STRONG2020 NA2-Small-x: Physics at the LHC and future DIS experiments - Interim Report
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Miscellaneous: RP1 (first 18 months)

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IJCLab:

Accessing the transverse spin content of the proton and the Odderon (C-) without target polarization

Diffractive Process $\gamma^* p \to \pi^0 p'$

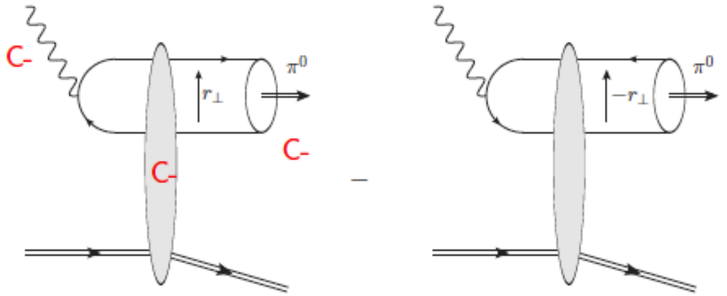
On an unpolarized proton, dominant contribution = helicity flip, i.e. $\vec{S}_\perp$:

$$\frac{d\sigma}{dt} = \sum_{SS'=\pm} \frac{d\sigma_{SS'}}{dt} \sim \frac{d\sigma_{+-}}{dt} + \frac{d\sigma_{-+}}{dt} \quad \text{et} \quad \frac{d\sigma}{dx dQ^2 d|t|} \sim \frac{c}{Q^6} \left[\int dk_\perp^2 \cdots f_{1T}^{\perp g}(x, k_\perp^2) \right]^2$$

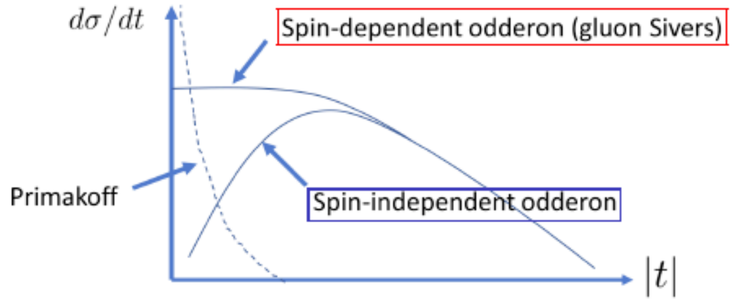
This contribution corresponds to the exchange of a spin dependent odderon :
spin dependent odderon = gluonic Sivers distribution at small x

$$\int d^2 r_\perp e^{-i(k_\perp \cdot r_\perp)} \langle P', S' | \mathcal{O}(r_\perp) | P, S \rangle \qquad (\vec{\Delta} \to 0)$$

$$\sim i(\vec{k}_\perp \cdot \vec{\Delta}_\perp)\ g_{1,1}\ , \quad (\vec{k}_\perp \times \vec{S}_\perp)_z\ g_{1,2}\ , \quad (\vec{k}_\perp \cdot \vec{\Delta}_\perp)(\vec{\Delta}_\perp \times \vec{S}_\perp)_z\ g_{1,3}.$$



$$\frac{1}{2}\left[\mathrm{Tr}\left(U_{b+\frac{r}{2}} U^\dagger_{b-\frac{r}{2}}\right) - \mathrm{Tr}\left(U_{b-\frac{r}{2}} U^\dagger_{b+\frac{r}{2}}\right)\right]$$



R. Boussarie, Y. Hatta, L. Szymanowski, S. Wallon, PRL 124 (2020) 17, 172501

ECT*:

Within the scope of the Task 2 we have performed the following activities:

- Used the collinearly-improved Balitsky-Kovchegov equation (derived earlied with the contribution of D.T.) to fit the HERA data for inclusive DIS at small Bjorken x:

  "HERA data and collinearly-improved BK dynamics", B. Ducloué, E. Iancu, G. Soyez, DT, Physics Letters B 803 (2020) 135305

- Studying longitudinal and transverse momentum dependence in SIDIS:

  E. Iancu, A.H. Mueller, DT, S.Y. Wei, to appear soon

NCBJ:

Gluon TMDs at small-x :

(i) “Probing the Gluon Sivers Function with Unpolarized Target: GTMD Distributions and the Odderons”
Renaud Boussarie, Yoshitaka Hatta (BNL), Lech Szymanowski (NCBJ, Warsaw), Samuel Wallon (Paris, LPTHE & Paris U. IV)
Phys. Rev. Lett. 124 (2020) no.17, 172501

It is commonly believed that the Sivers function has uniquely to do with processes involving a transversely polarized nucleon. In this paper it is shown that it is not necessarily the case and it is demonstrated that exclusive pion production in unpolarized electron-proton scattering in the forward region is a direct probe of the gluon Sivers function due to its connection to the QCD Odderon.

(ii) “Photoproduction of three jets in the CGC: gluon TMDs and dilute limit”
Tolga Altinoluk (NCBJ, Warsaw), Renaud Boussarie (BNL), Cyrille Marquet (Ecole Polytechnique), Pieter Taels (Ecole Polytechnique & INFN, Cagliari)
JHEP 2007 (2020) 143

Photoproduction of three jets (quark, antiquark and gluon) in photon-nucleus collisions is studied within the CGC framework. In the so-called correlation limit, the cross section is shown to be sensitive to both the unpolarized and linearly polarized Weizsäcker-Williams transverse momentum dependent gluon distribution function (gluon TMD).

Multi-particle Correlations and Thermalization:

(iii) “Effect of non-eikonal corrections on azimuthal asymmetries in the Color Glass Condensate”
Pedro Agostini (USC & IGFAE), Tolga Altinoluk (NCBJ, Warsaw), Nestor Armesto (USC & IGFAE)
Eur. Phys. J. C79 (2019) no.9, 790

The azimuthal structure of two gluon correlations in the Color Glass Condensate is studied including the effects that result from relaxing the shockwave approximation for the target. Within the Glasma graph approach, for dilute-dilute collisions, the azimuthal distributions are computed numerically and it is shown that both even and odd harmonics appear.

(iv) “Particle correlations from the initial state”
Tolga Altinoluk (NCBJ, Warsaw), Nestor Armesto (USC & IGFAE)
Eur. Phys. J. A56 (2020) no.8, 215

The ridge phenomena in small size collision systems such as pp and pA can still be described in the framework of relativistic viscous hydrodynamics. However, the applicability of this framework for small systems is less well grounded and initial state based mechanism have been suggested to explain the ridge. This paper is short review that discusses particle correlations from the initial state point of view, with focus on the most recent theoretical developments.