SIDIS - Working Group kick-off meeting

May 19, 2021

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Agenda

- Date and Time of SIDIS WG regular meetings; weekly, bi-weekly, or...?
- Physics Topics: discuss prioritisation w.r.t. detector features; which golden and silver channels?
- "Technical discussion": which plots, simulations?
- AOB

Calendar

2-we	2-week appointment planner					Calendarp Your source for ca	edia Ilendars			
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- Confirm / change date and time
- Choose weekly / bi-weekly / ... rate of meetings

SIDIS Physics Topics

- EIC White Paper golden channel:
 1. unpolarized TMD of valence/sea quarks

 - 2. Sivers TMD of valence/sea quarks
 - 3. unpolarized and Sivers TMD of gluons: di-hadron and/or di-jet ==> Jet / HF WG ?
- EIC White Paper silver channel:
 - 1. chiral-odd functions for valence/sea quarks: transversity and Boer-Mulders
 - 2. transversity (also as PDF) ==> tensor charge

SIDIS Physics Topics (update)

- unpolarized and helicity sea/strange quark PDFs ==> fragmentation function FFs
- polarized fragmentation (Λ)
- Jet-related TMDs (Sivers, Collins and jet substructure)
 ==> Jet / HF WG ?
- chiral-odd higher twist: e(x), ...
- in-medium PDFs and FFs ?

Where does Athena have an advantage and what physics topic might profit

• High B field

 \rightarrow resolution of high momentum tracks

 \rightarrow PID at high momenta

- → kinematic reach for evolution? Unexplored region
- Hermetic coverage

→Cc events

→Kinematic reach using hadronic final state

Topics vs. Detector features

- TMD evolution (Collins-Soper kernel) <==> energy reach
- Gluon Sivers <==> di-hadron acceptance ?
- Transversity and chiral-odd functions <==> (x,Q²) resolution, energy reach, PID coverage
- sea/strange PDFs with FFs <==> PID coverage, energy reach (z, Q^2)
- Λ fragmentation <==> low energy
- charged currents <==> hadronic final state

→Coordinate with DIS & Jet/HF WGs

in-medium PDFs & FFs <==> ?

Technical discussion

• Impact plots vs. kinematical coverage plots ?

- Full vs. fast simulations ?
 - Framework...?

People Power

•

Backup



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Sivers function



Integrals!



The balance between small/large-x is important for integrated observables **Toy example:** $A = \int_0^1 dx f_{1T;u}^{\perp}(x,0)$ $\delta A_{\rm IR1} \sim 6\%, \qquad \delta A_{\rm IR2} \sim 12\%$ $\delta A_{\rm IR1\cup IR2} \sim 3\%$

Concerning evolution







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"Golden Measurements"

Measurement/process	Main detector requirements	Anticipated plot	Comments
Quark Sivers, 3D momentum structure, TMD evolution from single hadrons \rightarrow 3D image (x, k_t) of the Sivers Function, Evolution test of Sivers at intermediate x Alexey Vladimirov,	 η acceptance for hadrons angular resolution granularity of the detector (central to forward -1 to 4), pi/K/p identification Comments: PID⇔Tracking, B —field → δp/p, min p 	 pseudo-3D Sivers function as a function kt for various x bins, Value of Tensor charge uncertainties + plot vs x, Q2 dependence of Sivers function or A_{UT} at fixed x 	 Use of existing simulations at Elke's group + smearing + weights originating from theorists. Work on common database ongoing, integrate in SW environment Theory work on fits/parameterizations. Preparation of fitting experimental pseudo-data ongoing
Gluon Sivers via di-jets/di- hadrons → Probing the size of the gluon Sivers function Bowen Xiao	acceptance for back-to- back dihadrons	Size of the asymmetry as a function of <i>x</i>	 Continuation of study based on <u>arXiv:1805.05290</u> together with current EIC detector design consideration of different jet algorithms Elke, Zheng, Lee and Yin Possible different parametrizations of gluon Sivers function inputs from Pavia

"Silver" channels

Measurement/process	Main detector requirements	Anticipated plot	Comments
Sea quark helicity measurements → flavor separated (anti)quark helicity distributions over wide range of x Ralf SeidI	hadron momentum and energy resolution in forward direction ($2 < \eta <$ 4) for CC events	Update of previous sea quark helicity PDF uncertainty plots	 Work will follow ongoing sensitivity studies by Elke's group + Argentinian global fitters. Implementation of detector smearing, etc needs to be added to existing studies. Concentration on CC and D/3He.
FFs/nFFs/nPDFs via single hadron FF	See TMD SIDIS reqs	nPDF uncertainty expectation, (n)FF expectation	 Prepared pythiaRHIC (Pythia 6) + eicsmear simulations using official 4 ep and 3 eAu beam energy combinations, for smeared simulation BeAST resolutions were used in eicsmear. Not implemented: magnetic field impact and PID (hadron, momentum, rapidity) ranges. Analysis will follow Charlotte's paper extended to nFFs (and <i>v</i> dependence of interest there)

"Silver" channels, cont

Measurement/process	Main detector requirements	Anticipated plot	Comments
Di-hadron correlations in eA →low x → Probing the onset of saturation phenomenon Bowen Xiao	backward hadron acceptance, granularity	decorrelation plot as in white paper	Continuation of work based on arXiv:1403.2413 with extension to jets with different algorithms using the new collisional energies at eRHIC.

"New" channels

Measurement/ process	Main detector requirements	Anticipated plot	Comments
Di-hadron FF for Tensor charge/Boer-Mulders → Anselm Vossen	Single hadron reqs+min <i>z</i> for partial wave expansion	 Impact on tensor charge/transversity extraction Projected BM asymmetries 	
Lambda related spin measurements → L/T spin transfer, polarizing FFs (universality), jet structure Anselm Vossen	 Λ acceptance Slow pion→low momentum cutoff, displaced vertex 	 Precision of Λ polarization measurements 	