TIEFINELASTISCHE STREUUNG, STRUKTURFKT. & QCD

JB: 87/88

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3. KLASSIFIKATION VON STRUKTURFUNKTIONEN
4. STREUQUERSCHNITTE IM PARTONBILD
5. PARAMETRISIERUNG VON QUARKVERTEILUNGEN

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13. BESTIMMUNG VON STRUKTURFKT. AUS DEN TREE-QUERSCHNITTEN

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20. EMC-EFFEKT: ZUSAMMENFASSUNG DES EXP. MATERIALS

21. EMC-EFFEKT: THEORIE $\lesssim$ 1987 (KURZE ÜBERSICHT)

DIS - HISTORY

(i) VORGESCHICHTE:

1903	PH. LENARD	$eA \rightarrow e'A$
1911	E. RUTHERFORD	$\alpha A \rightarrow \alpha' A$
$\lesssim$ 1960	R. HOFSTADTER	$Q^2 \sim O(.1 \ldots 1\,\mathrm{GeV}^2)$

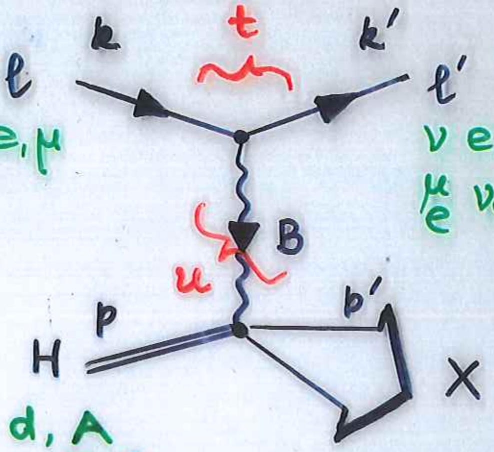
(ii) GESCHICHTE

1969	J.D. BJORKEN	SCALING HYPOTHESE
1969	R. P. FEYNMAN	PARTONEN
1972/75	GELL-MANN, FRITZSCH, LEUTWYLER, WILCZEK, GROSS, POLITZER, GEORGI ... T'HOOFT	ASYMPT. FREIHEIT & QCD SCALING VIOLATIONS
1973	O. NACHTMANN, ...	TARGET-MASSEN EFFEKTE
$\lesssim$ 1975	DOKSHITZER, ALTARELLI, PARISI ...	EVOLUTIONS-GLEICHUNGEN
1975/86	CDHS, CHARM, BEBC, SLAC, CCFR, EMC, BCDMS, ...	Λ^{exp}, F_1, F_L, F_2, $F_2^{(\bar\nu)}$, $xF_3^{(\bar\nu)}$, xG_3, R, xG, xq_i, $x\bar{q}_i$ ...
⋮		

(iii)

	HERA, UNK, ...	?

1. Kinematik von Lepton-Hadron-Reaktionen (DIS)



ν, e, μ

$\nu \; e \; \mu$ NC

$^{\mu}_{e} \; \nu_e \; \nu_\mu$ CC

$s \{$

p, d, A
(n,p)

$2 \rightarrow 2$

Mandelstamvariablen

$$s = (p+k)^2 = (p'+k')^2$$
$$t = (k-k')^2 = (p-p')^2$$
$$u = (k-p')^2 = (p-k')^2$$

$$s + \underbrace{t}_{\downarrow \; -Q^2} + u = m_\ell^2 + m_{\ell'}^2 + m_H^2 + \underbrace{m_X^2}_{M^2+2M\nu-Q^2}$$

LAB: $s = 2M_H E_{(k)}$ $\qquad \nu = y E_{(k)}$

$$x := Q^2 / sy$$

3 VARIABLEN: x, y, S

x, Q^2, S

$\vdots$

$0 \leq x \leq 1, \quad 0 \leq y \leq 1, \quad Q^2 \leq S = Q^2/xy$

STREUWINKEL:

LAB: e': $\sin^2(\theta/2) = (M^2 x / S) \frac{y}{1-y}$

X: $\sin\theta_J = \frac{1}{y}\left[\frac{(1-1/y)^2 - Mx^2/E^2}{1 + 2Mx/Ey}\right]^{1/2}$

COLLIDER:

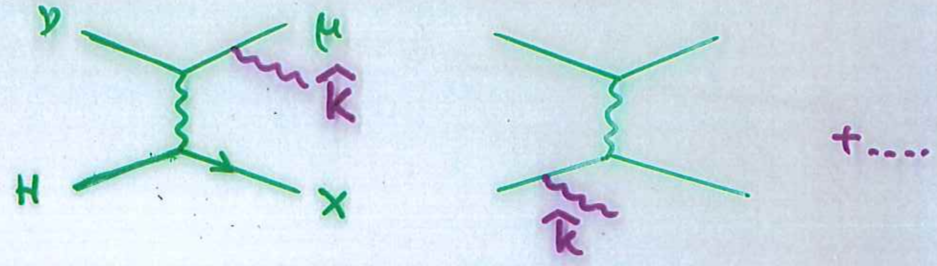
DESY HERA
83/08
(Lohrmann, Hess)

e': $Q^2 = 4E_e\lambda\sin^2(\theta_e/2)$, $x = \frac{\lambda\sin^2\theta_e/2}{E_p(1-\lambda/E_e\cos^2\theta_e/2)}$ (E

X: $Q^2 = \frac{E_J^2\sin^2\theta_H}{1-y}$, $x = \frac{E_e}{E_p}\frac{\sin^2\theta_H/2}{\left[\frac{E_e}{E_J} - \cos^2\theta_H/2\right]}$ (J

$\lambda = E_e(1-y) + E_p x y \; ; \; E_J = E_e y/\cos^2\theta_H/2$

KINEMATIK : PHOTON-BREMSSTR.



ÄNDERUNG DER SCALING VARIABLEN.

$\hat{k}$ - NEUER FREIHEITSGRAD : $2 \to 3$

■ LEPTON-LEG RADIATION (FINAL STATE)

$\hat{E}_\mu = E_\mu / z$: $z \geq \frac{E_\mu}{E_\nu}\left[1 + \frac{E_\nu}{M}(1-\cos\theta_\mu)\right]$

$z \to 1$: IR-LIMIT $E_\gamma = -E_\mu + \hat{E}_\mu$

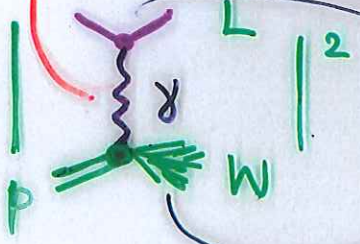
$$\hat{x} = \frac{x\,y}{z+y-1}$$

$$\hat{y} = \frac{z+y-1}{z}$$

2. STREUQUERSCHNITTE (TREE)

REAKTIONEN:		STREU-BOSON(EN):	
$\overset{(-)}{\nu}_\mu N \to \mu^\mp X$		$W^\pm$	$H^\pm \dots$
$\overset{(-)}{\nu}_\mu N \to \overset{(-)}{\nu}_\mu X$		Z^0	$H^{(0)} \dots$
$e^\pm N \to \overset{(-)}{\nu} X$	} i. allg. $\lambda \neq 0$,	$W^\pm$	$H^\pm \dots$
$e^\pm N \to e^\pm X$		γ, Z^0	$H^0 \dots$

$$\frac{d^2\sigma}{d\Omega\, dE'} = \frac{\alpha^2}{Q^4}\frac{E'}{E}\,|A|^2 \underset{\text{Df.}}{\equiv} \frac{\alpha^2}{Q^4}\frac{E'}{E}\, L^{(e)}_{\mu\nu}\, W^{\mu\nu}$$



$$L^{e}_{\mu\nu} = \frac{1}{2} \sum_{s'} \bar{u}(k's') \gamma_\mu u(ks) u(ks) \gamma_\nu \bar{u}(k's')$$

$$W_{\mu\nu} = \frac{1}{2} \sum_{n} \langle p | J^{+}_{\mu} | n \rangle \langle n | J_\nu | p \rangle (2\pi)^3 \delta (p+q-p_n)$$

UNPOLARIS. PROTON:

$$W^{\mu\nu} = W_1 g^{\mu\nu} + \frac{W_2}{M^2} p^\mu p^\nu + \frac{W_4}{M^2} q^\mu q^\nu + \frac{W_5}{M^2} (p^\mu q^\nu + q^\mu p^\nu)$$

$$\uparrow$$

$$|A^2| = L^{e}_{\mu\nu} \left(W^{\mu\nu}_{symm} + \cancel{W^{\mu\nu}_{asy}} \right)$$

$$W^{\mu\nu} = W_1(\nu, q^2) \left[-g^{\mu\nu} + \frac{q^\mu q^\nu}{q^2} \right] + \frac{W_2(\nu, q^2)}{M^2} \left[\left(p^\mu - \frac{pq}{q^2} q^\mu \right) \left(p^\nu - \frac{pq}{q^2} q^\nu \right) \right]$$

$$\frac{d^2\sigma}{dE' d\Omega} = \frac{4\alpha^2 E'^2}{Q^4} \left[\cos^2 \frac{\theta}{2} W_2 + 2 W_1 \sin^2 \frac{\theta}{2} \right]$$

BJORKEN: $M W_1(\nu, Q^2) \longrightarrow F_1(x = Q^2/2M\nu)$

$\nu W_2(\nu, Q^2) \longrightarrow F_2(x = Q^2/2M\nu)$

QUERSCHNITT IN MANDELSTAM-VARIABLEN:

$$(E', \Omega) \rightarrow (E', \vartheta) \rightarrow (t, u)$$

$$\frac{d^2\sigma}{dt\,du} = 2M \frac{u}{s} \frac{4\pi\alpha^2}{t^2} \left\{ \cos^2\frac{\theta}{2} \cdot W_2 + 2 \sin^2\frac{\theta}{2} W_1 \right\}$$

$$s + t + u = M^2 + W^2$$

$$\sin^2\frac{\theta}{2} = \frac{Q^2}{4EE'} = - \frac{tM^2}{su}$$

$$\nu = \frac{s+u}{2M}, \quad x = -\frac{t}{s+u}$$

$$\frac{d^2\sigma}{dt\,du} = \frac{4\pi\alpha^2}{t^2} \frac{1}{2} \frac{1}{s^2(s+u)} \left[2x F_1 (s+u)^2 - 2us F_2 \right]$$

$$\underset{CG}{=} \frac{\cancel{4}^{2}\pi\alpha^2}{Q^4} \frac{\cancel{1}}{\cancel{2}} \frac{s^2+u^2}{s^2(s+u)} F_2$$

$$(t, u) \rightarrow (x, Q^2)$$

$$\frac{d^2\sigma}{dx\,dQ^2} = \frac{2\pi\alpha^2}{xQ^4} Y_+ F_2$$

ANALOG: $\sigma^{\pm}_{nc,cc}(ep)$
$\sigma^{\pm}_{nc,cc}(\nu p)$

i. allg. komplizierten Tensorstr. für den lept. Tensor etc.

PARTON - INTERPRETATION VON F_2 etc.

$$\frac{d^2\sigma}{dt\,du}(e\mu \to e\mu) = \frac{4\pi\alpha^2}{t^2}\,\frac{1}{2}\,\frac{s^2+u^2}{s^2}\,\delta(s+t+u)$$

$$P_{Nucl} = \frac{1}{x}\,P_{parton}$$

$$s = (k+p)^2 \approx 2kp \Rightarrow xs$$
$$u \to ux$$

Vergleich

$$\left.\frac{d^2\sigma}{dt\,du}\right|_{eN\to eX} = \frac{4\pi\alpha^2}{t^2}\,\frac{1}{2}\,\frac{s^2+u^2}{s^2}\int dx\,\sum_i e_i^2\,x\,f_i(x)\,\frac{1}{s+u}\,\delta\!\left(x-\frac{1}{\omega}\right)$$

$$\omega = (s+u)/(-t)$$

$$\boxed{F_2^{ep} = \sum_i e_i^2\,x(q_i+\bar{q}_i)}$$

STREUQUERSCHNITTE:

$\overset{(-)}{\nu}p(d)$:

$$\frac{d^2\sigma^{\nu,\bar\nu}}{dx\,dy} = \frac{G_F^2 S P}{2\pi}\,\frac{1}{2}\left[Y_+ \begin{Bmatrix} \hat{W}_2^{\nu,\bar\nu} \\ F_2^{\nu,\bar\nu} \end{Bmatrix} \pm Y_- \begin{Bmatrix} x\hat{W}_3^{\nu,\bar\nu} \\ xF_3^{\nu,\bar\nu} \end{Bmatrix} \right]$$

$$\underset{CC}{\left(\frac{M_W^2}{M^2+Q^2}\right)^2} \leftrightarrow \underset{NC}{(M_W \leftrightarrow M_Z)}$$

$e^\pm p(d)$:

$$\frac{d^2\sigma^\pm}{dx\,dQ^2} = \frac{2\pi\alpha^2}{xQ^4}\left\{ Y_+ \begin{Bmatrix} k_W^2\left(\frac{1\pm\lambda}{2}\right) W_2^\pm \\ \mathbf{F}_2 \end{Bmatrix} + Y_- \begin{Bmatrix} \mp k_W^2 \left(\frac{1\pm\lambda}{2}\right) x W_3^\pm \\ x\mathbf{F}_3 \end{Bmatrix} \right.$$

$$P = \left[M_W^2/(M_W^2+Q^2)\right]^2$$

$$k_W = \frac{Q^2}{Q^2+M_W^2}\,\frac{1}{4\sin^2\theta_W}$$

$$\mathbf{F}_2 = F_2 + k_Z(-v \mp \lambda a)\,G_2 + k_Z^2(v^2+a^2 \pm 2va\lambda)\,H_2.$$

$$x\mathbf{F}_3 = k_Z(\pm a + \lambda v)\,xG_3 + k_Z^2(\mp 2va - \lambda(v^2+a^2))\,xH_3$$

3. KLASSIFIKATION VON STRUKTURFUNKTIONEN

ANNAHME: • σ_{CC} UNABH. VON U_{ij}^{KM}

• $2x\, \mathbb{F}_1 = \mathbb{F}_2$ (CALLEN & GROSS)

KLASSIFIKATION NACH: TREE !

• CURRENT:	CC	NC		
• BOSON EXCH.:	$\lvert W \rvert^2$	$\lvert \gamma \rvert^2$	$\lvert \gamma Z \rvert$	$\lvert Z \rvert^2$
• INIT. PART. $\ell^\pm$	W_i	F_i	G_i	H_i
$\overset{(-)}{\nu}$	$\hat{W}_i$			$\hat{F}_i$

• PARITY – EVEN: $i = 2$

– ODD: $i = 3$

$$Y_\pm = 1 \pm (1-y)^2$$

• TARGET: $\begin{cases} p \\ n \end{cases}$

KOMBINATIONEN VON PARTONVERTEILUNGEN

$$U(x,Q^2) = x\sum_i u_i(x,Q^2) := x(u_V + u_S + c + t)$$

$$\bar{U}(x,Q^2) = x\sum_i \bar{u}_i(x,Q^2) := x(\bar{u}_S + \bar{c} + \bar{t})$$

$$D(x,Q^2) = x\sum_i d_i(x,Q^2) := x(d_V + d_S + s + b)$$

$$\bar{D}(x,Q^2) = x\sum_i \bar{d}_i(x,Q^2) := x(\bar{d}_S + \bar{s} + \bar{b})$$

CHARGED CURRENT $\sim |W|^2$

νp: $\hat{W}_2 = 2(D+\bar{U})$ $\quad \times\hat{W}_3 = 2(D-\bar{u})$

$\bar{\nu} p$: $\hat{W}_2 = 2(u+\bar{D})$ $\quad \times\hat{W}_3 = 2(u-\bar{D})$

$e^- p$: $W_2 = 2(u+\bar{D})$ $\quad \times W_3 = 2(u-\bar{D})$

$e^+ p$: $W_2 = 2(D+\bar{u})$ $\quad \times W_3 = 2(D-\bar{u})$

d-TARGET:

$\overset{(-)}{u} \to \dfrac{\overset{(-)}{u}+\overset{(-)}{d}}{2} \qquad \overset{(-)}{d} \to \dfrac{\overset{(-)}{u}+\overset{(-)}{d}}{2}$

NEUTRAL CURRENT

$\sim |\gamma|^2$

$e^{\pm}p$: $F_2 = Q_u^2(U+\bar{U}) + Q_d^2(D+\bar{D})$ $\times F_3 \equiv 0$

$\sim |\gamma Z|$

ep : $G_2 = 2Q_u v_u (U+\bar{U}) + 2Q_d v_d (D+\bar{D})$

$\times G_3 = 2Q_u a_u (U-\bar{U}) + 2Q_d a_d (D-\bar{D})$

$\sim |Z|^2$

ep :

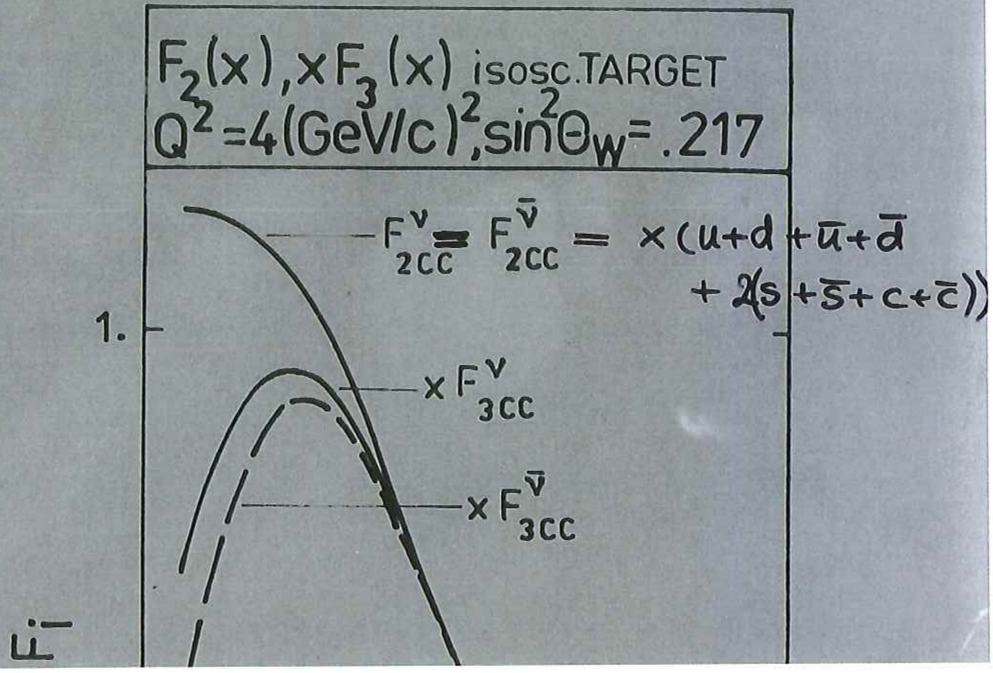
$H_2 = (v_u^2 + a_u^2)(U+\bar{U}) + (v_d^2 + a_d^2)(D+\bar{D})$

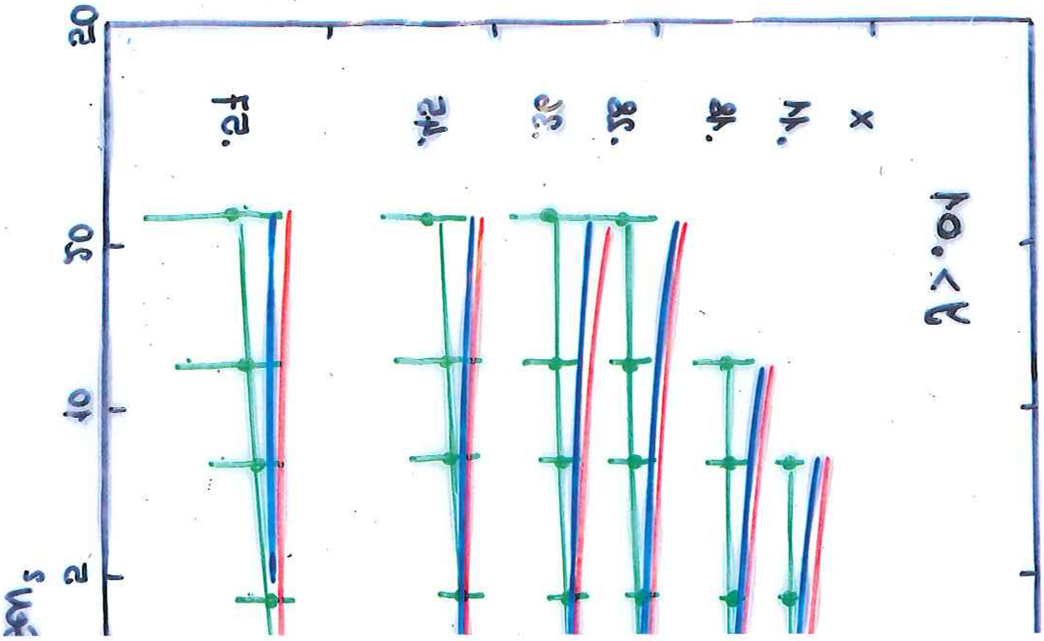
$\times H_3 = 2v_u a_u (U-\bar{U}) + 2v_d a_d (D-\bar{D})$

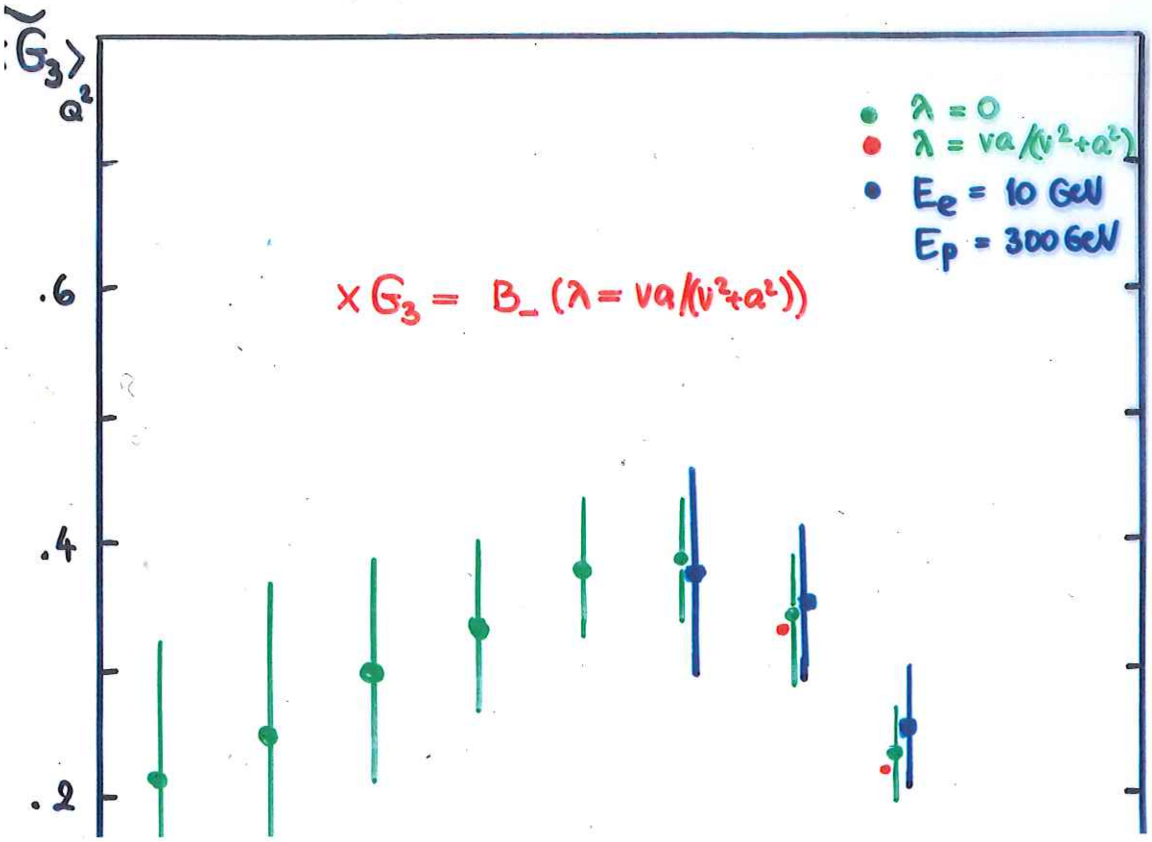
νp : $F_2 = (v_u^2 + a_u^2)(U+\bar{U}) + (v_d^2 + a_d^2)(D+\bar{D})$

$\times F_3 = 2v_u a_u (U-\bar{U}) + 2v_d a_d (D-\bar{D})$

$a_{u,d} = \pm 1/2, \quad v_{u,d} = \pm \frac{1}{2} \mp 2Q_i s_\theta^2$


$F_2(x), xF_3(x)$ isosc. TARGET
$Q^2=4(GeV/c)^2, \sin^2\Theta_W=.217$
$F^{\nu}_{2CC} = F^{\bar{\nu}}_{2CC} = x(u+d+\bar{u}+\bar{d} + 2(s+\bar{s}+c+\bar{c}))$
xF^{ν}_{3CC}
$xF^{\bar{\nu}}_{3CC}$
1.
Fi





$\langle G_3 \rangle_{Q^2}$
.6
.4
.2
$\lambda = 0$
$\lambda = va/(v^2+a^2)$
$E_e = 10$ GeV
$E_p = 300$ GeV
$x G_3 = B_-(\lambda = va/(v^2+a^2))$

4. STREUQUERSCHNITTE IM PARTON-BILD

$\overset{(-)}{\nu} p$:

$$\frac{d^2\sigma^{\nu,\bar\nu}}{dx\,dy} = \frac{G_F^2 SP}{2\pi}\,\frac{1}{2}\left[Y_+ \left\{ \begin{matrix} \hat{W}_2^{\nu,\bar\nu} \\ F_2^{\nu,\bar\nu} \end{matrix} \right\} \pm Y_- \left\{ \begin{matrix} x\hat{W}_3^{\nu,\bar\nu} \\ xF_3^{\nu,\bar\nu} \end{matrix} \right\} \right]$$

$$:= \frac{G_F^2 SP}{4\pi}\,\hat\sigma^{\nu,\bar\nu}$$

$$\begin{pmatrix} \hat\sigma_\nu^{cc} \\ \hat\sigma_{\bar\nu}^{cc} \\ \hat\sigma_\nu^{nc} \\ \hat\sigma_{\bar\nu}^{nc} \end{pmatrix} = 2 \begin{pmatrix} 0 & \overset{2}{Y_+ + Y_-} & \overset{2(1-y)^2}{Y_+ - Y_-} & 0 \\ \overset{2}{Y_+ + Y_-} & 0 & 0 & \overset{2(1-y)^2}{Y_+ - Y_-} \\ C_u^+ & C_u^- & C_d^+ & C_d^- \\ C_u^- & C_u^+ & C_d^- & C_d^+ \end{pmatrix} \begin{pmatrix} U \\ \bar U \\ D \\ \bar D \end{pmatrix}$$

$$C_q^\pm = Y_+ (v_q^2 + a_q^2) \pm 2Y_- v_q a_q$$

$\underline{e^{\pm}p}$:

$$\frac{d^2\sigma^{\pm}}{dx\,dQ^2} = \frac{2\pi\alpha^2}{xQ^4}\Big\{ Y_+ \left\{ \begin{array}{l} \kappa_w^2 \frac{1\pm\lambda}{2} W_2^{\pm} \\ F_2 + \kappa_Z(-v\mp\lambda a)\,G_2 + \kappa_Z^2(v^2+a^2\pm 2va\lambda)\,H_2 \end{array} \right\}$$

$$\mp Y_- \left\{ \begin{array}{l} \kappa_w^2 \frac{1\pm\lambda}{2} \times W_3 \\ \pm\kappa_Z(\pm a+\lambda v) \times G_3 \pm \kappa_Z^2(\mp 2va-\lambda(a^2+v^2)) \times H_3 \end{array} \right\}$$

$$\begin{pmatrix} \sigma_-^{cc} \\ \sigma_+^{cc} \\ \sigma_-^{nc} \\ \sigma_+^{nc} \end{pmatrix} = \begin{pmatrix} Y_+ + Y_- & 0 & 0 & Y_+ - Y_- \\ 0 & Y_+ + Y_- & Y_+ - Y_- & 0 \\ \hat{C}_u^+ & \hat{C}_u^- & \hat{C}_d^+ & \hat{C}_d^- \\ \hat{C}_u^- & \hat{C}_u^+ & \hat{C}_d^- & \hat{C}_d^+ \end{pmatrix} \begin{pmatrix} U \\ \bar{U} \\ D \\ \bar{D} \end{pmatrix}$$

SUMMENREGELN UND ÄQUIVALENZEN

CALLEN-GROSS: $R = 0$ PRL 22 (1969) 156

$$2xF_1 = F_2$$

LLEWELLYN-SMITH: $F_2^{en} - F_2^{ep} = \left[x\hat{W}_3^{\nu p} - x\hat{W}_3^{\nu n}\right] \cdot \frac{1}{6}$ NP B17 (1970) 277

ADLER: $\int_0^1 dx\,(u_v - d_v) = 1$ PR 143 (1965) 1144

GROSS-LLEWELLYN-SMITH: $\int_0^1 dx\,(x\,u_v + x d_v)/x = 3$ NP B14 (1969) 337

IMPULSBILANZ: $\int_0^1 dx\,[\Sigma(x) + xG] = 1$ PR D4 (1971) 2392

5. PARAMETRISIERUNG VON QUARKVERTEILUNGSFUNKTIONEN

- DIS : $e, \mu, \nu : \binom{n}{p} p$
- DIMUON - DATEN
- J/ψ x_F - DISTRIB.
- p_T - DATEN
- DRELL - YAN DATEN

$u_v, d_v, s, (u_s, d_s), c$
xG

- $pp \to \pi^0 X$
  γX
  $J/\psi X$

$\overset{(-)}{\nu}d:$

$$W_2 = \frac{2\pi}{G_F^2 SP}\left[\frac{d^2\sigma^{\nu}}{dxdy} + \frac{d^2\sigma^{\bar\nu}}{dxdy}\right] Y_+^{-1} - 2x(s-c)\frac{Y_-}{Y_+}$$

$$\boxed{=: \Sigma = x\sum_i(\bar q + q)}$$

$$p = \left(\frac{M_W^2}{Q^2+M_W^2}\right)^2$$

$$xW_3 = \frac{2\pi}{G_F^2 SP}\left[\frac{d^2\sigma^{\nu}}{dxdy} - \frac{d^2\sigma^{\bar\nu}}{dxdy}\right] Y_-^{-1}$$

$$\boxed{=: \Delta = x(u_v + d_v)}$$

$$x\bar q = \frac{2\pi}{G_F^2 SP}\left[\frac{d^2\sigma^{\bar\nu}}{dxdy} - (1-y)^2\frac{d^2\sigma^{\nu}}{dxdy}\right](Y_+ Y_-)^{-1} - x(s-c)/Y_+$$

$$\boxed{=: \sum_i x\bar q_i}$$

$\overset{(-)}{\nu} p$, $\overset{(-)}{\nu} d$:

$$\hat{\sigma}_i = 4\pi G_F^{-2} S \left[(M_W^2 + Q^2)/M_W^2\right]^2 \frac{d^2\sigma_i}{dx\,dy}$$

$$\hat{\sigma}_{\nu d} - \hat{\sigma}_{\nu p} = (Y_+^\nu + Y_-^\nu)(xu_v - xd_v) - 2Y_-^\nu \underbrace{(\bar{D} - \bar{U})}_{\approx (s-c)}$$

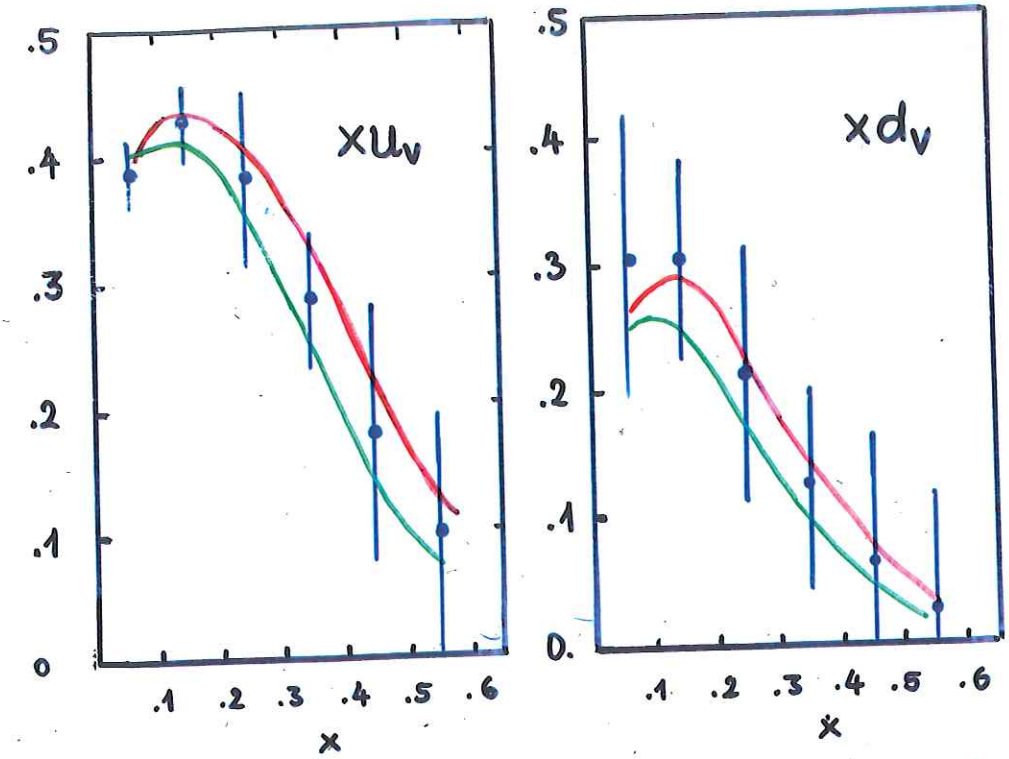
$$\boxed{\Rightarrow\ x(u_v - d_v)}$$

$e^\pm p$: $\hat{\sigma}_i = \frac{Q^4 x}{2\pi\alpha^2} \frac{d^2\sigma_i}{dx\,dQ^2}$

$\propto F_2$

$$\begin{pmatrix} \sigma_{nc}^+ \\ \sigma_{nc}^- \\ \sigma_{cc}^+ \\ \sigma_{cc}^- \end{pmatrix} = (A_{ij}) \begin{pmatrix} U \\ \bar{U} \\ D \\ \bar{D} \end{pmatrix} \longrightarrow (B_{ij}) \begin{pmatrix} L_1[q_i] \\ L_2[q_i] \\ L_3[q_i] \end{pmatrix}$$

$$\det{}_4 \| A_{ij} \| \sim K_Z^2 \left[(1 - (1-y)^4) \right] \ ; \quad K_Z = \frac{Q^2}{Q^2 + M_Z^2} \frac{1}{4 \sin^2\theta_W \cos^2\theta_W}$$


xu_v
xd_v
.5
.4
.3
.2
.1
0
0.
.1
.2
.3
.4
.5
.6
x
x

VALENZ - REGION:

$$x u_v = \frac{Q^4 x}{2\pi\alpha^2 K_W^2} \frac{2}{1-\lambda} \frac{d^2\sigma_{cc}^-}{dx\,dQ^2} / (Y_+ + Y_-)$$

$$x d_v = \frac{Q^4 x}{2\pi\alpha^2 K_W^2} \frac{2}{1+\lambda} \frac{d^2\sigma_{cc}^+}{dx\,dQ^2} / (Y_+ + Y_-)$$

$$K_W = \frac{Q^2}{Q^2 + M_W^2} \frac{1}{4\sin^2\theta_W}$$

<u>$e^\pm d$</u>:

$$F_2 = \frac{1}{2}(Q_u^2 + Q_d^2)\,x\,[u_v + d_v + S + 2c] + x\,(Q_u^2 - Q_d^2)(c - s)$$

$$x G_3 = x\,(Q_u a_u + Q_d a_d)(u_v + d_v)$$

$$W_2 = 2x\,(u_v + d_v + S + 2c)$$

$$x W_3 = 2x\,(u_v + d_v)$$

CC:

3 INSTEAD OF 4 STRUCTURE FUNCTIONS IN (ep).

$$W_2^{+N} \equiv W_2^{-N} = x\sum_i (q_i + \bar{q}_i) \cdot 2$$

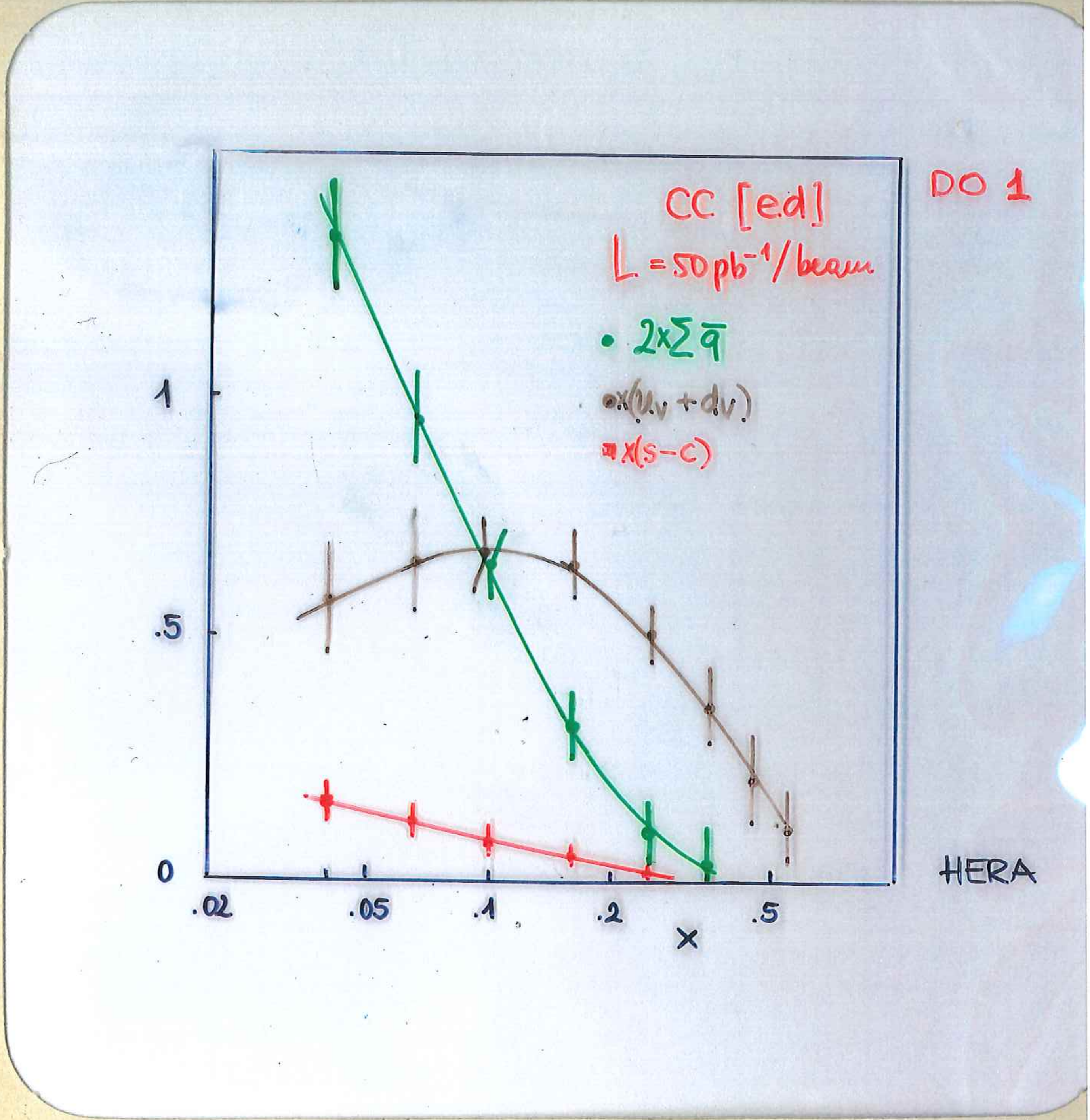
$$x W_3^{+/-N} \equiv 2 \cdot \left[(x u_v + x d_v) \pm 2x(s-c) \right]$$

DF.: $$x W_3^N = \frac{1}{2}\left(x W_3^+ + x W_3^-\right) \equiv 2\, x(u_v + d_v)$$

$$\equiv 2\, x V(x, Q^2)$$ FIG

MEASUREMENTS : F_2^N, W_2^N

FIG.


DO 1
CC [ed]
L = 50 pb⁻¹/beam
2x∑q̄
x(uv + dv)
x(s−c)
1
.5
0
.02
.05
.1
.2
.5
x
HERA

PARAMETRISIERUNGEN

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A. BURAS, K.J.F. GAEMERS: NP B 132 (1978) 249

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1987: CERN & OXFORD
:

GHR: VALENZ:

(58 PARAMETER)

$$xv = N \frac{C}{B(D+1, A/C)} x^A (1-x^C)^D \quad \Big| \; xu_v, xd_v$$

xs, xu_s, xd_s:

$$xw = A(1+Bx+Cx^2)(1-x)^D + E e^{-Fx}$$

$$A_i = a + b\bar{s}^{\alpha}, \quad \bar{s} = \ln\left[\frac{\ln(Q^2/\Lambda^2)}{\ln(Q_0^2/\Lambda^2)}\right] \qquad \Lambda = 400\,\mathrm{MeV}$$

2) DO:

(61 PARAMETER)

$$xu_v = xv - xd_v$$

$$xv = N_{ud}\, x^{\eta_1}(1-x)^{\eta_2}(1+\gamma_{ud}x)$$

$$xd_v = N_d\, x^{\eta_3}(1-x)^{\eta_4}(1+\gamma_d x)$$

$$x\bar{u} = x\bar{s} = x\bar{d} = xS/6 \;,\; xc$$

$$\sim A\,(1+Bx+Cx^2+Dx^3)\,x^a(1-x)^b$$

(ENTSPR. xG)

$$A_i = a + b\bar{s} + c\bar{s}^2$$

$\Lambda =$ 200 MeV : DO 1; 400 MeV : DO 2

3) EHLQ:

(577+8 PARAMETER)

$xq, x\bar{q}, xG$: $\quad q: u \to t\,!$

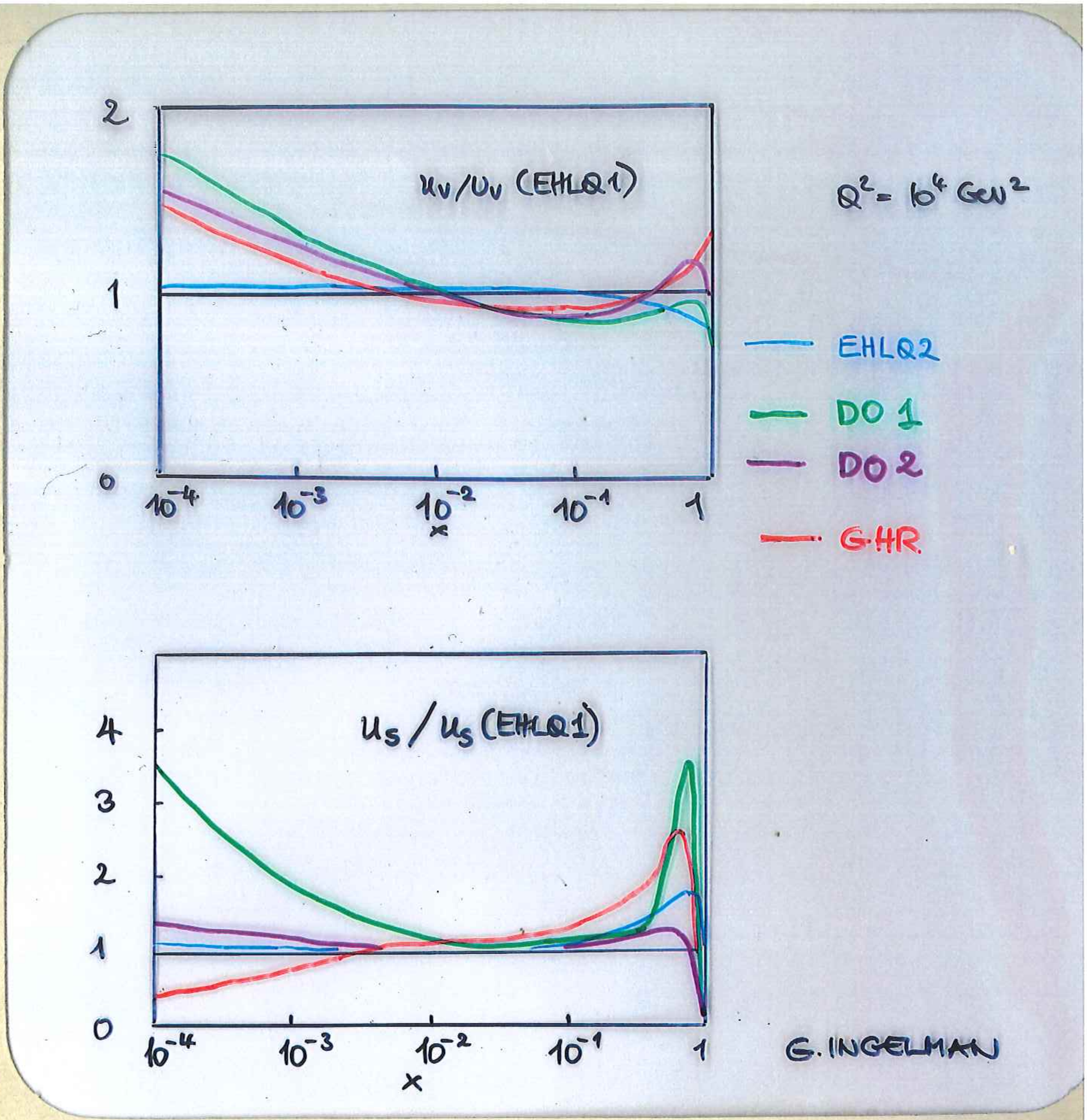
$$=: (1-x)^a \sum_{i,j=1}^{5} T_i(x')\,T_j(t')\,c_{ij}$$

$$x' = \frac{2x-1.1}{.9} \quad \text{ODER} \quad x' = \frac{2\ln x + 11.51293}{6.90776}$$

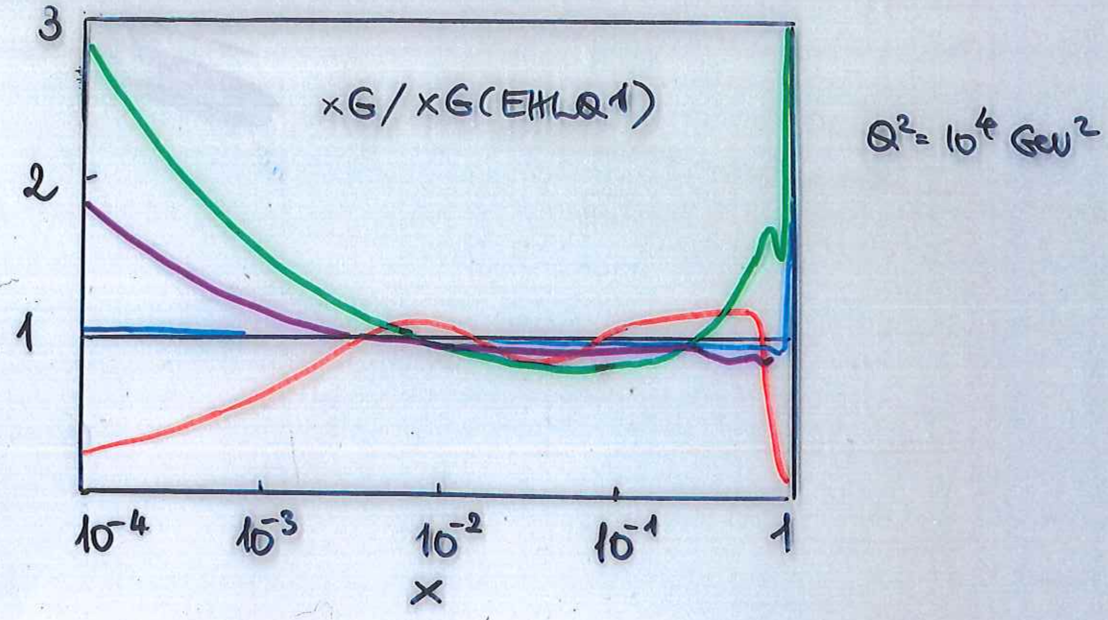
$$.1 < x < 1 \qquad\qquad 10^{-4} < x < 10^{-1}$$

$$t' = \frac{2t-(t_{max}+t_{min})}{t_{max}-t_{min}} \;,\quad t = \ln(Q^2/\Lambda^2)$$

$\Lambda =$ 200 MeV EHLQ 1 ; $\Lambda =$ 290 MeV EHLQ 2



uv/Uv (EHLQ1)
Q² = 10⁴ GeV²
EHLQ2
DO 1
DO 2
G.HR.
2
1
0
10⁻⁴
10⁻³
10⁻²
10⁻¹
1
x
us/us (EHLQ1)
4
3
2
1
0
G. INGELMAN


3
2
1
xG / xG(EHLQ1)
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
x
$Q^2 = 10^4$ GeV^2