# A Model independent approach to Semi-inclusive DIS

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based on papers written in collaboration with the

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## The goal:

to obtain the polarized parton densities

$$\Delta u \Rightarrow \Delta u_V, \quad \Delta\bar{u}$$
$$\Delta d \Rightarrow \Delta d_V, \quad \Delta\bar{d}$$
$$\Delta s, \Delta\bar{s}$$
$$\Delta G$$

## We have:

- polarized DIS asymmetries in $\overrightarrow{l} + \overrightarrow{N} \rightarrow l' + X$:

$$A_N^{DIS} = \frac{\Delta\sigma^{DIS}}{\sigma^{DIS}} = \frac{\sum e_q^2(\Delta q + \Delta\bar{q})}{\sum e_q^2(q + \bar{q})} = \frac{g_1^N}{F_1^N}$$

determine only the combinations

$$\Delta u + \Delta\bar{u}, \quad \Delta d + \Delta\bar{d}, \quad \Delta s + \Delta\bar{s}, \quad \Delta G.$$

- polarized SIDIS asymmetries in $\overrightarrow{l} + \overrightarrow{N} \rightarrow l' + h + X$:

$$A_N^h = \frac{\Delta\sigma_N^h}{\sigma_N^h} = \frac{\sum e_q^2\,(\Delta q\, D_q^h + \Delta\bar{q}\, D_{\bar{q}}^h)}{\sum e_q^2\,(q\, D_q^h + \bar{q}\, D_{\bar{q}}^h)}, \qquad h = \pi^\pm, K^\pm ...$$

## SIDIS

- determines $\Delta q$ and $\Delta\bar{q}$ separately $\rightarrow D_q \neq D_{\bar{q}}$
- but: we need to know the FFs: $D_q$ and $D_{\bar{q}}$
- up to now: $D_q^h$ are not well known
  mainly from $e^+e^- \rightarrow h+X$: only $D_{q+\bar{q}}^h \Leftrightarrow$ DIS $(\Delta q + \Delta\bar{q})$
- different assumptions about $D_q^h$
- different isospin rels. about polarized sea quarks:

$$\Delta\bar{u} = \Delta\bar{d} = \Delta\bar{s} \quad \text{or} \quad \Delta\bar{u}/\bar{u} = \Delta\bar{d}/\bar{d} = \Delta\bar{s}/\bar{s}$$

## We consider SIDIS

$$l + N \to l' + h + X, \qquad \overrightarrow{l} + \overrightarrow{N} \to l' + h + X$$

What can we learn from SIDIS - pol. and unpol. without assuming any knowledge:

- about $D_q$ and $D_{\bar{q}}$ separately
- about $\Delta\bar{u}$, $\Delta\bar{d}$, $\Delta s$, $\Delta\bar{s}$, $\Delta G$

We shall use information that comes only directly from measurable quantities:

1) DIS: $\quad g_1^p - g_1^n = \Delta q_3 = (\Delta u + \Delta\bar{u}) - (\Delta d + \Delta\bar{d})$

2) SIDIS: the difference asymmetries: $h = \pi^\pm$, $K^\pm$,...

$$A_N^{h^+-h^-} = \frac{\Delta\sigma_N^{h+} - \Delta\sigma_N^{h-}}{\sigma_N^{h^+} - \sigma_N^{h^-}}$$

$$R_N^{h^+-h^-} = \frac{\sigma_N^{h+} - \sigma_N^{h-}}{\sigma_N^{DIS}}$$

$\Rightarrow$ We single out observables that are flavour non-singlets on both the parton densities and the FFs $\Rightarrow$ in their $Q^2$-evol. they do not mix with other quantites.

## We show that one can determine directly:

- $\Delta u_V$ , $\Delta d_V$ $\to$ LO and NLO – JefLab
- $\Delta\bar{u} - \Delta\bar{d}$ $\to$ LO and NLO – JefLab
- $s(x) - \bar{s}(x)$, $\Delta s(x) - \Delta\bar{s}(x)$ $\to$ LO and NLO
- $D_u^{\pi^+-\pi^-}$ $\to$ LO and NLO
- possible tests of LO

to be used in JefLab – with A-rating approved this year!

## Definitions

$$A_{\parallel} = \frac{\sigma^{++} - \sigma^{+-}}{\sigma^{++} + \sigma^{+-}} = \frac{\Delta\sigma^h}{2\sigma^h} = \frac{Y_P}{2Y_M}\frac{\Delta\tilde{\sigma}^h}{\tilde{\sigma}^h} = D(y)\, A_N^h$$

$$Y_P = 2 - y, \quad Y_M = \frac{1 + (1-y)^2}{2y}, \quad D(y) = \frac{Y_P}{2\, Y_M}$$

$$we \quad consider: \quad A_N^h = \frac{\Delta\tilde{\sigma}^h}{\tilde{\sigma}^h}$$

**LO:**

$$A_N^h = \frac{2g_1^h}{2F_1^h} = \frac{e_q^2\, \Delta q\, D_q^h}{e_q^2\, q\, D_q^h}$$

**NLO:**

$$A_N^h = \frac{2g_1^h}{2\tilde{F}_1^h},$$

$$g_1^h(x, Q^2) = \frac{1}{2}\sum_i e_i^2 \left[\Delta q_i \left(1 + \otimes \frac{\alpha_s(Q^0)}{2\pi}\Delta C_{qq} \otimes D_q^h\right) + \right.$$
$$\left. + \frac{\alpha_s(Q^0)}{2\pi}\Delta q_i \otimes \Delta C_{qg} \otimes D_G^h + \frac{\alpha_s(Q^2)}{2\pi}\Delta G \otimes \Delta C_{gq} \otimes D_q^h\right]$$

$\Delta C_{ij}$ are the Wilson coeffs.

$$2F_1^h \to 2\tilde{F}_1^h = 2F_1^h + 2\gamma(y)\frac{F_L^h}{x},$$

$$2\tilde{F}_1^h(x,Q^2) = \frac{1}{2}\sum_i e_i^2 \left[ q_i \left( 1 + \otimes \frac{\alpha_s(Q^0)}{2\pi} C_{qq} \otimes D_q^h \right) + \right.$$
$$\left. + \frac{\alpha_s(Q^0)}{2\pi} q_i \otimes C_{qg} \otimes D_G^h + \frac{\alpha_s(Q^2)}{2\pi} G \otimes C_{gq} D_q^h \right]$$

$$C_{ij} = C_{ij}^1 + 2\gamma(y) C_{ij}^L, \quad \gamma(y) = \frac{1-y}{1+(1-y)^2}$$

$C_{ij}^{1,L}$ are the corresponding Wilson coeffs.

The cross sections are:

$$\frac{d\Delta\sigma^h}{dx\,dy\,dz} = \sigma_0\, Y_P\, \Delta\tilde{\sigma}^h,$$

$$\frac{d\sigma^h}{dx\,dy\,dz} = \sigma_0\, Y_M\, \tilde{\sigma}_h$$

$$\sigma_0 = \frac{4\pi\alpha_{em}^2}{Q^2}$$

$$\underline{\overrightarrow{l} + \overrightarrow{N} \to l' + \pi^{\pm} + X}$$

SU(2) and C: $\Rightarrow D_u^{\pi^+-\pi^-} = -D_d^{\pi^+-\pi^-}, \quad D_s^{\pi^+-\pi^-} = 0$

$\underline{\underline{\Delta u_V, \Delta d_V - LO :}}$ The FFs completely cancel:

*Frankfurt et al, P.L. B (1989)*

*E. Leader & E. Ch., P.L. B (1999)*

$$A_p^{\pi^+-\pi^-}(x, \underline{\underline{z}}, Q^2) = \frac{4\Delta u_V - \Delta d_V}{4u_V - d_V}(x, Q^8)$$

$$A_n^{\pi^+-\pi^-}(x, \underline{\underline{z}}, Q^2) = \frac{4\Delta d_V - \Delta u_V}{4d_V - u_V}(x, Q^2)$$

$\Rightarrow$ 2 $\underline{algebraic}$ eqs. for $\Delta u_V$ and $\Delta d_V$ $\Rightarrow$

$$\Delta u_V = \left\{4(4u_V - d_V)A_p^{\pi^+-\pi^-} + (4d_V - u_V)A_n^{\pi^+-\pi^-}\right\}$$

$$\Delta d_V = \left\{4(4d_V - u_V)A_n^{\pi^+-\pi^-} + (4u_V - d_V)A_p^{\pi^+-\pi^-}\right\}$$

$z$ = passive observable - test of LO

$\underline{\underline{\text{SU(2) for the polarized sea : } (\Delta\bar{u} - \Delta\bar{d}) - \text{LO}}}$

*E. Leader & E. Ch. N.P. B (2001)*

from DIS we know:

$$g_1^p(x, Q^2) - g_1^n(x, Q^2) = \frac{1}{6}\Delta q_3|_{LO}$$

$$\Delta q_3(x, Q^2) = (\Delta u + \Delta\bar{u}) - (\Delta d + \Delta\bar{d})$$

$\underline{\text{not}}$ $(\Delta u + \Delta\bar{u})$ & $(\Delta d + \Delta\bar{d})$ that depend on $\Delta s$ & $\Delta G$.

$$(\Delta\bar{u} - \Delta\bar{d})|_{LO} = [\Delta q_3 + \Delta d_V - \Delta u_V]\,|_{LO}$$

$\Rightarrow$ no influence from $\Delta s$ and $\Delta G$.

$(\Delta\bar{u} - \Delta\bar{d}) \simeq$ *small* $\mapsto$ NLO needed

# Testing LO -

$$\frac{\Delta\sigma_p^{h+\bar{h}} - \Delta\sigma_n^{h+\bar{h}}}{\sigma_p^{h+\bar{h}} - \sigma_n^{h+\bar{h}}}(x, \mathrm{z}, Q^2) = \frac{\Delta\sigma_p^{DIS} - \Delta\sigma_n^{DIS}}{\sigma_p^{DIS} - \sigma_n^{DIS}}(x, Q^2)$$
$$= \frac{g_1^p - g_1^n}{F_1^p - F_1^n}(x, Q^2)$$

$h = \pi^\pm$, $K^\pm$, etc. or their sum $h^\pm$

## Advantages:

- z is a passive observable
- no dependence on the parton densities and FFs
- only measurable quantities enter the l.h.s. and the r.h.s.

## Integrated:

$$\frac{\int dx \int dz [\Delta\sigma_p^{h+\bar{h}} - \Delta\sigma_n^{h+\bar{h}}]}{\int dx \int dz [\sigma_p^{h+\bar{h}} - \sigma_n^{h+\bar{h}}]} = \frac{g_A/g_V}{3S_G}$$

- used:

The Bjorken sum rule in LO:

$$\int dx (g_1^p - g_1^n) = g_A/g_V$$
$$g_A/g_V = 1.2670 \pm 0.0079$$

The Gottfried sum rule:

$$S_G = \int dx \frac{F_2^p - F_2^n}{x} = e_u^2 - e_d^2 + \frac{2}{3}\int dx(\bar{u} - \bar{d})$$
$$S_G = 0.235 \pm 0.026$$

## NLO

**LO** **NLO**

alg. eqs. (simple products) $\Rightarrow$ int. eqs. (convolutions)

$$q(x,U^2) \;\Rightarrow\; \int \frac{dx'}{x'} q\left(\frac{x}{x'}\right) C(x') = q \otimes C$$

$$q(x,Q^2)D(z,Q^3) \;\Rightarrow\; \int \frac{dx'}{x'} \int \frac{dz'}{z'} q\left(\frac{x}{x'}\right) C(x',z') D\left(\frac{z}{z'}\right)$$

$$= \;\; q \otimes C \otimes D$$

$C$ are ***known*** Wilson coefficients.

***LO :*** $\Rightarrow$ no gluons in the cross section

***NLO :*** $\Rightarrow$ gluons in $d\sigma$: $G(x)$, $\Delta G(x)$, $D_G^h(z)$

- polarized DIS

$$g_1^p(x,Q^2) \;=\; \frac{1}{2}\sum_i e_i^2 \left[\Delta q_i \left(1 + \otimes \frac{\alpha_s(Q^0)}{2\pi}\delta C_q\right) + \right.$$
$$\left. + \frac{\alpha_s(Q^2)}{2\pi}\Delta G \otimes \delta C_G \right]$$

- unpolarized DIS

$$\tilde{\sigma}^{DIS}|_{LO} = 2F_1 \quad \Rightarrow \quad \tilde{\sigma}^{DIS}|_{NLO} = 2F_1\left[1 + 2\gamma(y)R\right],$$

$$R = \frac{\sigma_L}{\sigma_T}, \qquad \gamma(y) = \frac{1-y}{1+(1-y)^2}.$$

## $\Delta u_V, \Delta d_V - NLO$

- **From polarized SIDIS $\Rightarrow$ $\Delta u_V$ and $\Delta d_V$:**

$$A_p^{\pi^+-\pi^-} = \frac{(4\Delta u_V - \Delta d_V)[1 + \otimes(\alpha_s/2\pi)\Delta C_{qq}\otimes]D_u^{\pi^+-\pi^-}}{(4u_V - d_V)[1 + \otimes(\alpha_s/2\pi)C_{qq}\otimes]D_u^{\pi^+-\pi^-}}$$

$$A_n^{\pi^+-\pi^-} = \frac{(4\Delta d_V - \Delta u_V)[1 + \otimes(\alpha_s/2\pi)\Delta C_{qq}\otimes]D_u^{\pi^+-\pi^-}}{(4d_V - u_V)[1 + \otimes(\alpha_s/2\pi)C_{qq}\otimes]D_u^{\pi^+-\pi^-}}$$

$\Rightarrow$ 2 eqs. for $\Delta u_V$ and $\Delta d_V$

- **From unpolarized SIDIS $\Rightarrow$ $D_u^{\pi^+-\pi^-}(z, Q^0)$:**

$$R_p^{\pi^+-\pi^-} = \frac{[4u_V - d_V][1 + \otimes(\alpha_s/2\pi)C_{qq}\otimes]D_u^{\pi^+-\pi^-}}{18F_1^p\,[1 + 2\gamma(y)\,R^p]}$$

$$R_n^{\pi^+-\pi^-} = \frac{[4d_V - u_V][1 + \otimes(\alpha_s/2\pi)C_{qq}\otimes]D_u^{\pi^+-\pi^-}}{18F_1^n\,[1 + 2\gamma(y)\,R^n]}.$$

$\Rightarrow$ 2 eqs. for $D_u^{\pi^+-\pi^-}(z, Q^2)$

$\Rightarrow$ $\Delta u_V$, $\Delta d_V$ and $D_u^{\pi^+-\pi^-}(z, Q^2)$ are non-singlets and don't mix with other PDs and FFs

## Sea quarks $(\Delta\bar{u} - \Delta\bar{d})$

$$(\Delta\bar{u} - \Delta\bar{d})|_{NLO} = \frac{1}{2}\,[\Delta q_3 + \Delta d_V - \Delta u_V]\,|_{NLO}$$

where $\Delta q_3$ is obtained directly through:

$$g_1^p(x, Q^2) - g_1^n(x, Q^2) = \frac{1}{6}\Delta q_3 \otimes \left(1 + \frac{\alpha_s(Q^2)}{2\pi}\delta C_q\right)$$

## SIDIS – $\pi^{\pm}$

### $\Delta u_V$, $\Delta d_V$ and $\Delta\bar{u} - \Delta\bar{d}$ determined in LO and NLO:

- no assumptions about FFs
- no assumptions about any polarized sea densities, even $s \neq \bar{s}$ and $\Delta s \neq \Delta\bar{s} \Leftarrow D_s^{\pi^+-\pi^-} = 0$
- only SU(2) and $C$ inv. of strong ints. assumed
- only unpolarized $u_V$ and $d_V$ to be known
- SU(2) breaking without knowledge of $\Delta\bar{u}$ and $\Delta\bar{d}$
- test for LO $\Rightarrow z =$ passive observable

  If a small dependence on $z \Rightarrow$ it can be considered as a system. error (theor. uncertainty) in a LO analysis
- $\Delta q_3$, $\Delta d_V$ and $\Delta u_V$ well determined in LO however their linear combination very small – NLO corrections important in $\Delta\bar{u} - \Delta\bar{d}$

## SIDIS – $K^{\pm}$

$\Rightarrow$ SU(2) does not relate $D^{K^{\pm}} \Rightarrow$ assumptions needed:

1. $D_d^{K^+-K^-} = 0$ – unfav. trans. are equal (but not small)
2. $\Delta s - \Delta\bar{s} = 0$ ($D_s^{K^+-K^-} \neq 0$)

instead: $\Delta u_V, \Delta d_V$ known from SIDIS $\pi^{\pm}$ without any assumptions, then $K^{\pm}$ determine $\Delta s - \Delta\bar{s}$ - LO and NLO

## SIDIS – $\Lambda, \bar{\Lambda}$

$\Rightarrow$ SU(2): $D_u^{\Lambda-\bar{\Lambda}} = D_d^{\Lambda-\bar{\Lambda}}$,

but $D_s^{\Lambda-\bar{\Lambda}} \neq 0 \Rightarrow$ assumption: $\Delta s - \Delta\bar{s} = 0$

## $\underline{\Delta u_V, \Delta d_V - SIDIS - K^{\pm}}$

**LO:**

$$A_p^{K^+-K^-}(x,z,Q^2) = \frac{\Delta u_V}{u_V}(x,Q^2)$$
$$A_n^{K^+-K^-}(x,z,Q^2) = \frac{\Delta d_V}{d_V}(x,Q^2)$$

**NLO:**

$$A_p^{K^+-K^-} = \frac{\Delta u_V(1+\otimes(\alpha_s/2\pi)\Delta C_{qq}\otimes)D_u^{K^+-K^-}}{u_V+\otimes(\alpha_s/2\pi)\,C_{qq}\otimes)D_u^{K^+-K^-}}$$
$$A_n^{K^+-K^-} = \frac{\Delta d_V(1+\otimes(\alpha_s/2\pi)\Delta C_{qq}\otimes)D_u^{K^+-K^-}}{d_V(1+\otimes(\alpha_s/2\pi)\,C_{qq}\otimes)D_u^{K^+-K^-}}$$

**From unpolarized SIDIS** $\Rightarrow D_u^{K^+-K^-}(z,Q^2)$**:**

$$R_p^{K^+-K^-} = \frac{u_V\,[1+\otimes(\alpha_s/2\pi)C_{qq}\otimes]D_u^{K^+-K^-}}{18F_1^p\,[1+2\gamma(y)\,R^p]}$$
$$R_n^{K^+-K^-} = \frac{d_V\,[1+\otimes(\alpha_s/2\pi)C_{qq}\otimes]D_u^{K^+-K^-}}{18F_1^n\,[1+2\gamma(y)\,R^n]}.$$

$\Rightarrow$ **SU(2) does not relate** $D^{K^{\pm}}$ $\Rightarrow$ **assumptions needed:**

**1.** $D_d^{K^+-K^-}=0$ **– unfav. trans. are equal (but not small)**

**2.** $\Delta s-\Delta\bar{s}=0$ $(D_s^{K^+-K^-}\neq 0)$

**better:** $\Delta u_V, \Delta d_V$ **known from SIDIS** $\pi^+, \pi^-$ **without any assumptions, then** $K^{\pm}$ **determine** $\Delta s-\Delta\bar{s}$

# $\Delta s - \Delta\bar{s} = ? - SIDIS - K^{\pm}$

$D_d^{K^+-K^-} = 0$ assumed

**LO:**

$$A_p^{K^+-K^-} = \frac{4\Delta u_V D_u^{K^+-K^-} + (\Delta s - \Delta\bar{s})D_s^{K^+-K^-}}{4u_V D_u^{K^+-K^-}}$$
$$A_n^{K^+-K^-} = \frac{4\Delta d_V D_u^{K^+-K^-} + (\Delta s - \Delta\bar{s})D_s^{K^+-K^-}}{4d_V D_u^{K^+-K^-}}$$

$\Rightarrow (\Delta s - \Delta\bar{s})D_s^{K^+-K^-} = ?$

$\longrightarrow$ note: $D_s^{K^+-K^-}$ is not small

$D_u^{K^+-K^-}$ : $\quad R_p^{K^+-K^-} = \dfrac{u_V D_u^{K^+-K^-}}{\sigma_p^{DIS}}, \quad R_n^{K^+-K^-} = \dfrac{d_V D_u^{K^+-K^-}}{\sigma_n^{DIS}}$

**NLO:**

$$A_p^{K^+-K^-} = \frac{[\Delta u_V D_u + (\Delta s - \Delta\bar{s})D_s] \otimes (1 + (\alpha_s)\Delta C_{qq}\otimes)}{u_V \otimes (1 + (\alpha_s/2\pi)\, C_{qq}\otimes)D_u^{K^+-K^-}}$$
$$A_n^{K^+-K^-} = \frac{[\Delta d_V D_u + (\Delta s - \Delta\bar{s})D_s] \otimes (1 + (\alpha_s)\Delta C_{qq}\otimes)}{d_V \otimes (1 + (\alpha_s/2\pi)\, C_{qq}\otimes)D_u^{K^+-K^-}}$$

$\Rightarrow$ 2 eqs. for $(\Delta s - \Delta\bar{s}) \otimes (1 + (\alpha_s)\Delta C_{qq}\otimes)D_s^{K^+-K^-}$.

From unpolarized SIDIS: $\Rightarrow D_u^{K^+-K^-}(z, Q^2)$:

$$R_p^{K^+-K^-} = \frac{u_V\, [1 + \otimes(\alpha_s/2\pi)C_{qq}\otimes]D_u^{K^+-K^-}}{18F_1^p\, [1 + 2\gamma(y)\, R^p]}$$
$$R_n^{K^+-K^-} = \frac{d_V\, [1 + \otimes(\alpha_s/2\pi)C_{qq}\otimes]D_u^{K^+-K^-}}{18F_1^n\, [1 + 2\gamma(y)\, R^n]}.$$

## $D^{\pi^+}_{u,d,s}$ from HERMES and $e^+e^-$ data

*S. Kretzer, E. Leader, E.Ch., EPJ (2001)*

1. HERMES data: $e+p \to e+\pi^{\pm}+X$, $< Q^2 >= 2.5\, GeV^2$

- $R_p^{\pi^+} = \left\{(4u+\bar{d})D_u^{\pi^+} + (4\bar{u}+d)D_d^{\pi^+} + (s+\bar{s})\, D_s^{\pi^+}\right\}/\sigma_p^{DIS}$
- $R_p^{\pi^-} = \left\{(4\bar{u}+d)D_u^{\pi^+} + (4u+\bar{d})D_d^{\pi^+} + (s+\bar{s})\, D_s^{\pi^+}\right\}/\sigma_p^{DIS}$

2. LEP data: $e^+ + e^- \to Z^0 \to \pi^{\pm} + X$

- $D_{meas}^{\pi^+ + \pi^-}(m_Z^2) \simeq D_{\Sigma}^{\pi^+ + \pi^-}(m_Z^2)$ - up to 5% uncertainties

$$D_{\Sigma}^{\pi^+ + \pi^-} = 2\left(D_u^{\pi^+} + D_d^{\pi^+} + D_s^{\pi^+}\right)$$

**Thus:** 3 eqs. for $D_u^{\pi^+}$, $D_d^{\pi^+}$, $D_s^{\pi^+}$ and no assumptions:

$$D_u^{\pi^+} - D_d^{\pi^+} = \frac{9\left(R_p^{\pi^+} - R_p^{\pi^-}\right)\sigma_p^{DIS}}{4u_V - d_V} = D_u^{\pi^+ - \pi^-}$$

$$D_u^{\pi^+} + D_d^{\pi^+} = \frac{9\left(R_p^{\pi^+} + R_p^{\pi^-}\right)\sigma_p^{DIS} - 2sD_{\Sigma}^{\pi^+}}{4(u+\bar{u}-s)+d+\bar{d}}$$

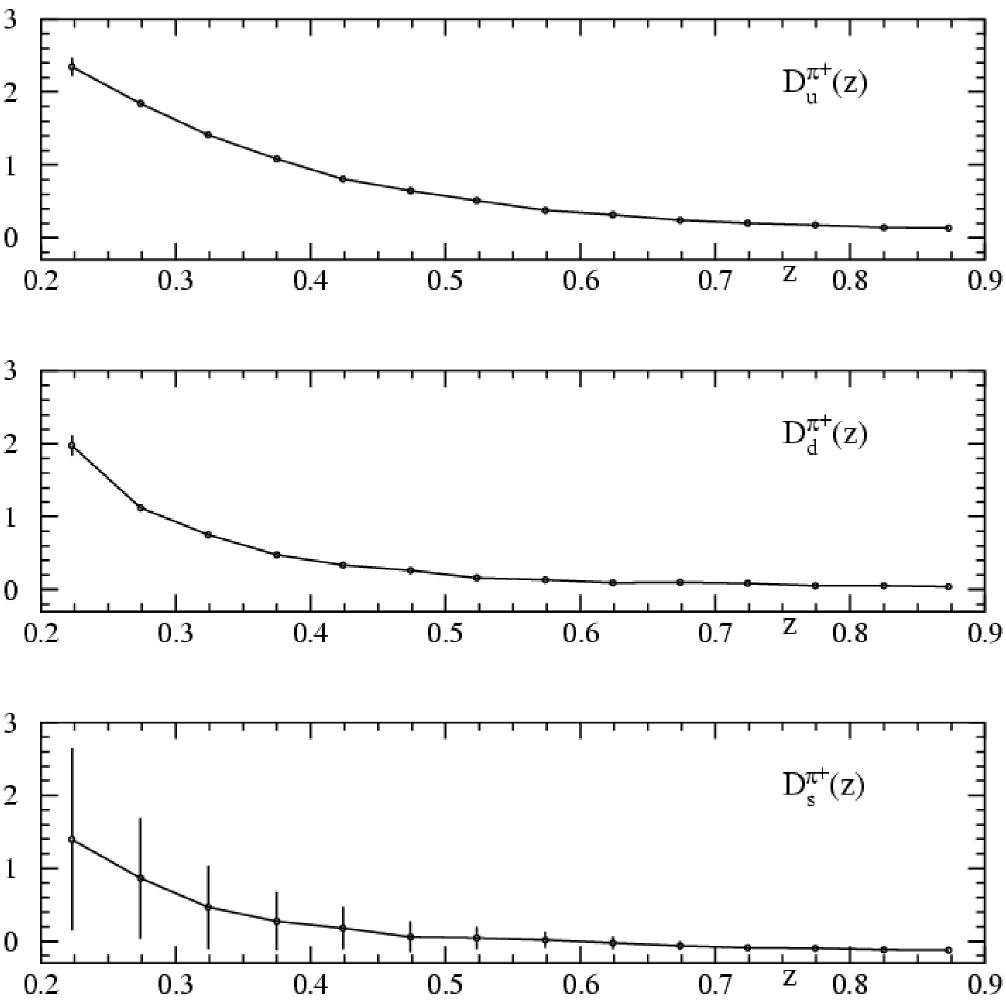
$$D_s^{\pi^+} = \frac{-18\left(R_p^{\pi^+} + R_p^{\pi^-}\right)\sigma_p^{DIS} + [4(u+\bar{u}) + (d+\bar{d})]\, D_{\Sigma}^{\pi^+}}{2[4(u+\bar{u}-s)+d+\bar{d}]}$$

the uncertainty in $D_{\Sigma}^{\pi^+} \simeq 20\%$

$$\Downarrow$$

$D_{\Sigma}^{\pi^+}(z, Q^2)$ = a flavour singlet
$D_{\Sigma}^{\pi^+}(Q^2 = m_Z^2) \longrightarrow D_{\Sigma}^{\pi^+}(Q^2 = 2.5 GeV^2) \Rightarrow D_G^h$ enters
$D_G^{\pi^+}$= poorly determined

**Note: $D_u^{\pi^+ - \pi^-}$ is not affected by $D_{\Sigma}$!!**




**The pion FFs**

# CONCLUSIONS

## We suggest a model independent approach to SIDIS

advantage : only measurable quantities are used

the price : precise measurements needed

- SIDIS-$\pi^{\pm}$: pol. and unpol. determine:

1) the valence quarks: $\Delta u_V$, $\Delta d_V$
2) SU(2) breaking for the pol. sea: $\Delta\bar{u} - \Delta\bar{d}$
3) $D_u^{\pi^+-\pi^-}$

$\longrightarrow$ LO & NLO

$\longrightarrow$ no assumptions about $\Delta q_{sea}$, $\Delta G$ and FFs

to be measured in JefLab –

- tests for the reliability of LO – "passive" observable

- SIDIS $K^{\pm}$: $\Delta s - \Delta\bar{s} \neq 0$?

- $D_u^{\pi^+}$, $D_d^{\pi^+}$, $D_s^{\pi^+}$ obtained from HERMES & LEP data

$\longrightarrow$ no assumptions about fav. and unfav. transitions