TESTING THE ELECTROWEAK STANDARD THEORY AND MEASURING STRUCTURE FUNCTIONS AND QUARK DISTRIBUTIONS AT HERA

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PHE 87-3; CONTR. TO HERA PHYSICS WORKING GROUPS

- EW. TESTS (HAIDT, RÜCKL)
- STRUCTURE FUNCTIONS & DIS (FELTESSE, INGELMANN)

1. INTRODUCTION
2. BASIC RELATIONS
3. TESTS OF THE EW-THEORY (GWS): STATISTICAL & THEOR. ERRORS
4. TESTING EXTENSIONS OF THE STANDARD THEORY
5. STRUCTURE FUNCTIONS & QUARK DISTRIBUTIONS : ep
6. STRUCTURE FUNCTIONS : THE DEUTERON OPTION
7. CONCLUSIONS

ELECTROWEAK TESTS

A. EXPERIMENTAL OPTIONS

0. $\lambda = 0$, $e^{\pm}$-MEASUREMENT, $Y > .1 \longrightarrow B(0)$

M_Z = const.

$\Delta \sin^2\theta_W = .041$

$\Delta M_W = 2.1 \text{ GeV } c^{-2}$

$\mathcal{L}_{tot} = 200 pb^{-1}$
(e^+, e^- – each $100 pb^{-1}$)

1. JET-MEASUREMENT CC & NC, $Y > .01$

   $R_-(0)$

2. —— " —— & $|\lambda| \lesssim .8$ $R_-(\lambda), A_-(\lambda)$

FIGS.

WA: $Q^2 > 500$ $R_- < 50$, $\geq 2\%$ CC, 5% A^-.

$x > .1$ RED. SEA UNCERTAINTY

$Y > .01$ JET'S & e- MEASUREMENT

$|\lambda| = .8$ ($Y > .1$, e-MEASUREMENT ONLY)

TOOLS OF INVESTIGATION

(i) STANDARD MODEL TESTS AT HIGH SPACELIKE Q^2

$$SU_3^c \times [SU_2^L \times U_1^Y]$$

(ii) SEARCH FOR NOVEL PHENOMENA (CASHMORE REPORT)

→ DEVIATIONS IN INCLUSIVE DISTRIBUTIONS
(STRUCTURE FUNCTIONS)

→ NEW (EFFECTIVE) COUPLINGS AT HIGH Q^2

→ INDIVIDUAL EVENTS WITH NEW SIGNATURES

$\boxed{\text{INTRODUCTION}}$

HERA : STUDY OF $e^{\pm}(\lambda)\,p$ - COLLISIONS
IN 2 EXPERIMENTS : H1 & ZEUS

AT : $4 \cdot E_e \cdot E_p = 4 \times 30 \times 820 \text{ GeV}^2 = S$

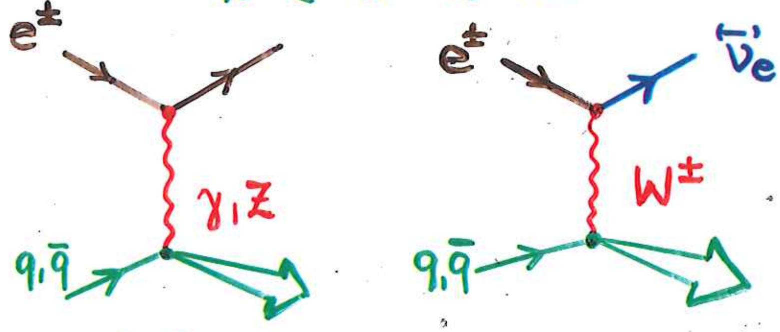
$\mathcal{L} = 1.5 \ldots 2 \cdot 10^{31} \text{ cm}^{-2} \text{sec}^{-1}$

$\longrightarrow \int dt\, \mathcal{L} = \underline{200\, pb^{-1}}$ in 154 ... 116 days

$\sqrt{S} = 315 \text{ GeV}$

$30 \leq Q^2 \leq 30000 \text{ GeV}^2$

$10^{-4} \leq x \leq .8$



NC CC

$|\lambda_e| \lesssim .8$ (d- TARGET ?)

BASIC RELATIONS

A. CROSS SECTIONS

$$\frac{d^2\sigma^{\pm}_{NC}}{dx\,dQ^2} = \frac{2\pi\alpha^2}{Q^4x}\Big\{Y_+\big[F_2 + \underset{\uparrow\ |\gamma Z|}{k_Z C_1 G_2} + \underset{\uparrow\ |Z|^2}{k_Z^2 C_2 H_2}\big]$$

$$+\,Y_-\big[\underset{\uparrow\ |\gamma|^2}{}\ \ k_Z C_3 x G_3 + k_Z^2 C_4 x H_3\big]\Big\}$$

$$\frac{d^2\sigma^{\pm}_{CC}}{dx\,dQ^2} = \frac{2\pi\alpha^2}{Q^4x}\,k_W^2\,\frac{1\mp\lambda}{2}\left\{Y_+W_2^{\pm} \pm Y_-\,xW_3^{\pm}\right\}$$

$$Y_+ = 2-2y+y^2/(1+R)\quad ; \quad Y_- = 1-(1-y)^2$$

$$C_i = C_i(v_j, a_j, \lambda)$$

$$v_j = I^L_{3j} - 2Q_j\sin^2\theta$$

$$a_j = I^L_{3j}$$

B. STRUCTURE FUNCTIONS

NC

S: $(F_2, G_2, H_2) = x \sum (q+\bar{q}) \{Q_q^2, 2 Q_q v_q, v_q^2 + a_q^2\}$

NS: $(xG_3, xH_3) = x \sum (q-\bar{q}) \{Q_q a_q, v_q a_q\}$

CC

S: $(W_2^+, W_2^-) = (x \sum d_i + \bar{u}_i, \; x \sum u_i + \bar{d}_i)$

NS: $(xW_3^+, xW_3^-) = (x \sum d_i - \bar{u}_i, \; x \sum u_i - \bar{d}_i)$

9 STRUCTURE FUNCTIONS FROM

≈ 6 PARTON DISTRIBUTIONS

$u_v, d_v, u_s = d_s, s, c, b, \cancel{t}$ at HERA (EHLQ $_{\text{NEW}}$)

C. PROPAGATORS

$$K_Z(Q^2) = \frac{Q^2}{Q^2 + M_Z^2} \; \frac{1}{4 s_\theta^2 c_\theta^2}$$

$$K_W(Q^2) = \frac{Q^2}{Q^2 + M_W^2} \; \frac{1}{4 s_\theta^2}$$

D. ELECTROWEAK PARAMETERS

$$\{\alpha, g, G_F, M_W, M_Z, s^2_\theta\}$$

GWS:

$$\boxed{\text{3 INDEPENDENT PARAMETERS!}}$$

α, G_F or $M_{Z,LEP}$ FIX, MEASURE:

M_W OR $\sin^2\theta$ OR g, ...

$$\sin^2\theta = \sin^2\theta(\alpha, G_F, M_W)$$
$$g = g(\alpha, G_F, M_W)$$
$$\vdots$$

etc.

E. OBSERVABLES

100 pb^{-1} each

$$A^-(\lambda) = \frac{\sigma_{NC}^-(-\lambda) - \sigma_{NC}^-(\lambda)}{\sigma_{NC}^-(-\lambda) + \sigma_{NC}^-(\lambda)}$$

$$R^-(\lambda) = \frac{\sigma_{NC}^-(\lambda)}{\sigma_{CC}^-(\lambda)}$$

200 pb^{-1} each

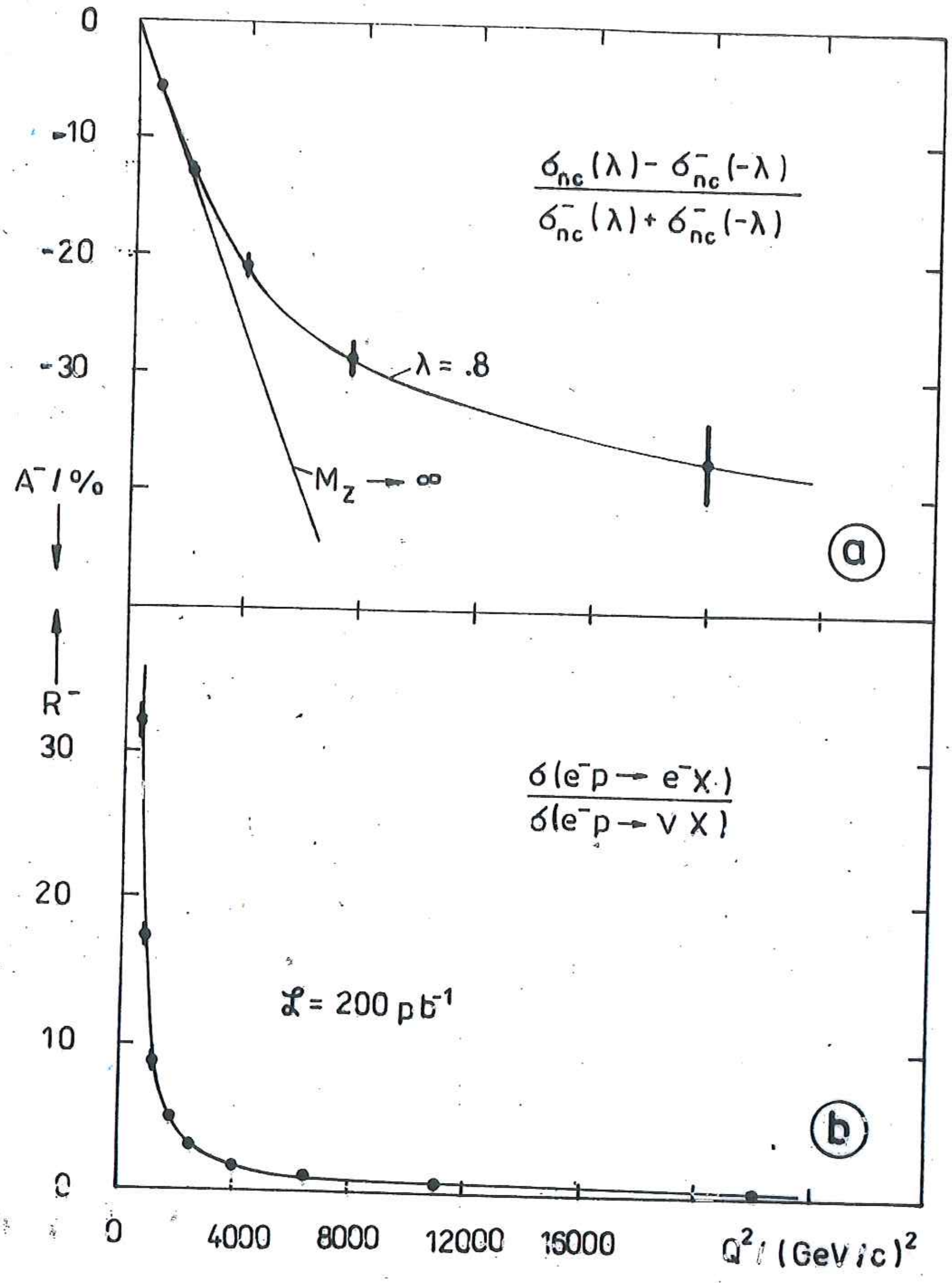
$$B(\lambda) = \frac{\sigma_{NC}^+(-\lambda) - \sigma_{NC}^-(\lambda)}{\sigma_{NC}^+(-\lambda) + \sigma_{NC}^-(\lambda)}$$

ONLY e's
$\lambda = 0$ FINITE

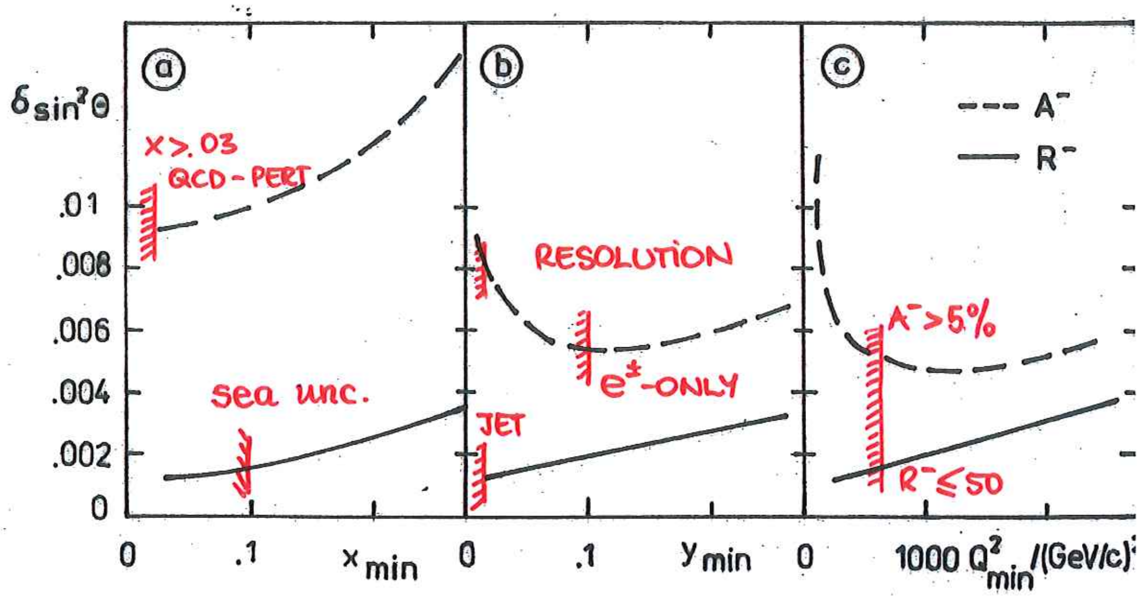
$A^+ \longrightarrow I_{3Re}$

OTHER CHOICES ARE EQUALLY POSSIBLE, STAT. ERRORS ARE GREATER I.G.

FIG.



0
-10
-20
-30
A⁻ / %
$\frac{\sigma^-_{nc}(\lambda) - \sigma^-_{nc}(-\lambda)}{\sigma^-_{nc}(\lambda) + \sigma^-_{nc}(-\lambda)}$
λ = .8
$M_Z \to \infty$
a
R⁻
30
20
10
0
$\frac{\sigma(e^- p \to e^- X)}{\sigma(e^- p \to \nu X)}$
$\mathcal{L}$ = 200 pb⁻¹
b
0
4000
8000
12000
16000
Q^2 / (GeV/c)²



M_Z = CONST.

OMS

Fig. 2

MADE USE OF MC-CALCULATIONS OF THE H1-RESOLUTIONS FOR

E_{JET}, θ_{JET} ; E_e, θ_e (J. FELTESSE '85 '86)

: H1 PROPOSAL MARCH 1986

B. STATISTICAL PRECISIONS: 1 PARAMETER FITTED

Tab. 1

fixed / error	s^2_Θ	M_Z	M_W	G_F
$\delta \sin^2\Theta$ A^- R^-	-	$\boxed{.005}$ $\boxed{.002}$ *)	$\boxed{.005}$ $\boxed{.002}$	.007 *) .005
δM_Z/GeV	3.02 .51	-	$\boxed{.25}$ $\boxed{.10}$	1.09 .76
δM_W/GeV	2.53 .45	$\boxed{.27}$ $\boxed{.10}$	-	1.38 .95

M_Z^{LEP} ↑

Statistical errors of $\sin^2\Theta$, M_Z, M_W in one-parameter fits assuming $\boxed{\alpha}$ and either s^2_Θ, M_Z, M_W or G_F, rep., to be fixed. The upper values refer to A^- and the lower ones to R^- at $/\lambda/ = .8$, $L = 200\ pb^{-1}$.

*) A RECENT ANALYSIS (APRIL 1987) BY D. HAIDT & H. PAUL HAS CONFIRMED THESE VALUES.

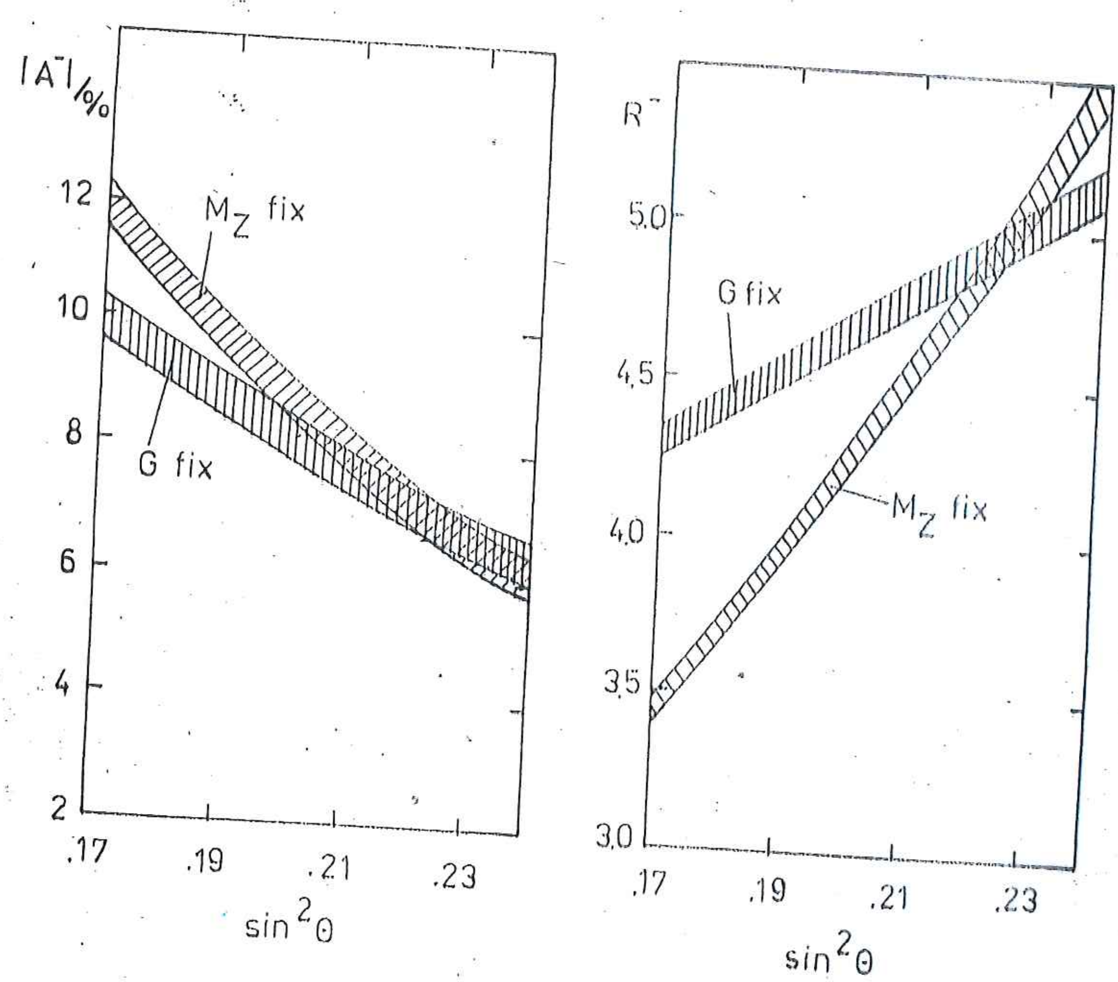

|A⁻|/%
12
10
8
6
4
2
M_Z fix
G fix
.17
.19
.21
.23
sin²Θ
R⁻
5.0
4.5
4.0
3.5
3.0
G fix
M_Z fix
.17
.19
.21
.23
sin²Θ

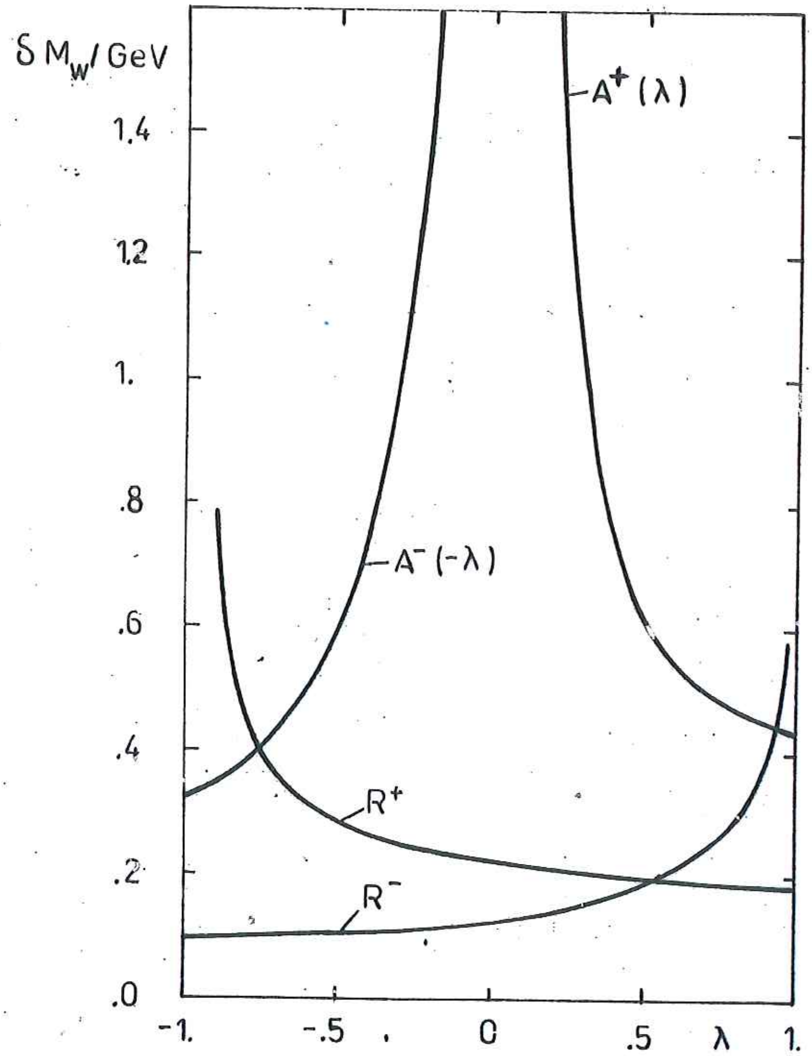
Fig. 2

FIXING: α, $\sin^2\theta$ AND FITTING EITHER M_W OR M_Z:

R_-: $\Delta M_W = \pm 450$ MeV, $\Delta M_Z = \pm 3$ GeV

A_-: $\Delta M_Z = \pm 5.6$ GeV

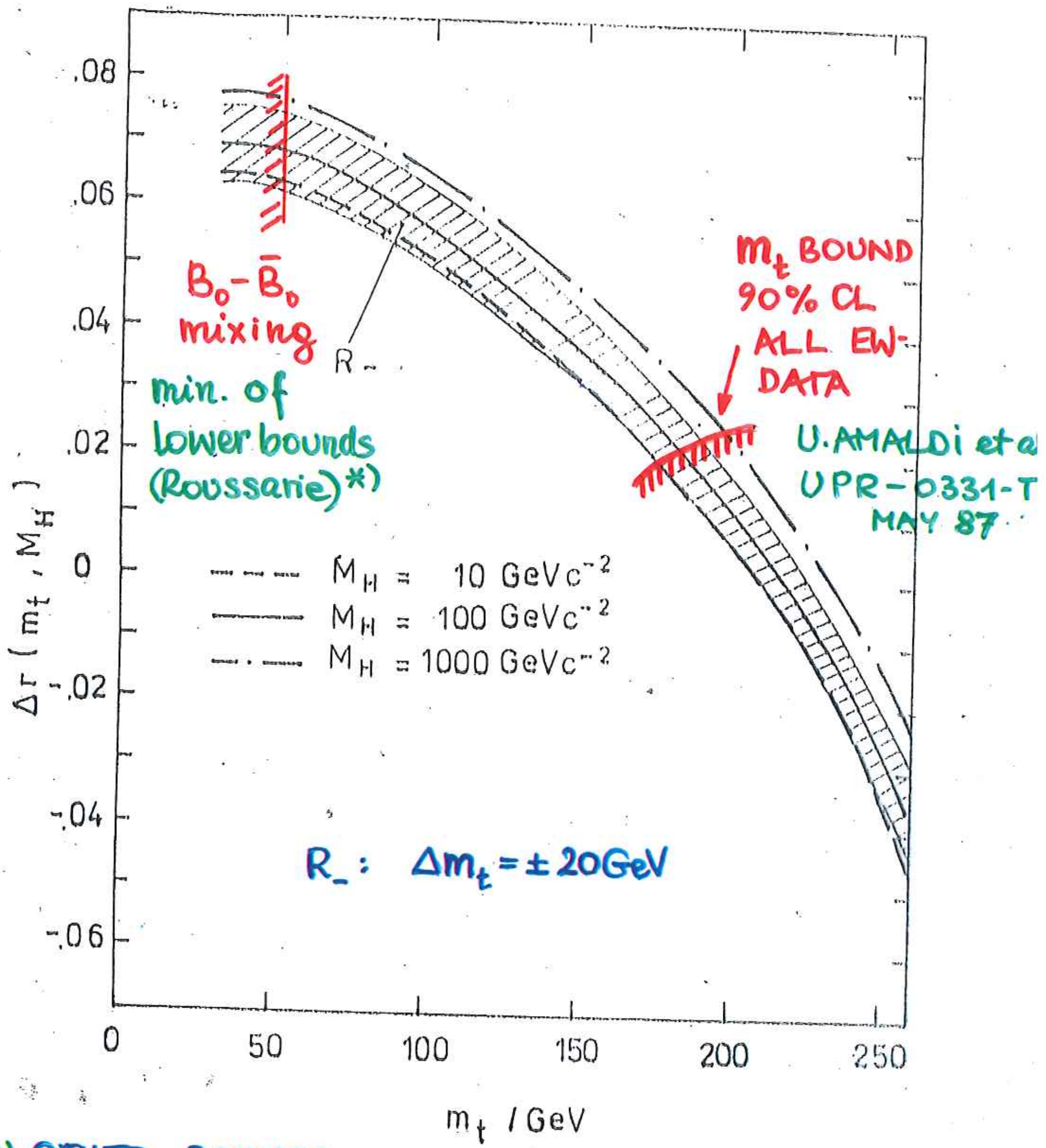
C. POLARIZATION EFFECTS



λ

	$\|\lambda\| = .8$		$\lambda = 0$	
ΔM_W :	.104 GeV	$\longrightarrow$	.130 GeV	R_-
Δs^2_θ :	.002	$\longrightarrow$	.0023	R_-

D. BOUNDING m_T & m_H

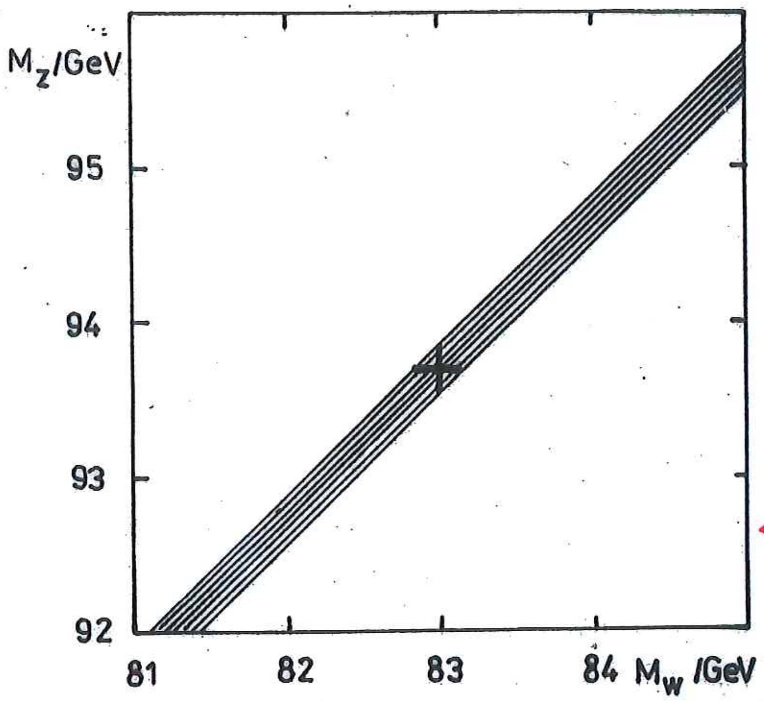


*) OTHER BOUNDS: BIGI, ELLIS et al., ROOS et al.

Fig. 5

E. TWO PARAMETER FITS

e.g.
Fix α, FIT M_W & M_Z.



R_- (λ=.8)

STRONG CORRELATION

$\Delta M_{W,Z} \sim 5 \ldots 10$ G

Fig. 4

- DO THE ERROR CONTOURS FOR A_-, R_- INTERSECT IN A WAY THAT DIMINISHES THE GLOBAL ASYM. ERRORS ?

$\longrightarrow$ AT HERA NOT.

$|Z|^2 \ll |\gamma|^2 + |\gamma Z|$ $\qquad Q^2 \ll M_W^2, M_Z^2$

$$R_- = \kappa_W^2 \phi_1 \longrightarrow \kappa^2 \phi_1$$

$$A_- = \kappa_Z \phi_2 \longrightarrow \kappa \phi_2 + O(\kappa^2), \quad \kappa^2 \ll \kappa^1 !$$

$$\delta R_- \sim 2\kappa \phi_1 \left\{ (\partial_{x_1} \kappa)^2 \delta x_1^2 + (\partial_{x_2} \kappa)^2 \delta x_2^2 \right\}^{1/2}$$

$$\delta A_- \sim 2\phi_2 \left\{ (\partial_{x_1} \kappa)^2 \delta x_1^2 + (\partial_{x_2} \kappa)^2 \delta x_2^2 \right\}^{1/2}$$

$\longrightarrow$ NEARLY PARALLEL ERROR CONTOURS

UNCERTAINTIES OF THE ANALYSIS

Tab. 2

A. PARAMETER-FIXING:

Fixed \ Fitted	$\delta \sin^2 \theta_W$		δM_Z/GeV		δM_W/GeV	
	A^-	R^-	A^-	R^-	A^-	R^-
$\Delta \sin^2\theta_W = .001$	-	-	$-.58$ $+.57$	$\mp .26$	$-.54$ $+.53$	$\mp .28$
LEP: $\Delta M_Z = \pm 50$ MeV	$\pm .0001$	$\pm .0002$	-	-	$+.05$ $-.04$	$\pm .05$
$\Delta M_W = \pm 50$ MeV	$\mp .0001$	$\mp .0002$	$+.04$ $-.05$	$\pm .05$	-	-

Errors in $\sin^2 \theta_W$, M_Z, M_W due to the experimental error of fixed input quantities.

B. $R = \sigma_L / \sigma_T$

$R = 0 \longrightarrow R = .1$

A_- : $\Delta s^2_\theta = .0003$

R_- : $\Delta s^2_\theta = .0008$

C. m_q finite (m_b) ($Q^2 > 500$ GeV^2)

(m_c is already massless at this Q^2.)

R_- : $\Delta s^2_\theta = .0001$

D. PARTON DISTRIBUTIONS

10% CHANGES OF EITHER u_v, d_v, s INDUCE:

δs_θ^2	s	u_v	d_v
A_-	$\mp .0003$	$\mp .0014$	$\pm .0011$
R_-	$\pm .0017$	$\mp .0031$	$\pm .0015$

DO, $\Lambda = .2$ GeV

$\sin^2\theta = .217$

AN ANALYSIS OF THE MEASUREMENT OF F_2 AND $\sigma_{CC}^+/\sigma_{CC}^-$ SHOWS, THAT THESE QUANTITIES CAN BE CONTROLLED ON THE LEVEL OF $\Delta/Q \sim 5\%$, I.E. THE PARTON-DISTRIBUTION UNCERTAINTIES ARE LESS THAN THE STAT. PRECISION.

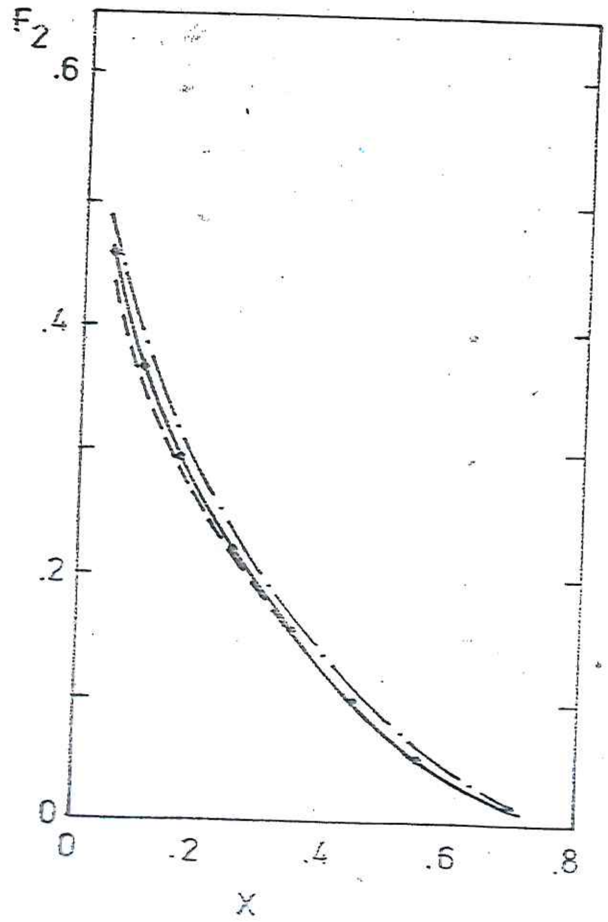


Fig.6

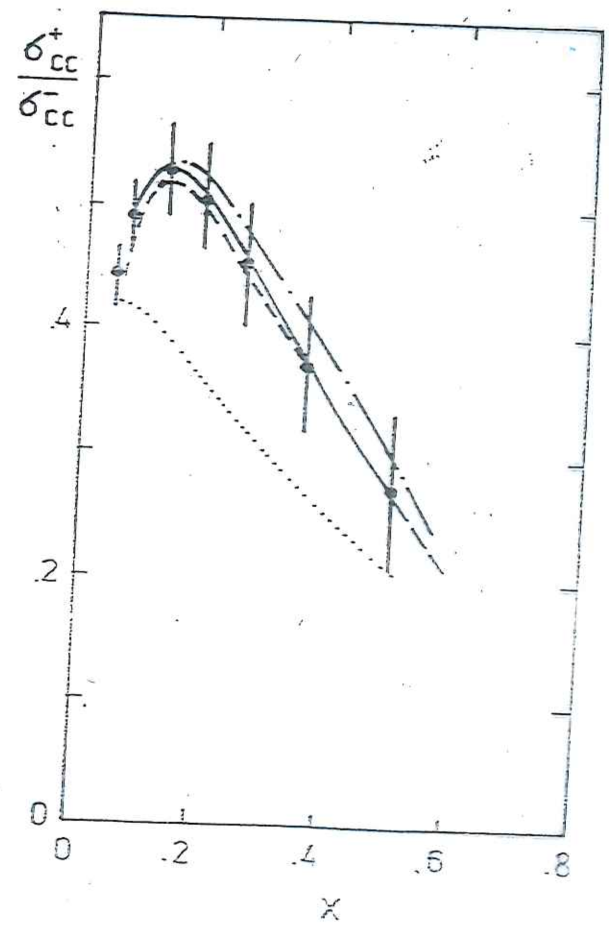


Fig. 7

EW-TESTS BEYOND GWS

A. ϱ AS INDEPENDENT PARAMETER IN OMS

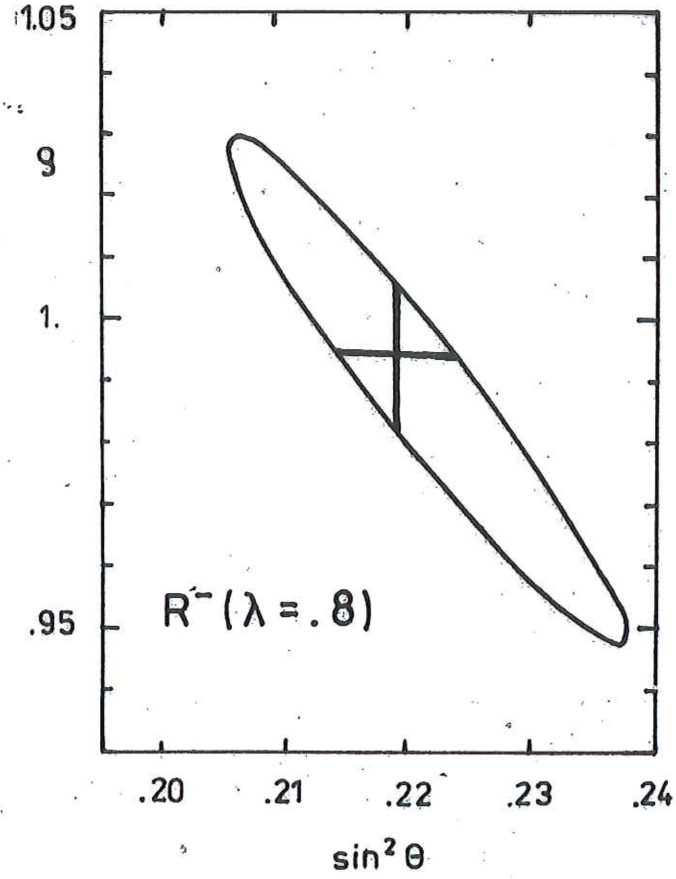


Fig. 8

$|\lambda| = .8$

PARABOLIC ERROR: $\delta\varrho = .01$

FIXING $\sin^2\theta = \sin^2\theta_{LEP}$: $\delta\varrho = .003$

B. FINITE R.H-ISOSPIN COMPONENTS

$$v_i = I_{3Li} - 2Q_i \sin^2\theta_W + I_{3Ri}$$
$$a_i = I_{3Li} \qquad\qquad\qquad - I_{3Ri}$$

$\leftarrow$ GWS $\equiv 0$

$i \in [u, d, e]$

HIGHEST SENSITIVITY : $A_{\pm}$ ($|\lambda| \rightarrow .8$)

i	δI_{3Ri}	
	$A^-(.8)$	$A^+(.8)$
u	.016	.015
d	.034	.036
e	.056	.030

C. ADDITIONAL W'S OR Z'S

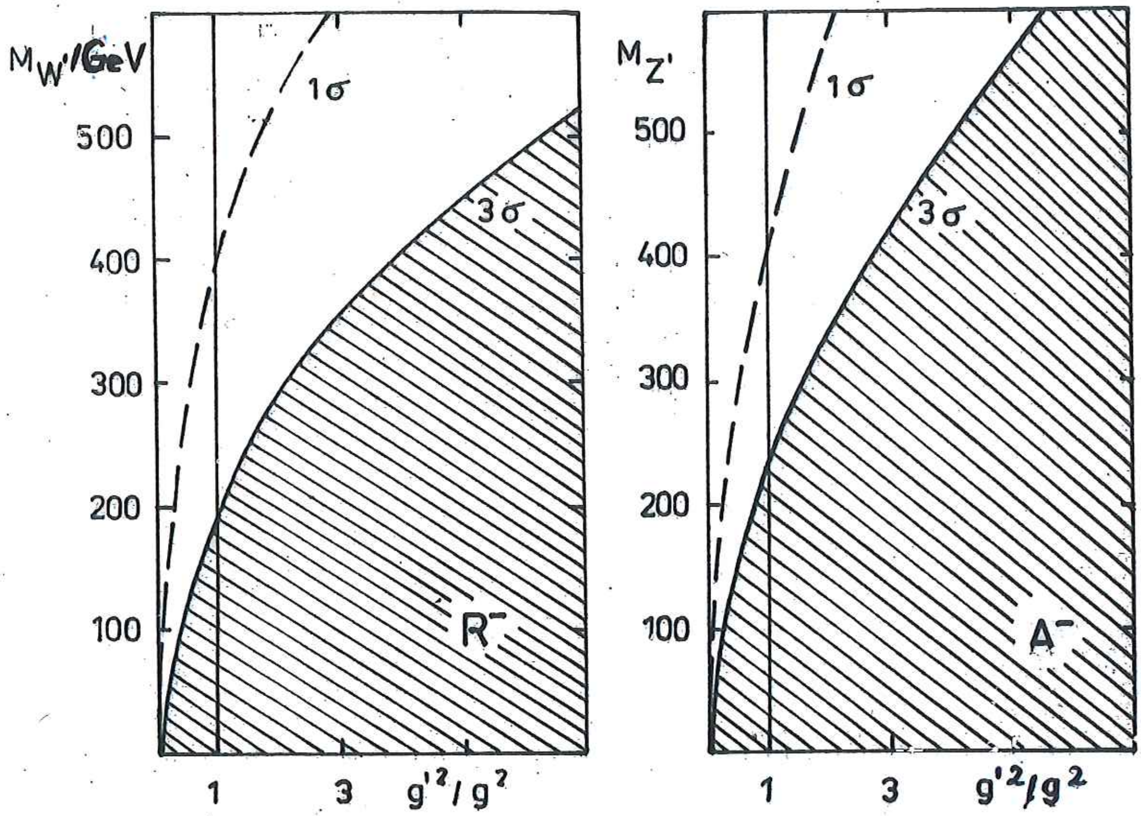


Fig. 8

$$K(Q^2) = g^2 \frac{M^2}{M^2+Q^2} + g'^2 \frac{M'^2}{M'^2+Q^2}$$

$M = M_W, M_Z$

D. COMPOSITENESS SCALE OF W's & Z's

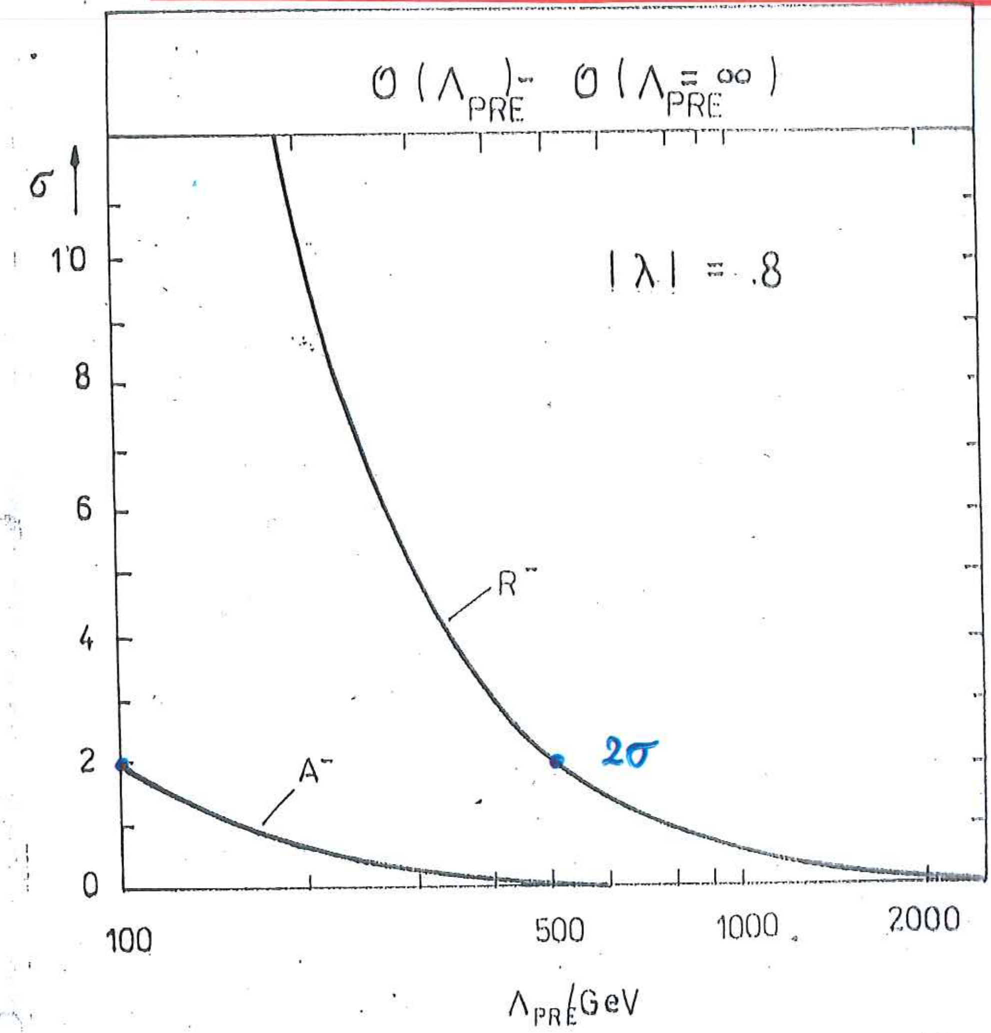


Fig.10

$$K_{Z,W} = K_{Z,W} \cdot 1/(1+Q^2/\Lambda_{PRE})$$

MEASUREMENT OF STRUCTURE FUNCTIONS: $e^{\pm}p$

NC: $B_{\pm}(\lambda) = \frac{1}{2}[\sigma_{NC}^{+}(\lambda) \pm \sigma_{NC}^{-}(\lambda)]$ (KLEIN, RIEMANN '8

$$B_{+} \cdot \frac{Q^4 x}{2\pi\alpha^2 Y_{+}} = F_2 + f_1(\kappa_Z, G_2, H_2, \lambda)$$

CONTR. VANISHES FOR $\lambda = v/a \approx 0$

- CONTAINS ONLY SINGLET FUNCTIONS
- COUPLINGS, κ's CAN NOT BE SEPARATED AS FACTORS (cf. $e^{\pm}D$)

FIG.

$$B_{-} \frac{Q^4 x}{2\pi\alpha^2 Y_{-}} \frac{1}{\kappa_Z} = xG_3 + f_2(\kappa_Z, xH_3, \lambda)$$

SMALL

CONTR. VANISHES FOR $\lambda = 2va/(v^2+a^2)$

- CONTAINS ONLY NON-SINGLET FUNCTIONS

FIG.

CC: 4 STRUCTURE FUNCTIONS $W_2^{\pm}, xW_3^{\pm}$ VS. 2 CROSS SECTION

(B.) MEASUREMENT OF STRUCTUREFUNCTIONS

- MORE SIZEABLE EFFECTS (NO RATIOS OF CROSS SECTIONS)
- RC_{1L} HAS TO BE CORRECTED FOR TO MEASURE E.G. F_2, I.E. $\Delta\sigma_{1L}(x,y)/\sigma_{1L}(x,y) \lesssim 30\%$

$\rightarrow$ CONSTRAINS (x,y) TO MEDIUM VALUES

RADIATIVE CORRECTIONS

∃ CALCULATIONS OF: $\frac{d\sigma^{tr}}{dxdy} \cdot (1 + RC_{1L}(x,y))$ BY:

STILL NOT IN AGREEMENT
- BÖHM & SPIESBERGER (WÜRZBURG UNIV.)
- BARDIN, FEDORENKO, RIEMANN et al. (DUBNA)

EARLY '80ies

RECALCULATION $\lessapprox$ JUNE 1987

- MÖHRING, KRIPFGANZ (LEIPZIG UNIV.) (PARTS ONLY)

⋮

EFFECTS ON:

(A.) TESTS OF EWTHY:
$$\begin{cases} A_\pm \longrightarrow A^{tr}_\pm (1 + \delta_{1L} A_\pm) \\ R_\pm \longrightarrow R^{tr}_\pm (1 + \delta_{1L} R_\pm) \end{cases}$$

(DIFFERNCE,) & RATIOS

$m_t, m_H, (x,y)$-cu

~(PARTON DISTR'S

$$S^2_{\theta tt} \longrightarrow S^2_{\theta tt} + \Delta S^2 (m_t, m_H, x_c, y_c; x\overleftrightarrow{q}_i)$$

$$M_W^{tr} \longrightarrow M_W^{tr} + \Delta M_W(\ldots)$$

⋮

LET $\{Q_i \pm \Delta_i\}_{i=1}^{N}$ BE MEASUREMENTS OF Q. $\langle Q \rangle \pm \Delta$ IS THEN OBTAINED BY

$$\langle Q \rangle \pm \Delta = \sum_i \frac{Q_i}{\Delta_i^2} \Big/ \sum_i \frac{1}{\Delta_i^2} \pm 1 \Big/ \left(\sum_i \frac{1}{\Delta_i^2}\right)^{1/2}$$

Q_i ENTERS $\langle Q \rangle$ WITH THE WEIGHT $\frac{1}{\Delta_i^2}$

THE FITTING PROCEDURE

- CALCULATE : A_-, R_- FOR THE x & Q^2-BINS
- DEFINE : $\chi^2 = \sum_{\text{BINS}} \left[\frac{Q_i - Q(i; EW_1, EW_2, EW_3)}{\Delta Q_i} \right]^2$
- MINIMIZE : χ^2 FIXING : EW_2 & EW_3 VARYING EW_1.

→ $EW_1 \pm \Delta EW_1$

$$\Delta EW_1 \approx \left[2 / [\partial^2 \chi^2 / \partial EW_1^2] \right]^{1/2} = \frac{\partial EW_1}{\partial Q} \left(\sum_i \Delta Q_i^{-2} \right)^{-1}$$

THE VALUE OF $\frac{\partial Q}{\partial EW}$ DOES STRONGLY DEPEND ON $Q = Q(EW)$.

(A. BÖHM, JB MK TR, HIOKI)

$e^+e^- \to : s_\theta^2$

: THE RATIO OF A DISPLACEMENT (BIAS) OF E

$$Q_{meas} \to Q_{nature} + \Delta$$

$$\delta E_{meas} = \frac{\partial E}{\partial Q} \Delta$$

AND ΔE_{STAT} DEPENDS NOT ON $\frac{\partial E}{\partial Q}$ (J. KÜHN)

EW-TESTS BEYOND GWS

SUMMARY: (DETAILS IN: PHE 87-3)

A: $\rho_{(OMS)}$ AS INDEPENDENT PARAMETER

$\rho - \sin^2\theta$: $\delta\rho = .01$, $\delta \sin^2\theta = .006$, R_-

ONLY ρ : $\delta\rho = .003$

B: I_3^R :

e	$A^+(.8)$	.030
u	$A^+(.8)$	.015
d	$A^-(.8)$	.034

C: W' R^- $\geq 3\sigma$ SENSITIVE $M_{W'} < 200$ GeV

Z' A^- $\geq 3\sigma$ $M_{Z'} < 240$ GeV

D: $\Lambda^{W,Z}_{PRE}$ R^- A^- $\geq 2\sigma$ SENSITIVE $\Lambda < 500$ GeV

$\Lambda < 100$ GeV

DEUTERONS AT HERA

NC: $$F_2^{eN} = \frac{Q_u^2 + Q_d^2}{2} \sum_i (xq + x\bar{q}) + \frac{Q_u^2 - Q_d^2}{2} 2x(c-s)$$

SIMILAR FACTORIZATION OF COUPLINGS FOR : $B_+(\lambda)/Y_+ \cdot Q^4 x / 2\pi\alpha^2$

- CONTAINS SINGLET FUNCTIONS ONLY
- PROPAGATORS FACTORIZE IF ONE CORRECTS FOR $(c-s)$

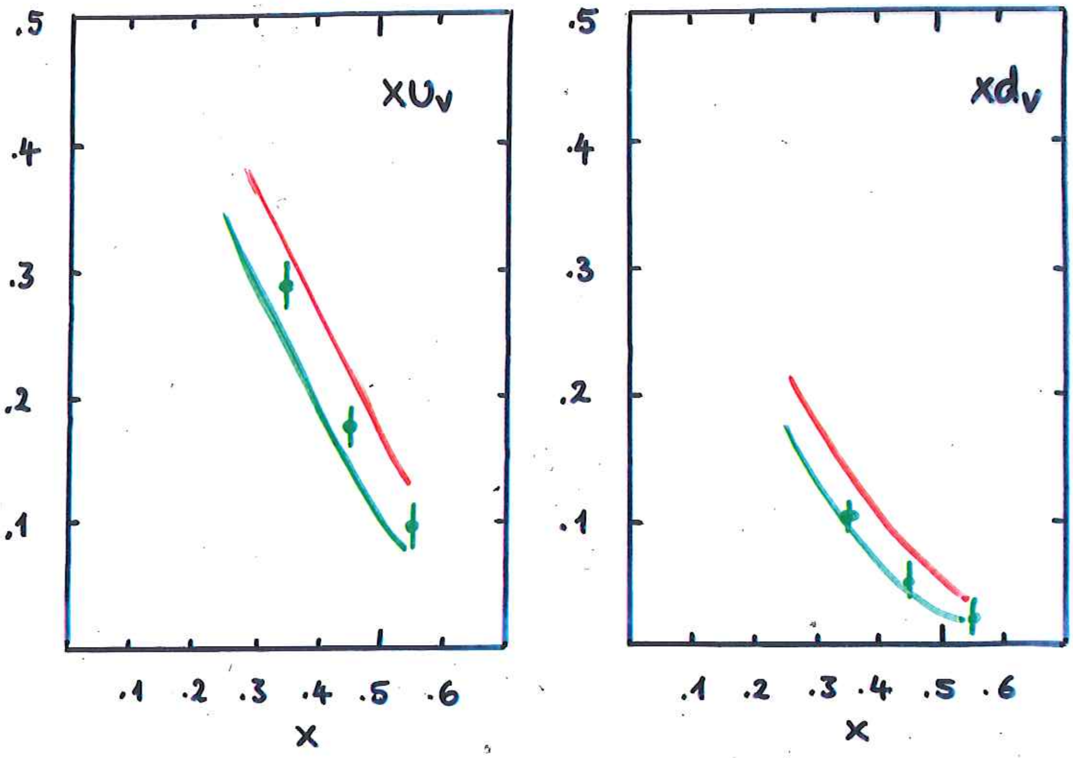
FIG.

$$xG_3 = (Q_u a_u + Q_d a_d) \times (u_v + d_v)$$

SIMILARLY : $B_-(\lambda)/Y_- \, K_Z \, Q^4 x / 2\pi\alpha^2$

FIG.

VALENCE APPROXIMATIONS



$\sigma^{\pm}_{nc}$, $\sigma^{\pm}_{cc}$, $x \gtrsim .3$

RECONSTRUCTION OF QUARK DISTRIBUTIONS : $e^{\pm}p$

9 STRUCTURE FUNCTIONS

6 QUARK DISTRIBUTIONS

$\boxed{4}$ CROSS SECTIONS $\sigma_{NC}^{\pm}, \sigma_{CC}^{\pm}$

MAP : $\begin{pmatrix} \sigma_{NC}^{+} \\ \sigma_{NC}^{-} \\ \sigma_{CC}^{+} \\ \sigma_{CC}^{-} \end{pmatrix} \xrightarrow[A_{ij}]{} \begin{pmatrix} \Sigma u \\ \Sigma d \\ \Sigma \bar{u} \\ \Sigma \bar{d} \end{pmatrix}$

$$\det_4 A_{ij} \sim K(Q^2)\,[1-(1-y)^4]$$

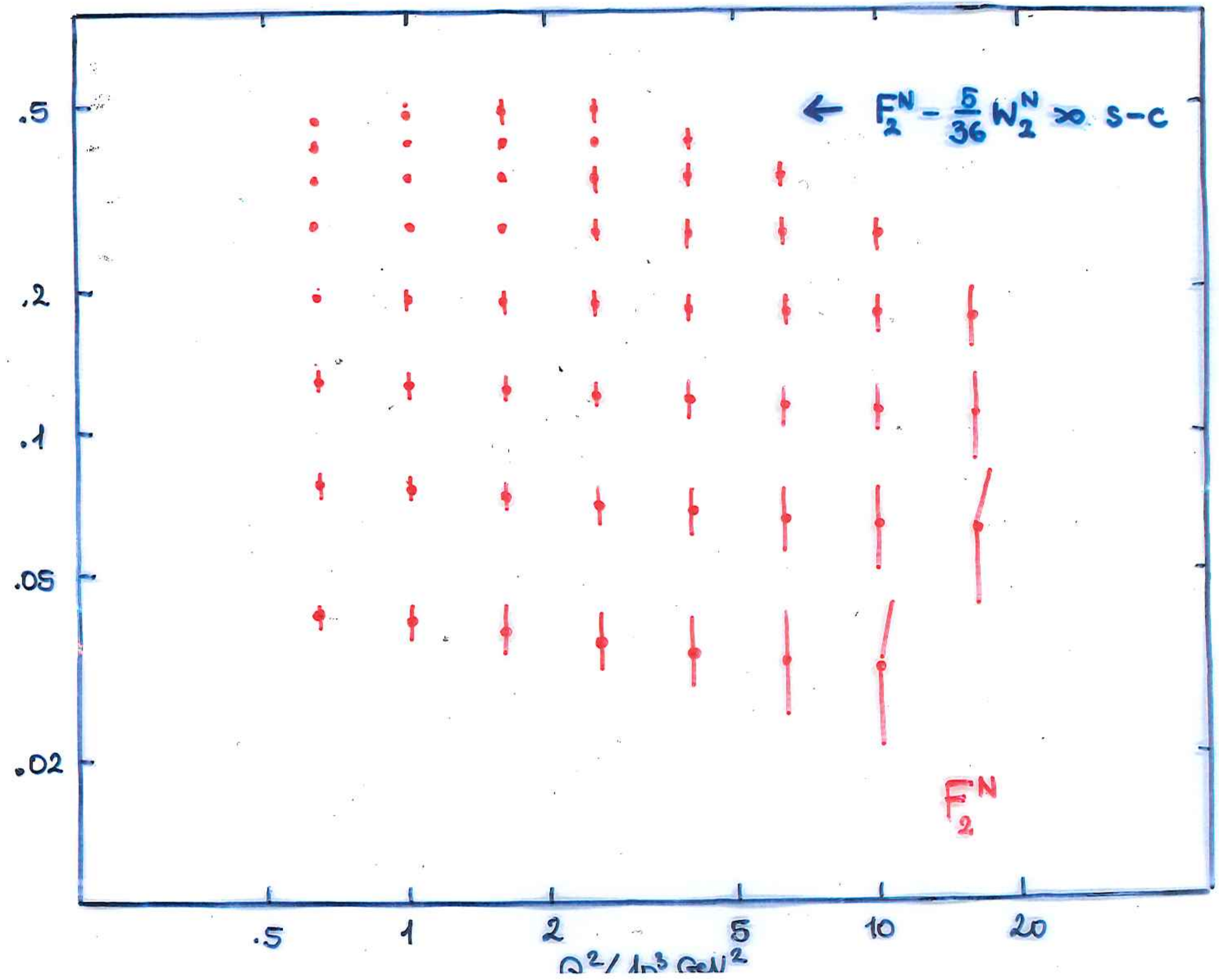
SINGULARITY AT LOW Q^2, y

$\sigma_{NC}^{+} \to \sigma_{NC}^{-}$.

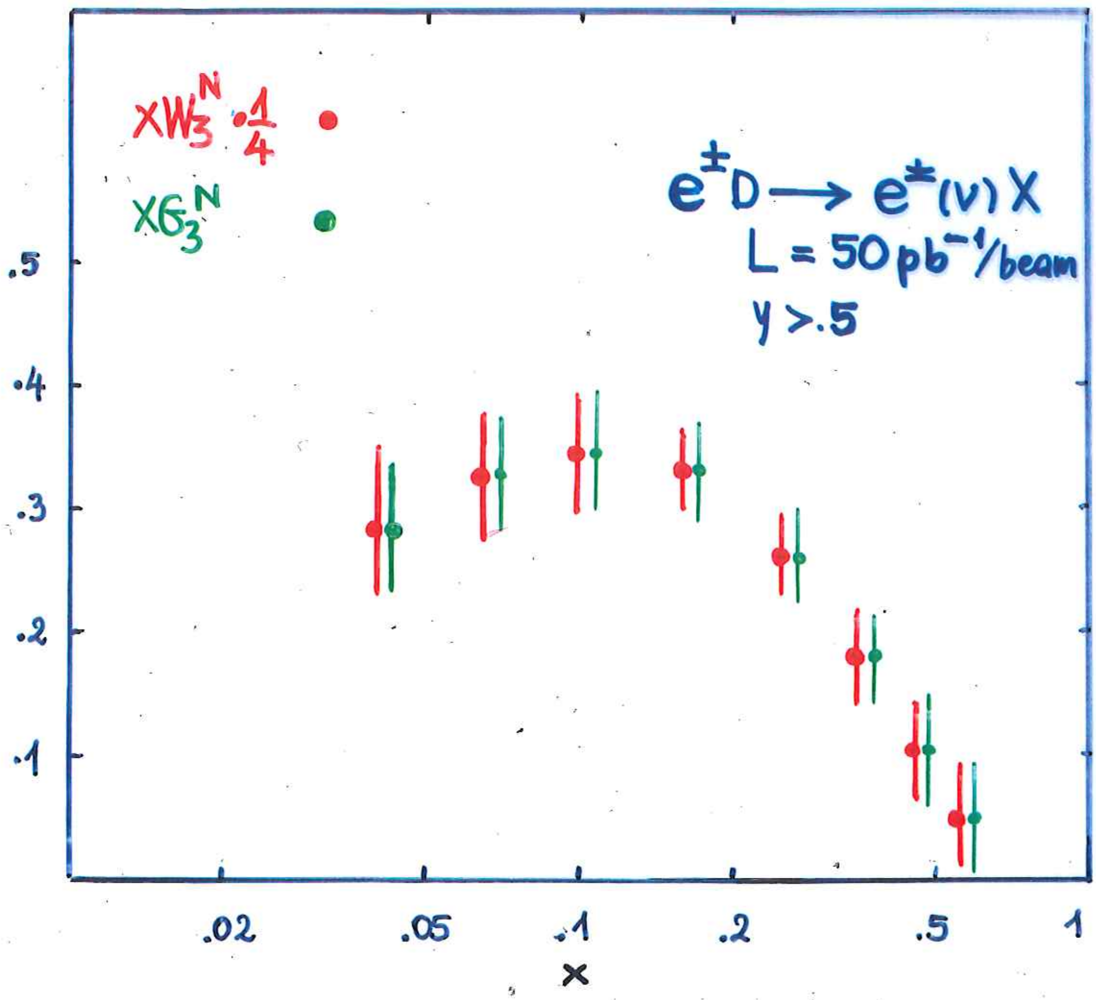
USE : 3 CROSS SECTIONS : $\sigma_{NC}^{-}, \sigma_{CC}^{+}, \sigma_{CC}^{-}$

ASSUME : $u_s = d_s = \text{const.} \cdot s$, "ignore" c, b

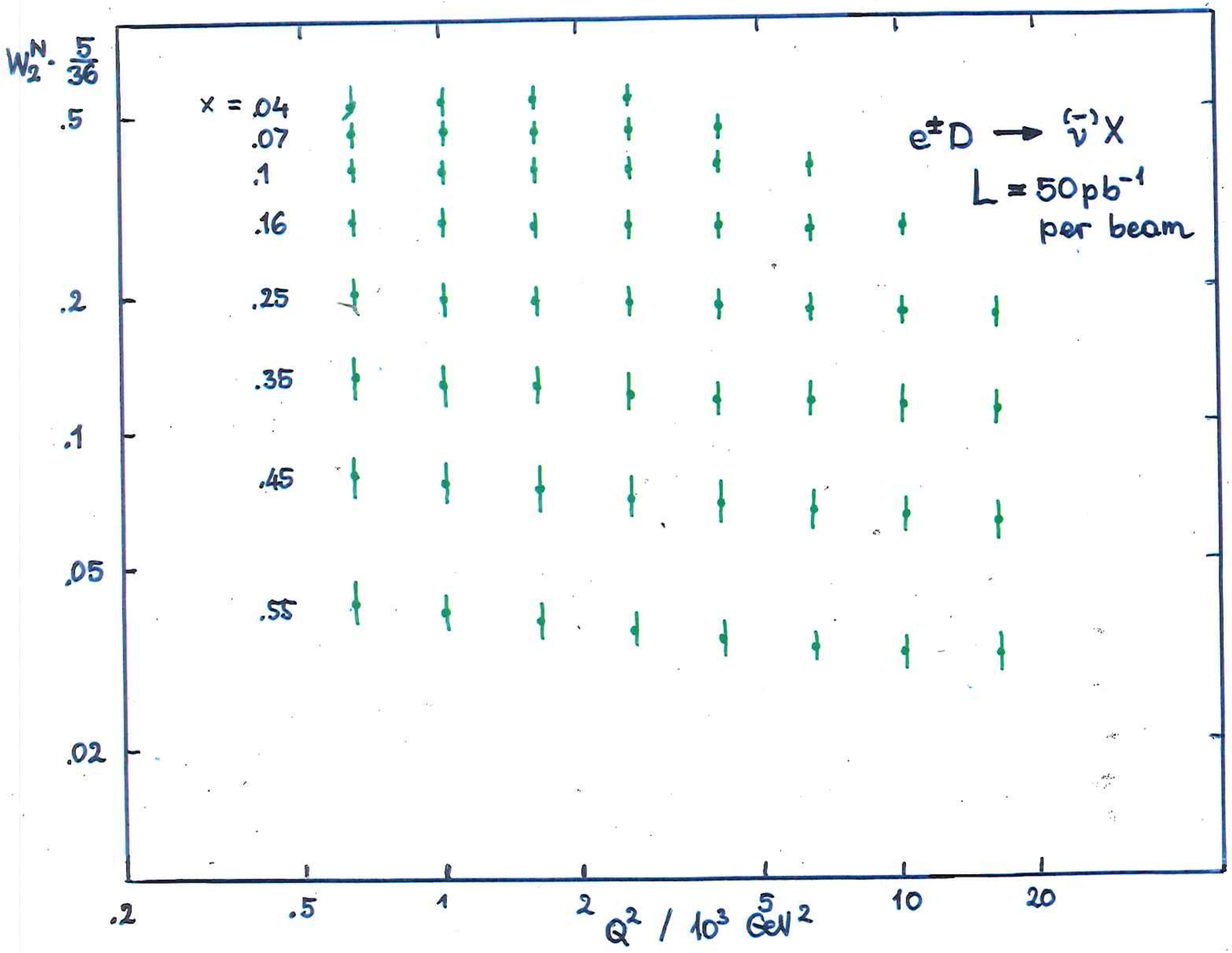
$\longrightarrow u_v, d_v, s\ (u_s)$

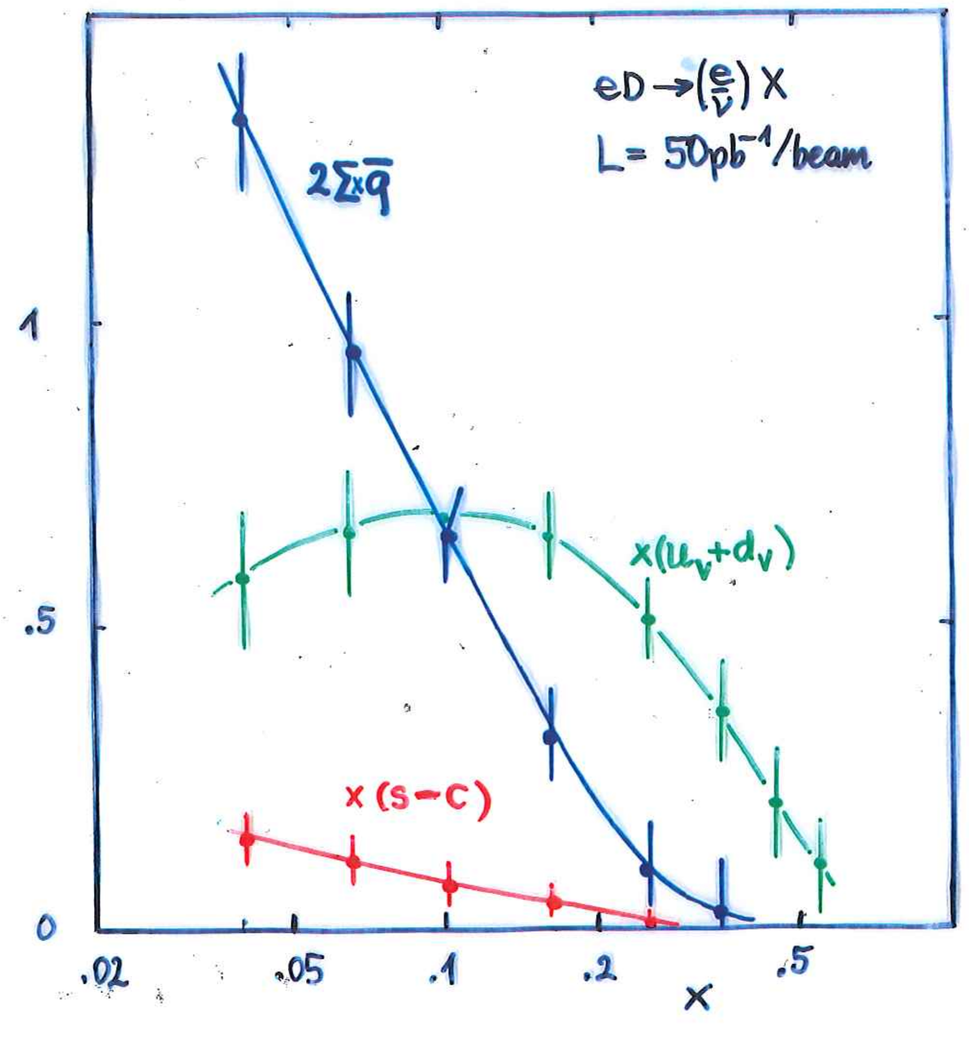


.5
.2
.1
.05
.02
.5
1
2
5
10
20
$Q^2/10^3$ GeV^2
$\leftarrow F_2^N - \frac{5}{36} W_2^N \propto$ S-C
F_2^N



$xW_3^N \cdot \frac{1}{4}$
xG_3^N
$e^{\pm}D \longrightarrow e^{\pm}(\nu)X$
$L = 50\,pb^{-1}$/beam
$y > .5$
.5
.4
.3
.2
.1
.02
.05
.1
.2
.5
1
x


$W_2^N \cdot \frac{5}{36}$
.5
.2
.1
.05
.02
x = .04
.07
.1
.16
.25
.35
.45
.55
$e^{\pm}D \rightarrow \overset{(-)}{\nu} X$
$L = 50 pb^{-1}$
per beam
.2
.5
1
2
5
10
20
Q^2 / 10^3 GeV^2



$eD \to \left(\frac{e}{\nu}\right) X$
$L = 50 pb^{-1}$/beam
$2\sum x\bar{q}$
$x(u_v + d_v)$
$x(s-c)$
1
.5
0
.02
.05
.1
.2
.5
x

CONCLUSIONS

- A STUDY HAS BEEN PRESENTED OF HERA'S POTENTIAL TO TEST THE STANDARD MODEL AND POSSIBILITIES TO EXTRACT QUARK DISTRIBUTIONS.
- R_- APPEARS TO BE THE BEST SUITED QUANTITY TO MEASURE $\sin^2\theta$, M_W, m_t IN THE GWS-MODEL AND TO TEST MODEL EXTENSIONS AS: $\exists\, W', Z'$, $\Lambda_{PRE} < \infty$
- POLARIZATION IS, FROM THIS POINT OF VIEW, LESS IMPORTANT THAN A PRECISE JET-MEASUREMENT AND A GOOD SEPARATION OF NC & CC-EVENTS
- $\mathcal{L} = 200\ pb^{-1}$ MAY YIELD:

  $\Delta s^2_\theta = \pm .002$, $\Delta M_W = \pm 100$ MeV (STAT.)

  THE MAJOR UNCERTAINTY - OF UP TO THE ORDER OF STAT. PRECISION - IS INDUCED BY PARTON DISTRIBUTION UNCERTAINTIES.

- BEYOND THE GWS MODEL ONE EXPECTS TO OBTAIN:

$\delta g = \pm .003$, $\delta I_3^{Re} = .03$, $\left.\begin{array}{l} M'_W \leq 200\ \text{GeV} \\ M'_Z \leq 240\ \text{GeV} \end{array}\right\}$ 3σ SENSITIVITY FOR $g = g'$

$\Lambda_{PRE} \leq 500$ GeV 2σ SENSITIVITY

- DIRECT MEASUREMENT OF PARTON DISTRIBUTIONS IS ONLY POSSIBLE IN THE VALENCE REGION.
- UNDER SOME ASSUMPTIONS $\langle x\overset{(-)}{q} \rangle_{Q^2}$ CAN BE EXTRACTED WITH O(25%) ERRORS.
- INTERFERENCE EFFECTS CAN BE USED TO MEASURE xG_3 AT THE SAME LEVEL.
- THE DEUTERON OPTION AT HERA WOULD ALLOW TO MEASURE

$x(u_v + d_v)$, xS , $x(S - C)$ AS A FUNCTION OF x