ZEUS status report

70. PRC meeting - open session, 14th oct 2010, DESY Zeuthen

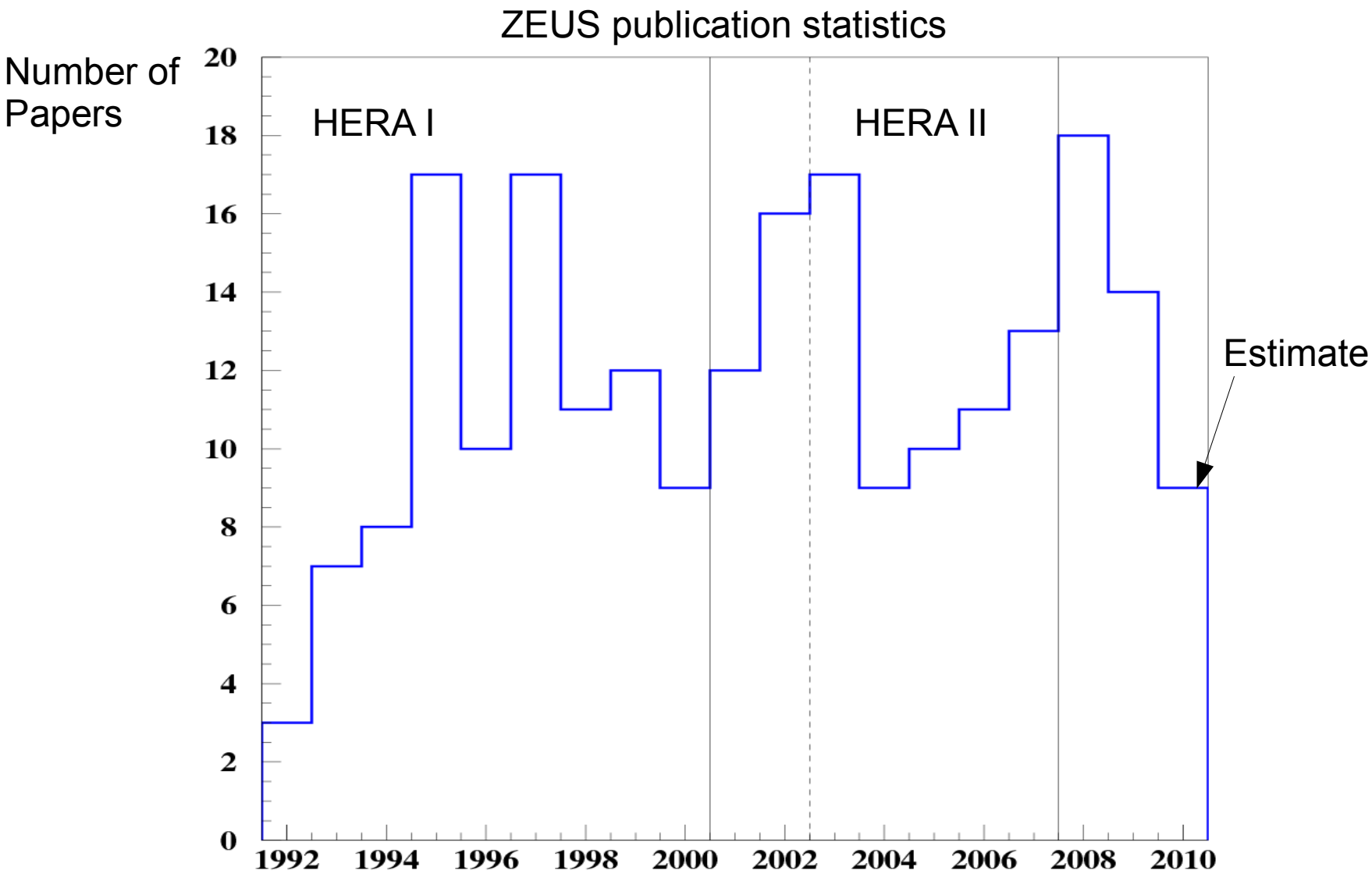
Olaf Behnke (DESY)

on behalf of the ZEUS Collaboration

- General remarks
- Physics Highlights
- Conclusions

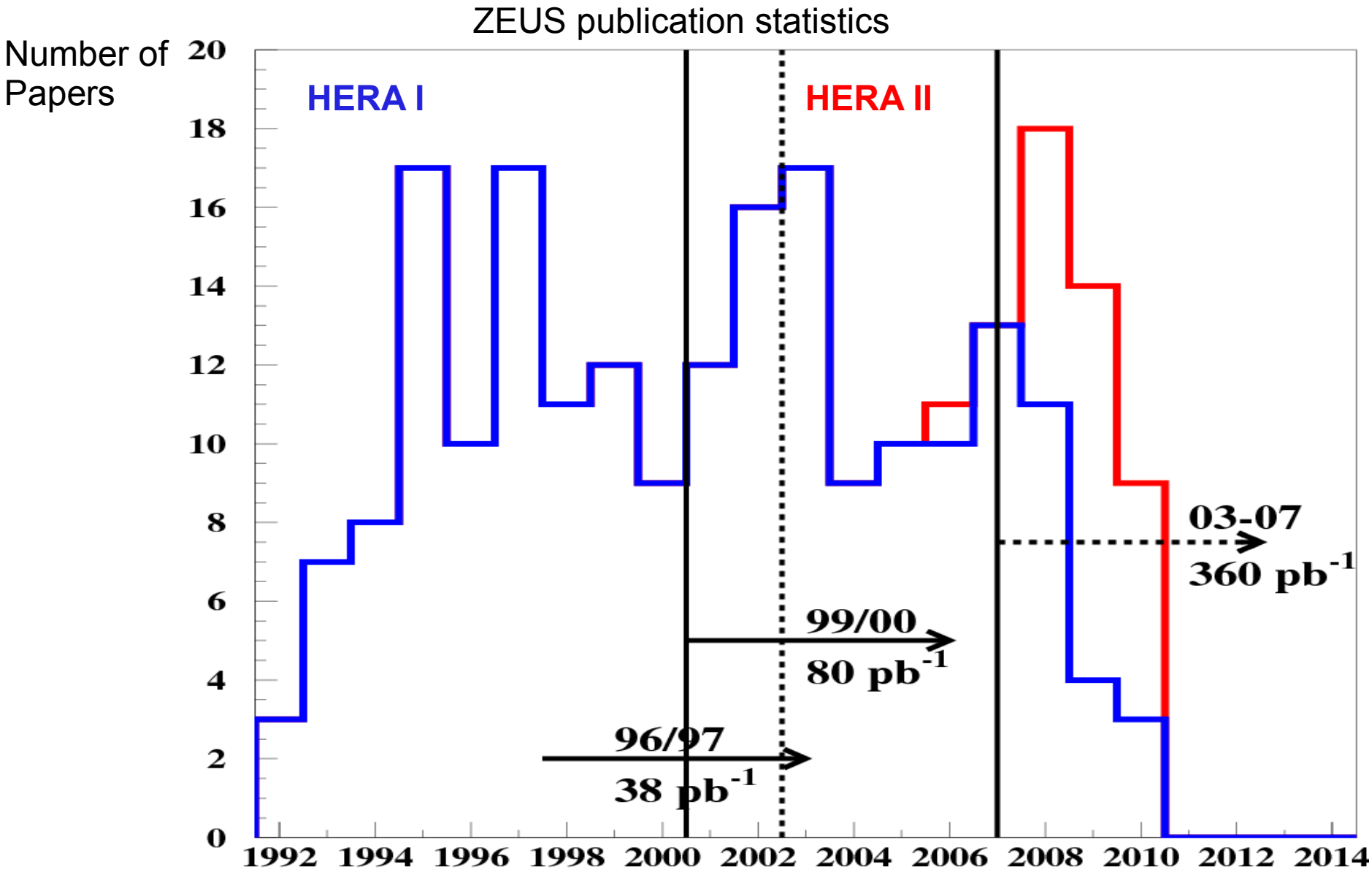
ZEUS physics output and activities

- 4 papers so far in 2010, expect further 5 until end of year



HERA publication cycles

Typically 5-6 years after data taking maximum of publication output



ZEUS physics output and activities

- 4 papers so far in 2010, expect further 5 until end of year
- 12 new preliminary results since last PRC
  - from which 3 are H1+ZEUS combined
  - in total 20 HERA talks (parallel sessions) at ICHEP2010 :-)
- 70 ongoing analyses:
  - 5 Beyond Standard Model searches
  - 8 Inclusive cross sections, structure functions+PDFs
  - 38 Heavy flavour (Charm and Beauty)
  - 14 QCD (Jets, particles & correlations, prompt photons)
  - 5 Diffraction (inclusive and final states)
- Manpower is directed to complete speedily high profile analyses (such as High-Q2 e+p DIS)
- ZEUS+H1 combinations: progressing in almost all areas, but suffering from manpower shortages

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- Expect o(40) ZEUS publications for ≥ 2011
- Analyis/publications will carry on until ≥ 2014

Data preservation and analysis model

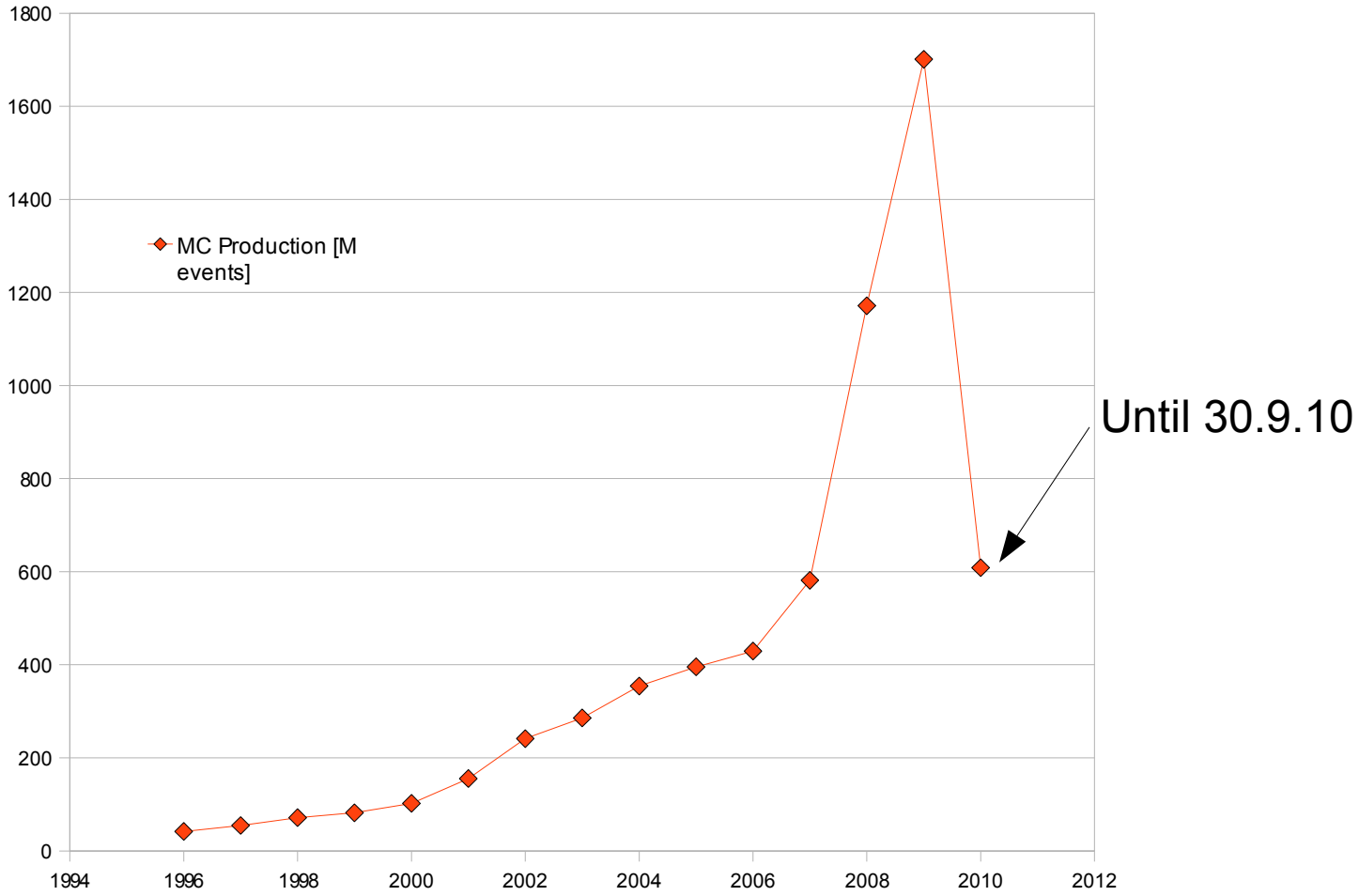
→ See also D. South talk on HERA data preservation

- Settled on the final ZEUS model
  - Common ntuple (CN) format (root and paw)
  - Virtualized MC and analysis software
  - MC generation on the grid

Timescales for completing the transition to final model are currently rediscussed

Monte Carlo simulations

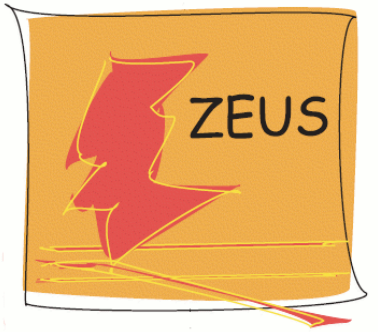
- Essential for data analysis
- Expect in total ≥800 M simulated events in 2010



- Drop in 2010: rate will increase again with the next MC production version (for simulation and common ntuple)

ZEUS Management

- Spokesperson:
  - Aharon Levy (Tel Aviv)
- Physics Chairs:
  - Achim Geiser (DESY)
  - Burkard Reisert (MPI Munich)



Many thanks to previous management:

Monica Turcato and Enrico Tassi (physics chairs) and

Tobias Haas (spokesperson)

New ZEUS papers since last PRC

- Measurement of high-Q2 charged current deep inelastic scattering cross sections with a longitudinally polarised positron beam at HERA

  DESY-10-129, submitted to EPJ C **Results see A. Parenti, PRC69 talk**

- Dijets in neutral current events: **Results see A. Parenti, PRC69 talk**

  paper at directorate **DESY-10-170**

Six papers in ZEUS Editorial Board process, one after reading, for three further readings are imminent

New ZEUS preliminary results since last PRC

Inclusive ep, structure functions & PDFs:

- Energy dependence of the total photon-proton cross section
- H1+ZEUS: Combined Measurement of Neutral and Charged Current xsecs
- H1+ZEUS: PDF fits including HERA II high Q^2 data ⟷ **See talk by R.Placakyte**
- H1+ZEUS: Charm mass parameter in the QCD analysis and implications for LHC
- Beauty production in DIS using decays into electrons
- Measurement of beauty production in DIS and F2bb extraction at ZEUS

Jet production:

- Dijet cross sections in photoproduction
- Inclusive-jet cross sections in photoproduction at HERA and a comparison of the kt, anti-kt and SIScone jet algorithms

Diffraction:

- Upsilon production t-slope measurement

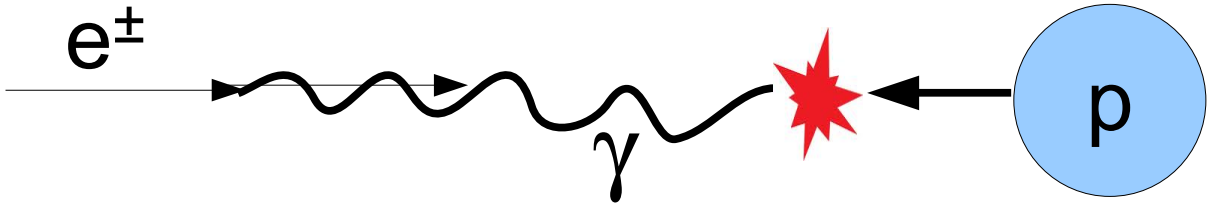
Spectroscopy:

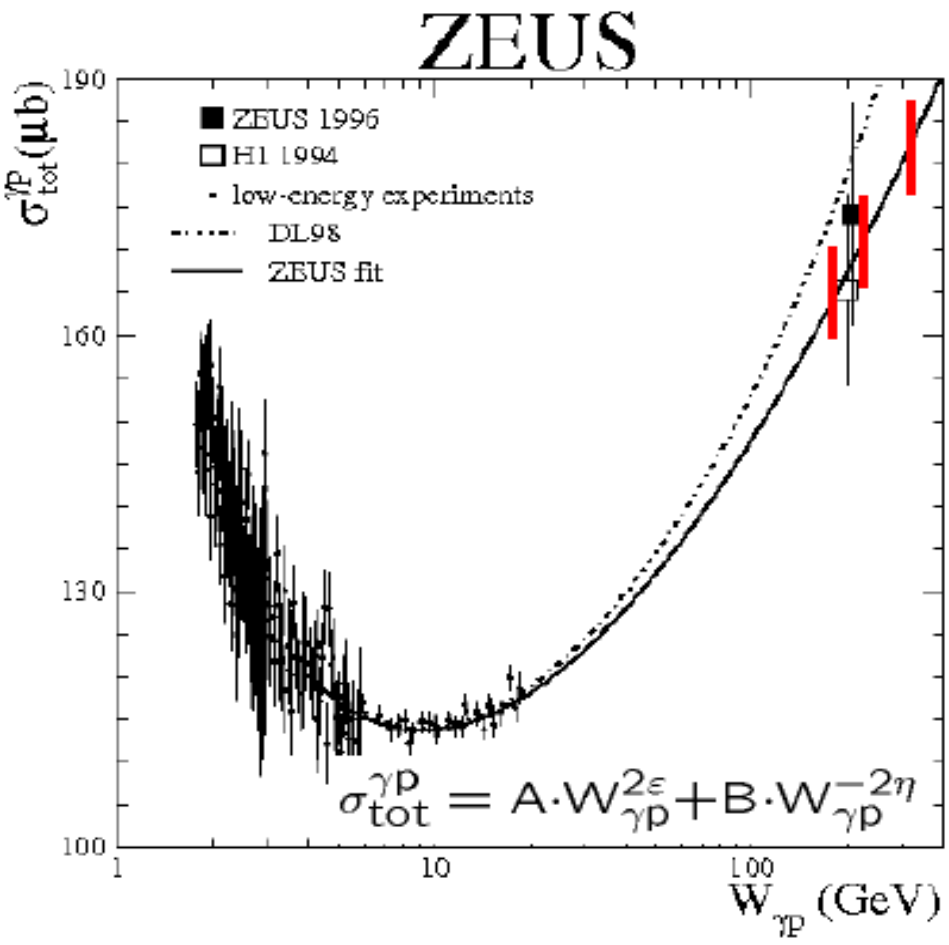
- Production of excited charm mesons $D_1^0(2420)$ and $D_2^*(2460)$ at HERA
- Two pion diffractive electro-production

Fragmentation:

- Scaled momentum distributions for K^0s and Lambda in DIS

Energy dependence of total γp cross section





$\sigma^{\gamma p}_{tot}$: is a fundamental expt. quantity:

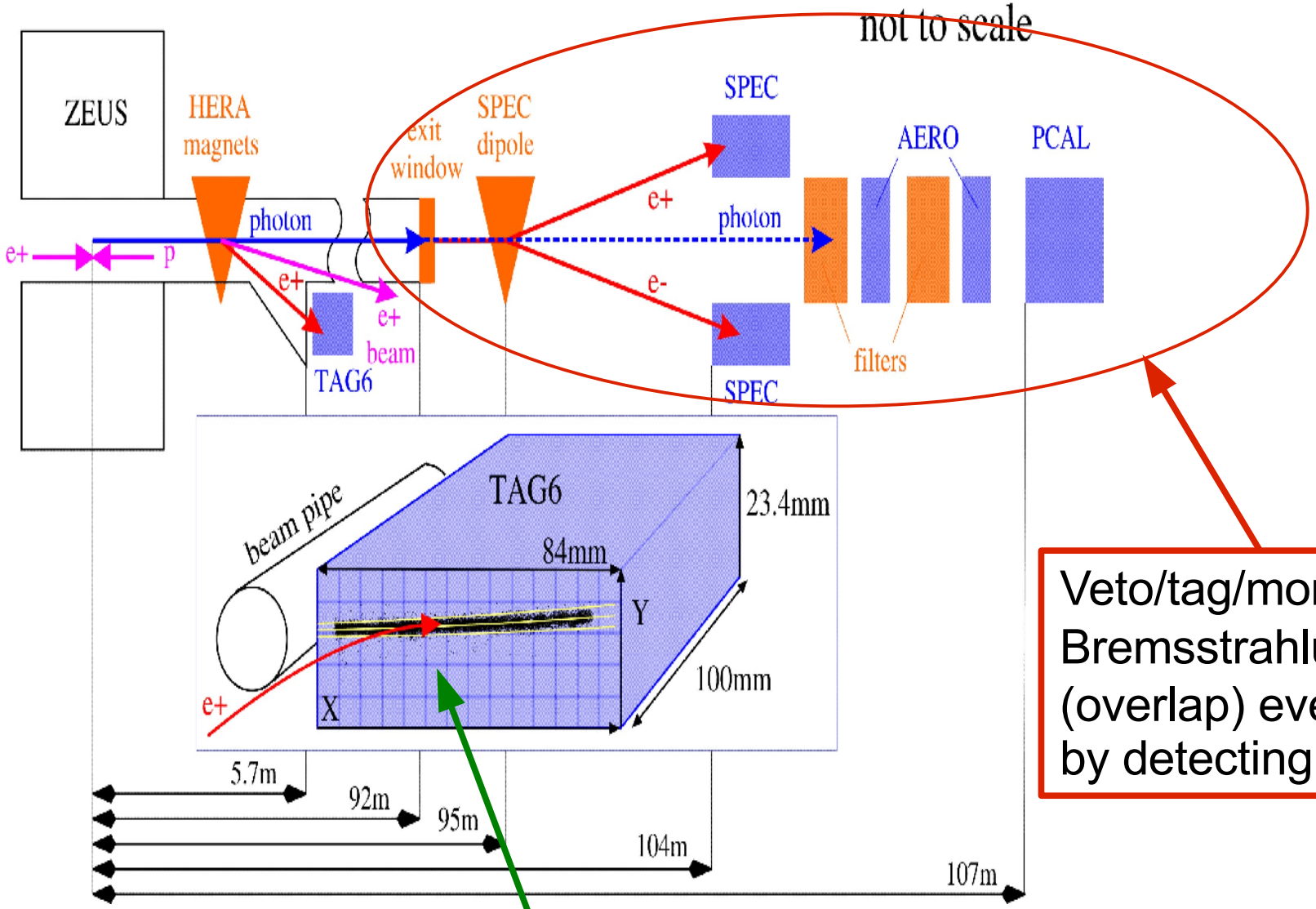
- Measured @ HERA-I @ one $W_{\gamma p}$
- End of HERA-II: 3 $W_{\gamma p}$ points

using high, medium and low proton energy runs (Ep =920, 575, 460 GeV)

- **directly measure high energy W dependence with our data**
- many systematics on ε cancel

- Much more luminosity:
  - ≥ 0.5-1 pb^{-1} each $W_{\gamma p}$ point, ≥100k evts
  - ≥ 5 times more statistics, study systematics
- Simpler e^+ tagger closer to IP: 35m→6m

Energy dependence of $\sigma_{\gamma p}$: Detector setup

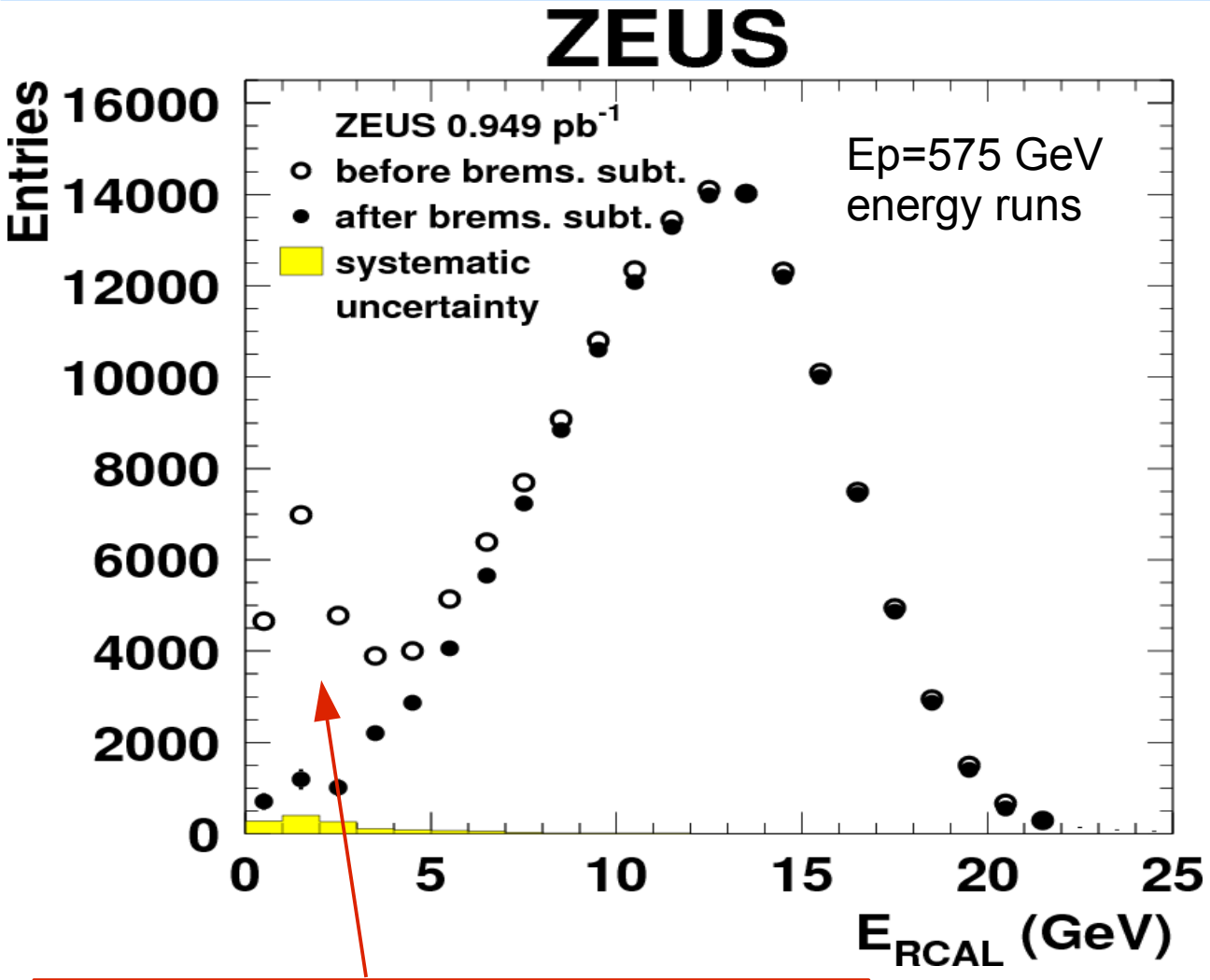


Veto/tag/monitor
Bremsstrahlung ep → epγ
(overlap) events
by detecting photon

Used to tag γp signal events by scattered e^+

Energy dependence of $\sigma_{\gamma p}$: subtract Bremsstrahlung overlap events

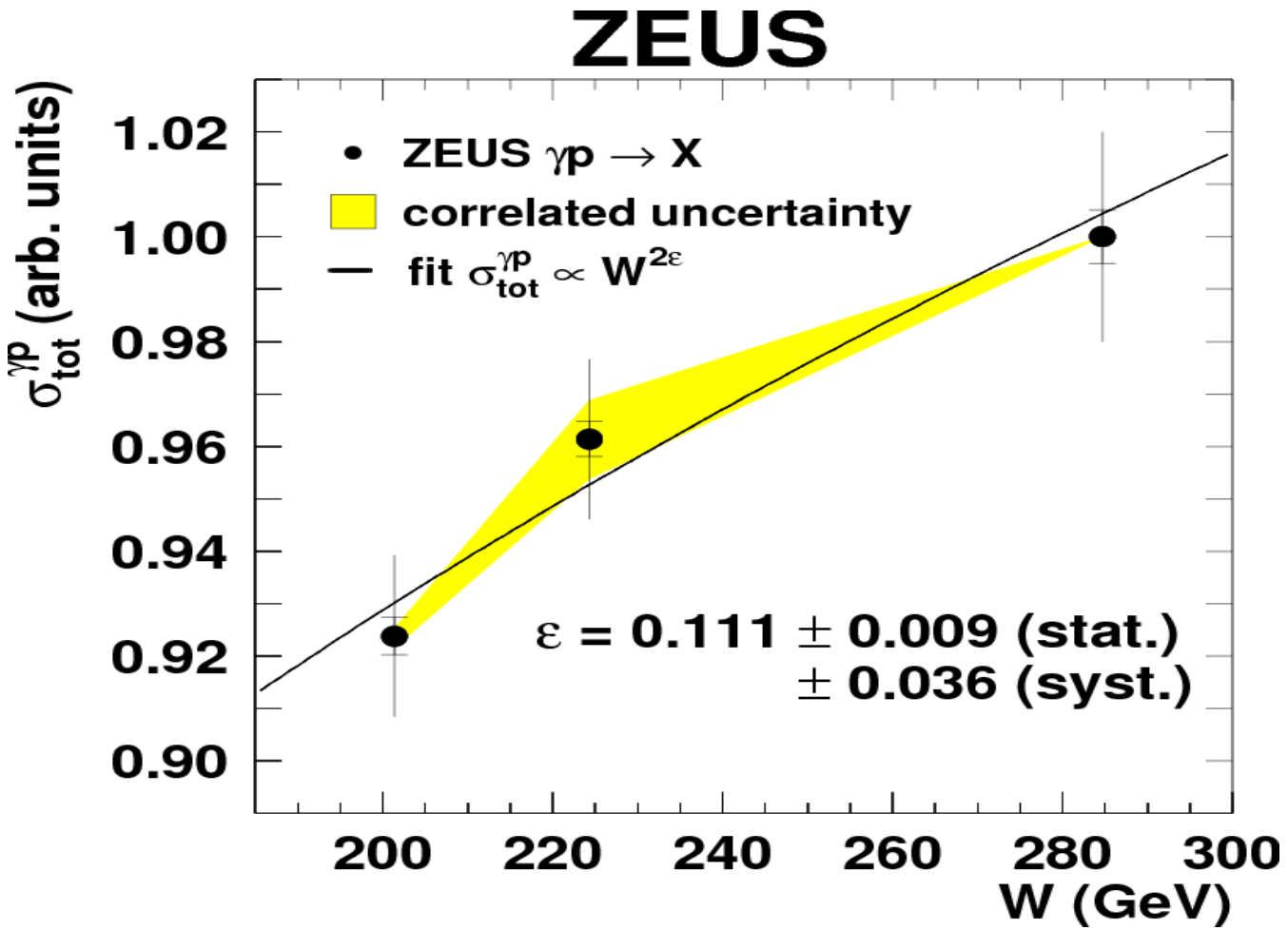
Total energy in rear calorimeter of main detector



Bremsstrahlungs overlap events, Statistically subtracted using tagged Bremsstrahlungs events

Energy dependence of $\sigma_{\gamma p}$: *Results*

After determining photon flux from e^+ and dividing by it arrive at $\sigma_{\gamma p}$



➔ First determination of energy dependence in a single experiment

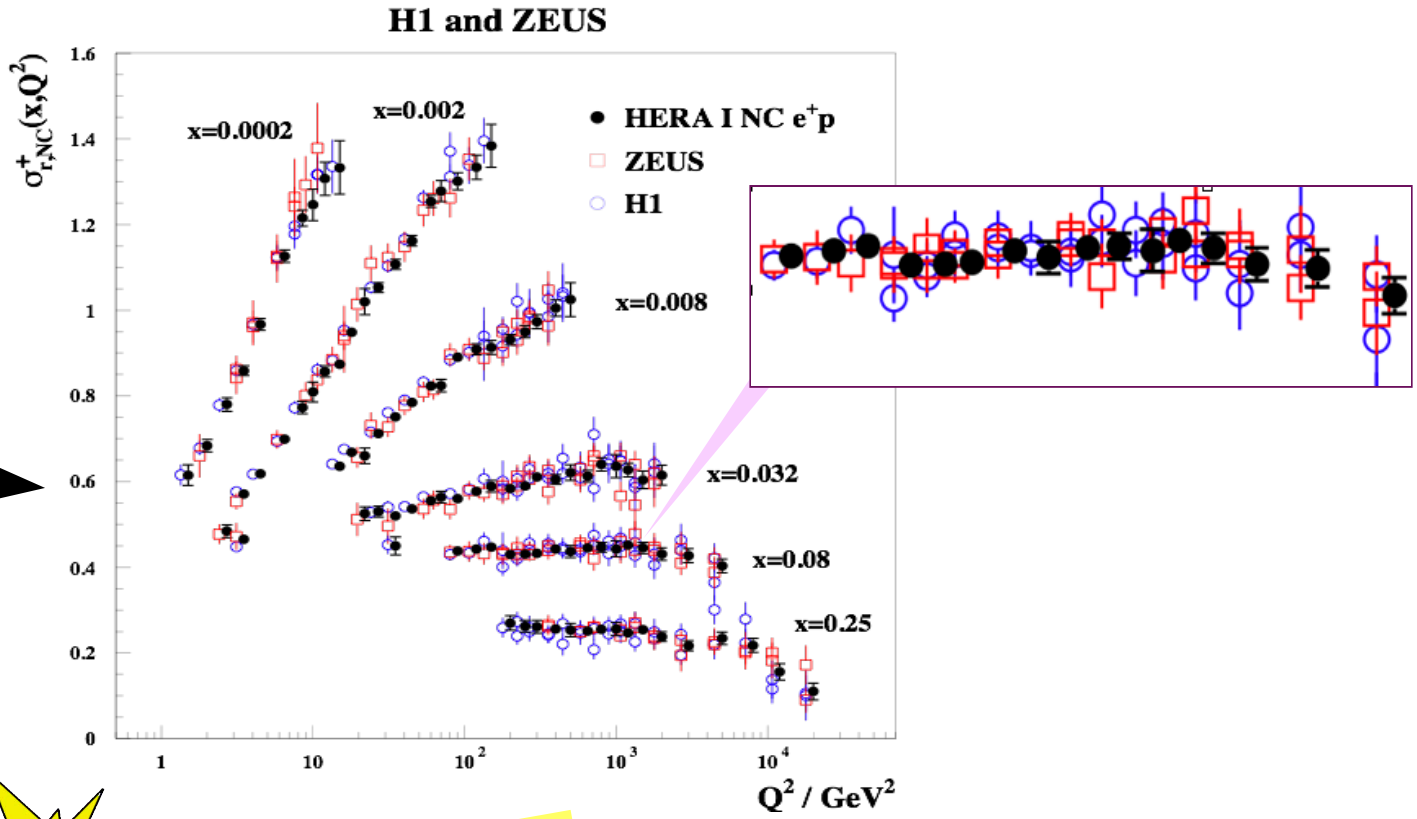
➔ Measured value of ε is compatible with the energy dependence observed in hadron-hadron interactions

H1+ZEUS inclusive DIS combination

NC = Neutral Current,
CC = Charged Current

HERA I:

JHEP01 (2010) 109:
all HERA I e+p and e-p NC and CC



HERA II: high Q^2

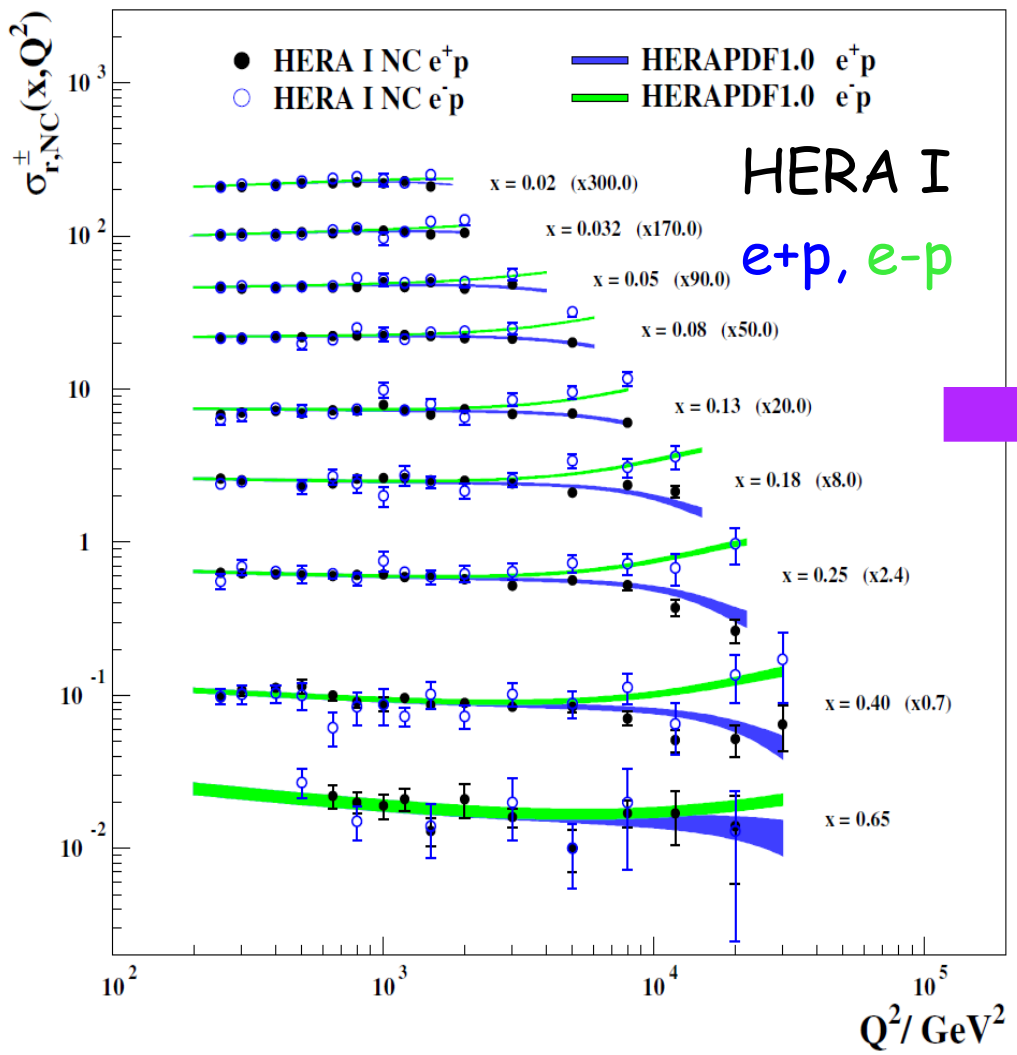
NEW

All added/combined for ICHEP2010

H1:	H1prelim-09-042:	HERA II e+p and e-p NC
H1:	H1prelim-09-043:	HERA II e+p and e-p CC
ZEUS:	EPJC 62 (2008) 625-658:	HERA II e-p NC
ZEUS:	EPJC 61 (2009) 223-235:	HERA II e-p CC
ZEUS:	submitted to EPJC (DESY-10-129):	HERA II e+p CC

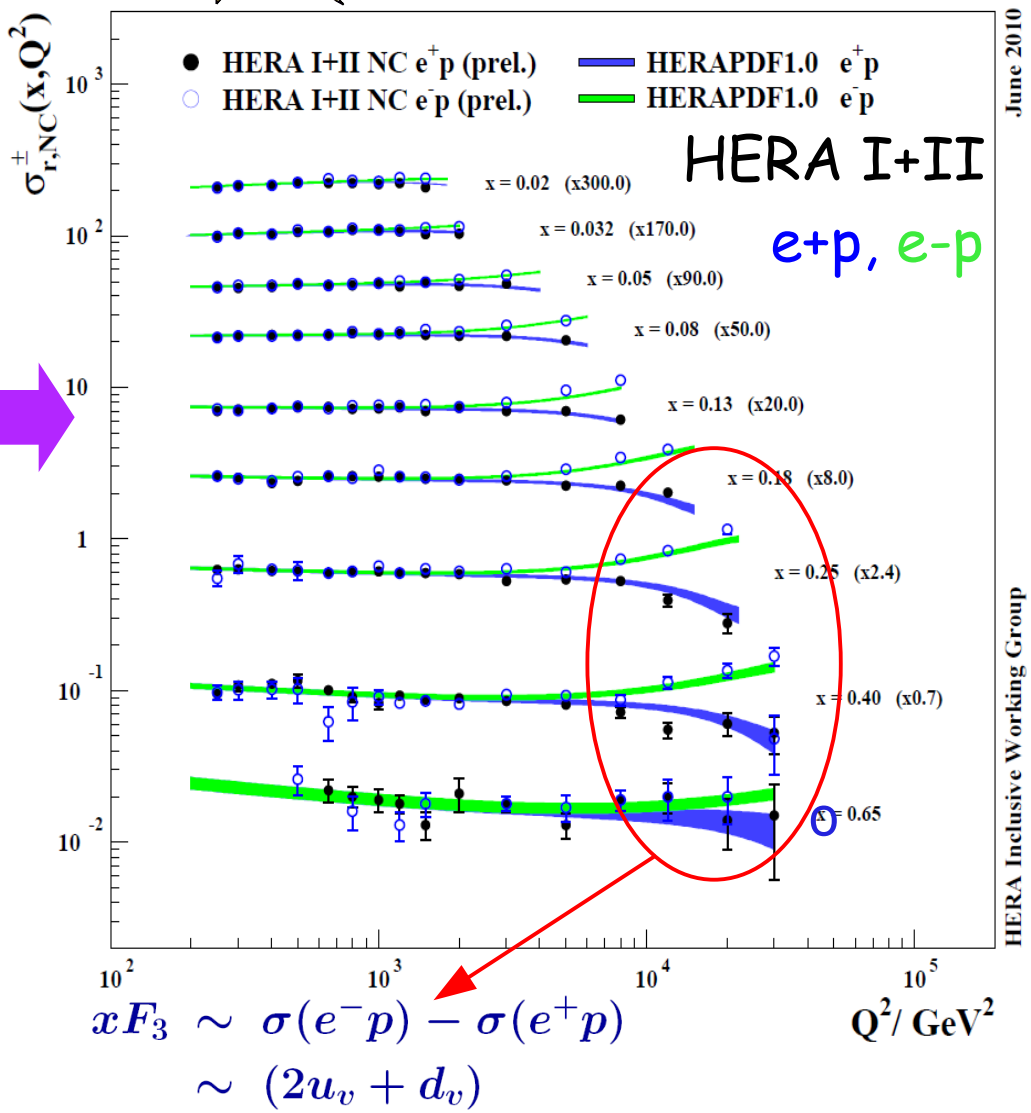
H1+ZEUS combination: High Q^2 Neutral Currents

Published: JHEP 1001:109 (2010)



NEW

ZEUS PREL.10-017, H1PREL.-10-141

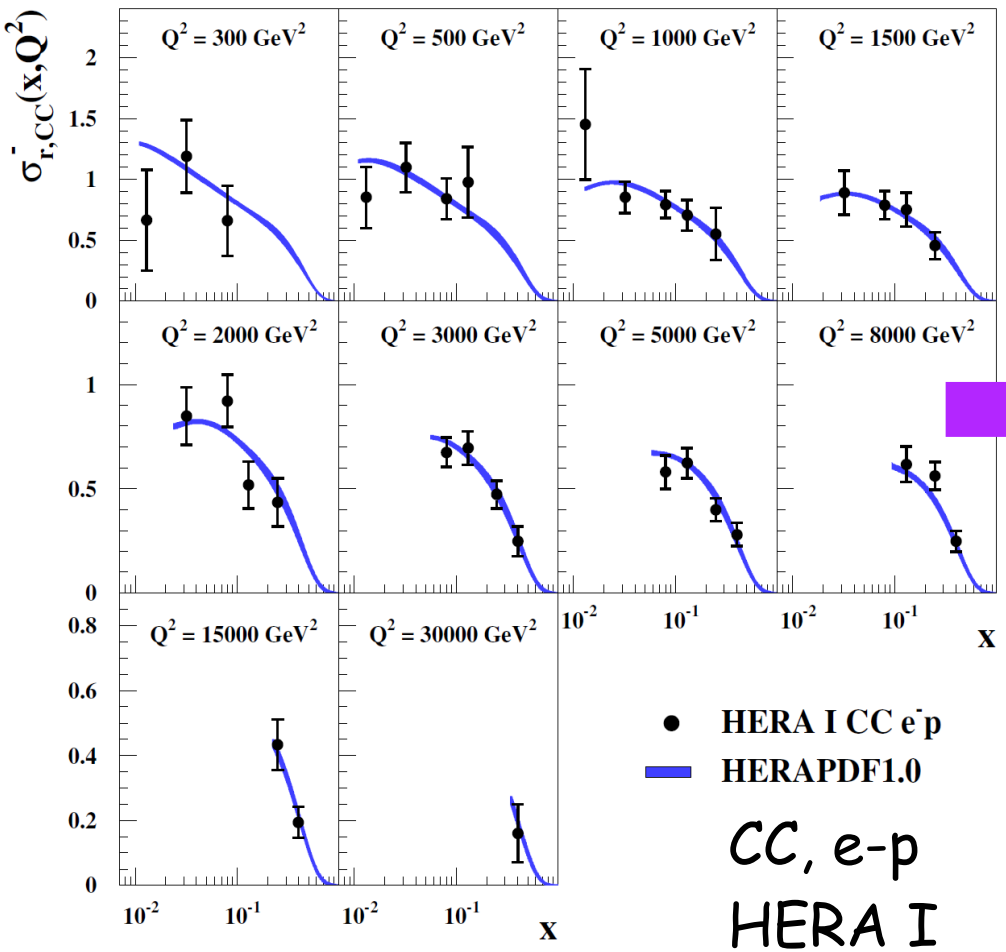


$$xF_3 \sim \sigma(e^-p) - \sigma(e^+p) \sim (2u_v + d_v)$$

➔ Huge improvement especially for e-p data, constrain better valence quarks

H1+ZEUS combination: High Q^2 Charged Currents

Published: JHEP 1001:109 (2010)



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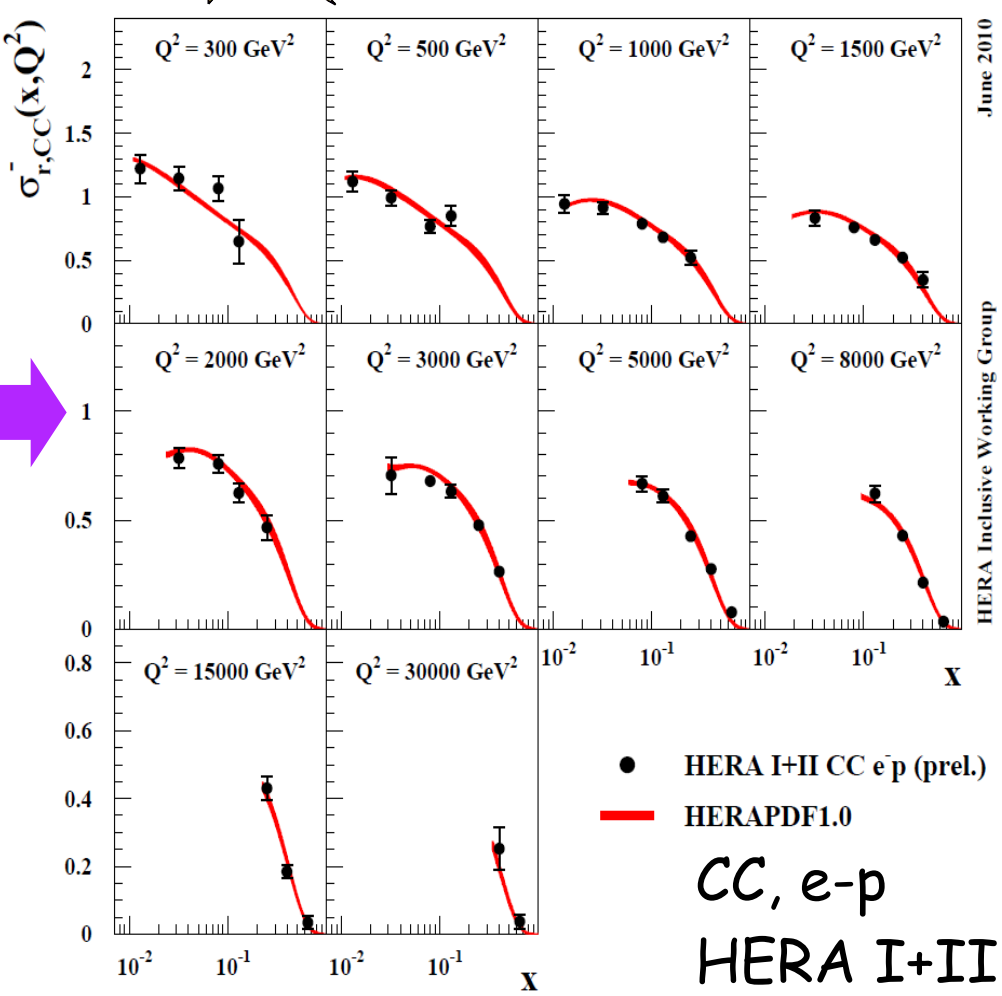


➔ Improve mainly u(x)

H1+ZEUS: recent QCD analyses = PDF fits

Charm mass parameter in the QCD analysis and implications for LHC	• NC & CC published HERA I • and preliminary HERA F2cc data	Aug. 2010	H1prelim-10-143, ZEUS-prel-10-019
HERAPDF1.5	• NC & CC published HERA I and • preliminary HERA II data	Aug. 2010	H1prelim-10-142 ZEUS-prel-10-018
PDF fits including HERA data with reduced proton beam energy	• NC & CC published HERA I data and • preliminary HERA low and medium energy data	Apr. 2010	H1prelim-10-044 ZEUS-prel-10-008
PDF fits including charm data	• NC & CC published HERA I and • preliminary HERA F2cc data	Apr. 2010	H1prelim-10-045 ZEUS-prel-10-009

See R. Placakytes talk for more details

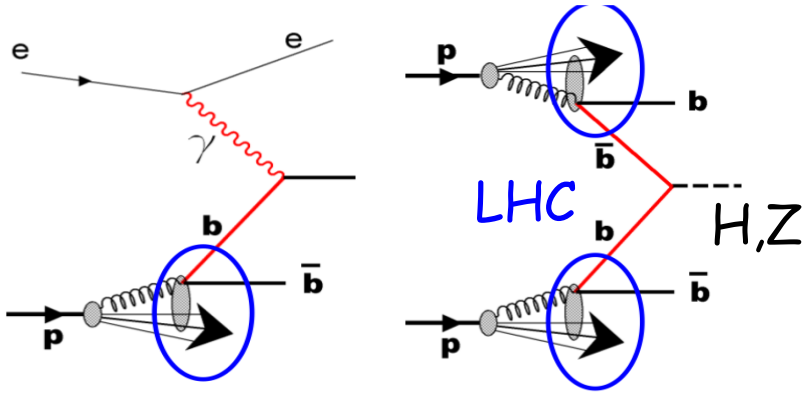
presented at PRC69

HERA PDFs are becoming more and more recognised in HEP (before was CTEQ, MRST, etc.)

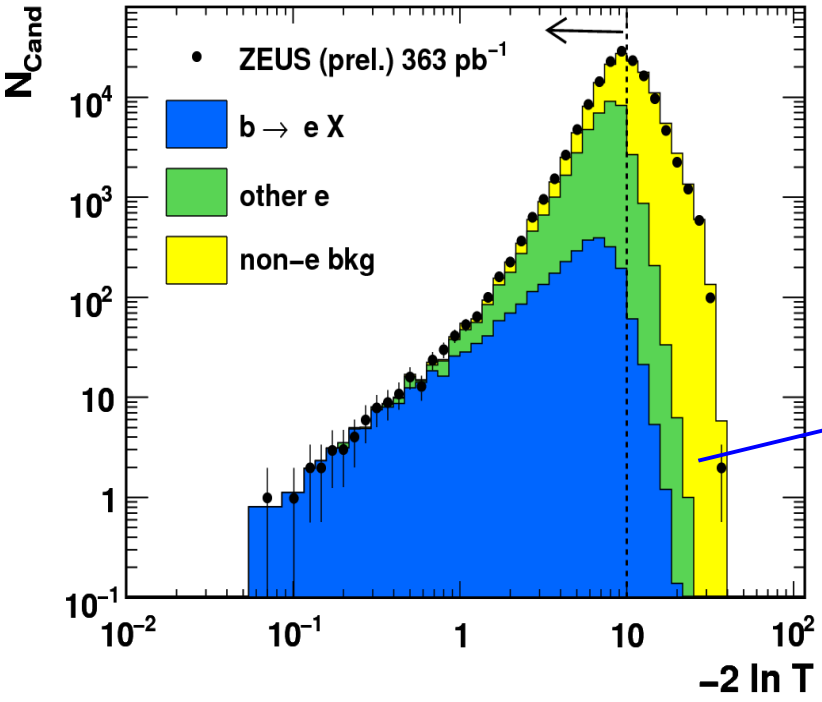
Beauty in DIS: New F2bb results with b->eX

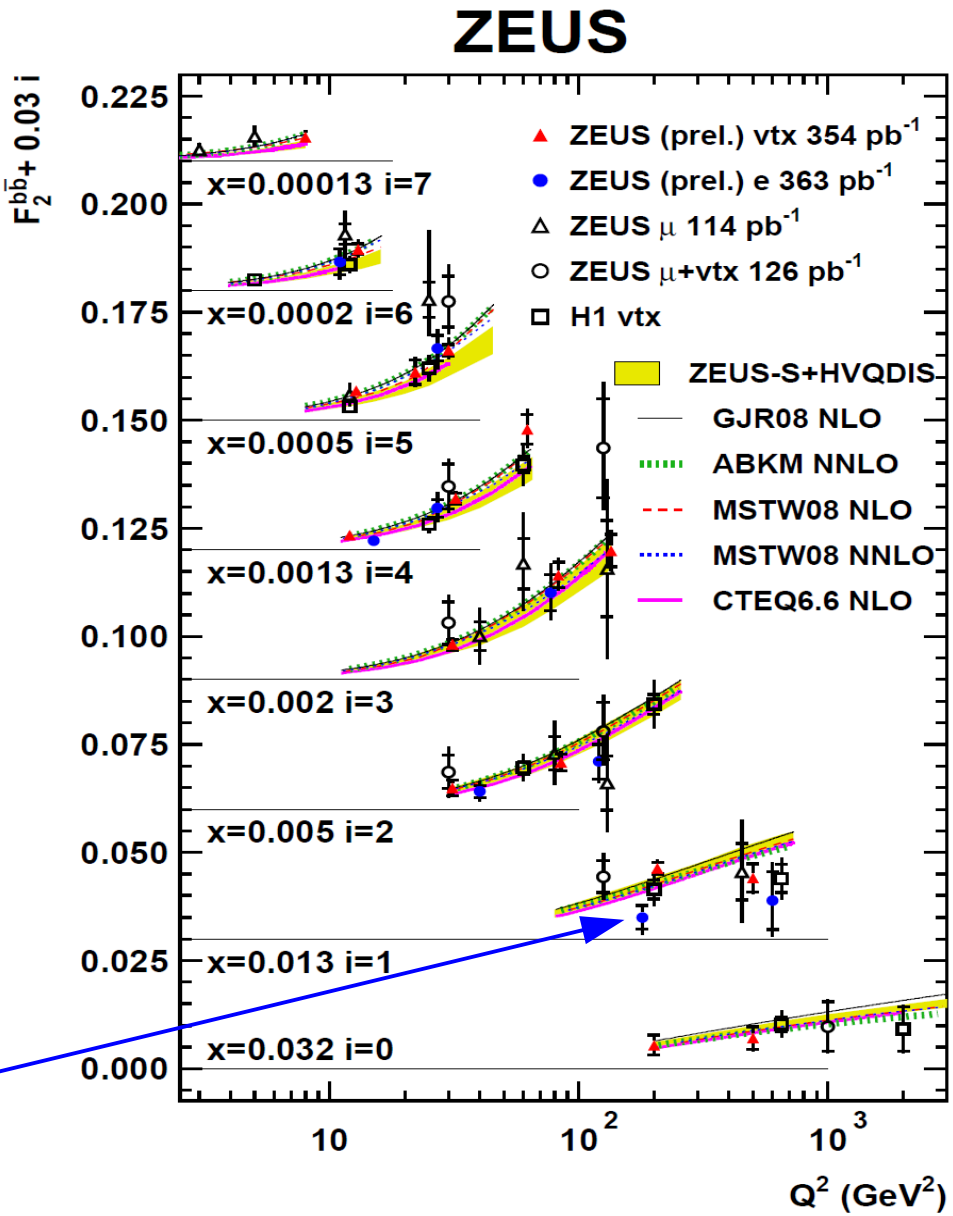
ZEUS PREL.10-016

b(x) from HERA "goes to" LHC



Use likelihood discriminant T based on 6 input variables



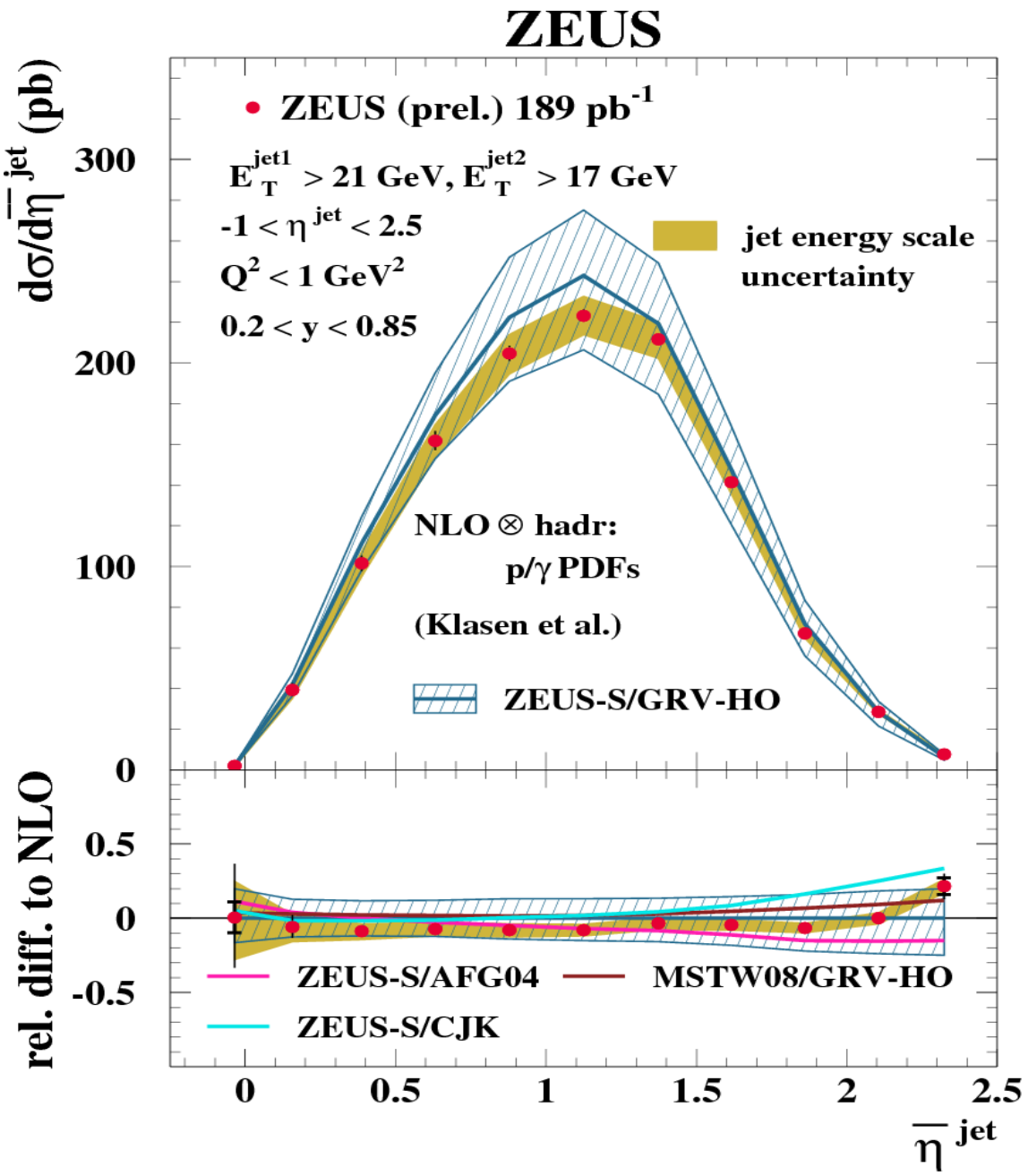


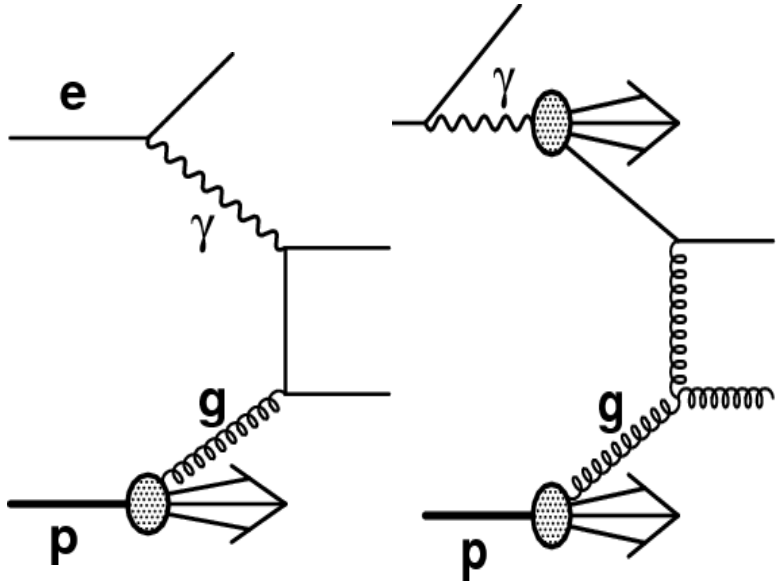
➔ Valuable new measurements

➔ Ultimate goal: combined H1+ZEUS F2bb

Dijets in photoproduction

ZEUS PREL.10-014





➔ Highly sensitive to
- Proton PDF (gluon density)
- Resolved photon PDF

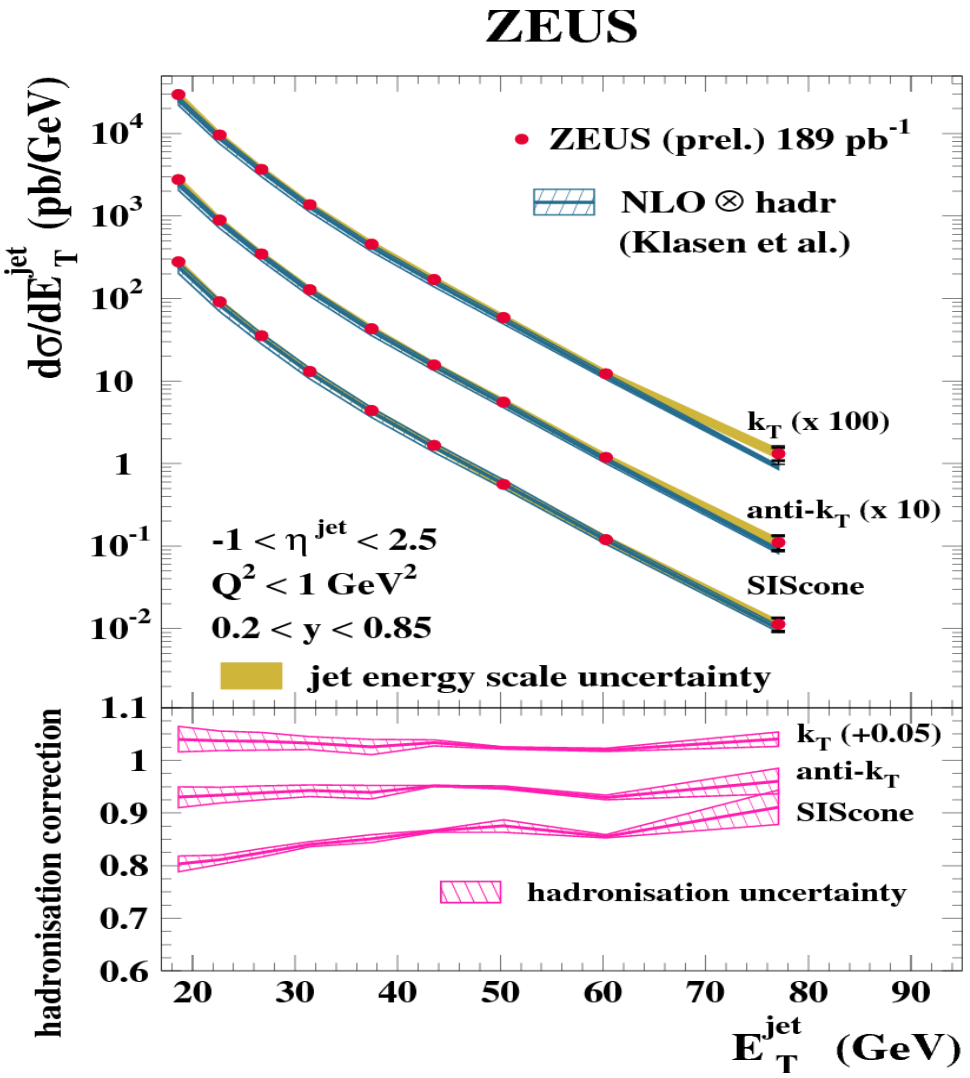
Inclusive jets in photoproduction

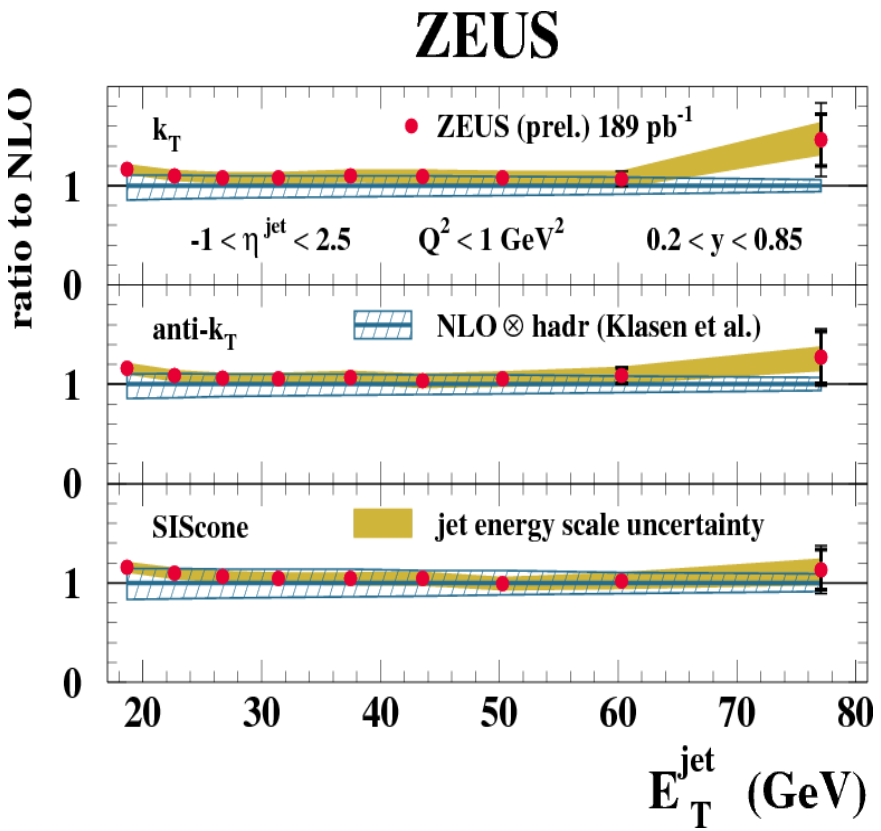
ZEUS PREL.10-015

Anti-k_T and SIScone: recent new jet algorithms

- produce more circular shaped jets than inclusive k_T
- could be favourable to use them at LHC to calibrate jet energy & underlying event

⇒ **HERA jet measurements can provide nice benchmark tests for these algorithms**

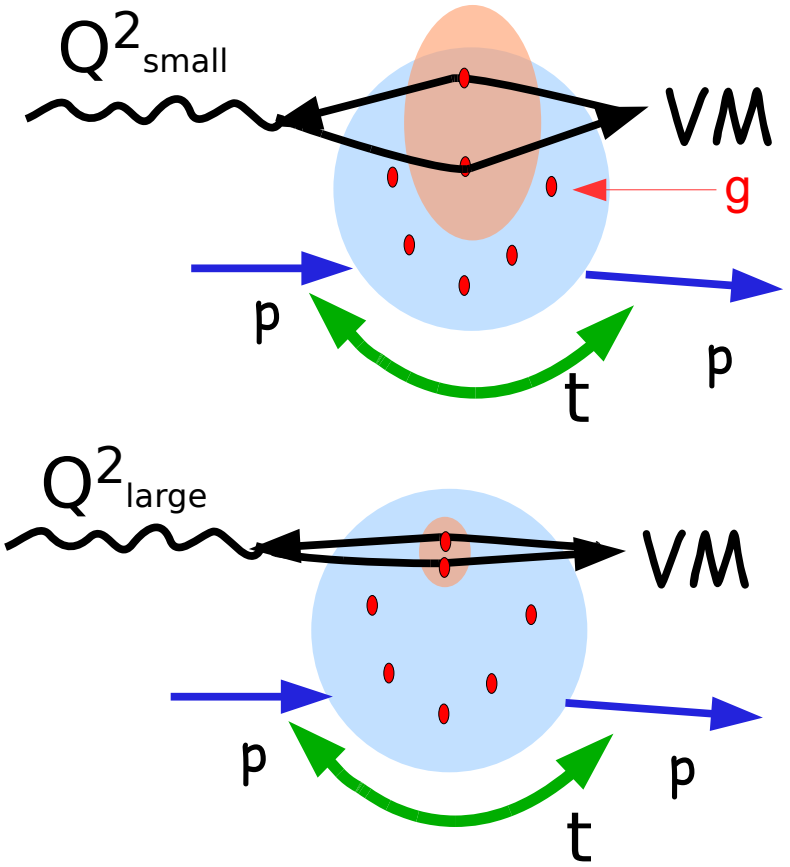


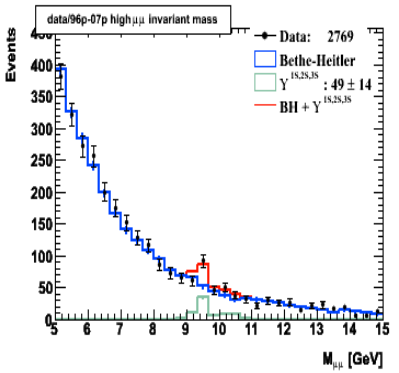


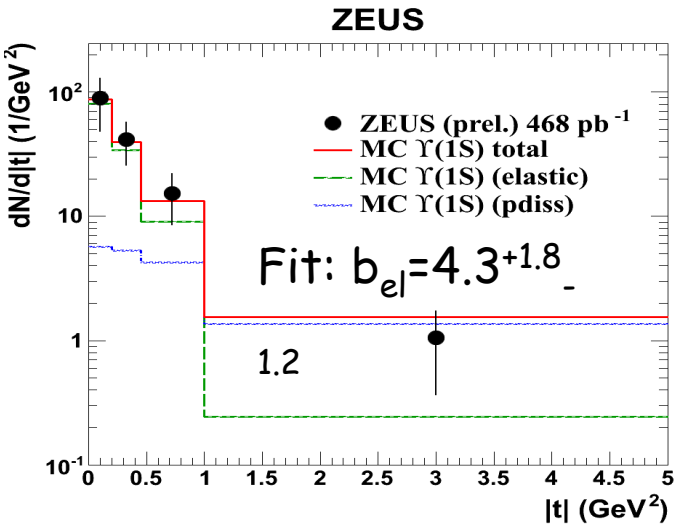
➔ Data similarly well described by all the algorithms

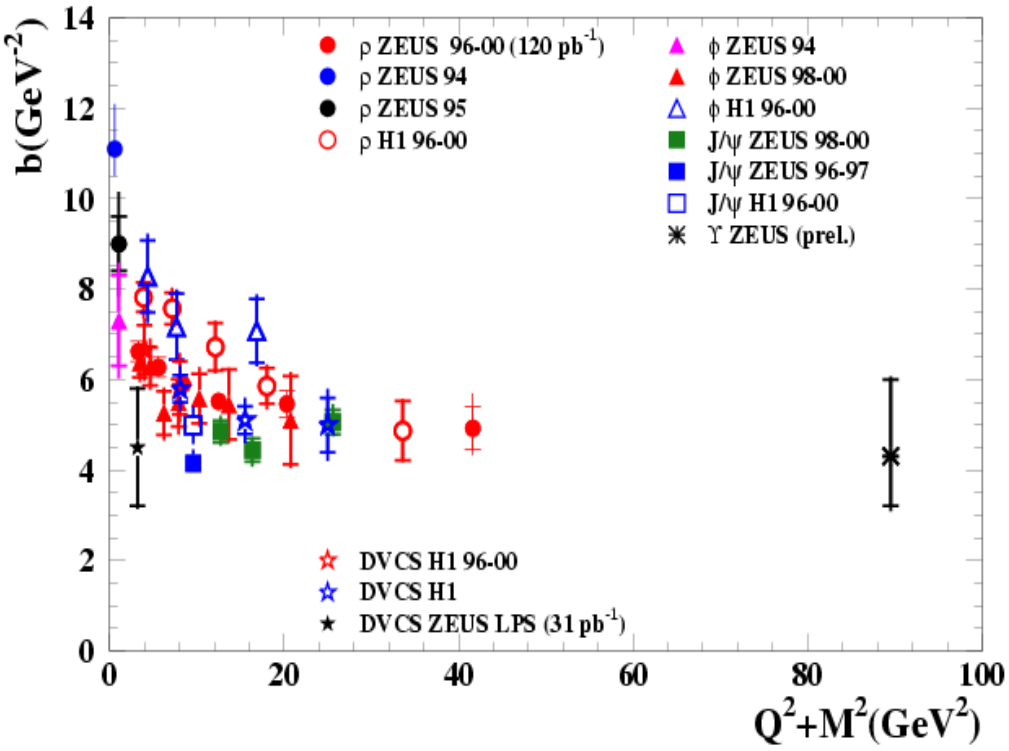
Diffractive Υ: t-slope measurement

$dN/dt \sim e^{-b|t|}$ $b \sim r_p^2 + r_{qq}^2$



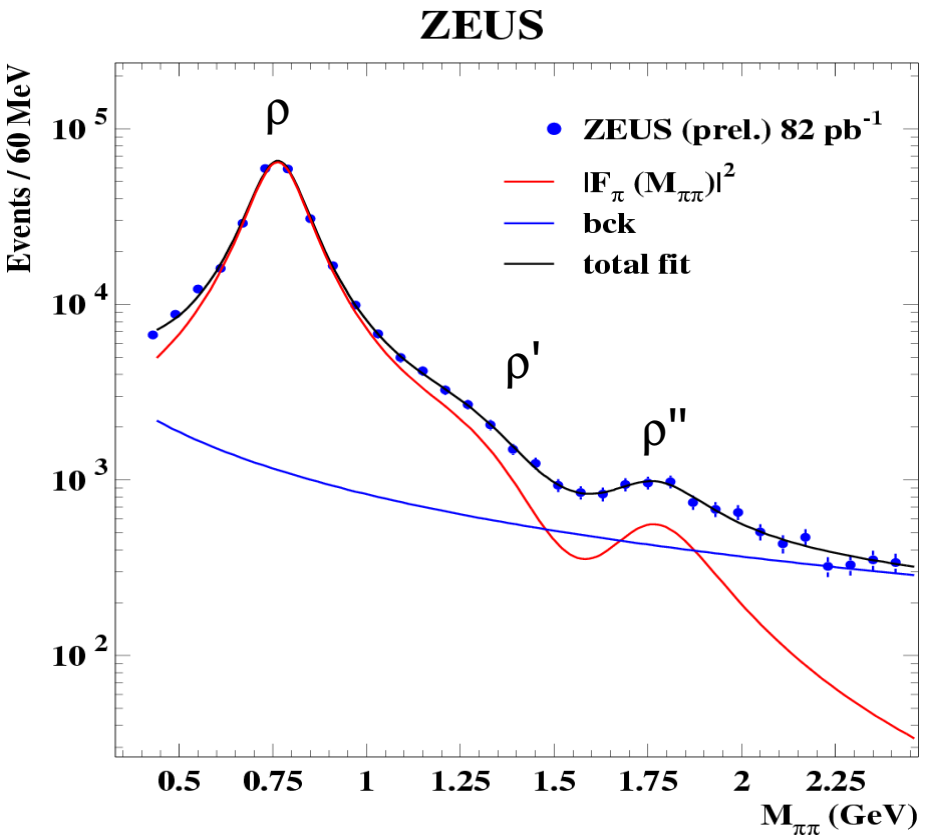


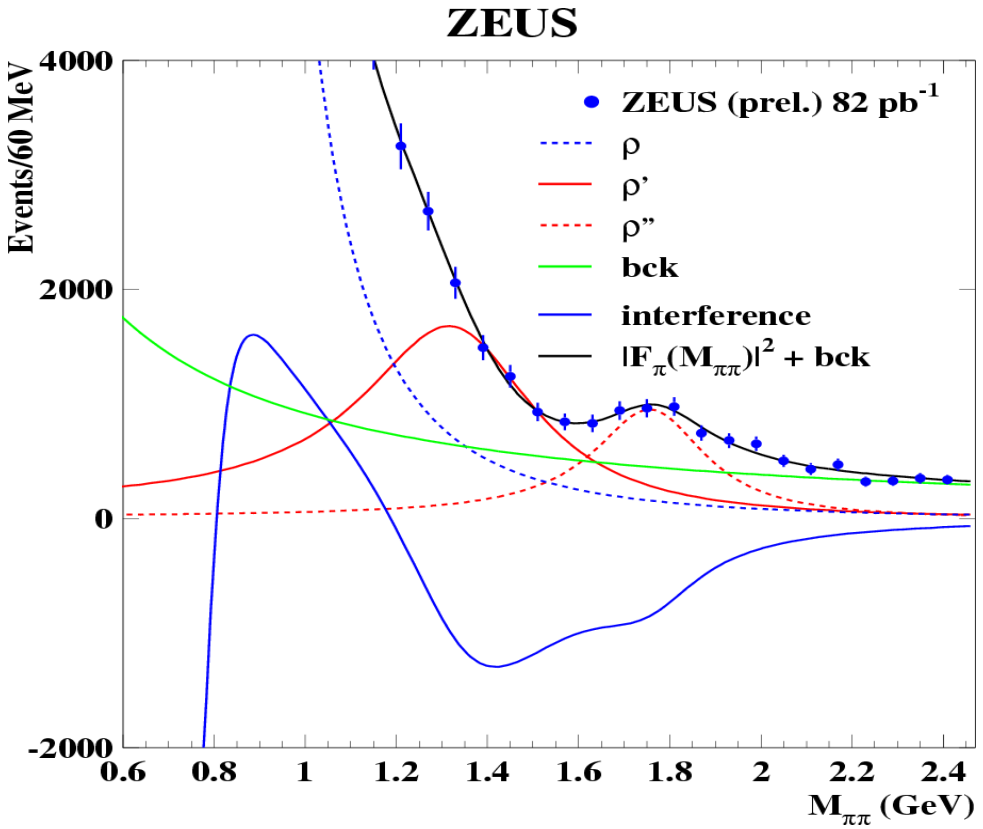




➔ New Υ-point provides hardest Q^2+M^2 scale tested so far
Verifies/extends that at large Q^2+M^2 $b \sim r_p^2$ = const

Spectroscopy: Two pion diffractive electroproduction



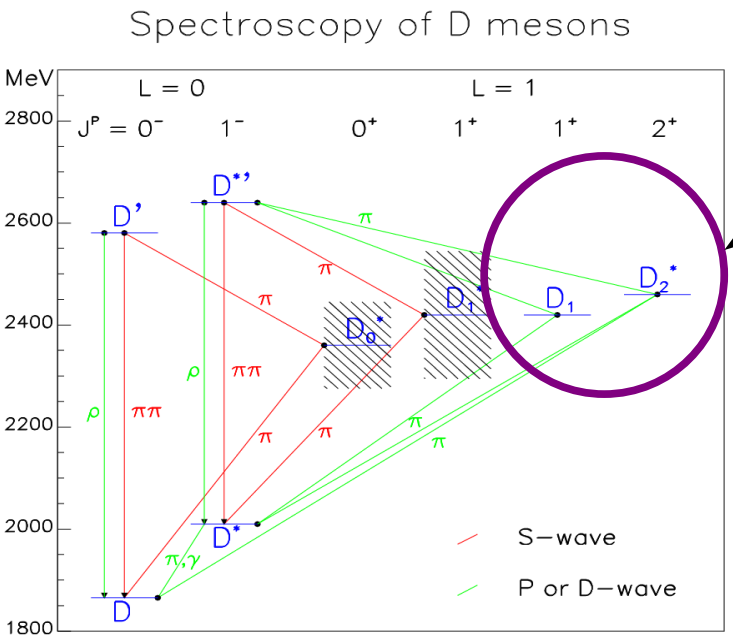


Parameter	ZEUS (prel.)	PDG2010
M(ρ') [MeV]	$1360 \pm 20^{+20}_{-30}$	1465±25
Γ(ρ') [MeV]	$460 \pm 30^{+40}_{-45}$	400±60
M(ρ'') [MeV]	$1770 \pm 20^{+15}_{-20}$	1720±20
Γ(ρ'') [MeV]	$310 \pm 30^{+25}_{-35}$	250±100

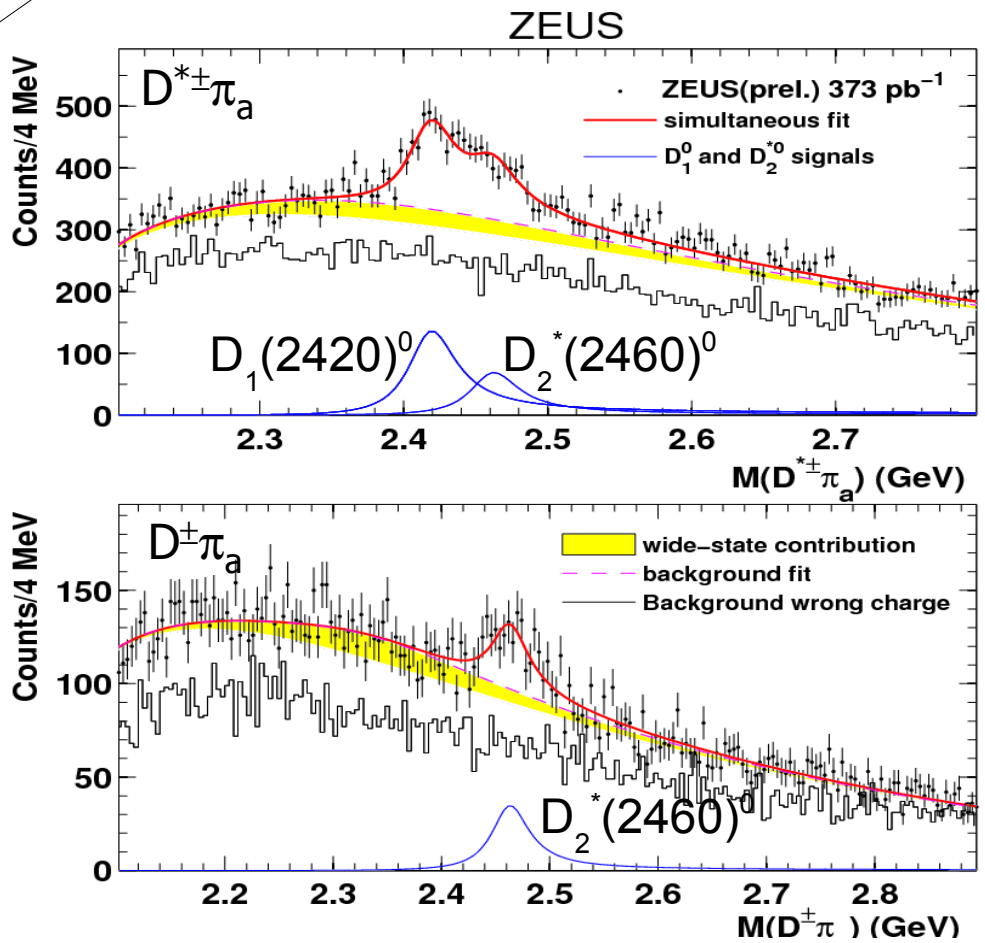
Fitted mass of rho' significantly below PDG value, however PDG admit themselves that their numbers are only educated guesses, due to contradictory results on the market ⇒ ZEUS results add valuable new information

Spectroscopy: Excited charm mesons

ZEUS PREL.10-016



Study Doublet with $j=L+s_q = 3/2$
D-wave decays ⇒ narrow states



	HERA I	HERA II	PDG
$M(D_1^0)$ MeV	$2420.5 \pm 2.1 \pm 0.9$	$2422.2 \pm 1.7^{+1.2}_{-2.8}$	2422.3 ± 1.3
$\Gamma(D_1^0)$ MeV	$53.2 \pm 7.2^{+3.3}_{-4.9}$	$43.4 \pm 6.2^{+7.3}_{-10.4}$	20.4 ± 1.7
$h(D_1^0)$	$5.9^{+3.0+2.4}_{-1.7-1.0}$	$3.5^{+1.6+2.0}_{-1.0-0.8}$	
$M(D_2^{*0})$ MeV	$2469.1 \pm 3.7^{+1.2}_{-1.3}$	$2465.0 \pm 3.3^{+1.2}_{-2.9}$	2461.1 ± 1.6
$\Gamma(D_2^{*0})$ MeV	43 fixed	43 fixed	43 ± 4
$h(D_2^{*0})$	-1 fixed	-1 fixed	

➔ $D_1(2420)^0$ width significantly higher than PDG2008,
compare to new Babar result: Γ=31.4 MeV

Conclusions

- ZEUS Data analysis/publications still in full swing
  - Many new exciting published/preliminary results in 2010
  - Expect ~40 publications
    over the next few years, including numerous
    HERA legacy measurements (e.g. final combined H1+ZEUS high Q2 structure functions and PDFs)
  - Data analysis/publications will carry on until ≥ 2014
  - Goal: The final HERA reference book on
    > proton structure and QCD <