ZEUS STATUS REPORT

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Focus on:

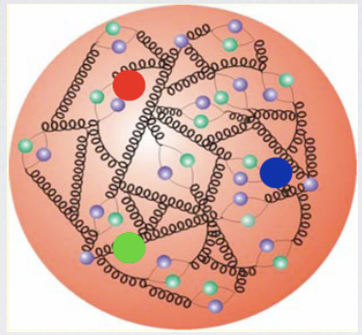
On the way of preserving the ZEUS data.
Ongoing physics activity.

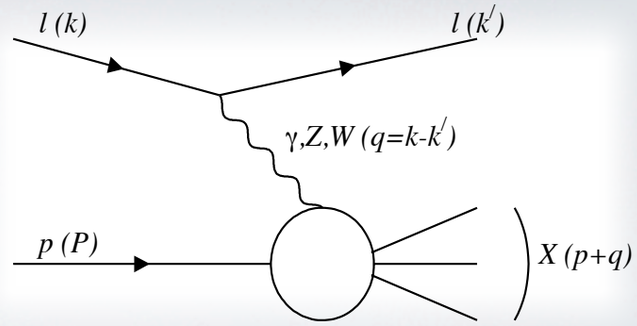
72. Physics Research Committee
October 25, 2011

HERA PHYSICS

HERA and DIS:

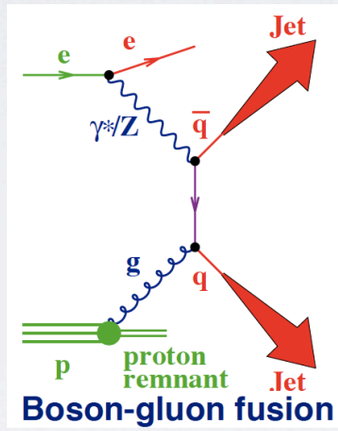
- provide input to determine the structure of the proton

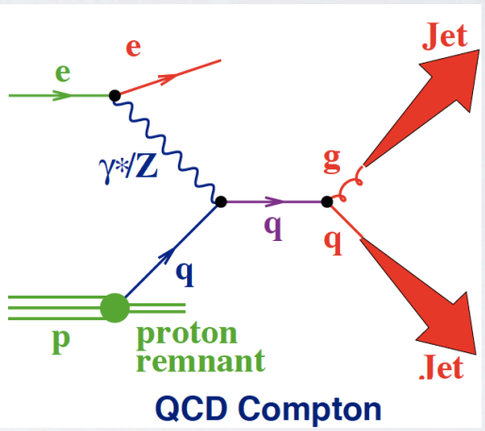


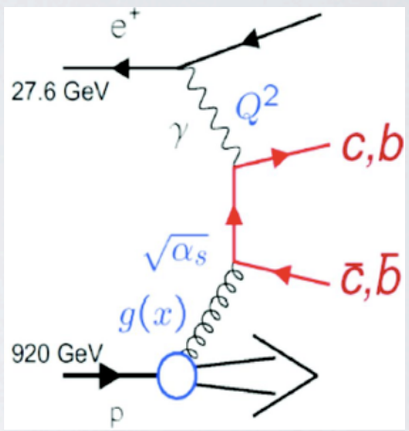


HERA and QCD:

- jet production, measure α_s;
- heavy flavour production;
- diffraction.

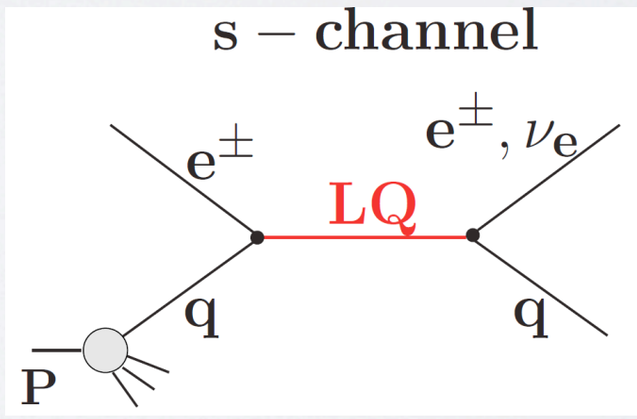






HERA and searches:

- investigate the EW frontier
- look for model-predicted (SUSY, Leptoquarks) and model-independent signatures.



ZEUS IN A NUTSHELL

EPS2011 abstracts

Abs#	Title
301	Inclusive Jets in PHP with anti-kt and SIScone ← α_s
302	Jets in NC DIS with kt, anti-kt and SIScone ← α_s
303	Inclusive jets in NC DIS ← α_s
304	Dijets in NC DIS
305	Dijets in PHP and constraints on p and gamma PDFs
306	Prompt photons in DIS
308	Prompt photons ← jets in DIS
309	Scaled momentum spectra of identified particles (K^0, Λ) in the Breit frame
310	Scaled Momentum Spectra in deep inelastic Scattering
311	Energy dependence of total photon-proton cross section
695	QCD NLO analysis of inclusive, charm and jet data (HERAPDF 1.7)
312	elastic ρ/ρ'
313	Diffractive J/ψ at high t
314	Upsilon t slope
316	Leading neutron with dijets
699	combination of diffractive data and fits
321	Double differential inelastic J/ψ cross sections in photoproduction
325	F_2b in dijet↔electron events
329	F_2b/F_2c from inclusive secondary vertexing
331	F_2b in dijet↔muon events
336	excited charm mesons
347	D^*/Λ_c to $K^0\pi/K^0p$ in DIS
348	Heavy quark jet photoproduction
691	F2 charm form D mesons in DIS with ZEUS and H1 (data)
693	F2 charm form D mesons in DIS with ZEUS and H1 (analysis)
694	QCD analysis – HERAPDF charm mass scan
351	CC e↔p cross sections with a polarized e← beam
354	NC DIS e↔p at high Q2
355	NC at high x in e-p and e↔p
680	Combination of NC and CC Cross Sections HERA I HERAPDF 1.0
682	Combination of NC and CC Cross Sections HERA I↔II
688	Combination of low energy cross sections
356	Di-tau
357	Single top
360	Single top
698	Isolated leptons with missing pt
685	HERAPDF 1.5 HERA I↔II
686	HERAPDF 1.5 NNLO HERA I↔II
687	HERAPDF 1.5 ↔ jets
690	HERAPDF 1.0 ↔ low energy

Alive and reasonably well...

Spokesperson: Aharon Levy (Tel Aviv)
Physics Chairs: Iris Abt (MPI Munich),
Olaf Behnke (DESY)

Two physics groups:
QCD+Structure Functions and Exotics,
Heavy Flavour physics.

A lot (41) of young (<30) people:
15 PhD students, 16 MSC, 10 BSC

40 abstracts sent to EPS2011
(27 ZEUS only), 10 talks, 6 posters.
66 talks in conferences up to now this year.

Many (~40) ongoing analyses.

DATA PRESERVATION

ZEUS strategy is to store the data and MC events in common ntuples in root format
(~500 M data + 2.5 G MC events to be stored).

The process of creating the common ntuples has started in 2006. Of course, many iterations are needed in order to spot missing variables, bugs in the code, and so on.

At present most of the analyses are using common ntuples,
and the first paper and preliminary results are out.

ZEUS is preparing to freeze its software (end of this year)
and to go for the final production of common ntuples.

A lot of work going on in order to preserve the knowledge:
store paper documents, details of the analyses, create web pages with instructions on how to make an analysis, store the analysis code...

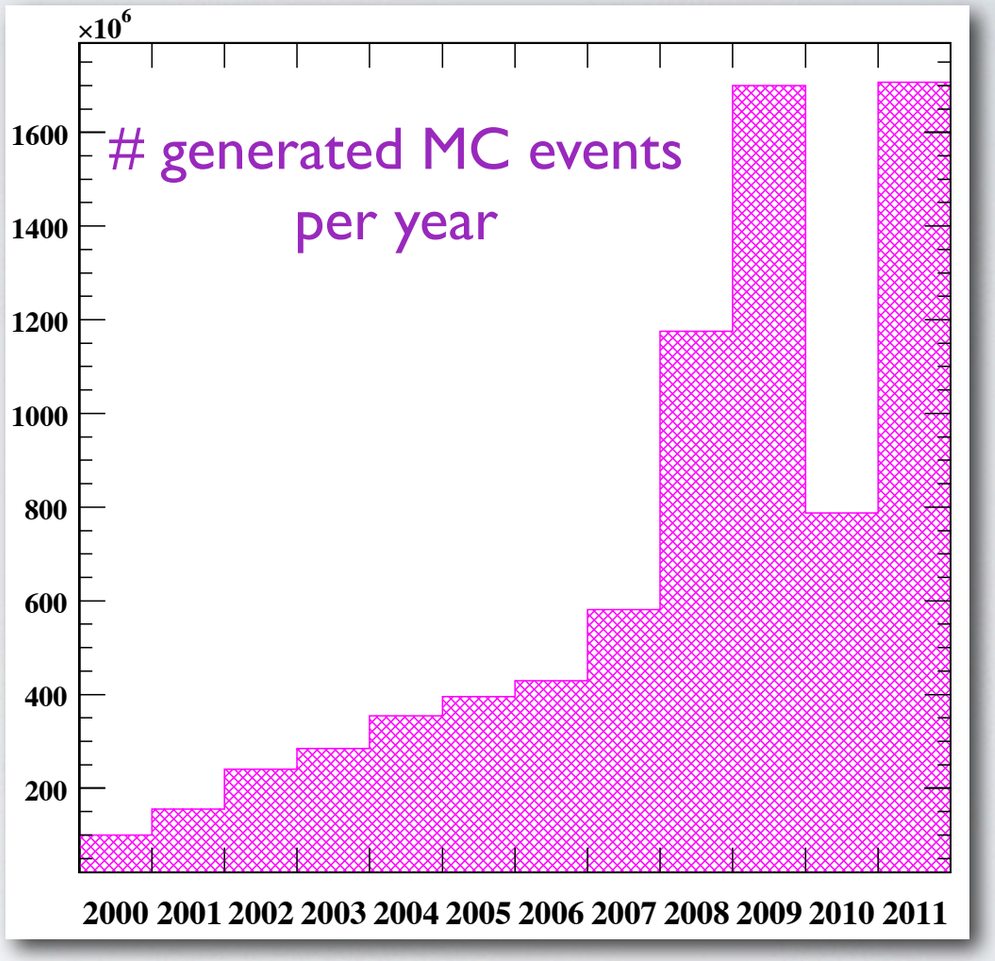
DATA PRESERVATION AND MONTE CARLO GENERATION

Monte Carlo samples will also be stored in root ntuples.

Generation of MC events:
at peak, 20M events/day,
5.5 M events/day on average in 2011.
~1.7 G events processed up to now in 2011.

The recreation of the last MC samples will take the last ~6 months of 2012.

~ 2.5 G events foreseen in common ntuples



Data-preservation issues take a lot of time and effort.
Given the fact that the standard ZEUS analysis framework will not run after 2012, a lot of (wo)manpower is at present devoted to data-preservation issues.

Still Physics is being done...

PAPERS AND PRELIMINARY RESULTS

Published papers:

1. Measurement of heavy-quark jet photoproduction at HERA, DESY-11-067, *Eur. Phys. J. C71, 1659 (2011).*
2. Measurement of beauty production in deep inelastic scattering at HERA using decays into electrons, DESY-11-005, Eur. Phys. J. C71, 1573 (2011).

Papers read:

1. Measurement of the *t* dependence in exclusive photoproduction of $\Upsilon(1S)$ mesons at HERA, DESY-11-186.
2. Scaled momentum distributions for K^0_s and $\Lambda/\bar{\Lambda}$ in DIS at HERA.
3. Exclusive electroproduction of two pions at HERA.
4. Search for single-top production in *ep* collisions at HERA (EPS2011 preliminary).

New papers in the editorial process:

1. Inclusive-jet photoproduction at HERA and determination of α_s (DIS2011 preliminary).
2. Search for first generation Leptoquarks at HERA (EPS2011 preliminary).

New preliminary results since last PRC meeting (EPS2011 preliminary):

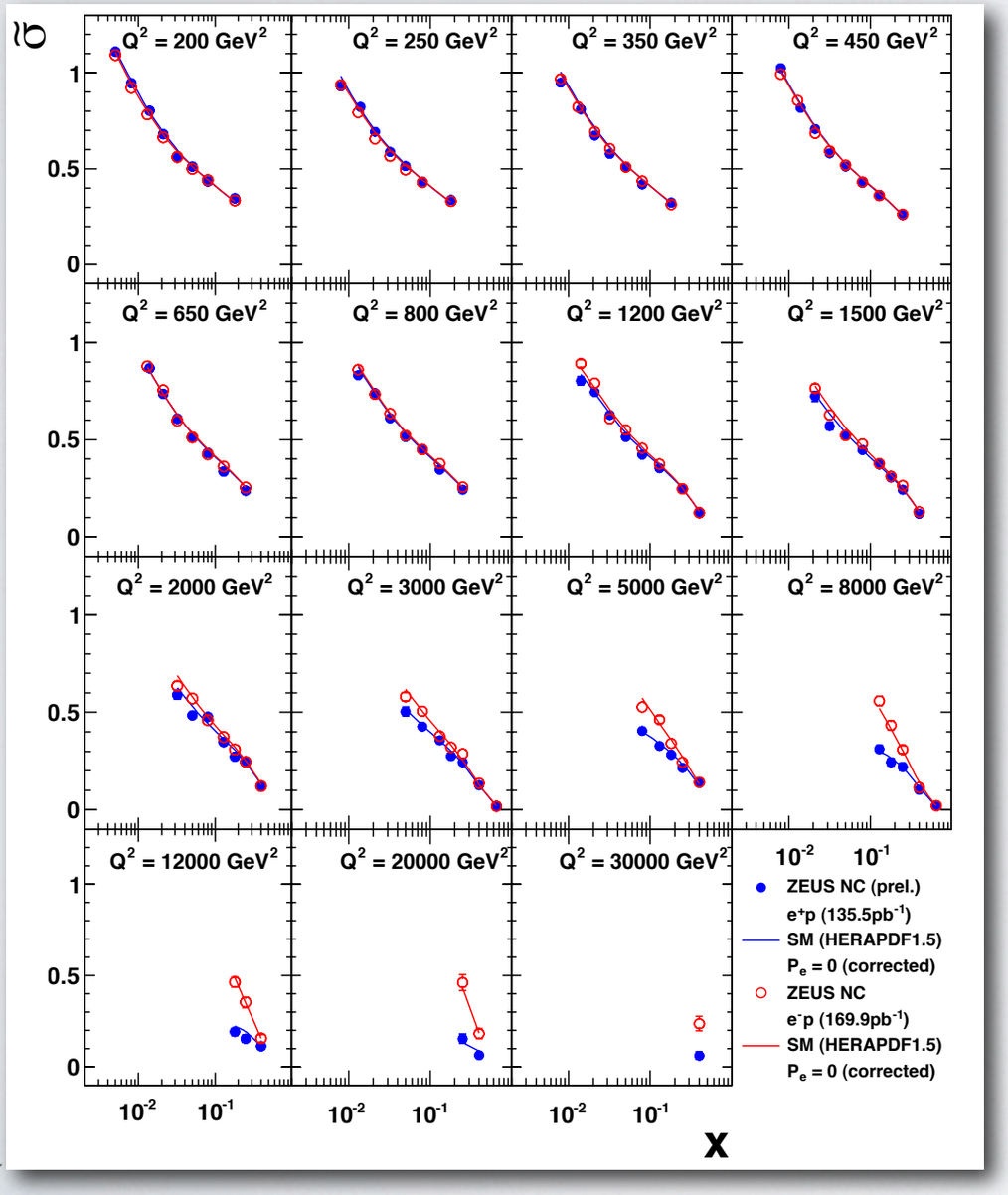
1. Determination of xF_3.
2. D^* production in deep inelastic scattering and determination of F_2^c.
3. HERAPDF1.7 (covered in the next talk).
4. Combination of Diffraction Measurements at HERA using H1 FPS and ZEUS LPS.

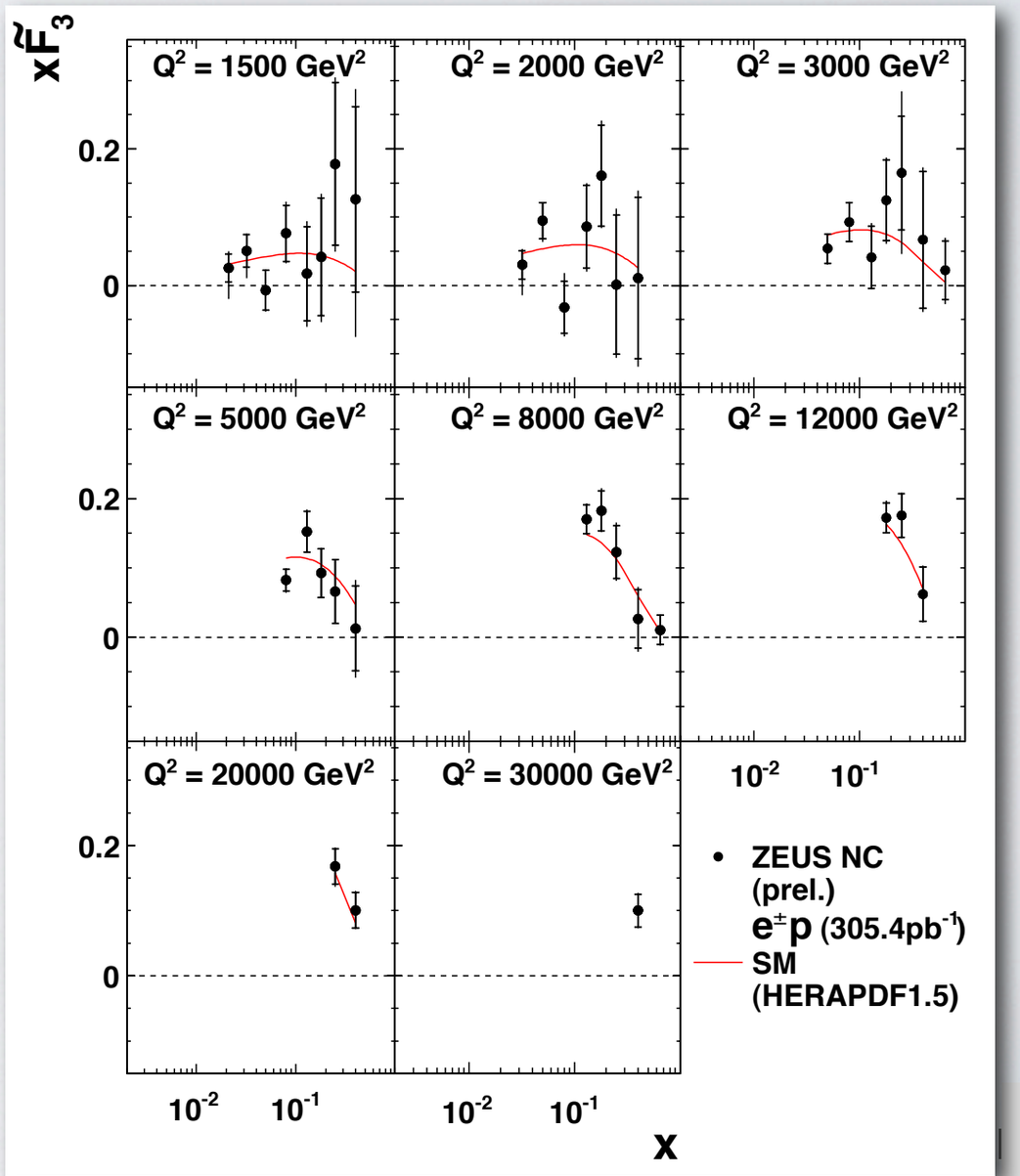
NEW PRELIMINARY: xF_3 from NC e^-p and e^+p data

NC double-differential cross section vs x and Q2 can be expressed via structure functions:

$$\frac{d^2\sigma^{e^\pm p}}{dxdQ^2} = \frac{2\pi\alpha}{xQ^4}[Y_+F_2(x,Q^2) \mp Y_-xF_3(x,Q^2) - y^2F_L(x,Q^2)] \quad \text{where} \quad Y_\pm = 1 \pm (1-y)^2$$

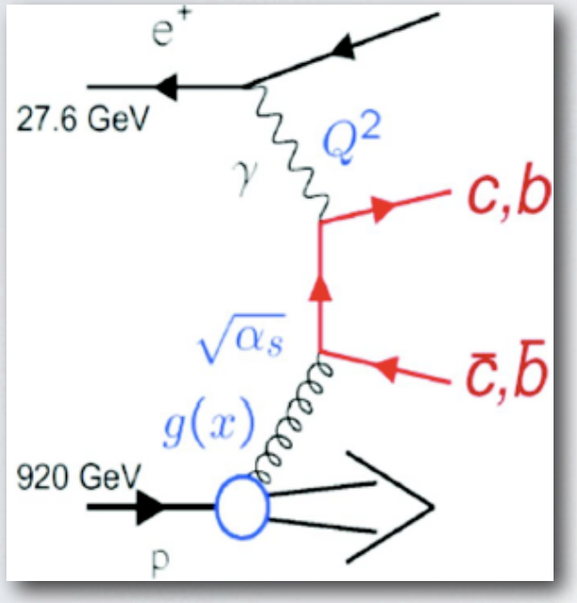
xF_3 can be measured by looking at the difference between the e^+p and the e^-p cross sections.



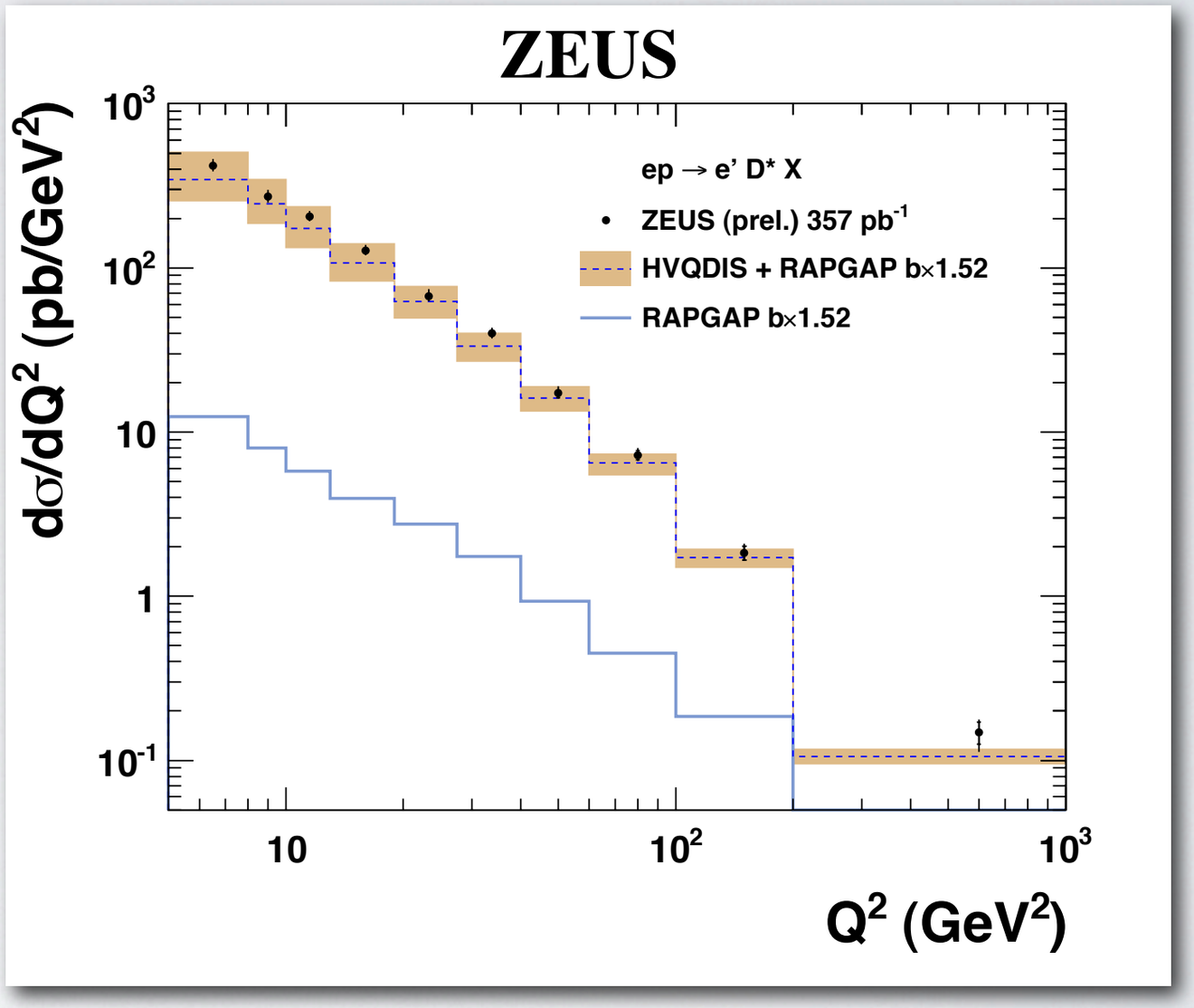


NEW PRELIMINARY: D* in deep inelastic scattering

Charm production in DIS: testing ground of perturbative QCD, probe of the gluon in the proton, important to understand heavy flavours in PDF fits.



Full HERAII statistics used



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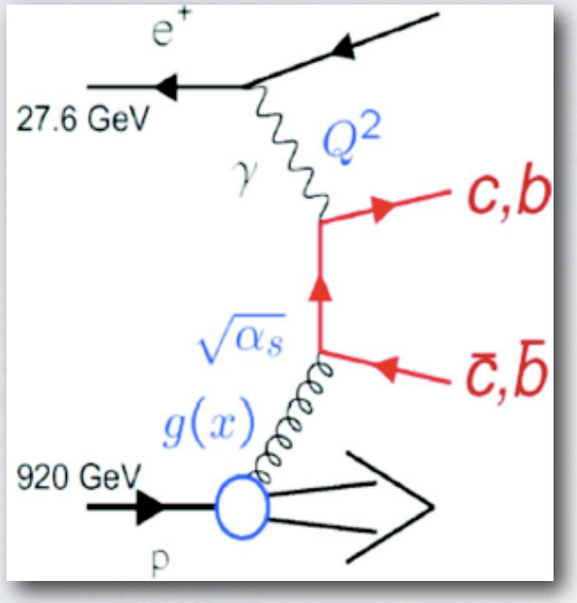

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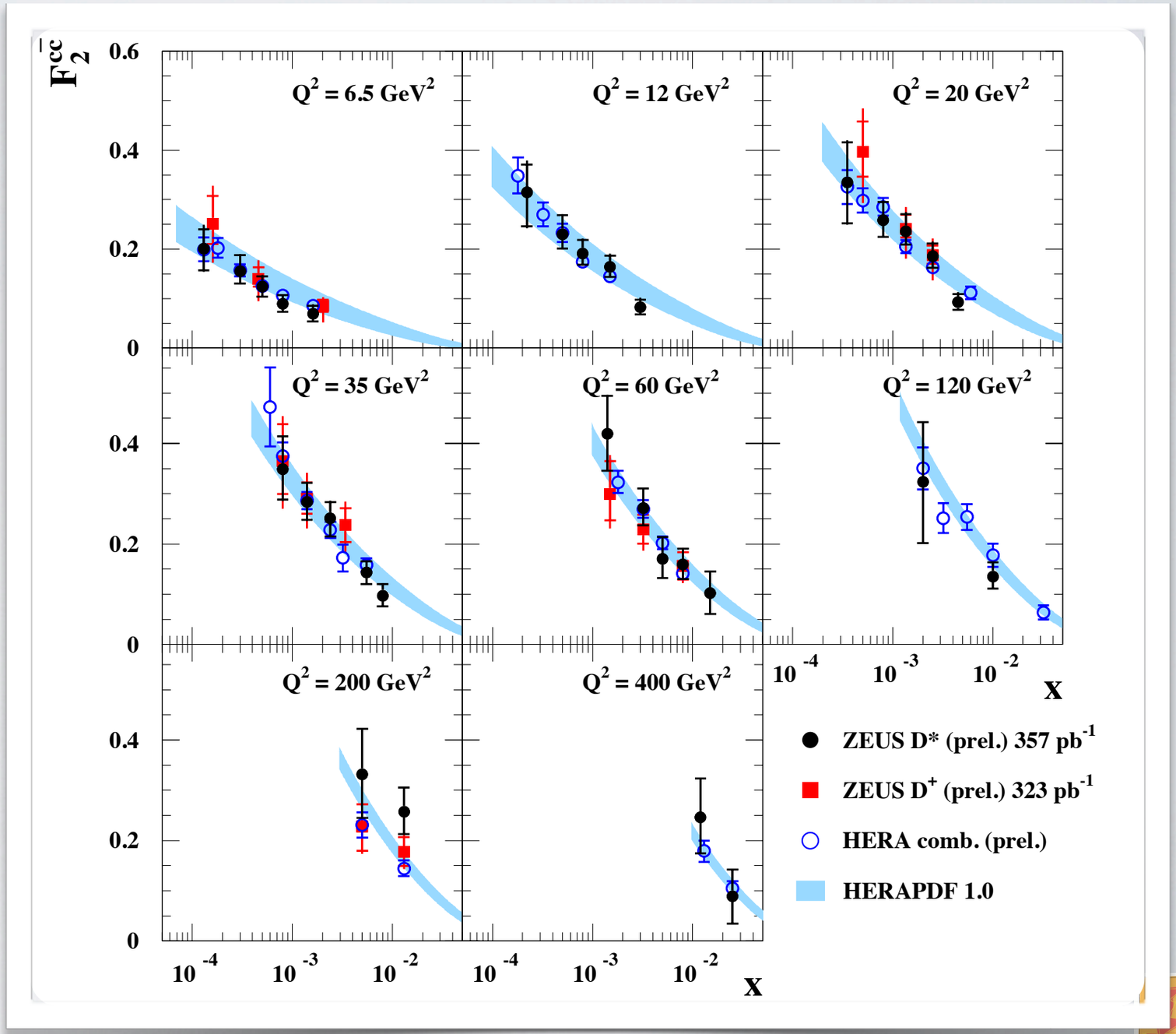


NEW PAPER: Scaled momentum distributions for K^0_s and Λ in DIS

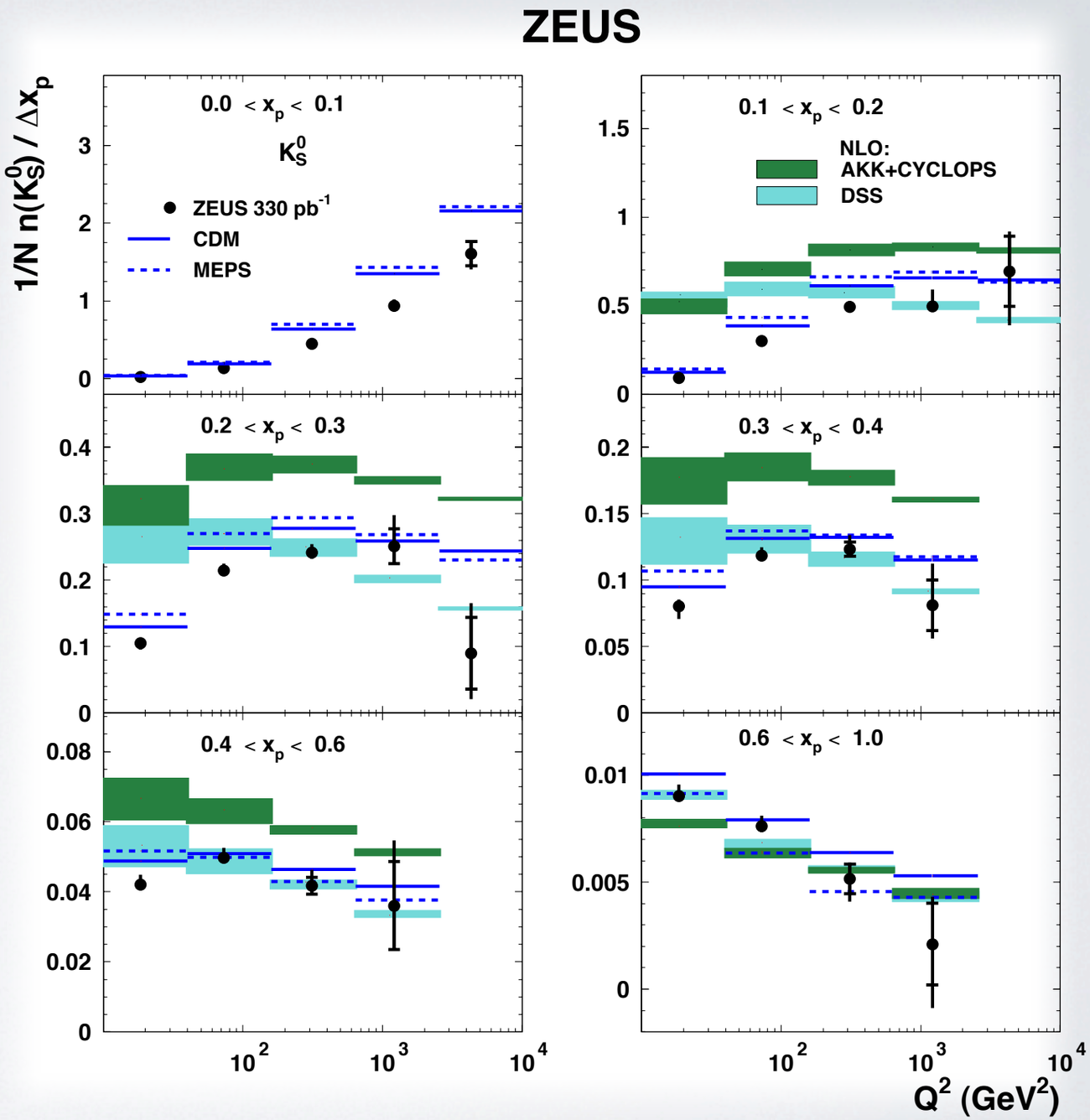
Important input for models of fragmentation functions. First measurement in *ep* DIS for K^0_s and Λ.

Comparison with predictions based on e^+e^- data, or on global analyses of e^+e^-, *pp* and *ep* data.

The data are not well described by any model.

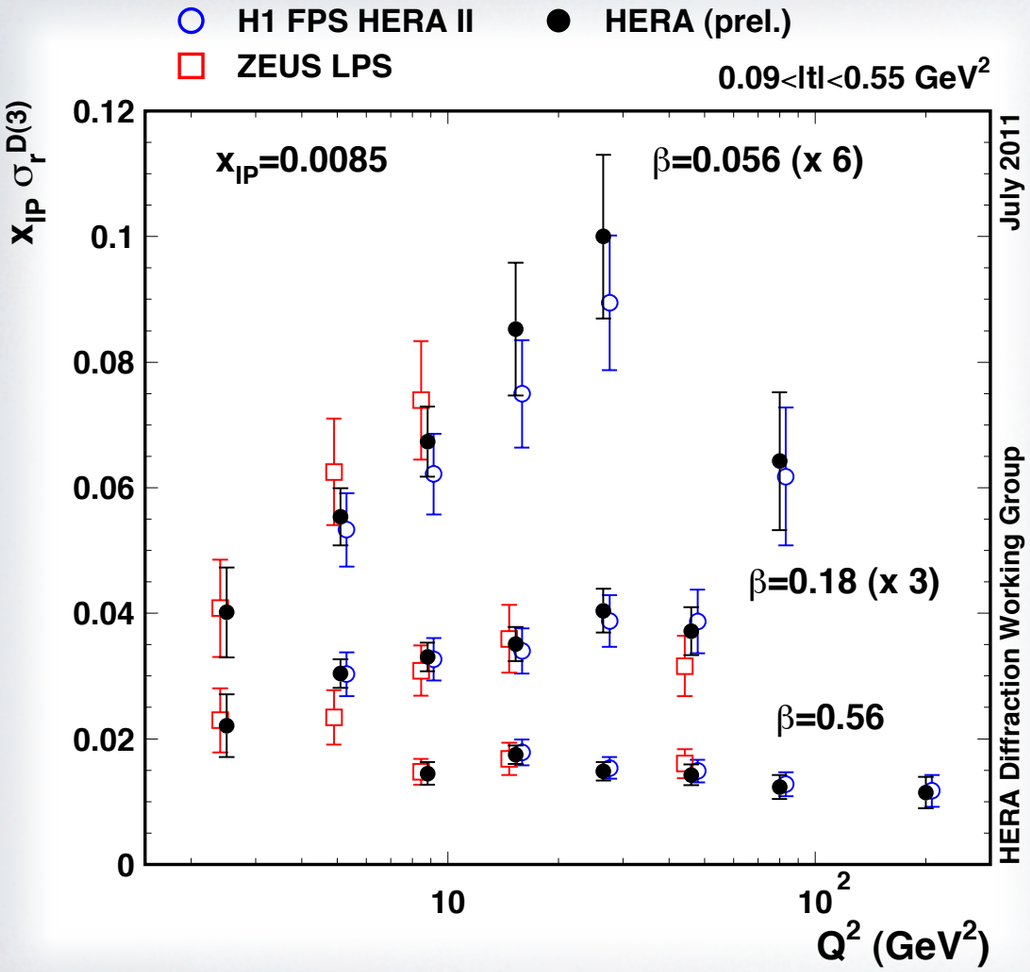
They can significantly help in constraining the FF models of K^0_s and Λ.

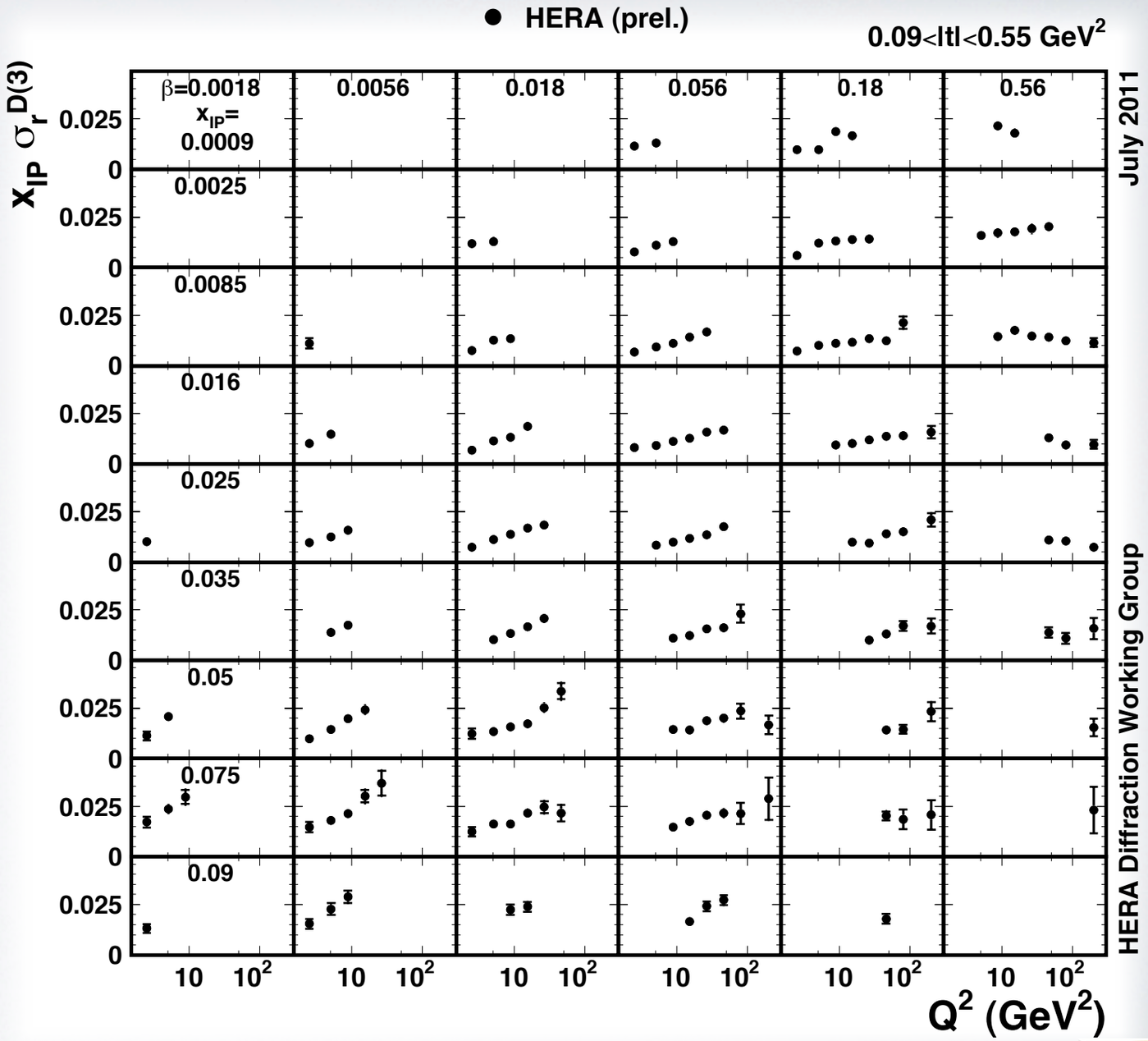
Full HERAII statistics used



NEW H1+ZEUS PRELIMINARY: combined diffractive cross sections

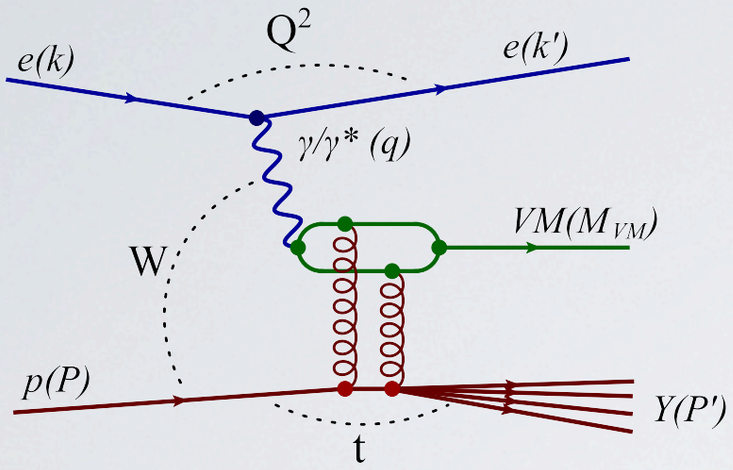
H1 and ZEUS diffractive cross sections measured using the proton taggers have been combined.
Cross sections extracted in a common phase space.
121 H1 and 106 ZEUS points give169 combined cross sections.





Significant improvement in precision

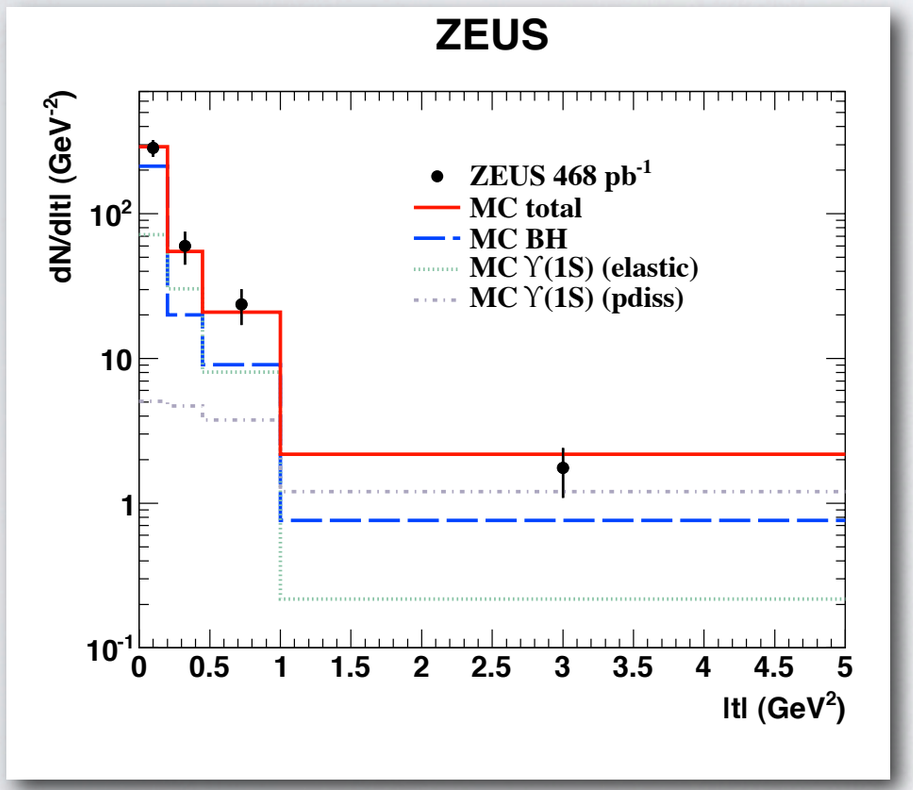
NEW PAPER: Measurement of the *t* dependence in exclusive PHP of Υ(1S) mesons



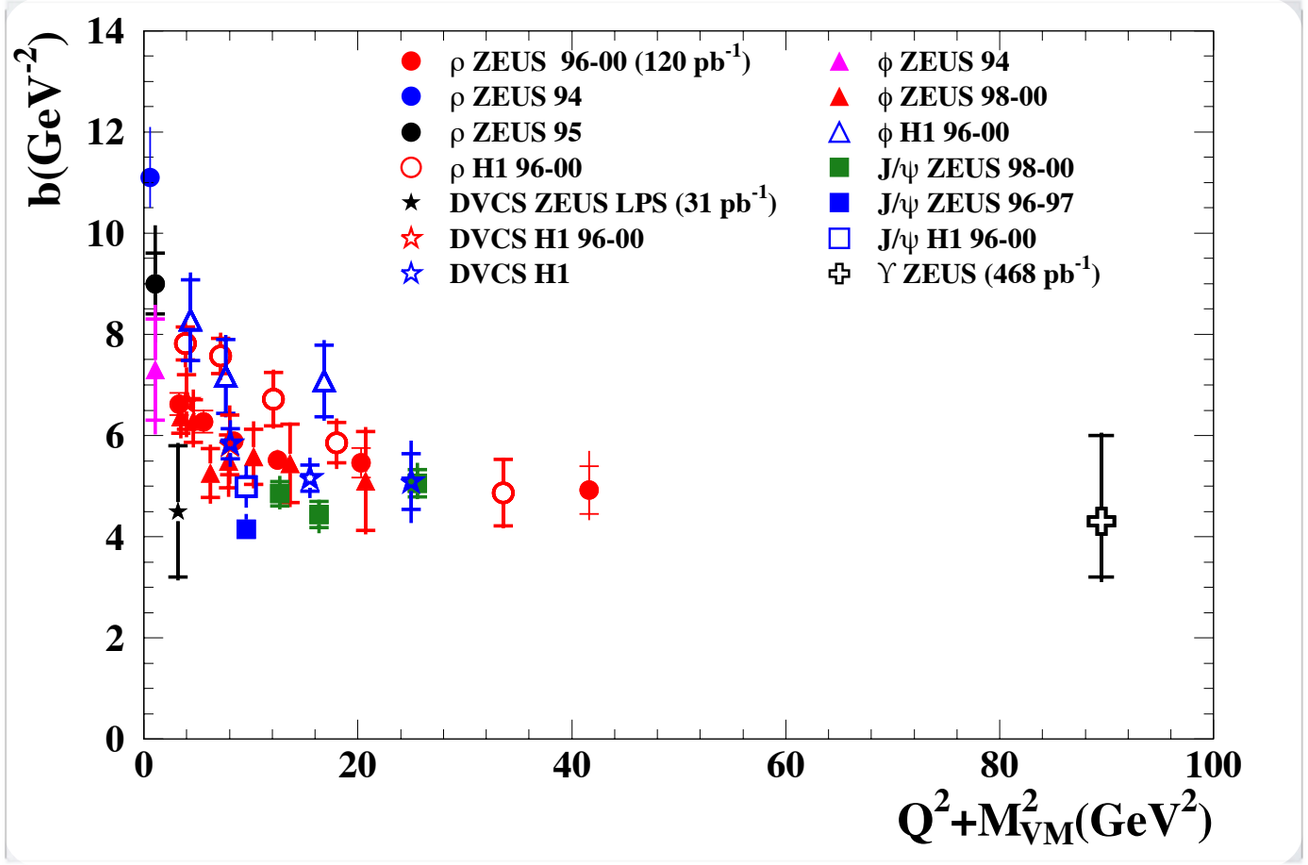
Exponential dependence of the cross section on *t* ruled by the slope parameter *b*:

$$\frac{d\sigma}{d|t|} \propto e^{-b|t|}$$

First measurement of b for Υ(1S) production.

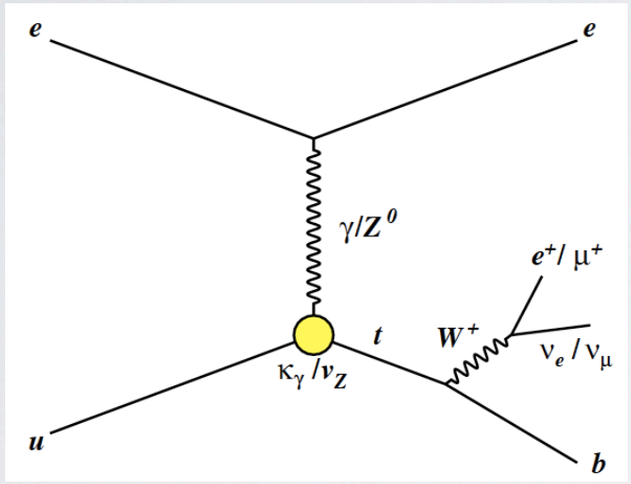


Full ZEUS statistics used



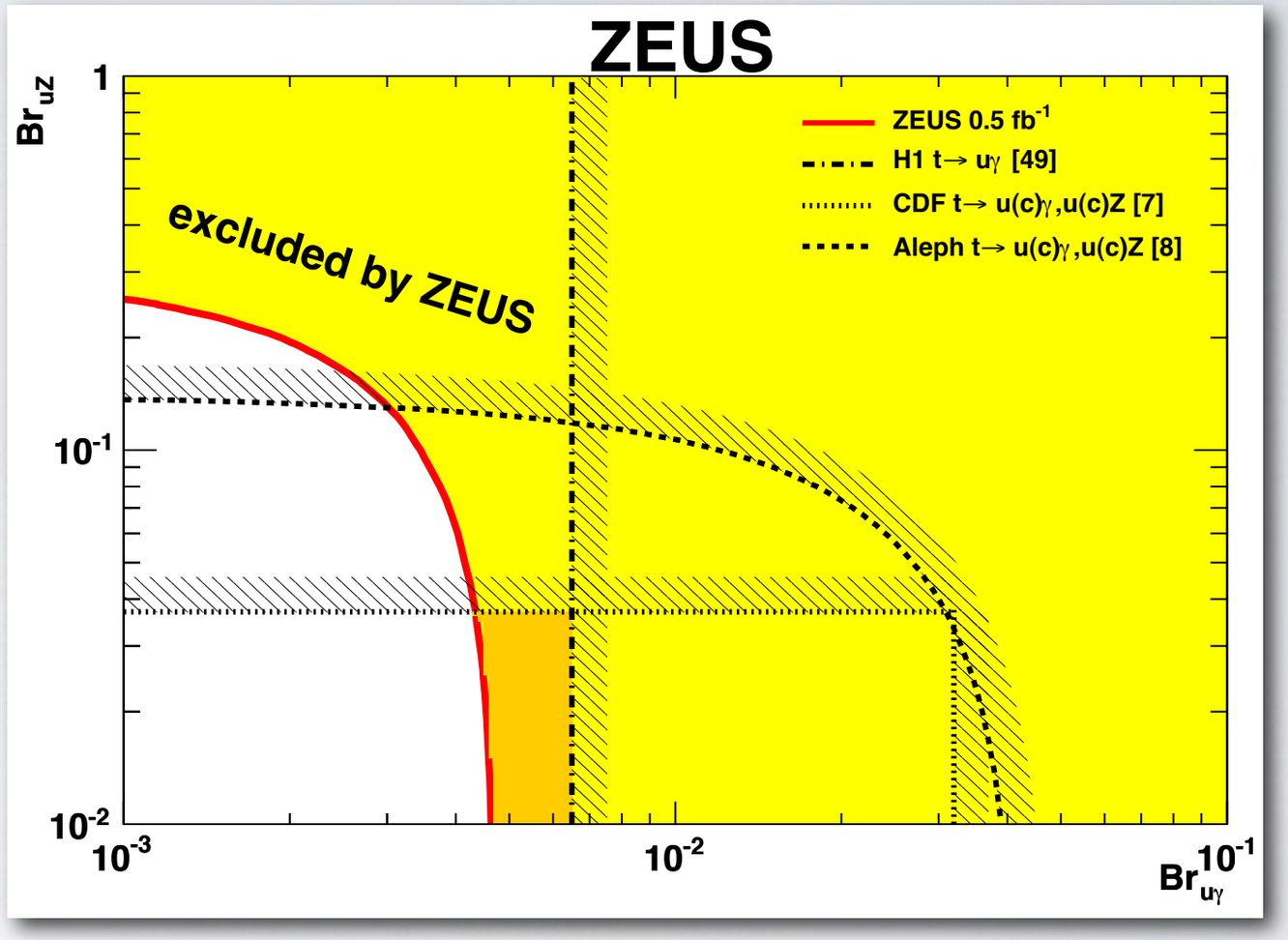
NEW PAPER: Single-top production

Single-top production in the SM has a too low cross section to be observed at HERA.
Anomalous FCNC can enhance the cross section.



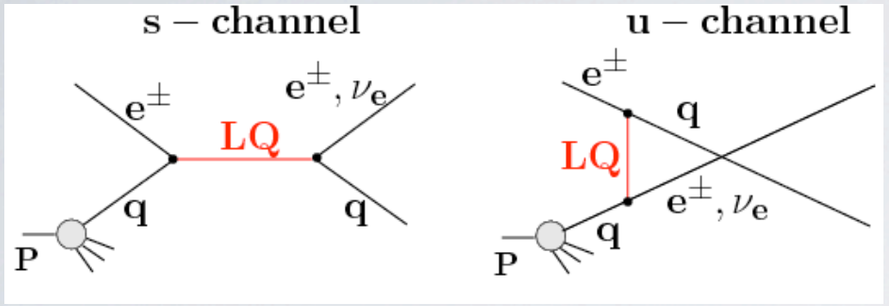
Events with a high-p_T lepton and missing p_T in the final state: look for deviations from the SM.

As nothing is found, set limits on cross sections and branching ratios.



Full ZEUS statistics used

NEW PRELIMINARY: First generation leptoquarks



LQ: exotic particles carrying both baryon and lepton number. Can be produced at HERA as resonances (if the mass is lower than the c.o.m. energy) or produce deviation in the NC/CC DIS cross sections if the mass is higher.

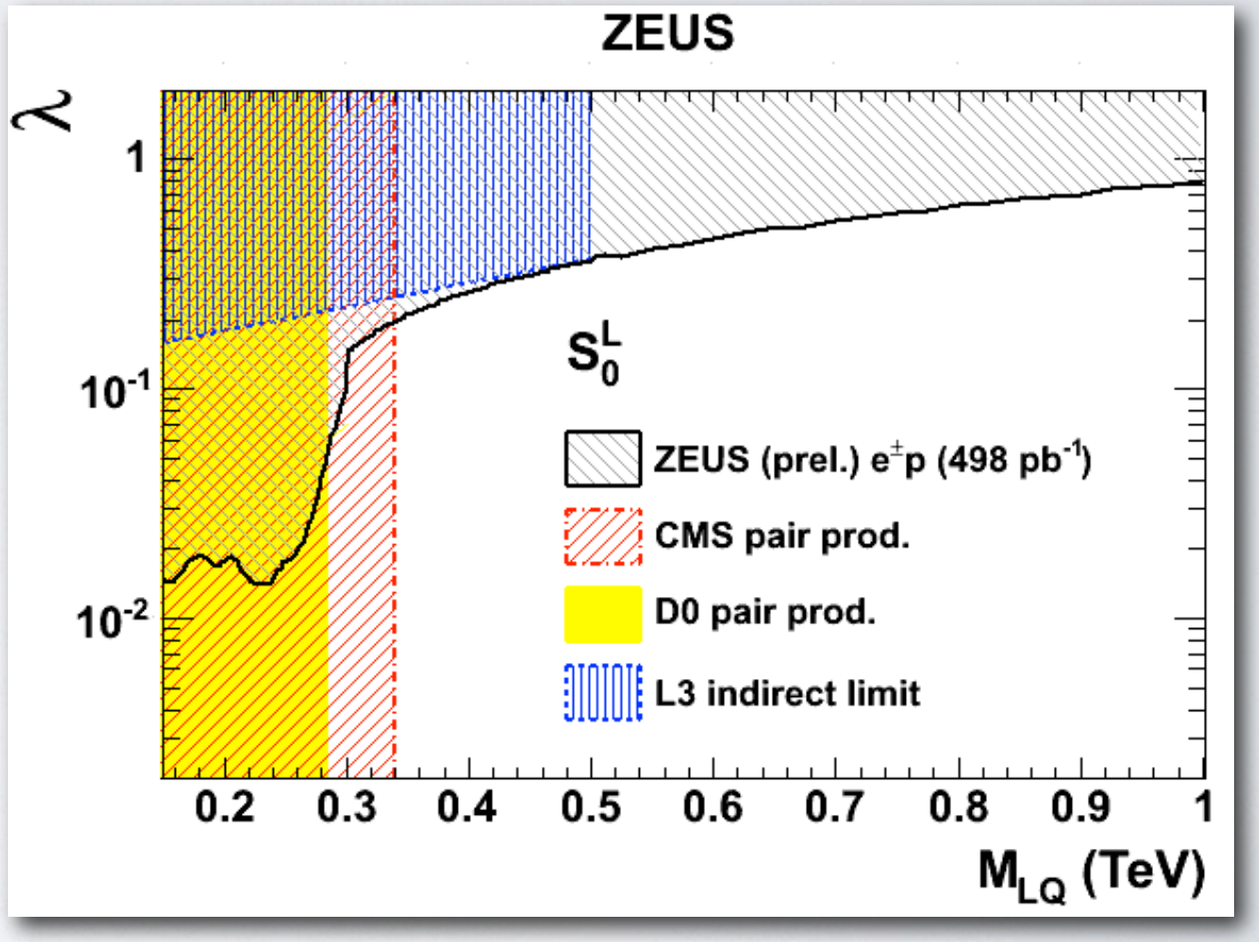
No deviation wrt SM predictions observed.

Assuming $\lambda = 0.3$

LQ Type (F=0)	V_0^L	V_0^R	$\tilde{V}_0^R$	V_1^L	$S_{1/2}^L$	$S_{1/2}^R$	$\tilde{S}_{1/2}^L$
M_{LQ}(GeV) ZEUS (prel.)	504	293	343	629	322	300	293
LQ Type (F=2)	S_0^L	S_0^R	$\tilde{S}_0^R$	S_1^L	$V_{1/2}^L$	$V_{1/2}^R$	$\tilde{V}_{1/2}^L$
M_{LQ}(GeV) ZEUS (prel.)	435	326	291	466	292	324	409

Limits extracted for the coupling λ as a function of the mass of the LQ.

Full ZEUS statistics used



OUTLOOK

HERA flagship analyses (NC/CC, jets, heavy flavours) being finalised.
But HERA is still a perfect place to study QCD:

- on jets and hadronic final states: combination with H1, use of jets in the PDF fits, jet-jet correlations (interesting also for the LHC), prompt-photon topologies, scaled momenta for different kind of particles (i.e. positive and negative);

- on heavy flavours: combine the data with H1 (being done, but to be updated with latest measurements), higher statistics allows to perform measurements that were never done: correlation variables, double tagging, access to the lower momentum region...

- on diffraction: combination with H1 for the extraction of diffractive PDFs, analysis of vector mesons at HERAII...

Bearing in mind that one of the goals is to include many different inputs (inclusive data, jets, heavy flavours...) in the PDF fits.

Still a lot of possibilities for students joining now!

CONCLUSIONS

ZEUS producing important physics output.
Focusing also on the preservation of the data for the future.

Final version of the ZEUS software in preparation. Monte Carlo will follow.

Common ntuple structure well tested and used for physics results.
Plans for the preparation of the final data and MC ntuples are ready.

Four new papers read since DIS, two more in the editorial process. Six papers will most likely be published this year. New preliminary results on important topics.
Overall 66 talks in conferences this year.

Many young and motivated students are carrying on important analyses...

... and still a lot of possibilities for students joining now.