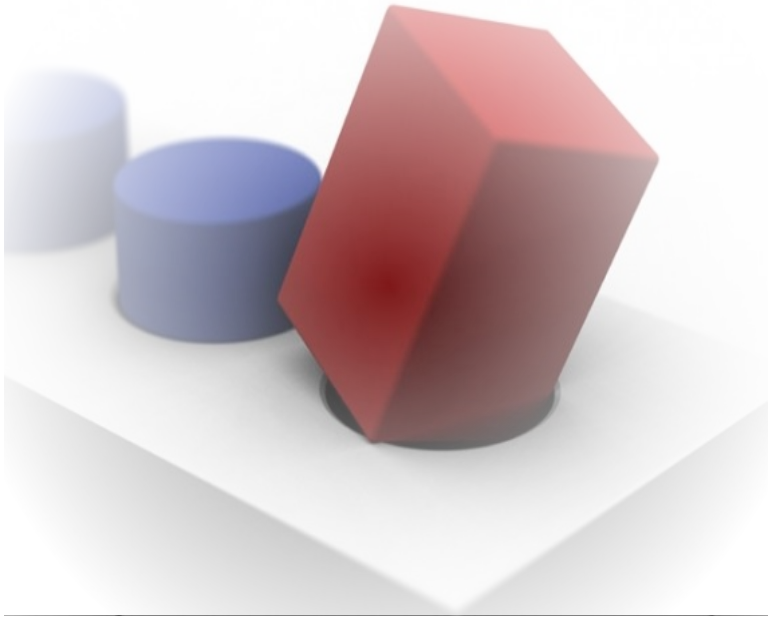
Polarisation update in ZEUS HERA2 inclusive data

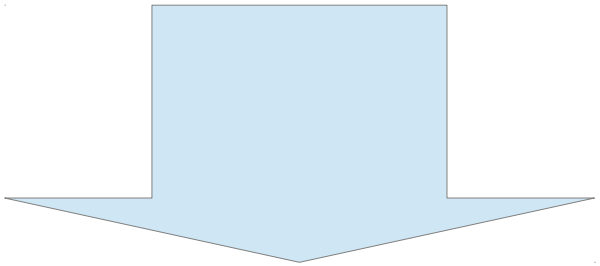


I. Abt, A. Cooper-Sarkar, C. Gwenlan,
K. Klimek, V. Myronenko

ZEUS analysis forum
7.10.2015, Hamburg

New recommendations from POL group

- The TPOL values were reevaluated:
  - Improvement of corrections to known destabilising effects;
  - New corrections to the effects, not considered previously;
  - Improvement of the overall analysis strategy.



arXiv:1201.2894v1 [physics.ins-det] 13 Jan 2012

DESY 11-259
POL2000-2011-002

Polarisation at HERA
– Reanalysis of the HERA II Polarimeter Data –

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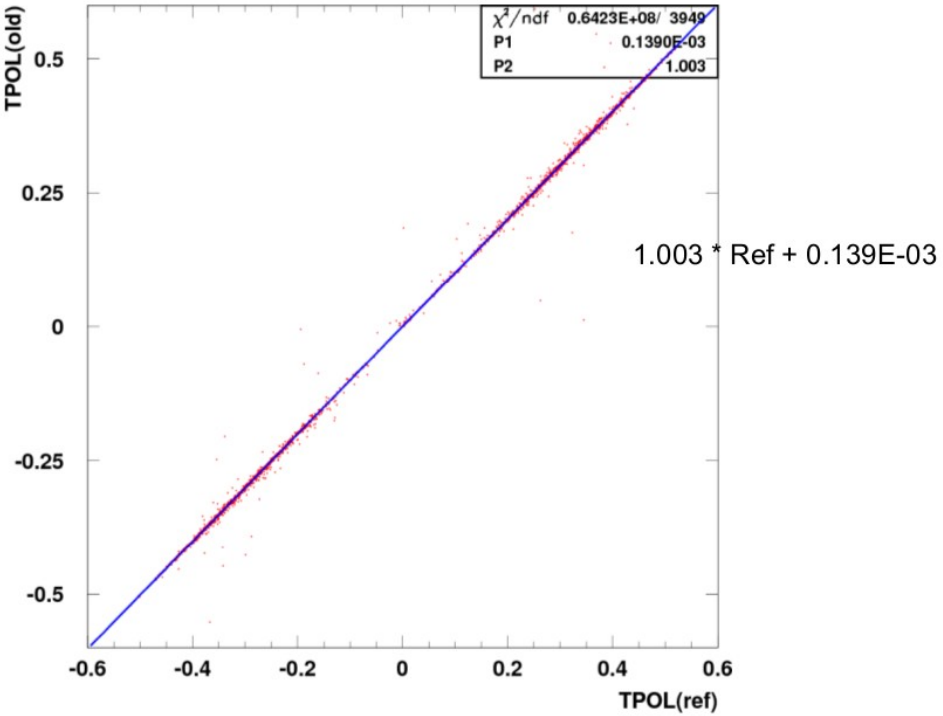
Abstract

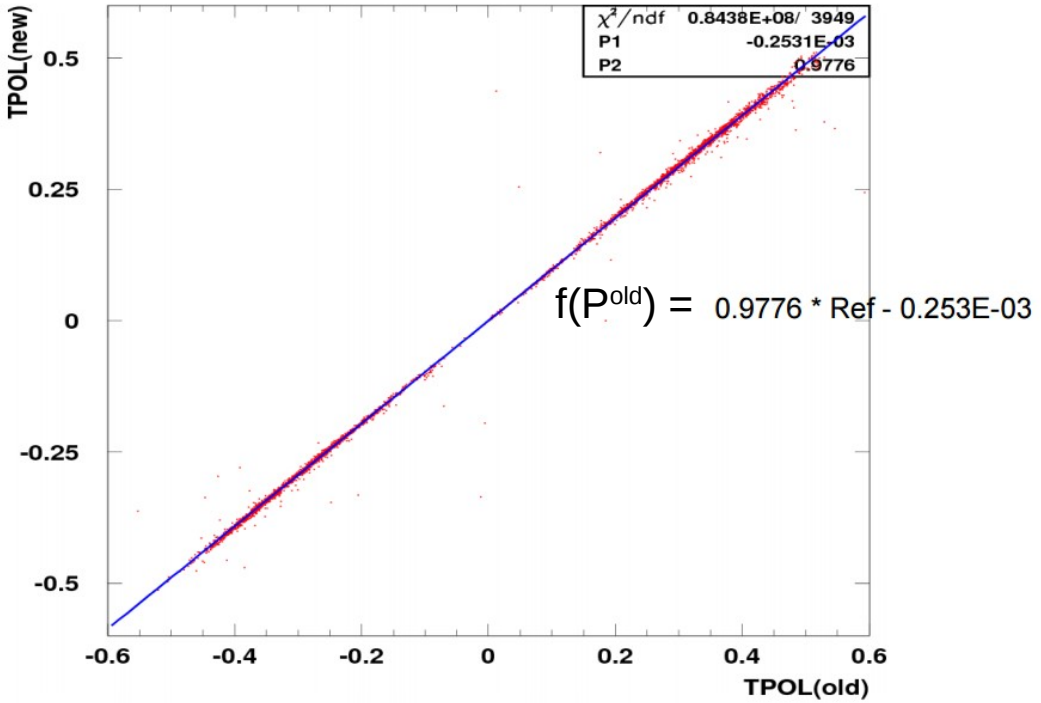
In this technical note we briefly present the analysis of the HERA polarimeters (transversal and longitudinal) as of summer 2011. We present the final reanalysis of the TPOL data, and discuss the systematic uncertainties. A procedure to combine and average LPOL and TPOL data is presented.

- TPOL values were reevaluated (small changes).
- Uncertainty on TPOL decreased ~ by half (decision made to leave old TPOL unc.).

New P_e values per run

- Old TPOL values were successfully reproduced.

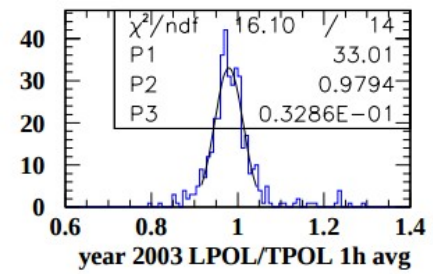


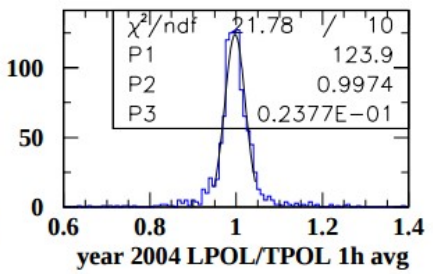


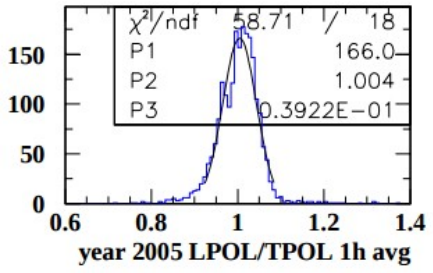
- New TPOL values were obtained.

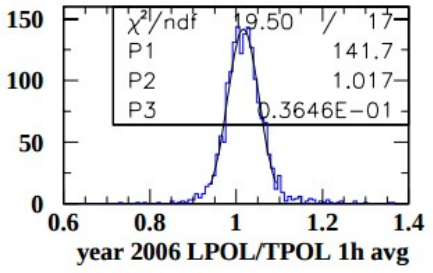
See talk by Justina T. (16.09.13 or earlier)

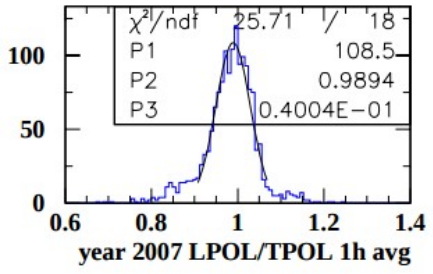
New P_e values per run

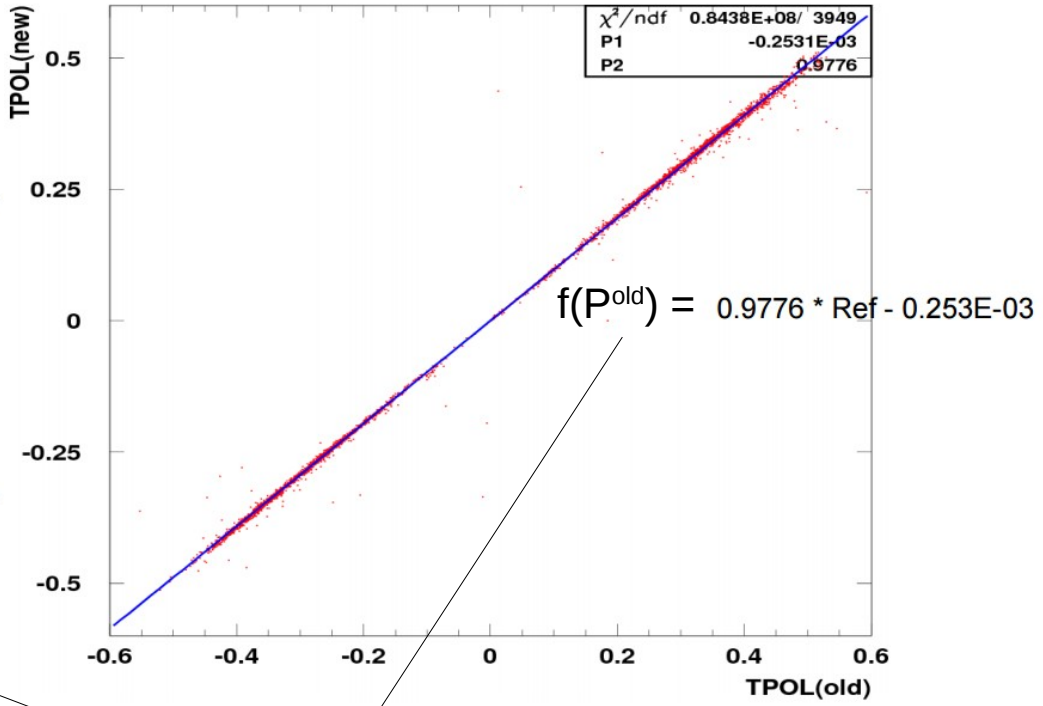












$$P_e^{new} = P_e^{old} w_{LPOL} + f\left(P_e^{old}\right) w_{TPOL}$$

" The choice of polarimeter measurement was made on a run-by-run basis depending on which was active the longer, in order to maximise the luminosity. For the final selection, the TPOL was used for 64% (24%) of the negative (positive) polarisation run period. The combined, luminosity-weighted systematic uncertainty on the polarisation measurement was 4.0% (3.7%) for negative (positive) polarisation. "

High Q2 CC (DESY-10-129)

New P_e values per reaction

- Polarisation values are changed.

	old	new	LPOL fraction	TPOL fraction	Change, %
Ccem LH	-0.270313	-0.2665997128	0.36	0.64	1.3736990703
Ccem RH	0.297579	0.2959184953	0.76	0.24	0.5580046657
Ccep LH	-0.362806201	-0.3577669313	0.36	0.64	1.3889701123
Ccep RH	0.329081357	0.3272514956	0.76	0.24	0.5560513643
Ncem LH	-0.266	-0.262348544	0.36	0.64	1.3727278195
Ncem RH	0.291	0.289374864	0.76	0.24	0.5584659794
Ncep LH	-0.358	-0.353029632	0.36	0.64	1.3883709497
Ncep RH	0.318	0.316229712	0.76	0.24	0.5566943396

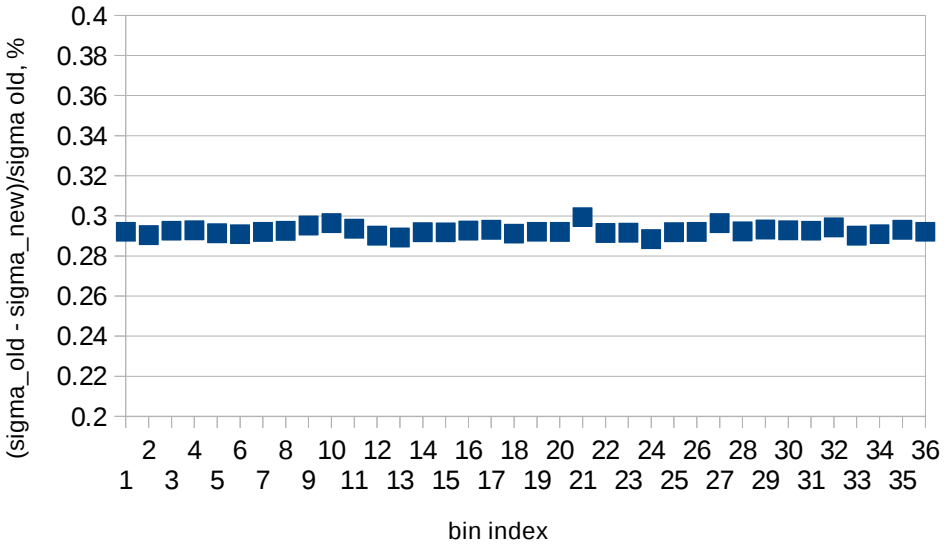
- Technical values from the original analysis were used.
- P values for LH polarisation are the most affected (1.39% tops).

New P_e values: effect on cross section

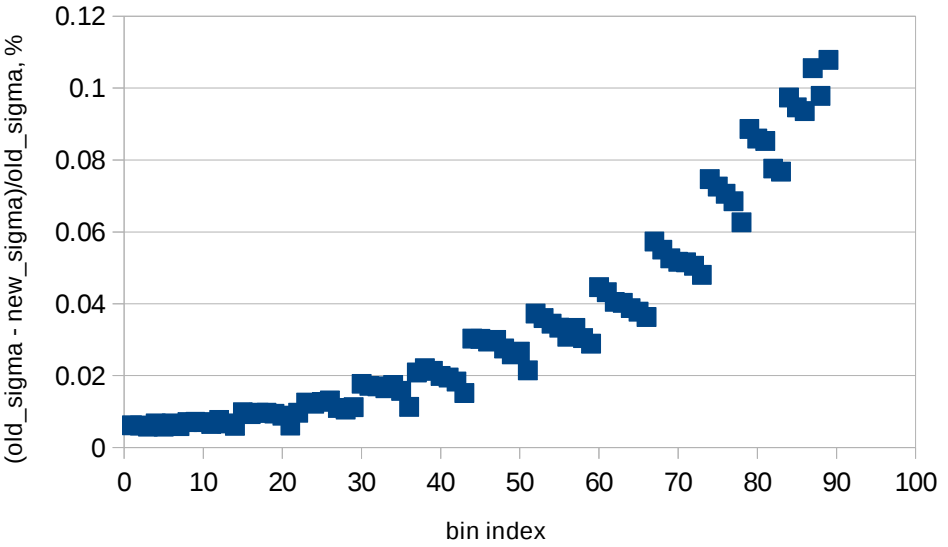
- Correction from QCD predictions (PDF → HERAPDF2.0)

$$\sigma_{pol}^{\pm NEW} = \frac{\sigma_{NEW\,P_e}^{pred}}{\sigma_{OLD\,P_e}^{pred}} \sigma_{pol}^{\pm OLD}$$

ZEUS CCem LH

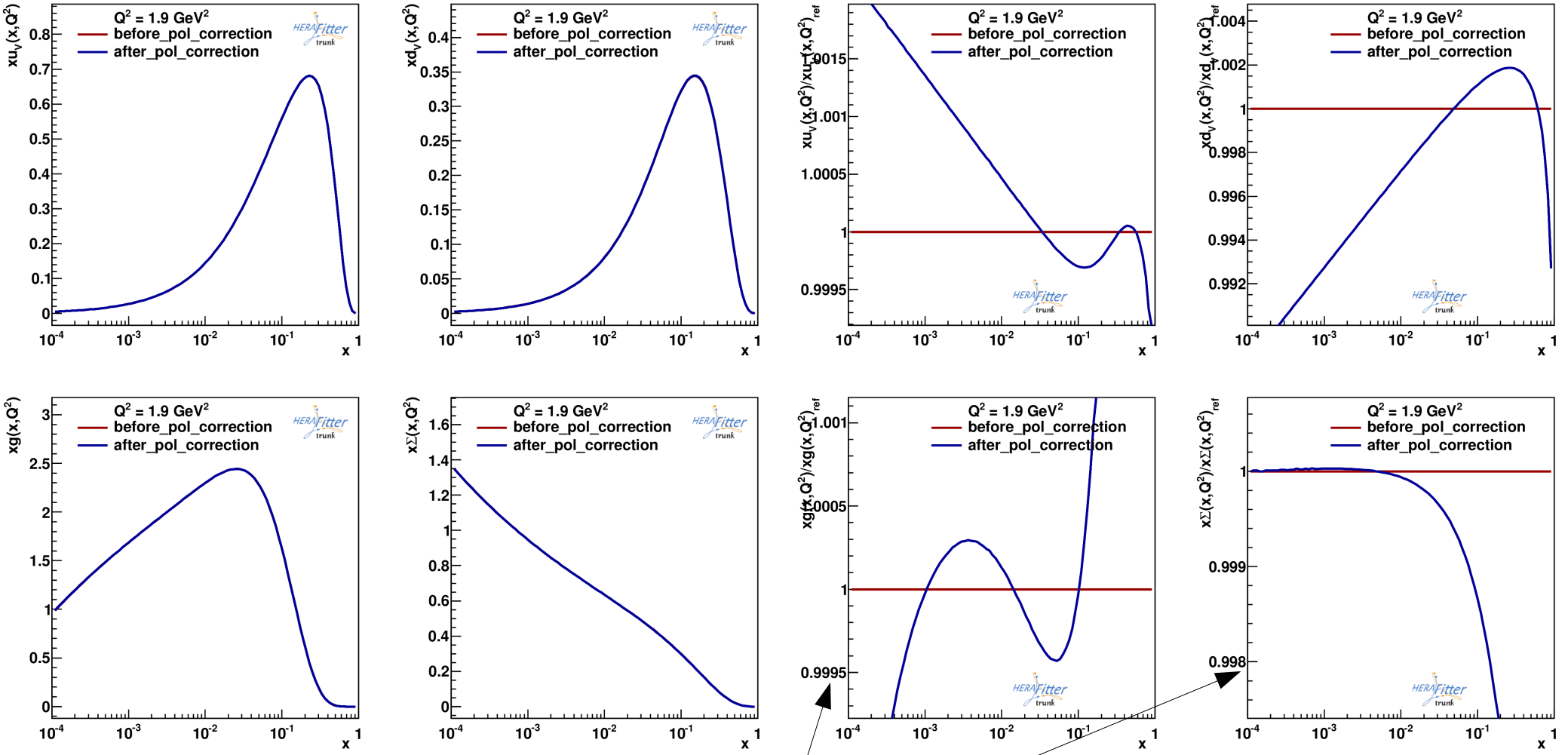


ZEUS NCem LH



- CC → ~same correction factor over all kinematic range.
- NC → growth of correction factor with Q^2.
- Very tiny effect on the cross sections.

New P_e values: effect on EW fit



- Almost no effect on the PDFs.
- Note y scale!

New P_e values: effect on EW fit

Parameter	before pol correction	after pol correction
'Bg'	−0.030 ± 0.079	−0.030 ± 0.080
'Cg'	8.63 ± 0.86	8.61 ± 0.86
'Aprig'	1.51 ± 0.70	1.50 ± 0.70
'Bprig'	−0.118 ± 0.067	−0.118 ± 0.067
'Cprig'	25.00	25.00
'Buv'	0.745 ± 0.026	0.744 ± 0.026
'Cuv'	4.708 ± 0.085	4.708 ± 0.085
'Euv'	9.4 ± 1.2	9.4 ± 1.2
'Bdv'	0.781 ± 0.079	0.783 ± 0.079
'Cdv'	4.37 ± 0.32	4.37 ± 0.32
'CUbar'	3.60 ± 0.47	3.59 ± 0.47
'ADbar'	0.1994 ± 0.0089	0.1995 ± 0.0088
'BDbar'	−0.1582 ± 0.0053	−0.1582 ± 0.0053
'CDbar'	4.4 ± 1.1	4.4 ± 1.1
'alphas'	0.1180	0.1180
'fs'	0.4000	0.4000
'auEW'	0.518 ± 0.061	0.520 ± 0.063
'adEW'	−0.52 ± 0.22	−0.52 ± 0.23
'vuEW'	0.148 ± 0.070	0.148 ± 0.071
'vdEW'	−0.44 ± 0.18	−0.45 ± 0.18
Total χ^2 / dof	3590 / 3231	3590 / 3231

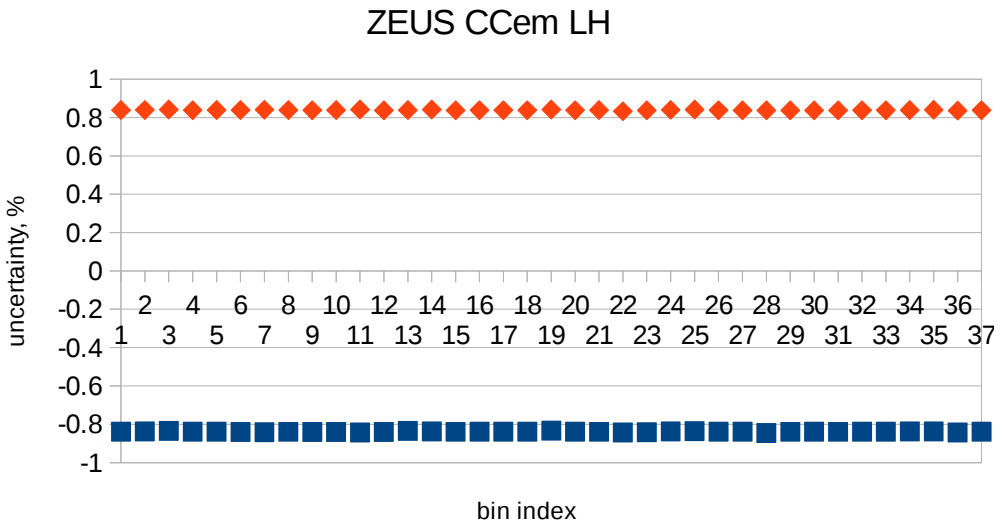
- Very tiny numerical differences both for couplings and PDF parameters.

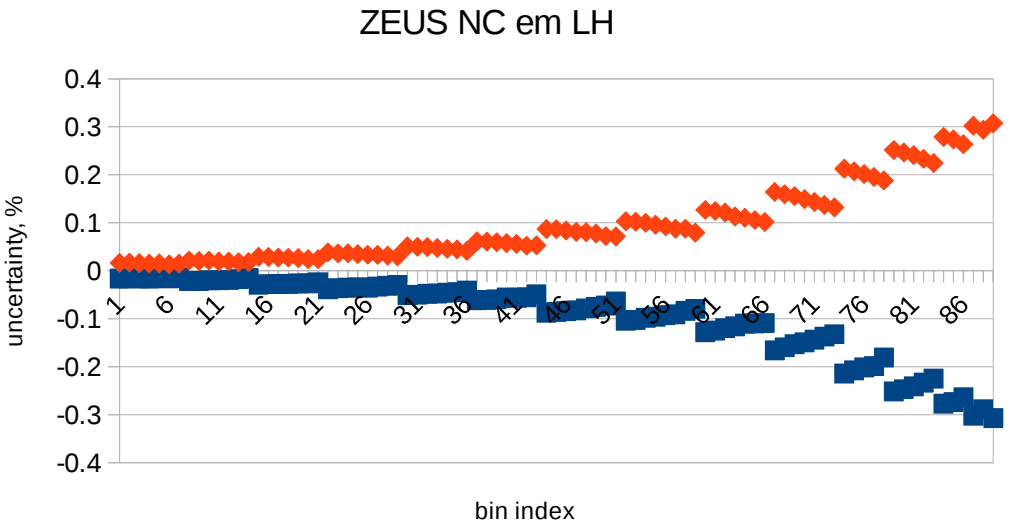
Polarisation uncertainty

	LPOL fraction	TPOL fraction	LPOL unc.,%	TPOL unc.%	full unc.,%
Ccem LH	0.36	0.64	3.6	4.2	3.984
Ccem RH	0.76	0.24	3.6	4.2	3.744
Ccep LH	0.36	0.64	3.6	4.2	3.984
Ccep RH	0.76	0.24	3.6	4.2	3.744
Ncem LH	0.36	0.64	3.6	4.2	3.984
Ncem RH	0.76	0.24	3.6	4.2	3.744
Ncep LH	0.36	0.64	4	4	4
Ncep RH	0.76	0.24	4	4	4

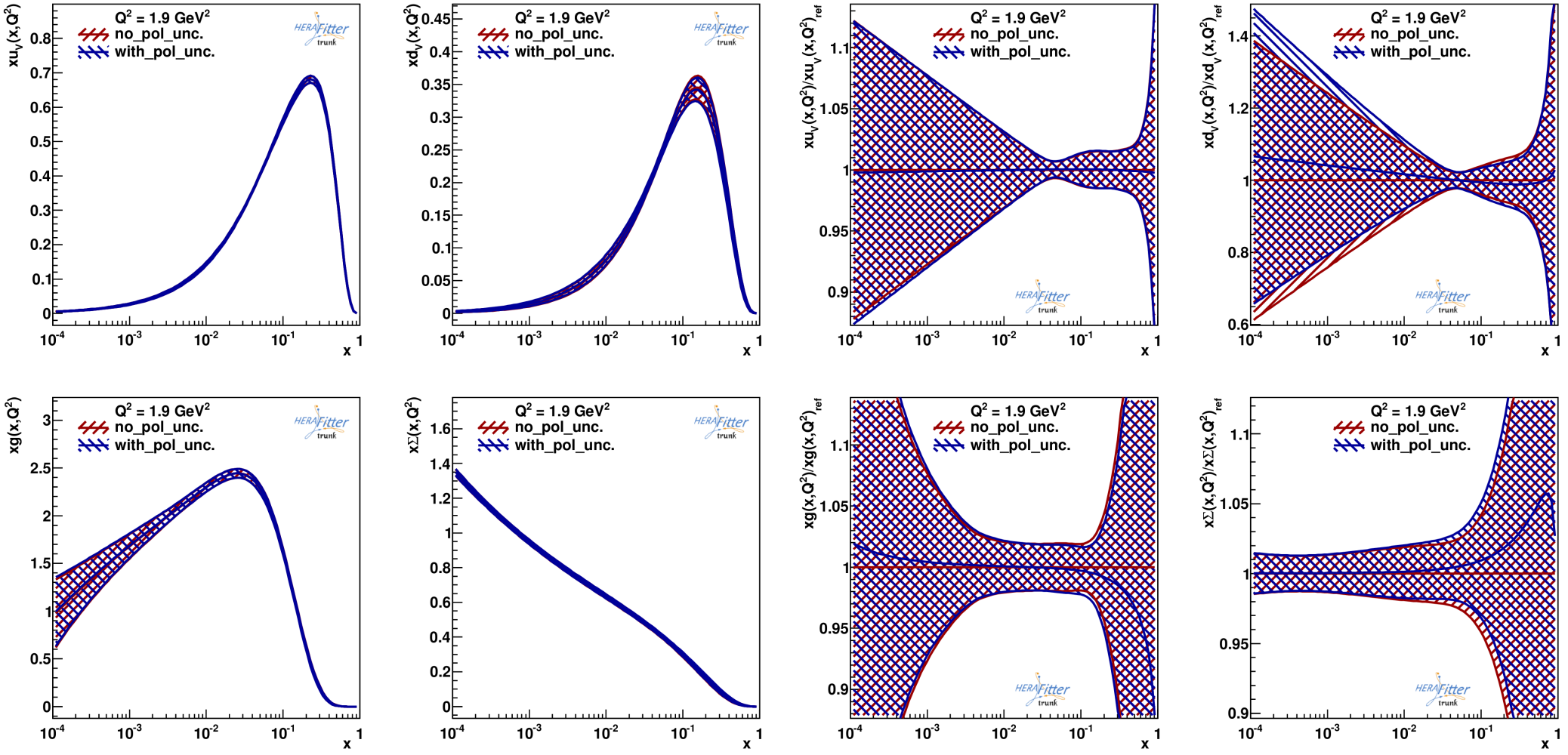
Almost ideally symmetric uncertainties → final numbers were symmetrised

Uncertainties are treated as correlated (bin-by-bin and between data sets corresponding to the same helicity of the same leptons).





Polarisation uncertainty:effect on EW fit



- Almost no change in the uncertainties.
- Chi2 changes from 3590 / 3231 to 3588 / 3231.

Correlation of systematic uncertainties

- Table of sys. unc. correlations was produced.
- Unc. were renamed according to their real meaning.
- Table will be placed in my thesis (and additional material for ZEUS-EW paper).
- So far the table is available on demand.

	LUMINOSITY			
ZEUS HERA2				
Ccem LH	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_em_LH_ZEUS	
Ccem RH	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_em_RH_ZEUS	
Ccep LH	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_ep_LH_ZEUS	δ_lumi_newest
Ccep RH	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_ep_RH_ZEUS	δ_lumi_newest
Ncem LH	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_em_LH_ZEUS	
Ncem RH	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_em_RH_ZEUS	
Ncep LH	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_ep_LH_ZEUS	δ_lumi_newest
Ncep RH	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_ep_RH_ZEUS	δ_lumi_newest
H1 HERA2(pol)				
Ccem LH			δ_lumi_em_LH_H1	δ_lumi_QEDcorr_H1
Ccem RH			δ_lumi_em_RH_H1	δ_lumi_QEDcorr_H1
Ccep LH			δ_lumi_ep_LH_H1	δ_lumi_QEDcorr_H1
Ccep RH			δ_lumi_ep_RH_H1	δ_lumi_QEDcorr_H1
Ncem LH			δ_lumi_em_LH_H1	δ_lumi_QEDcorr_H1
Ncem RH			δ_lumi_em_RH_H1	δ_lumi_QEDcorr_H1
Ncep LH			δ_lumi_ep_LH_H1	δ_lumi_QEDcorr_H1
Ncep RH			δ_lumi_ep_RH_H1	δ_lumi_QEDcorr_H1
ZEUS HERA2(unpol)				
Ccem	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_em_HERA2_ZEUS	
Ccep	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_ep_HERA2_ZEUS	δ_lumi_newest
Ncem	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_em_HERA2_ZEUS	
Ncep	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS	δ_lumi_ep_HERA2_ZEUS	δ_lumi_newest
H1 HERA2(unpol)				
Ccem			δ_lumi_em_HERA2_H1	δ_lumi_QEDcorr_H1
Ccep			δ_lumi_ep_HERA2_H1	δ_lumi_QEDcorr_H1
Ncem			δ_lumi_em_HERA2_H1	δ_lumi_QEDcorr_H1
Ncep			δ_lumi_ep_HERA2_H1	δ_lumi_QEDcorr_H1
ZEUS red Ep				
FL HER nominal	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS		δ_lumi_her_norm
FL HER satellite	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS		δ_lumi_her_sat
FL LER nominal	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS		δ_lumi_ler_norm
FL LER satellite	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS		δ_lumi_ler_sat
FL MER nominal	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS		δ_lumi_mer_norm
FL MER satellite	δ_lumi_BH_th	δ_lumi_HERA2_ZEUS		δ_lumi_mer_sat
H1 red Ep				
H1 HER NC med Q2	δ_lumi_BH_th			δ_lumi_lowq2_HER_H1
H1 HER NC low Q2	δ_lumi_BH_th			δ_lumi_lowq2_HER_H1
H1 MER NC high Q2	δ_lumi_BH_th			δ_lumi_mer_H1

Summary

- Polarisation values are updated according to the TPOL group recommendations.
- ZEUS HERA-II inclusive data files are updated for new pol. values.
- HERA-II inclusive data files are updated with uncertainties due to polarisation.
- Table of systematic uncertainties correlations are produced (available upon request).

Backup

Correction of the measured cross sections

- Brute force correction:

CC:
$$\sigma_{pol}^{\pm OLD} = \left(1 \pm P_{OLD}\right)\sigma_{unpol}$$

$$\sigma_{pol}^{\pm NEW} = \frac{\sigma_{pol}^{\pm OLD}}{1 \pm P_{OLD}}\left(1 \pm P_{NEW}\right)$$

NC:
$$\sigma_{pol}^{\pm} = H_{unpol}^{\pm} + P H_{pol}^{\pm}$$

Disadvantage: $H^{+/-}_{pol}$ stays unchanged.

$$\sigma_{pol}^{\pm NEW} = \frac{P_{NEW}}{P_{OLD}}\left(\sigma_{pol}^{\pm NEW} - \sigma_{unpol}^{\pm}\right) + \sigma_{unpol}^{\pm}$$

- Correction from QCD predictions (PDF → HERAPDF2.0)

$$\sigma_{pol}^{\pm NEW} = \frac{\sigma_{NEW\,P_e}^{pred}}{\sigma_{OLD\,P_e}^{pred}}\sigma_{pol}^{\pm OLD}$$