Workshop on opportunities for DY at RHIC
BNL May 10 - 13

Sivers function from SIDIS,PP and DY

We analysed Sivers function using TMD factorization (SIDIS data) and twist-3 formalism (PP data). We find that Sivers function for u quark exibits a node at x ~ 0.4. Prediction for Drell Yan experiments at RHIC are given and the region of xF which is resemblant to SIDIS kinematical region is found to be xF from 0 to 0.2. The measuremets of predicted sign change of Sivers function is of extreme importance for our understanding of color gauge invariance of QCD.

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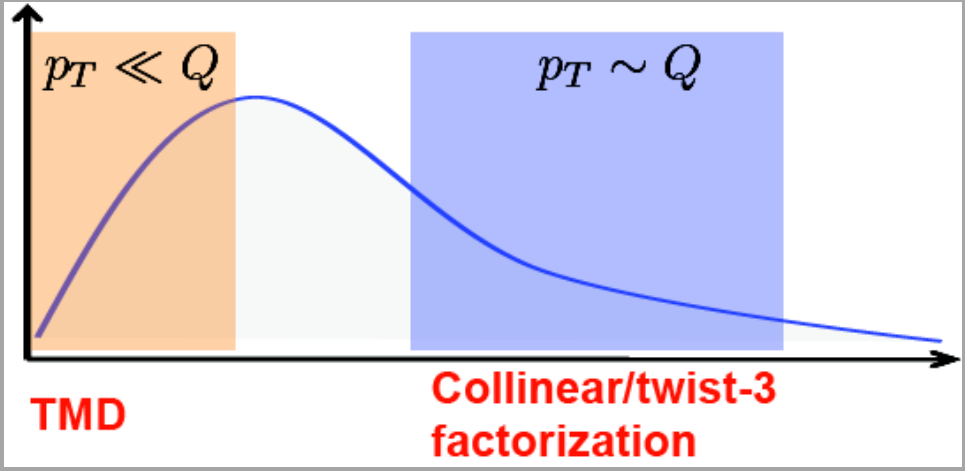
TMD and Collinear factorizations

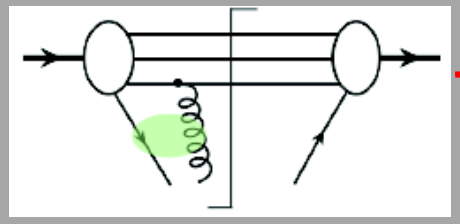
Both factorizations are consistent in the overlap region



Talks of John Collins, Piet Mulders, Ted Rogers, Jian-Wei Qui, Alessandro Bacchetta

Relation of multyparton correlations and moments of TMDs

$$\int d^2p_T \frac{p_T^2}{M} f_{1T}^{\perp}(x, p_T^2) + UVCT(\mu^2) = T_F(x, x, \mu^2) \qquad f_{1T}^{\perp(1)} \equiv \int d^2p_T \frac{p_T^2}{2M^2} f_{1T}^{\perp}(x, p_T^2)$$



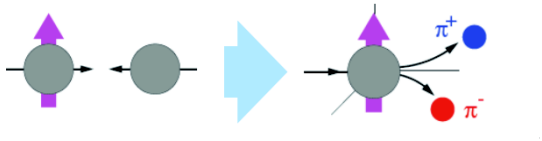
Sivers function is related to TF, but counterterm matters!

Talks of John Collins, Piet Mulders, Ted Rogers, Jian-Wei Qui

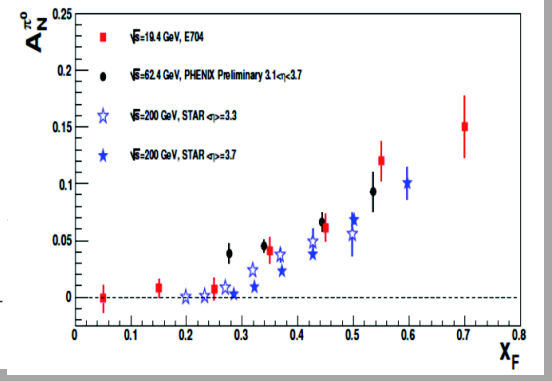
Data analysis

Proton Proton

$$A(p_A, s_\uparrow) + B(p_B) \to \pi(p) + X$$



$$A(\ell, \vec{s}) \equiv \frac{\Delta\sigma(\ell, \vec{s})}{\sigma(\ell)} = \frac{\sigma(\ell, \vec{s}) - \sigma(\ell, -\vec{s})}{\sigma(\ell, \vec{s}) + \sigma(\ell, -\vec{s})}$$



Only one scale P_T

Collinear analysis:

Kouvaris, Qiu,
Vogelsang, Yuan (2006)
Kanazava, Koike (2010)

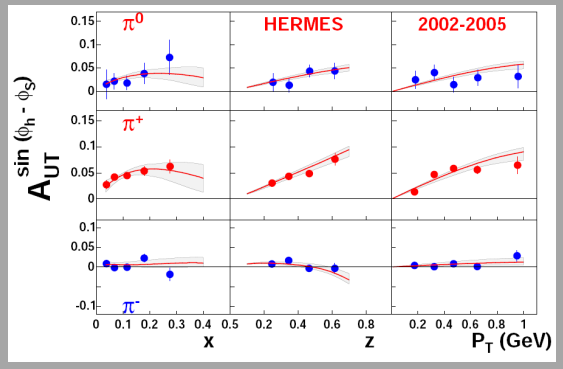
TMD analysis:

Anselmino et al (2006)

SIDIS

$$A_{UT} = \frac{d\sigma^\uparrow - d\sigma^\downarrow}{d\sigma^\uparrow + d\sigma^\downarrow}$$

$$d\sigma^\uparrow - d\sigma^\downarrow \propto \underbrace{f_{1T}^\perp \otimes D_1 \sin(\phi_h - \phi_S)}_{\text{Sivers effect}}$$



Two scales P_T, Q

$$\Lambda^2_{\mathrm{QCD}} < \mathrm{P}^2_{\mathrm{h}\perp} \ll \mathrm{Q}^2$$

TMD analysis: Anselmino et al (2008);
Collins et al (2007) ; Vogelsang, Yuan (2006)

Parametrization

$$\mathbf{f_{1T}^{\perp q} \propto x^{\alpha_q}(1-x)^{\beta_q}(1-\eta_q x)}$$

as in De Florian, Sassot, Stratmann, Vogelsang (2009)

$1-\eta_q x$ has a node if $\eta_q > 0$

SIDIS: HERMES, COMPASS data $\pi^{\pm}, \mathbf{K}^{\pm}$

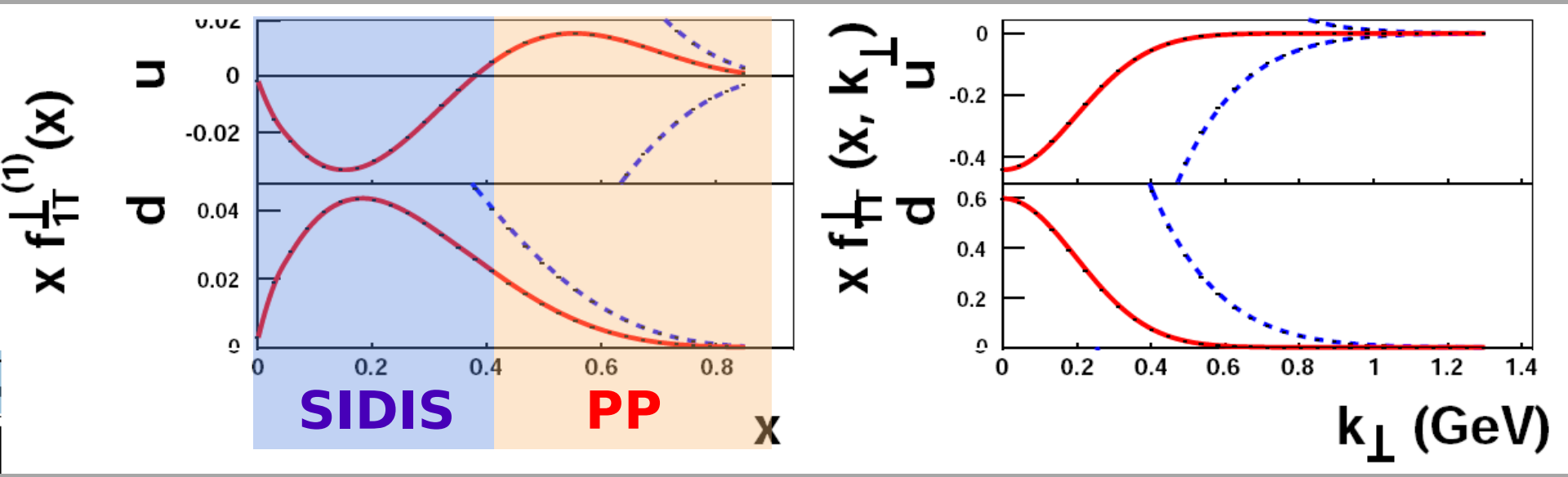
$$\mathbf{A_{UT}^{\sin(\Phi_h - \Phi_S)} \sim f_{1T}^{\perp} \otimes \sigma \otimes D_1}$$

PP: STAR data π^0

$$\mathbf{A_N \sim T_F \otimes \sigma \otimes D_1}$$

using PDF GRV98 and FF DSSV

Results: Sivers function



Sivers function has a node!

$$x_{node} \sim 0.4$$

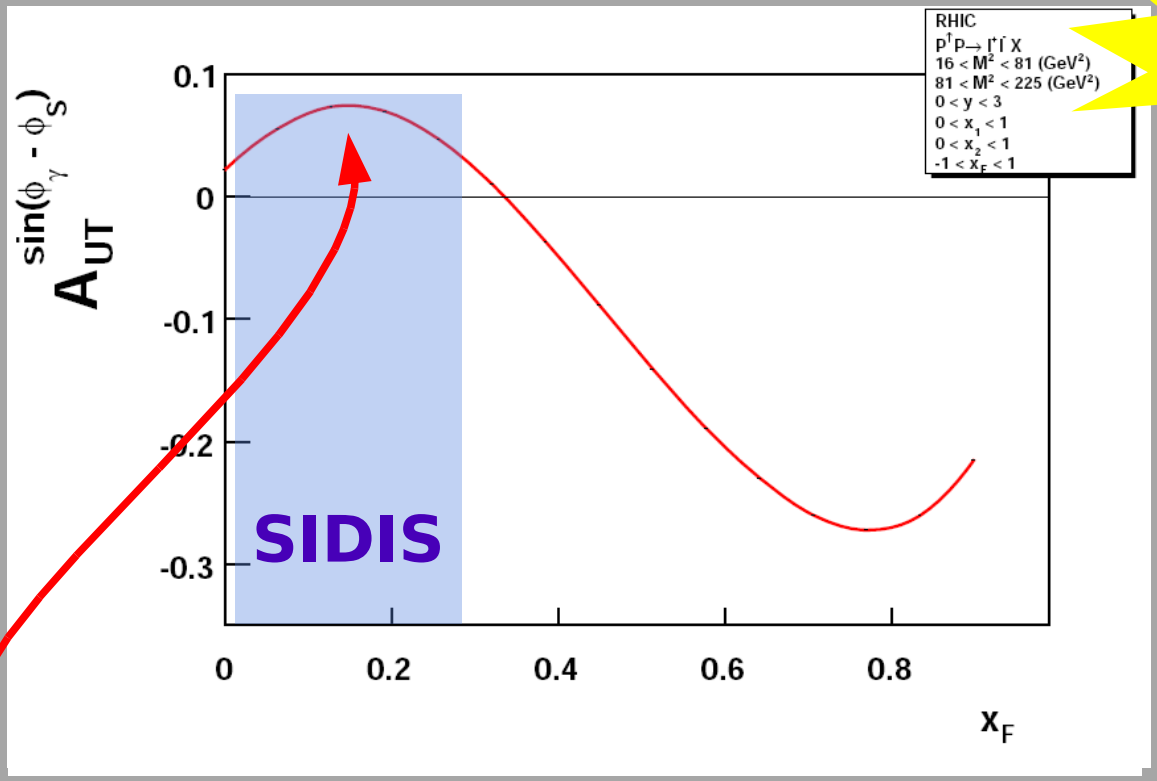
Drell Yan

$$A_N = \frac{\sum_q f_{1T}^{\perp q}(x_1, p_T) \otimes f_1^{\bar{q}}(x_1, p_T)\sigma_{q\bar{q}}}{\sum_q f_1^{q}(x_1, p_T) \otimes f_1^{\bar{q}}(x_1, p_T)\sigma_{q\bar{q}}}$$

Analysis at LO in hadronic cm frame

Kang, AP (2011)

AP, Kang 2011



New!

To measure in order to check

$$-f_{1T}^{\perp}\big|_{DY} = f_{1T}^{\perp}\big|_{SIDIS}$$