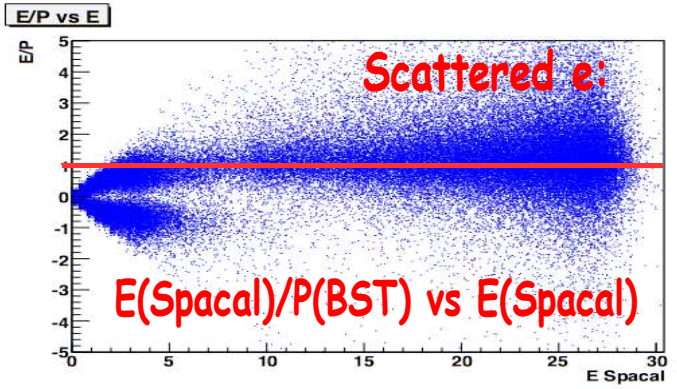




Z-v. FST



Z-vertex CT



➔ Good performance of both detectors

2. Low energy run – preparatory aspects

A direct measurement of $F_l(x,Q^2)$ requires low E_p run and:

1. Measure the scattered electron down to 3 GeV
   - ✔ Analyse low E(e+) data taken now
   - ✔ Linear energy scale (π^0,J/ψ)
   - ✔ Improve Trigger efficiency
2. Control of photoproduction background to 2% at lowest electron energies
   - ✔ BST, CJC measurement of p(e+)
   - ✔ Determine fake e from charge asymmetry
3. Control of relative xsec efficiencies (low p energy/high p energy) @1%
   - ✔ Work on 2% absolute xsec measurement with low Q^2 data
4. Luminosity measurement to 1%
   - ✔ Improved Lumi measurement (satellites, time dependence)

➔ Agreed with ZEUS and HERA to do it at the end of HERA

➔ Common H1-ZEUS-HERA working group has started

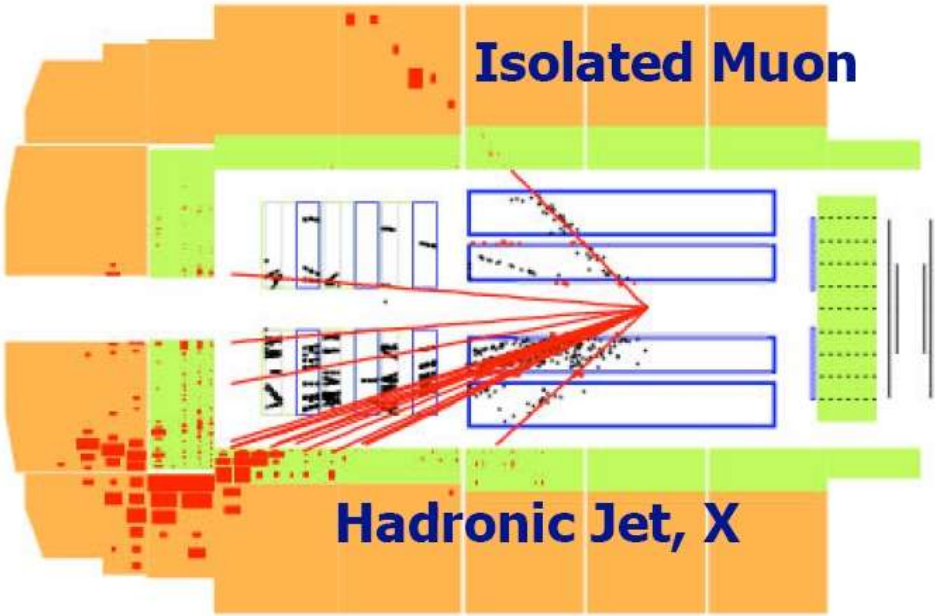
➔ Final H1 decision for the low energy run: beginning 2007

3. Recent Physics highlights

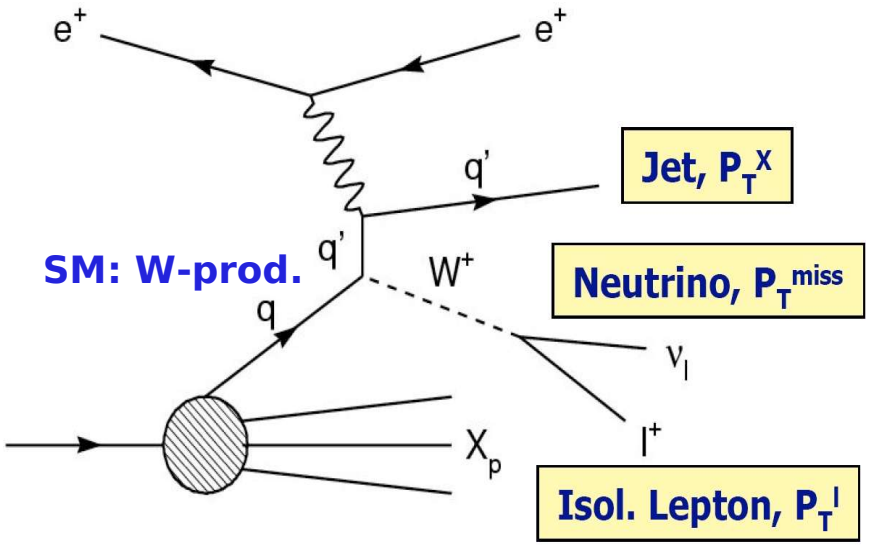
- Status of isolated lepton events and multileptons
- Searches with (almost) complete HERA e-p sample
- QCD studies: heavy flavour, diffraction

Isolated Leptons - Reminder

➔ Most prominent excess over SM seen in HERA I : Isolated leptons!



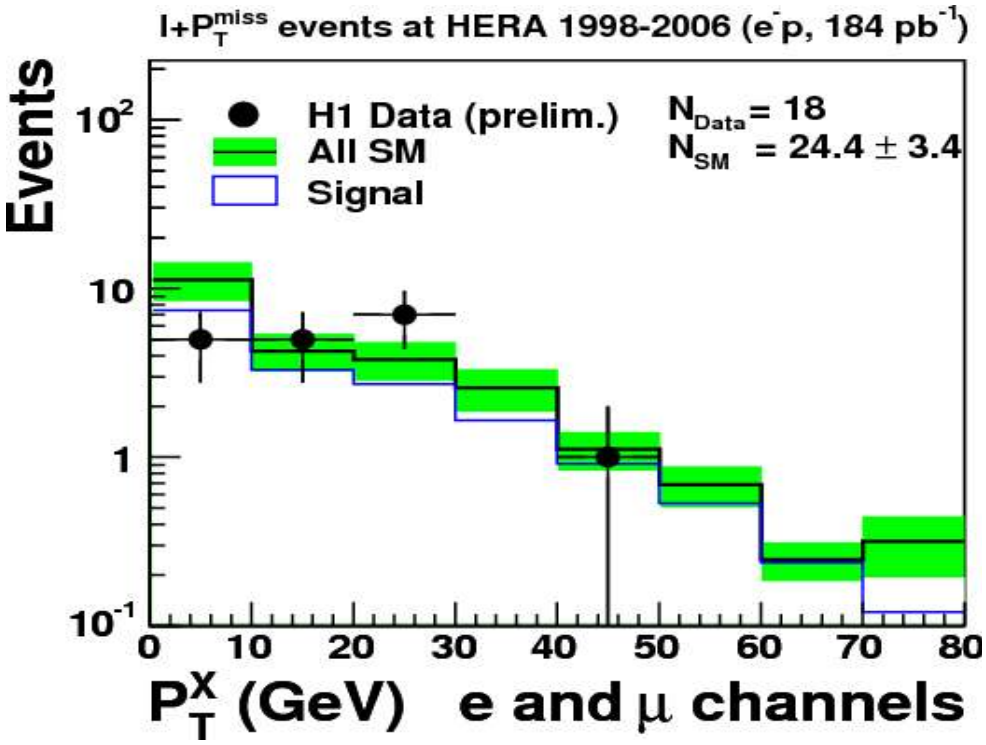
HERA I μ + P_T^{miss} event



➔ Excess observed for p_T^X >25 GeV

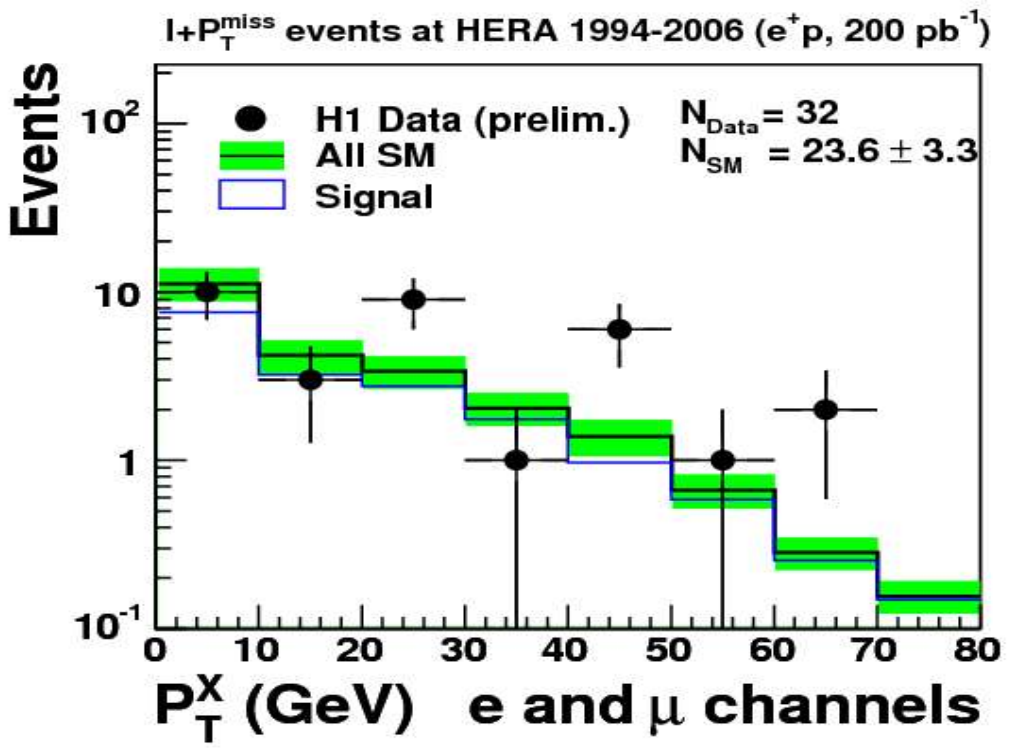
Isolated leptons: all HERA I+II data

➔ e^-p, (184 pb^{-1}) including 65 pb^{-1} (2006):



➔ No indications for excess in e^-p

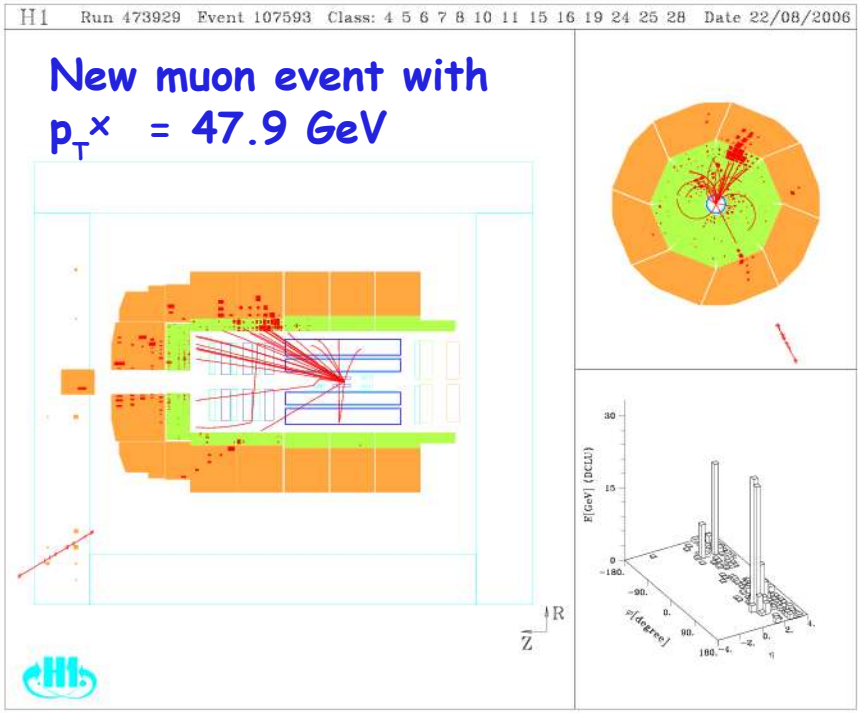
➔ e^+p, (200 pb^{-1}) including brand-new 42 pb^{-1} (2006):



$p_T x$>25 GeV: 17 (obs.) / 6.0±1.0 (exp.)

➔ Excess at 3.3 σ level

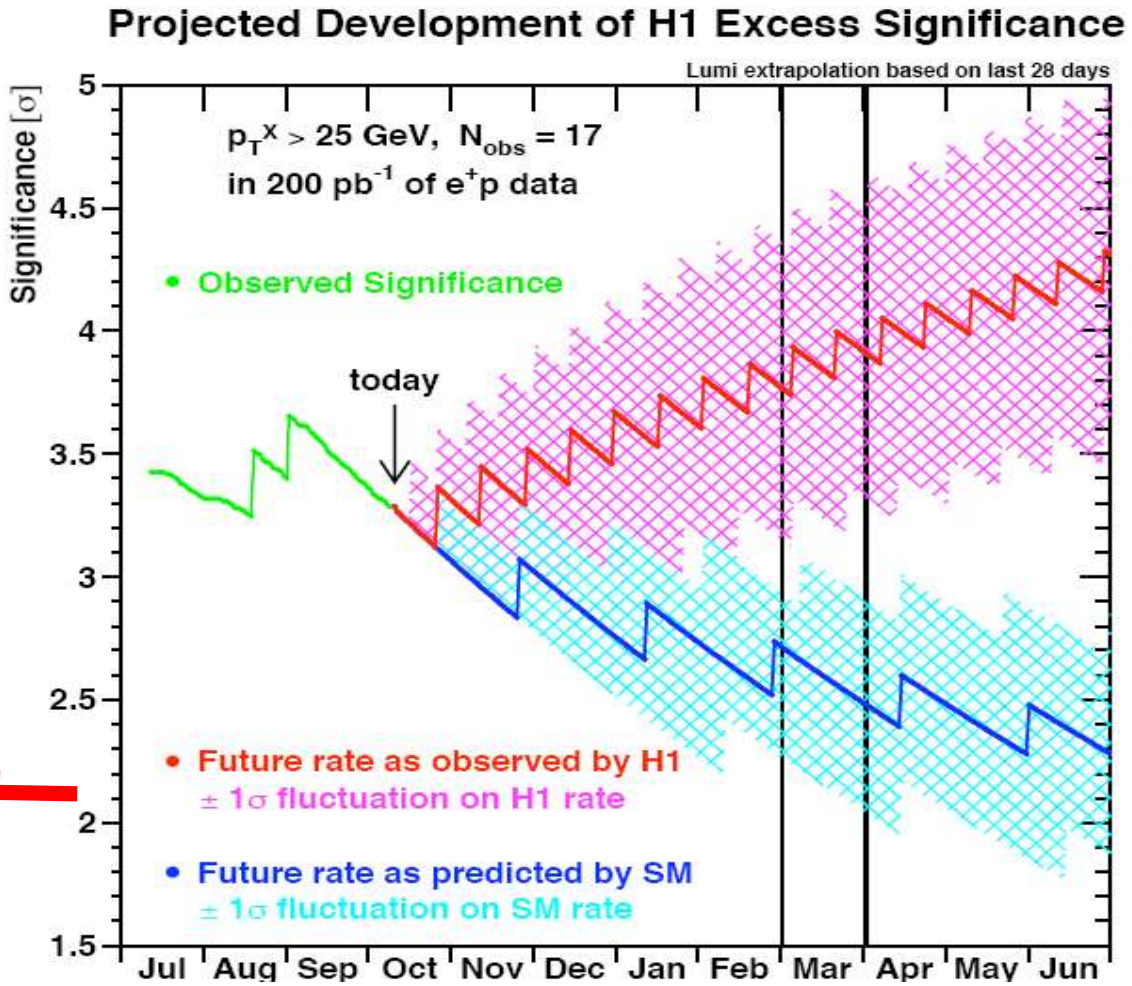
Isolated Leptons in recent e⁺p data (2006)



Yields in 2006 e⁺p data (42pb^{-1}):

Total: 4(obs.) / 5.1±0.7 (exp.)

p_T^X>25 GeV: 2(obs.) / 1.4±0.2 (exp.)

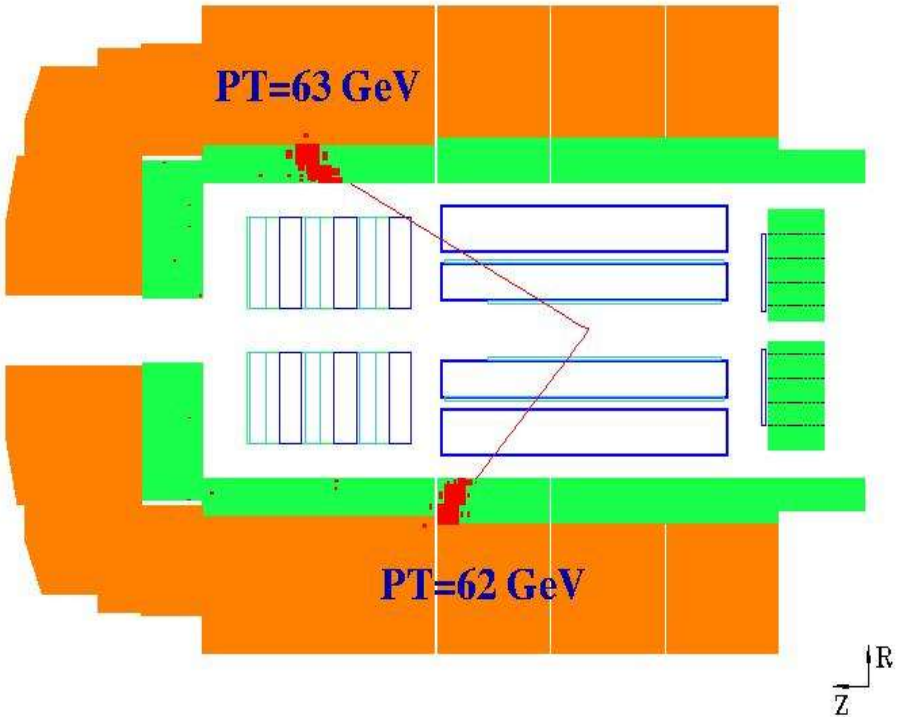


Needs highest lumi to clarify!

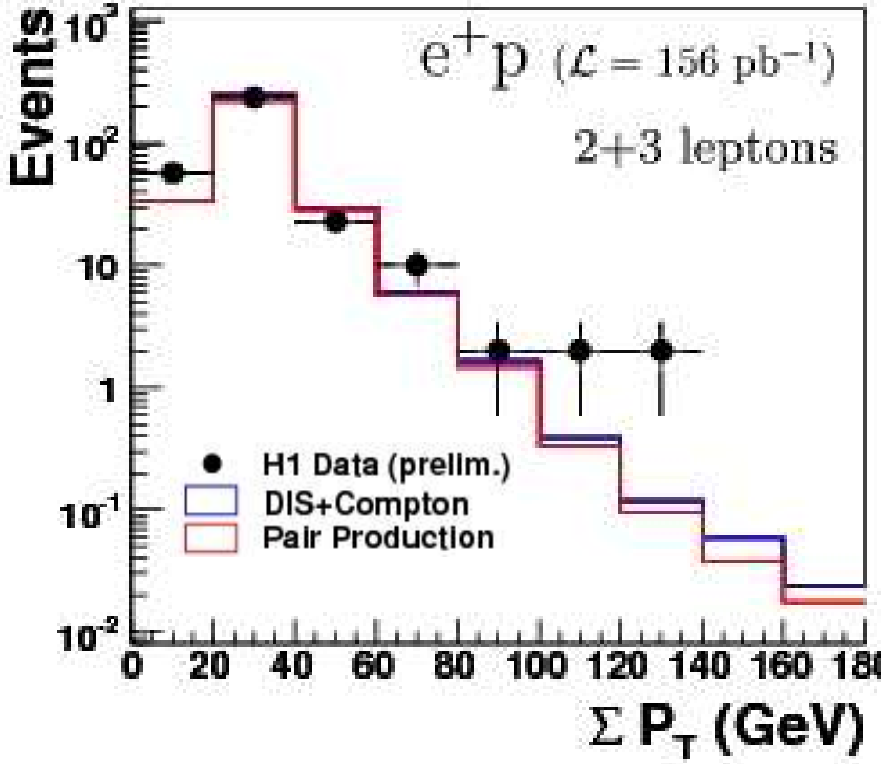
Multileptons

Outstanding high-Pt multi-electron events observed at HERA I

Eur. Phys. J. C31 (2003) 17



HERA I + HERA II (2004) e^+p data:
ee $\mu\mu$, eμ, eee, e$\mu\mu$ channels



News: No new event found at very high Σp_T in the recent e^+p data (2006)

Searches with HERA II e-p sample 2005/06

Compare:

HERA I e-p sample ~ 15 pb^{-1}

HERA II e-p sample ~ 160 pb^{-1}

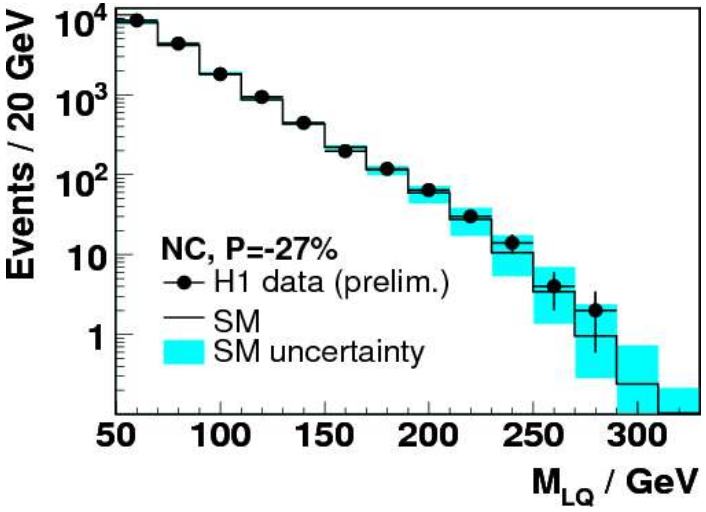
➔ ~10 times more data

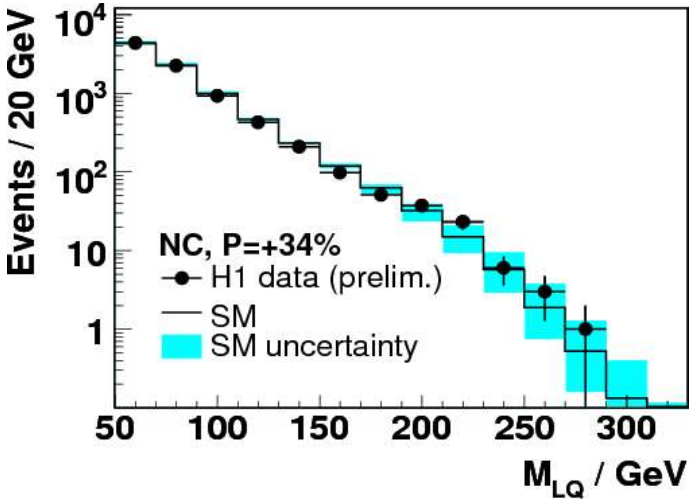
New results presented at ICHEP06 ->

Search for Leptoquarks

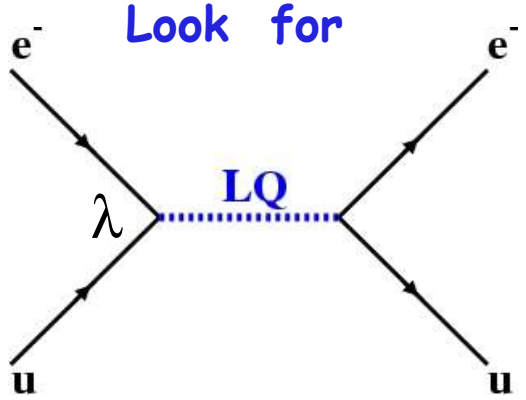
➔ Use data from 2005

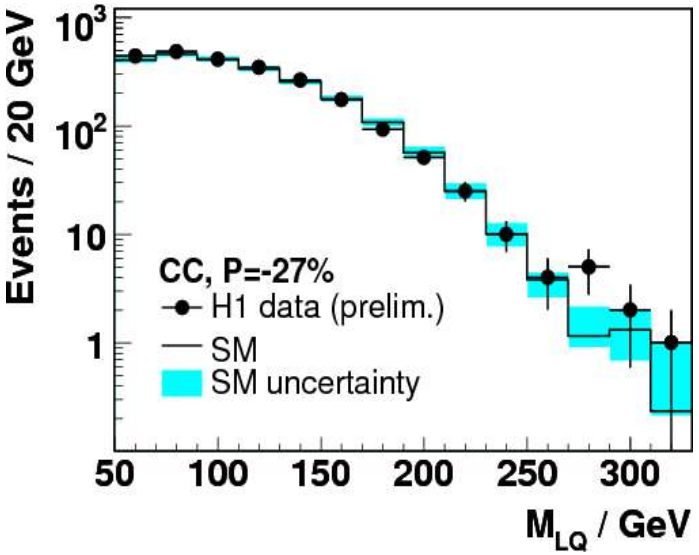
➔ e-p especially sensitive to LQ's with Fermion number = 2

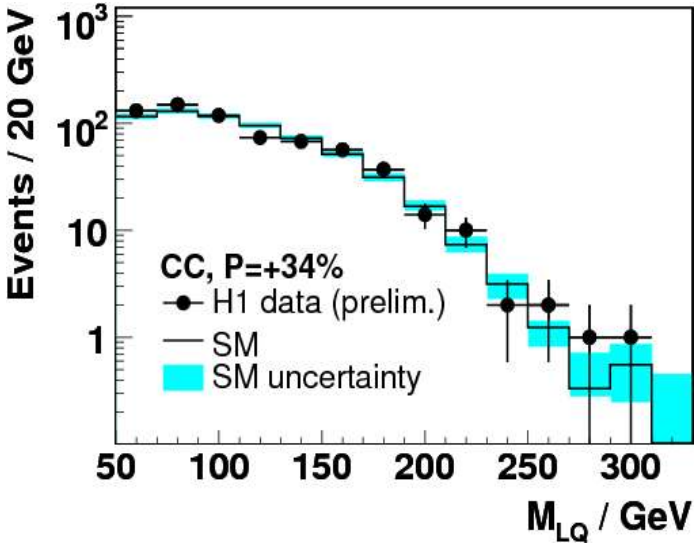


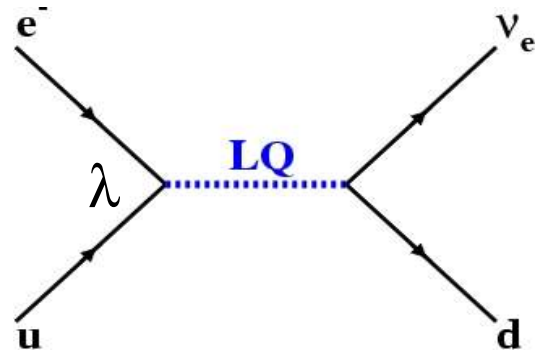


Look for







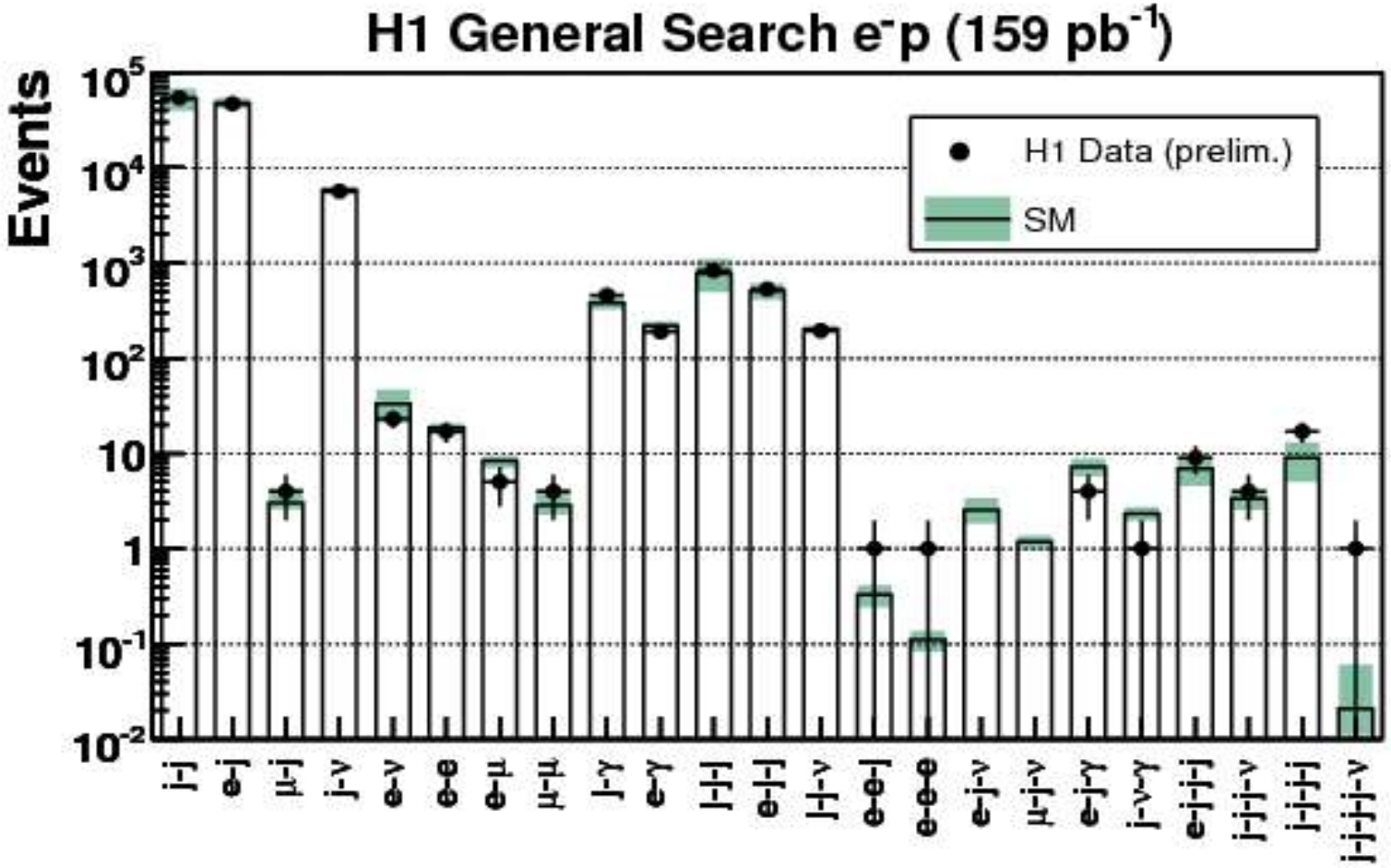


➔ No indications for a LQ signal

Generic search in e⁻p data

- Search for deviations from SM using all suitable final states (Jets, Leptons)
- Employ standardised particle finders

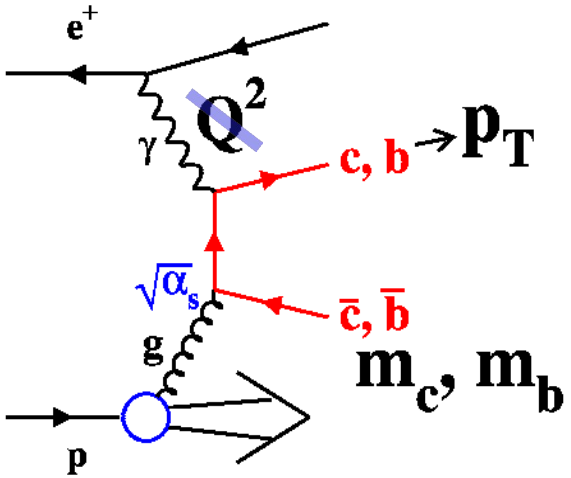
'05 and '06 e⁻p data



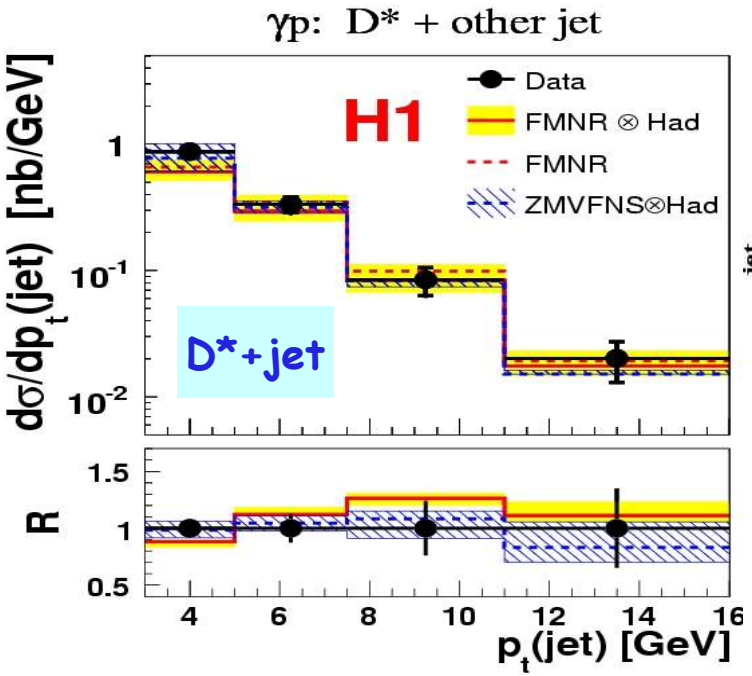
→ SM ok !

New H1 results on
QCD studies with the hadronic final state

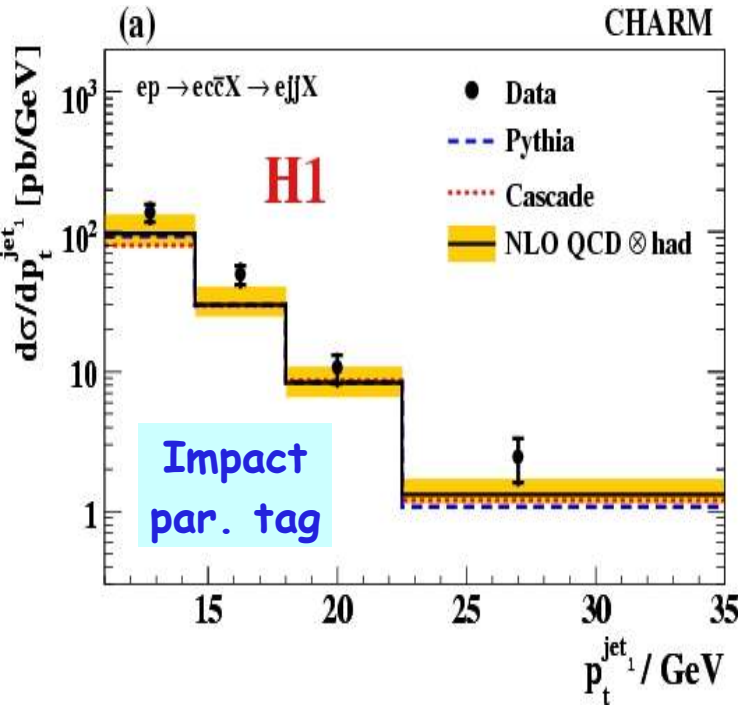
Open charm photoproduction: Q^2~0



DESY 06-110



DESY 06-039

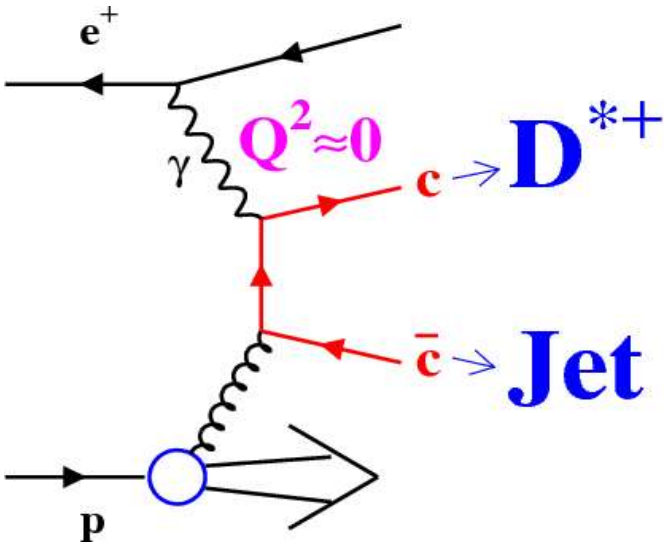


➔ Huge range: $3 < p_T(c) < 35$ GeV

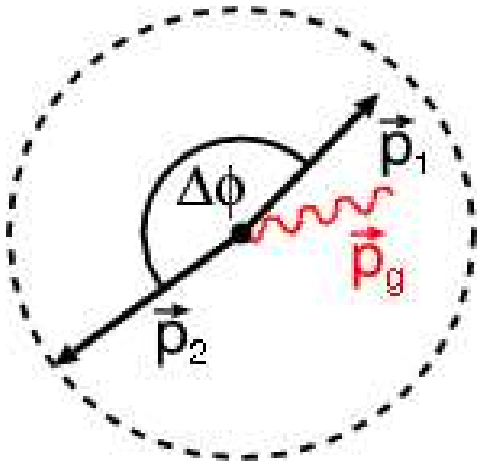
➔ Reasonably well described by NLO

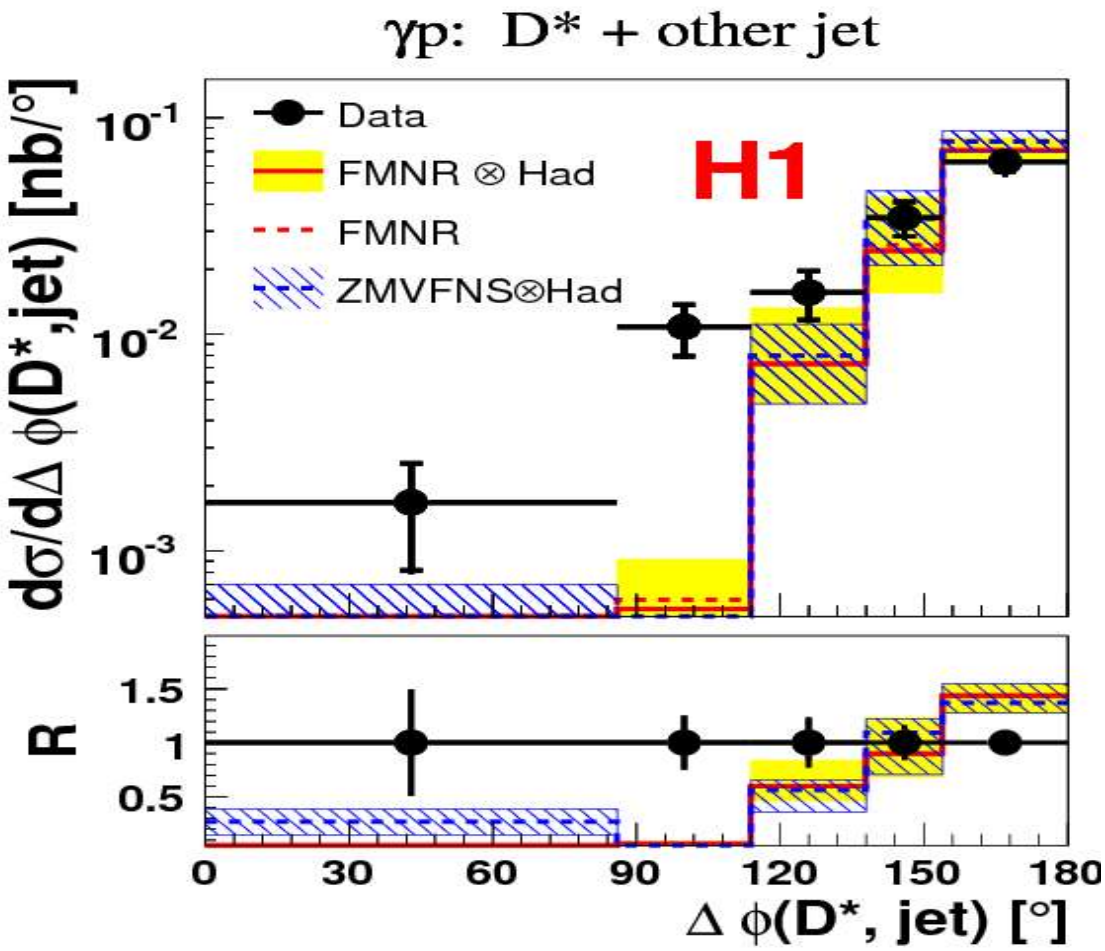
DESY 06-110

D* jet azimuthal correlations



➔ Higher orders cause non 'back to back' topology

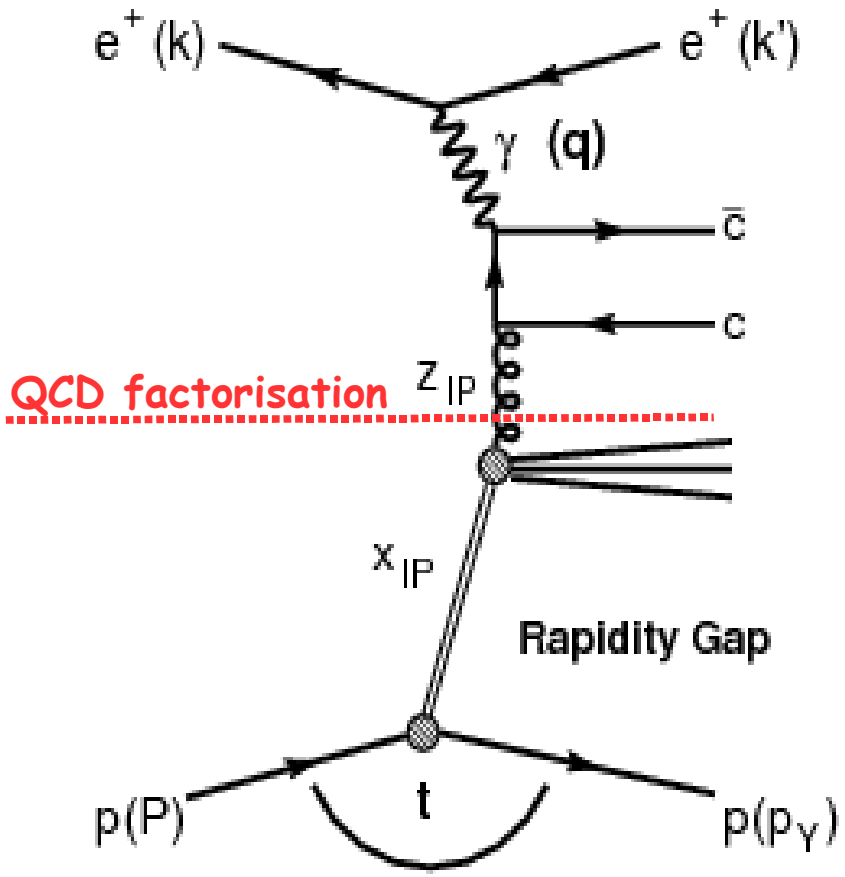




➔ NLO (FMNR, ZMVFNS) fails for small opening angles

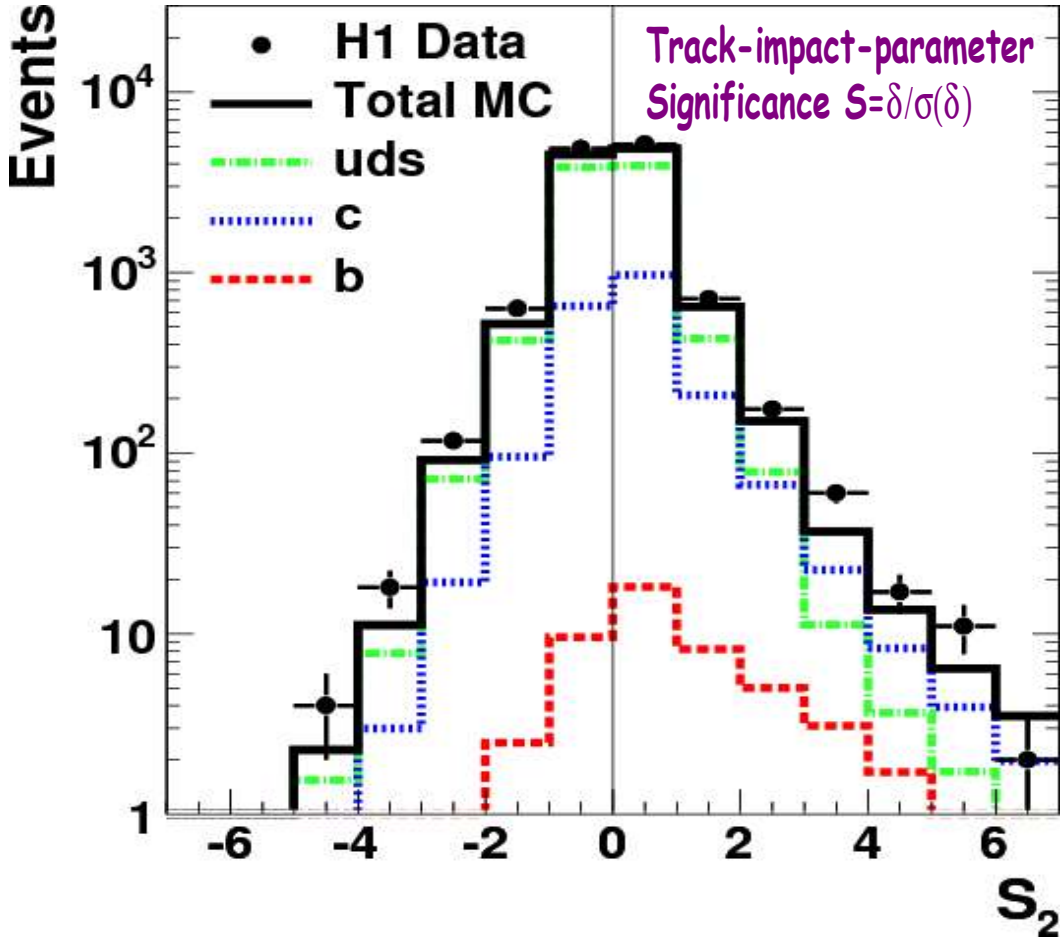
DESY 06-164

Diffractive charm: test QCD factorisation



➔ Use two charm tag methods:

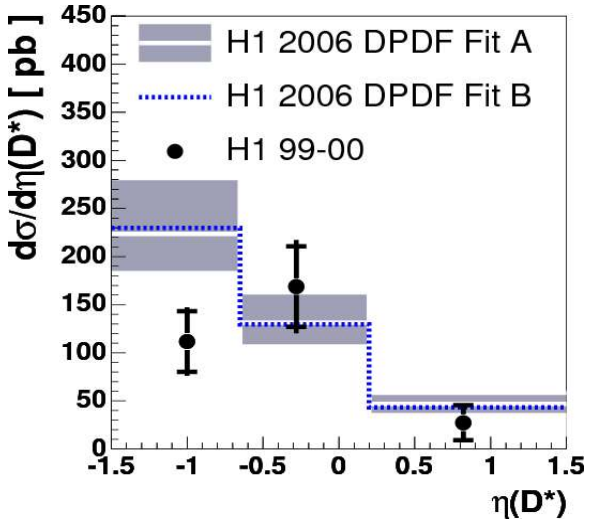
1. D* tag
2. inclusive Lifetime tag (for the first time in diffraction @ HERA)



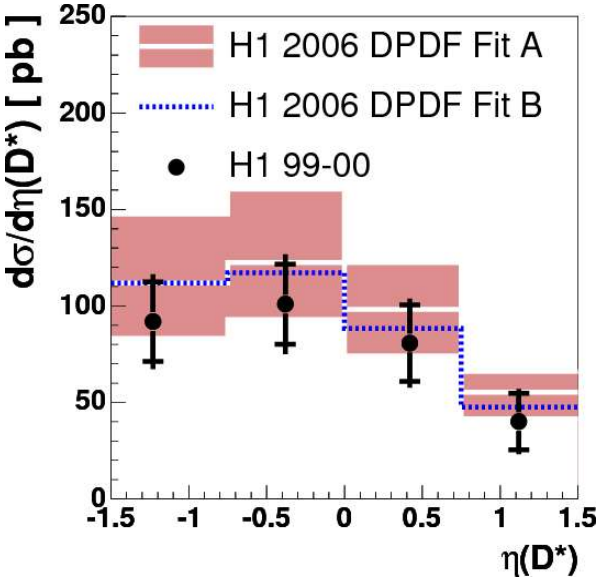
DESY 06-164

Diffractive charm: Results

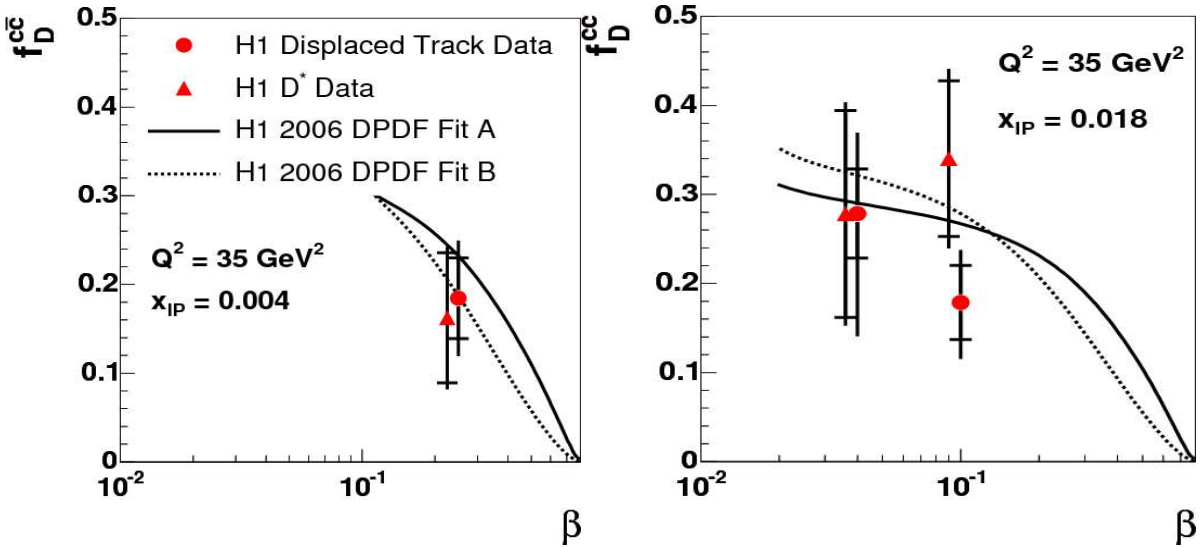
D* in photoproduction:



D* in DIS:



Inclusive Lifetime and D* tag in DIS - fractional charm contribution to xsec:



➔ All results in agreement with QCD factorisation

4. Preparing for the analysis of the final HERA data set

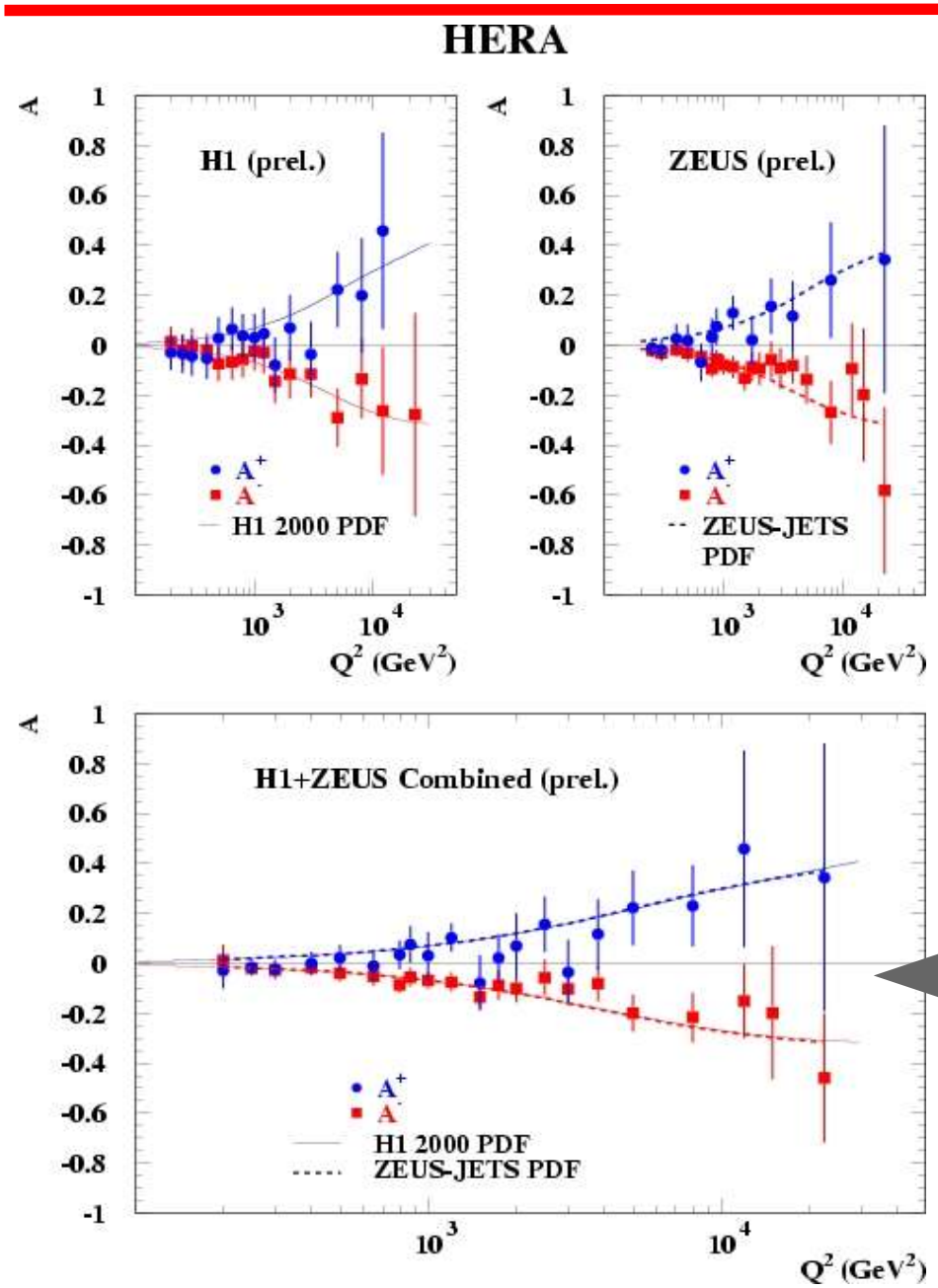
H1-ZEUS combined working groups

June 13, 2006: H1 and ZEUS agreed on five combined analysis projects:

- Structure functions and PDFs
- Isolated leptons
- Leptoquarks, Contact Interactions etc.
- Multileptons
- α_s

Mission: "To combine the measurements of the two experiments on selected topics to strengthen the impact of HERA physics to HEP"

First H1+ZEUS results: Neutral Current P_e asymmetries



presented at ICHEP06:

$$A^{\pm} = \frac{2}{P_R - P_L} \cdot \frac{\sigma^{\pm}(P_R) - \sigma^{\pm}(P_L)}{\sigma^{\pm}(P_R) + \sigma^{\pm}(P_L)}$$

➔ Probe parity violation in γ-Z interference

H1 & ZEUS combined data

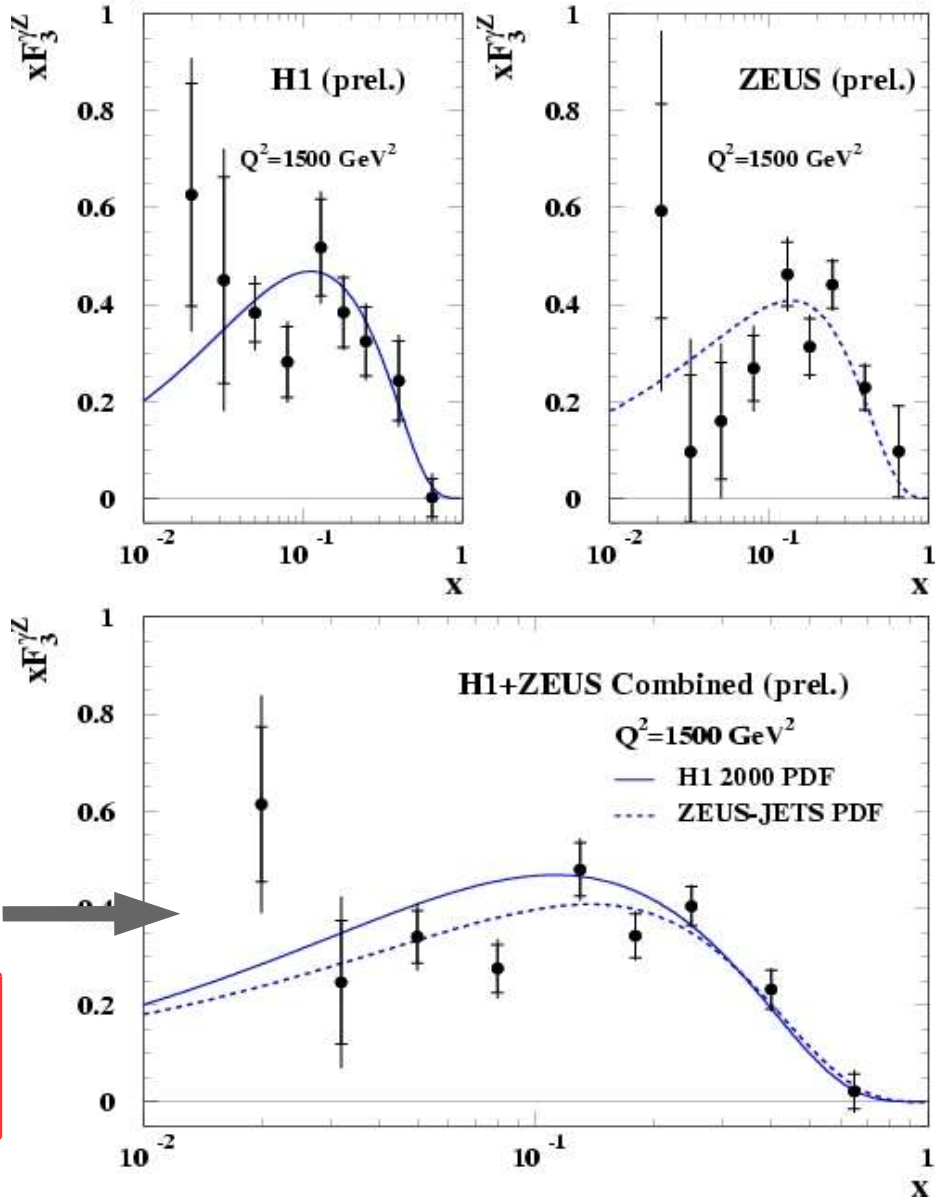
➔ First observation of parity viol. in NC e±p data at R down to 10^{-18} m

First H1+ZEUS results: NC lepton charge asymmetry

➔ γ-Z interference flips sign for $e^+p \rightarrow e^-p$

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

HERA I + II



H1 & ZEUS combined data

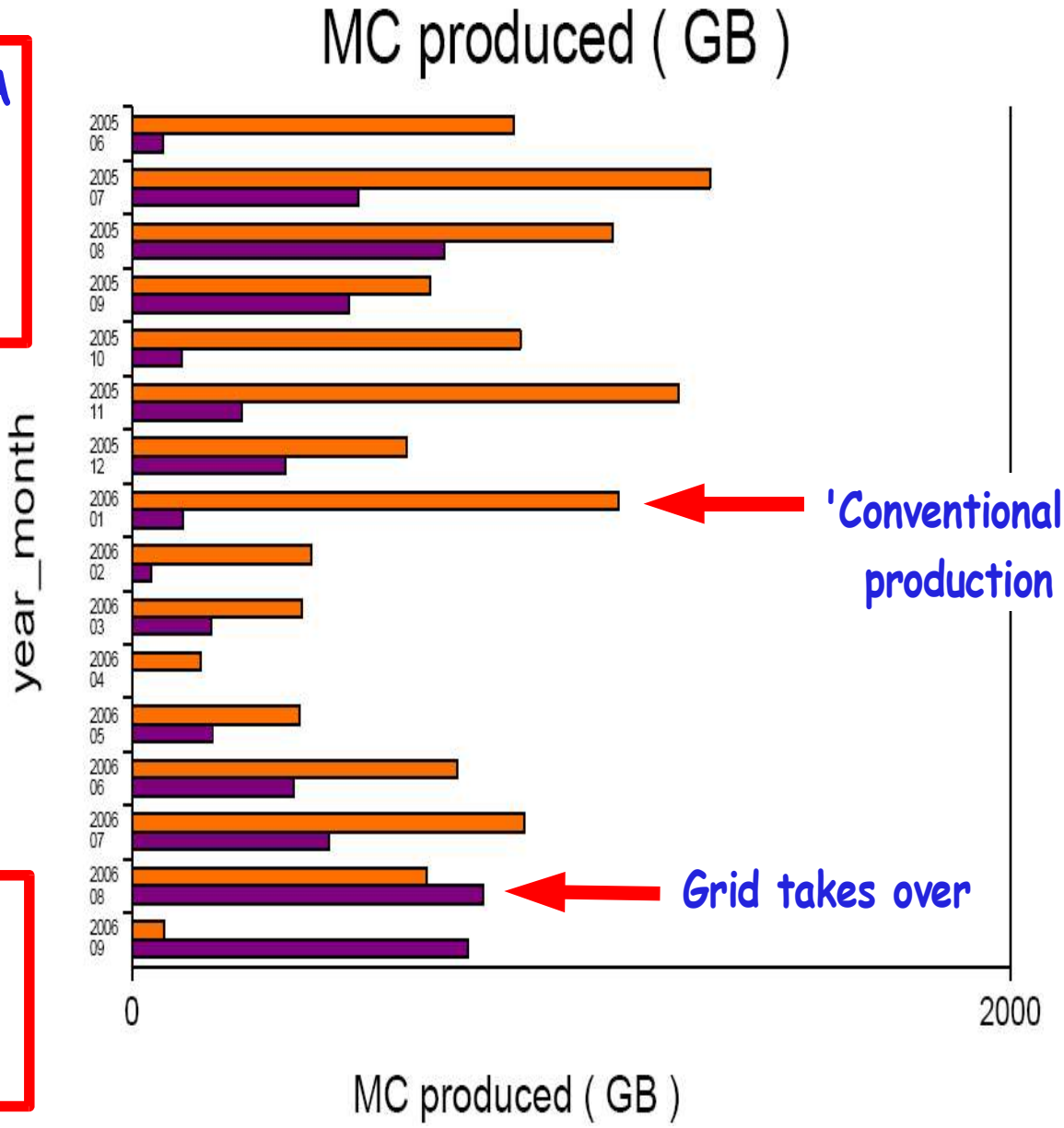
➔Adds to the knowledge of valence quarks at lower x

Computing for the final physics analysis phase

➔ Final analysis of full HERA data set 1992-2007 will require computing power at highest level for several years

➔ Intense ongoing efforts to secure supplies

➔ Have prepared a detailed strategy document for 2006-2010 for funding agencies



Conclusions

HERA and H1:

- ➔ H1 detector in best shape, improved HV efficiency, Trigger, calibrations – determined to take the highest luminosities from HERA
- ➔ Preparations for low energy run in spring 2007

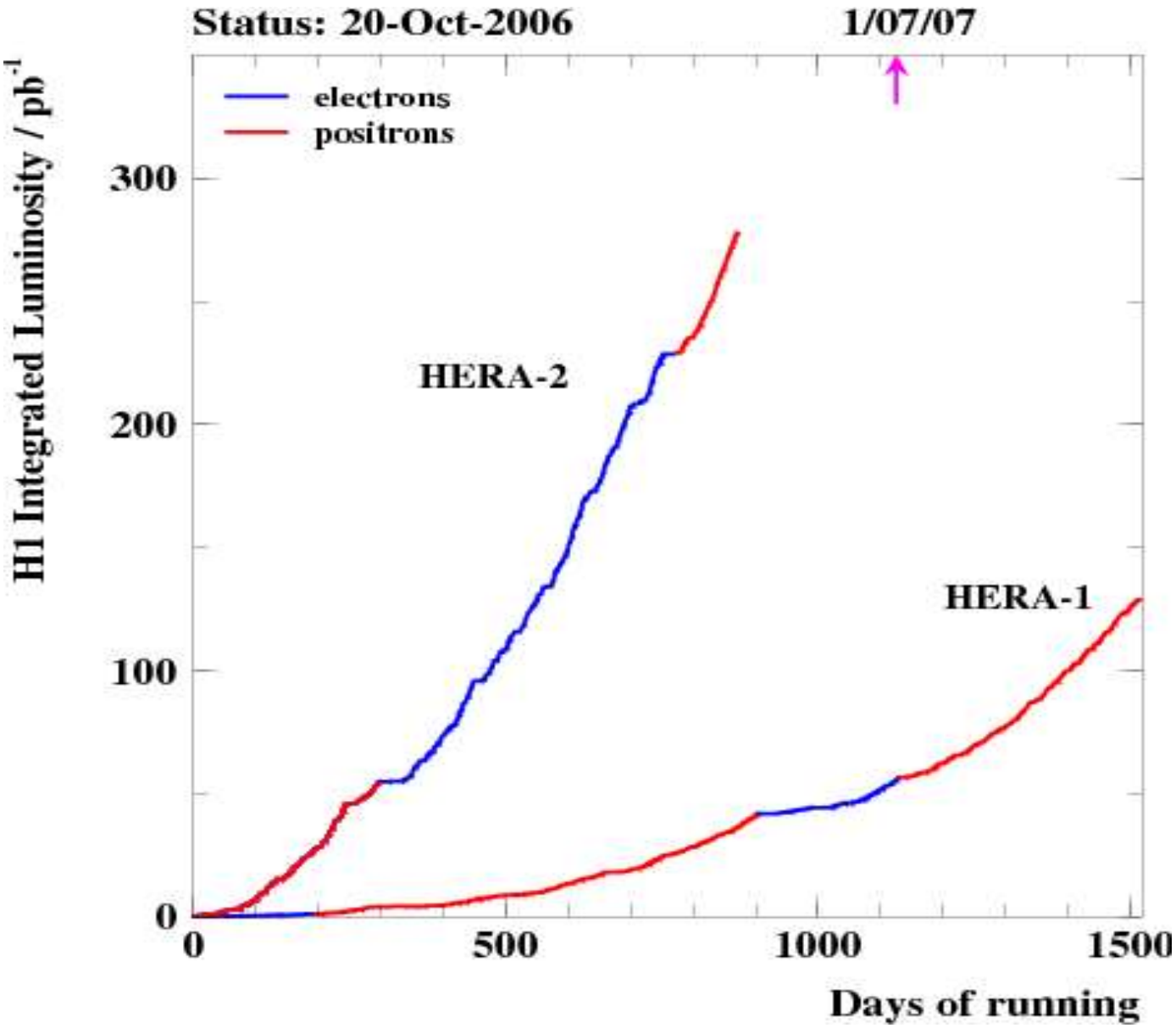
Physics highlights:

- ➔ Isolated leptons: new events in e^+p data, need more data to clarify excess (combined H1-ZEUS quantitative results expected in the next months)
- ➔ Searches with e^-p data: improved limits
- ➔ Continuous physics output (already 10 publications this year)

H1 is consolidating for the final straight:
Computing, calibrations, physics analyses, H1-ZEUS-LHC

Backup slides

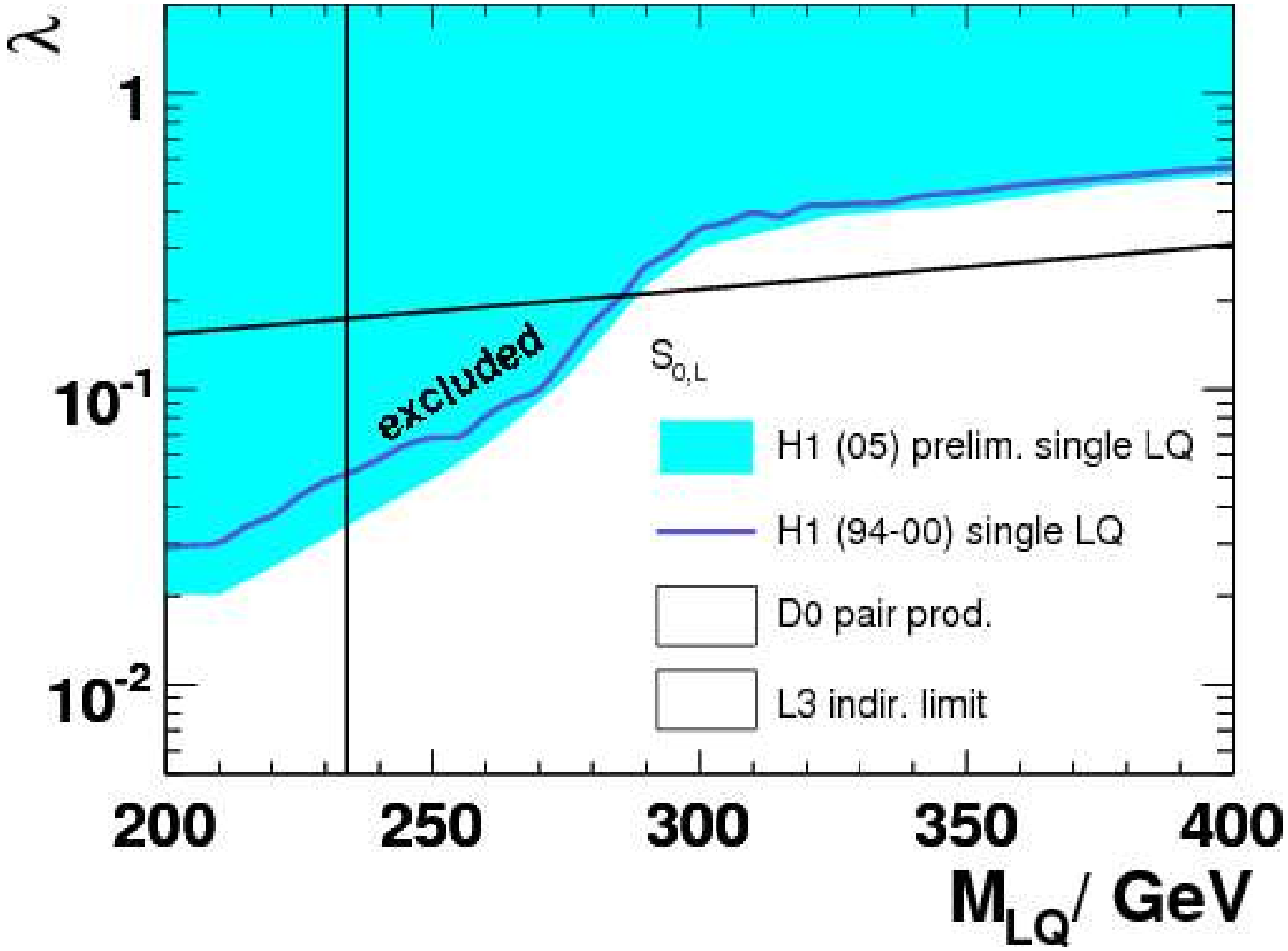
Total good H1 lumi



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