

Future SPD Measurements in the Context of Global Analyses

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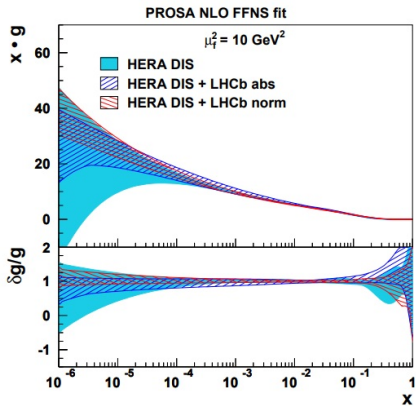
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Future SPD Measurements

- Even with a rich variety of SIDIS data, gluon distributions inside nucleons is not well understood as gluons do not interact in the leading order in these
- With possible measurements of productions and asymmetries of charmoniums, prompt photons and charm mesons (open charm channel), SPD will provide a plethora of probes
- Although various TMDs of gluons are major focus for Physics at SPD, unpolarized gluon density and gluon helicity may also be improved with SPD data
- If we can quantify the impact of these measurements, it would make a better case to the funding agencies/committees

Unpolarized Gluon Distributions $f_1^g(x)$

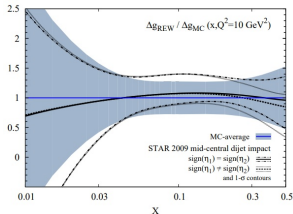
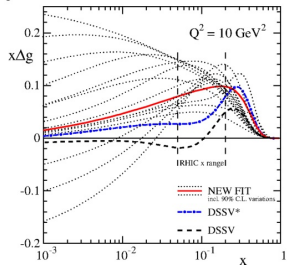


(Eur. Phys. J. C 75, 396 (2015))

- Global analysis from PROSA collab (at DESY) to extract improved gluon density
- Data included : HERA inclusive + c,b hadron, LHCb c,b hadron
- Relative uncertainties of $g(x)$ (f_1^g) in the bottom panel are considerably high below $x = 5^{-5}$ and above $x = 3 \times 10^{-1}$
- To estimate SPD impact, we can use mock data (one of the existing D^0 data) with projected uncertainties from SPD (estimated from MC) and see how it helps improve uncertainty in the large x

Gluon Helicity Distributions $g_1^g(x)$

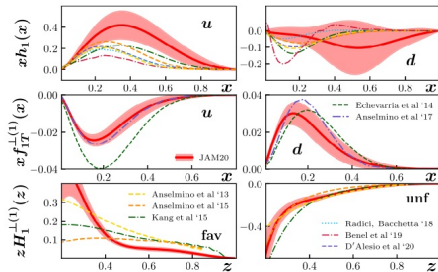
Phys. Rev. Lett. 113, 012001 (2014)



Phys. Rev. D 100, 114027 (2019)

- Upper left : global analysis from DSSV (Stratmann et al.). Improved fit with RHIC 2009 data (STAR jet + PHENIX π^0)
- Bottom left : recent work uses reweighted MC to estimate impact of STAR di-jet measurements on uncertainties of extracted $g_1^g(x)$
- A similar exercise might give guidance to whether SPD can afford to take enough longitudinal data to make noticeable improvements

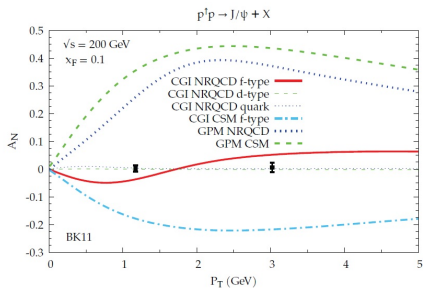
Gluon Sivers Distributions $f_{1T}^{\perp g}$



Phys. Rev. D 102, 054002 (2020)

- Gluon does not interact in leading order in SIDIS and e^+e^- interactions, so it's extremely difficult to do 'global analysis' with a variety of data
- There is no gluon Sivers global analysis yet, there is a single very recent global analysis of u, d Sivers
- Whereas it is difficult judge impact of SPD data in the global context of gluon Sivers distribution, we are in a happy position to be leaders in the field with new data

Gluon Sivers Distributions $f_{1T}^{\perp g}$



arXiv:2011.10350

- D'Alesio et al. has recent work on gluon Sivers and its comparison with A_N at RHIC

- They test various models (GPM, CGI-GPM) for the TMD + CS and NRQCD (with two sets of LDME for final hadronization) to predict A_N of charmoniums
- Although no global analysis, SPD impact may be demonstrated by showing projected stat. err. of A_N of charmoniums from SPD on a similar plot
- Interpretation of charmonium A_N is difficult (feed-down). Still can be helpful in constraining different models

Next To Do

- Look in detail for the status of study on gluon Boer-Mulders ($h_1^{\perp g}$) and Transversity ($h_1^{\perp g} T$)
- Contact the groups with expertise on some of these global analyses (don't want to invent wheel) for pieces of code and/or suggestions how to quantify impact of future SPD measurements
- Coordinate with Igor, Artur to use already existing MC to generate estimated statistics of SPD measurements in a certain period (one/two yr)
- Make a more quantitative case for the physics goal of SPD at NICA
- Present updates in the Physics and MC meeting