Future of DIS: Expectations from H1 and ZEUS

> DIS 2007, April 18, Munich Olaf Behnke (Heidelberg)

HERA: End of high energy run







HERA proton PDF --> LHC W production



Prediction using ZEUS-S-PDF



→ HERA u, d and gluon determine precision - how far can we improve this?

HERA observables and Proton PDFs

e+p and e-p NC and CC inclusive cross sections:

	$\sigma_{NC}^{\pm} \sim Y_+ F_2 \mp Y x F_3$							
		F_2	xF_3	σ_{cc}^+	σ_{cc}^-			
U=u+c+b	U	$4(\boldsymbol{U}+\bar{U})+(D+\bar{D})$	$\frac{2(U-\bar{U})+(D-\bar{D})}{2(D-\bar{U})}$	$\bar{U} + (1-y)^2 D$	$\frac{U}{U} + (1-y)^2 \bar{D}$			
D=d+s	D	$4(U+\bar{U}) + (\mathbf{D}+\bar{D})$	$2(U-\bar{U}) + (\mathbf{D}-\bar{D})$	$\bar{U} + (1-y)^2 D$	$U + (1-y)^2 \bar{D}$			
	\bar{U}	$\frac{4}{U}(U+\bar{U})+(D+\bar{D})$	$\frac{2(U-\bar{U})+(D-\bar{D})}{2(U-\bar{U})}$	$\overline{U} + (1-y)^2 D$	$U + (1-y)^2 \bar{D}$			
	\bar{D}	$4(U+\bar{U})+(D+\bar{D})$	$2(U-\bar{U}) + (D-\bar{D})$	$\bar{U} + (1-y)^2 D$	$U + (1-y)^2 \overline{D}$			

HERA weak points: dbar-ubar asymmetry, s

H1 PDF2000 and H1 PDF-Final

H1 PDF 2000

H1 PDF-Final



Datasets	Q^2 [GeV ²]	L [pb ⁻¹]	
NC MB99/SVX00	0.2-8.5	0.5-2	-
NC e+p 00	10-150	28	
NC e+-p 03/07	~ 20 -150	350	
NC/CC e+p 03-07	>150	190	
NC/CC e-p 03-07	>150	170	
DIS jets 94-07	>150	470	
γp dijets 94-07	0	470	
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Something extremely nice

Many systematic challenges, but still also some statistical limitations

xF₃ and valence quark densities



QCD fit prospects

Study by C. Gwenlan, A. Cooper-Sakar, C. Targett-Adams, HERA-LHC proceedings

Assumptions:

- → 700 pb⁻¹ Lumi at HERA II ≈ reached by combining H1+ZEUS
- Only statistical improvements, no systematical







Analysis of H1 2000 Data





Gluon density determination



Gluon density from F_2 scaling violations



Gluon from jets



α_{s} determination from Jets





Gluon density from F_2^{cc} alone







LHC luminosity monitor: Z⁰ production
→ gg -> bb -> Z⁰ is 5% contribution
→ Must be known at 20% for 1% accuracy

HERA I: H1 displaced tracks:

$Q^2 [GeV^2]$	σ_{stat}	σ _{sys}	σ_{tot}
25	~20%	~20%	~30%
650	~40%	~25%	~50%

HERA II projection:

$Q^2 [GeV^2]$	σ_{stat}	σ_{sys}	σ_{tot}
25	~10%	~10%	~15%
650	~20%	~20%	~30%

+ ZEUS! + other tagging

→ 20% goal seems reachable

Assembly of final HERA PDF (H1 & ZEUS)



Sea and gluons at low x: Further Improvements (not shown here) from inclusive low Q^2 data: \rightarrow H1 2000 data (~28 pb⁻¹) - F₂ improvement up to factor 2

- → 300 pb⁻¹ HERA II Q² > 20 GeV² on tape, extreme systematic challenge
- →H1 & ZEUS weighted average of 96/97 data-> Reduce dramatically the systematics

The hadronic final state:

A wealth of information on the proton and on QCD

to be revealed with the new HERA II data:

- Diffraction:
 - DVCS: access to transverse degrees of freedom in proton
 - High precision diffractive PDFs -> predictions for LHC
 - Vector mesons at highest t -> Test of BFKL dynamics
- Jets and particles:
 - Dijets: How well can we determine 'intrinsic kt' of gluon in p?
 - Multiple interactions/underlying event: Potential to tune models for LHC with HERA data?
 - Identified particle spectra and fragmentation

20.3.2007: End of the HERA II high Ep run, yielded ~360 pb⁻¹ per experiment H1 and ZEUS have collected together ~1 fb⁻¹ good HERA data

- Now write the "HERA handbook" of Highest precision proton gluon and quark densities (improvements at hand often factor ~2, sometimes much more)
- Complete the HERA mission: Low E_p data are taken now for direct F_L measurement

