Impact of sidis data on pPDFs

Rodolfo Sassot
Buenos Aires

INT 10-03 Workshop, October 2010
OUTLINE:

✓ General Framework for Helicity Parton Densities (pPDFs)
✓ Status 2010: DSSV, BB, LSS, NNPDFs ...
  W-program, Run09, ...

Werners’s talk 1st week

Impact of new sidis data (COMPASS) in pPDFS (DSSV,LSS10):

✓ What is the actual impact: on pPDFS
   on uncertainties

✓ What could we learn from future data

✓ Where/what should we check
   Implications for $\Delta s$
DSSV 08

**FLAVOR AT SMALL-X?**

**STRANGE/KAONS?**

- DSSV
- DNS (DSS FFs)
DSS FFs

**PIONS**

\[
\frac{1}{N_{\text{DIS}}} \frac{dN^{\pi^{+}}}{dzdQ^{2}}
\]

\[
\frac{1}{N_{\text{DIS}}} \frac{dN^{\pi^{-}}}{dzdQ^{2}}
\]

**KAONS**

\[
\frac{1}{N_{\text{DIS}}} \frac{dN^{K^{+}}}{dzdQ^{2}}
\]

\[
\frac{1}{N_{\text{DIS}}} \frac{dN^{K^{-}}}{dzdQ^{2}}
\]

PION FFs ARE SAFE

KAON FFs?

“Hermes”
DSSV 08

FLAVOR AT SMALL-X?
STRANGE/KAONS?

- DSSV
- DNS (DSS FFs)
Compass Sidis Data:


DSSV+Compass

SMC $A_{lp}^{h+}$
HERMES $A_{lp}^{h+}$
HERMES $A_{lp}^{\pi+}$
HERMES $A_{ld}^{\pi+}$
COMPASS $A_{ld}^{\pi+}$

SMC $A_{lp}^{h-}$
HERMES $A_{lp}^{h-}$
HERMES $A_{lp}^{\pi-}$
HERMES $A_{ld}^{\pi-}$
COMPASS $A_{ld}^{\pi-}$

HERMES $A_{He}^{h+}$
HERMES $A_{He}^{h-}$
HERMES $A_{ld}^{K+}$
HERMES $A_{ld}^{K-}$
COMPASS $A_{ld}^{K+}$
COMPASS $A_{ld}^{K-}$

HERMES $A_{He}^{h+}$
HERMES $A_{He}^{h-}$
HERMES $A_{ld}^{K+}$
HERMES $A_{ld}^{K-}$
COMPASS $A_{ld}^{K+}$
COMPASS $A_{ld}^{K-}$

DNS (DSS FFs)
DSSV08
DSSV+ compass
HERMES A

COMPASS A

DNS (DSS V/)

DSSV08

DSSV+
## Numerology†:

<table>
<thead>
<tr>
<th></th>
<th>+D Data</th>
<th>+D&amp;P Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSSV</td>
<td>392.50</td>
<td>456.40</td>
</tr>
<tr>
<td>DSSV+</td>
<td>418.95</td>
<td>452.98</td>
</tr>
</tbody>
</table>

~2 units   ~4 units

DSSV well within the error bars of DSSV+

\[ \Delta \chi^2 = 1 \text{ IS TOO LITTLE} \]

\[ \Delta \chi^2 = 2\% \text{ IS TOO MUCH} \]

† Numerology: 1. the branch of knowledge that deals with the occult significance of numbers.
PPDFS

Within bands at small x

Less polarization?

Shrink at small x
LSS10 arXiv:1010.0574

DIS+SIDIS

DSS FFs

TMC+HT for DIS data

Remarkable agreement
LIGHT SEA QUARKS

SIZABLE IMPACT ON UNCERTAINTIES

NEW DATA PREFER LESS POLARIZATION

NO TENSION: PIONS & KAONS PULL TOGETHER
STRAINS† QUARKS

**DIS/3F-D CANNOT SIZE**

\[ \Delta s \text{ at large } x \]

\[ \chi^2_i \]

\[ \Delta s^1, [0.001-1.0] \]

(a)

**NOW MUST BE CONSIDERED**

**NEED MORE/BETTER SIDIS DATA AT SMALL X**

† strange: 1. unusual or surprising in a way that is unsettling or hard to understand
2. not previously visited, seen, or encountered; unfamiliar or alien
3. having a nonzero value for strangeness

**DISK**

\[ \pi^\pm 09 \]

\[ K^\pm 09 \]

\[ \pi^\pm + K^\pm 09 \]

**F, D**

**DIS**

**RHIC**

**SIDIS**

**SIZABLE IMPACT ON UNCERTAINTY**

**COMPROMISE BETWEEN DIS AND SIDIS DATA**

**NOT F&D CONSTRAINTS**

\[ \Delta s^1, [0.02-1.0] \]

\[ \Delta s^1, [0.001-0.02] \]
**CAN \( \Delta s \neq \Delta \bar{s} \)?**

\[ A_1 \sim \Delta s + \Delta \bar{s} \]

\[ K^+ \sim u\bar{s} \]

\[ K^- \sim \bar{u}s \]

**NO SIGNIFICANT EFFECT AT LARGE \( x \)**

**TOO LARGE ERRORS AT SMALL \( x \)**
Summary:

New SIDIS data is in agreement with DSSV

Sizeable impact in the fit:

The uncertainty bands shrink

No tensions with the kaon data

No surprises at small $x$

Towards an unpolarized sea?

$\Delta \bar{d}$ Next item:

Negatively charged pions?

$\Delta s$ Still an open issue:

Kaon SIDIS (pol & unpol) at small $x$
A case for SIDIS/FFs:

SIDIS/FFs until now in the backstage: LARGE UNCERTAINTIES

THIS SHOULD CHANGE!

FFs as fundamental as PDFs: NOT SO WELL KNOWN YET

MORE HARD TO MEASURE

FFs linked to fundamental physics:

FLAVOR & KINEMATIC FEATURES

OF HADRONIZATION

NOT WELL UNDERSTOOD YET

FFs/SIDIS as tools:

\[ \bar{d} - \bar{u} =? \]

\[ s - \bar{s} =? \]

ISOSPIN BREAKING

HIDDEN BY NUCLEAR EFFECTS

LIMITATIONS OF DY/ W

SIDIS at EIC vs. PDFs uncertainties?

† fundamental: 1. forming a necessary base or core; 2. of central importance;
3. affecting or relating to the essential nature of something or the crucial point about an issue