

SIDIS working group key measurements and status

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"Golden Measurements"

Measurement/process	Main detector requirements	Anticipated plot	Comments
<p>Quark Sivers, 3D momentum structure, TMD evolution from <u>single hadrons</u></p> <p>→ 3D image (x, k_t) of the Sivers Function, Evolution test of Sivers at intermediate x</p> <p>Alexey Vladimirov,</p>	<ul style="list-style-type: none"> η acceptance for hadrons angular resolution granularity of the detector (central to forward -1 to 4), $\pi/K/p$ identification <u>Comments:</u> PID↔Tracking, B -field $\rightarrow \frac{\delta p}{p}$, min p 	<ul style="list-style-type: none"> pseudo-3D Sivers function as a function k_t for various x bins, Value of Tensor charge uncertainties + plot vs x, Q^2 dependence of Sivers function or A_{UT} at fixed x 	<ul style="list-style-type: none"> 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
<p>Gluon Sivers via <u>di-jets/di-hadrons</u></p> <p>→ Probing the size of the gluon Sivers function</p> <p>Bowen Xiao</p>	<p>acceptance for back-to-back dihadrons</p>	<p>Size of the asymmetry as a function of x</p>	<ul style="list-style-type: none"> Continuation of study based on arXiv:1805.05290 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

"Golden Measurements"

Measurement/process	Main detector requirements	Anticipated plot	Comments
<p>Spectroscopy possibilities</p> <p>→ Representative spectroscopy channel : X,Y</p> <p>→ $J/\psi\pi\pi$, DD^*</p> <p>Justin Stevens</p>	<ul style="list-style-type: none"> dilepton identification for J/ψ <ul style="list-style-type: none"> displaced vertex π/K separation for open charm forward proton/neutron recoils from diffractive production (similar to DVCS reqs) 	<p>Kinematic coverage for decay particles in representative channels</p> <p>Possibly expected limits on coupling vs mass for $J/\psi\pi\pi$, DD^* final states</p>	<p>Generator, EICsmear for mass resolution etc., bkgd. estimation</p>

“Silver” channels

Measurement/process	Main detector requirements	Anticipated plot	Comments
<p>Sea quark helicity measurements</p> <p>→ flavor separated (anti)quark helicity distributions over wide range of x</p> <p>Ralf Seidl</p>	<p>hadron momentum and energy resolution in forward direction ($2 < \eta < 4$) for CC events</p>	<p>Update of previous sea quark helicity PDF uncertainty plots</p>	<ul style="list-style-type: none"> • 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 $D/3He$.
<p>FFs/nFFs/nPDFs via <u>single hadron FF</u></p> <p>→ Single hadron fragmentation functions for ep and eA for FFs, nFFs, nPDFs</p> <p>Ralf Seidl</p>	<p>See TMD SIDIS reqs</p>	<p>nPDF uncertainty expectation, (n)FF expectation</p>	<ul style="list-style-type: none"> • 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 ν dependence of interest there)

“Silver” channels, cont

Measurement/process	Main detector requirements	Anticipated plot	Comments
<u>Di-hadron correlations in eA</u> → 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
<u>Di-hadron</u> FF for Tensor charge/Boer-Mulders → Anselm Vossen	Single hadron reqs+min z for partial wave expansion	<ul style="list-style-type: none"> Impact on tensor charge/transversity extraction Projected BM asymmetries 	
<u>Lambda</u> related spin measurements → L/T spin transfer, polarizing FFs (universality), jet structure Anselm Vossen	<ul style="list-style-type: none"> Λ acceptance Slow pion → low momentum cutoff, displaced vertex 	<ul style="list-style-type: none"> Precision of Λ polarization measurements 	

Overlap with Jet/HF group: Discussed in joint session Friday morning II

- Hadron in jet measurements
- Heavy flavor pair measurements for gluon Sivers
- Discussed in Jets/HF group

BACKUP

Key physics channels

Physics channels	Detector requirements
Quark Sivers, 3D momentum structure, TMD evolution	eta acceptance for hadrons, angular resolution, granularity of the detector (central to forward -1 to 4), pi/K/p identification
Gluon Sivers via di-jets/di-hadrons	acceptance for back-to-back dihadrons
Spectroscopy possibilities	Particle ID, Vertex (open charm),
Sea quark helicity measurements	hadron momentum and energy resolution in forward direction (2-4) for CC events
FFs/nFFs/nPDFs via single hadron FF	
Di-hadron correlations in eA \rightarrow low x	backward hadron acceptance, granularity
Di-hadron FF for Tensor charge/Boer-Mulders	likely similar to quark Sivers, coverage to low momenta (for partial wave decomposition)
Lambda related spin measurements	Vertex requirements? proton ID, low momentum coverage, mass resolution (feed down)
Hadron in jet measurements	
Heavy flavor pair measurements for gluon Sivers	

Sea quark helicity measurements

Channel	Workforce (responsible co-convenor in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
<u>Sea quark helicity measurements via SIDIS (and CC DIS)</u>	Ralf Seidl + Elke's group, Rodolfo Sassot, Ignacio Borsa, other fitters, Yuxian Zhao	flavor separated (anti)quark helicity distributions over wide range of x	Update of previous sea quark helicity PDF uncertainty plots	hadron momentum and energy resolution in forward direction (2-4) for CC events	Combined fits of PDFs/FFs/helicities?	

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

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
Single hadron fragmentation functions for ep and eA for FFs, nFFs, nPDFs ()	Valerio Bertone, Pia Zurita, Elke+Charlotte, Will Brooks, Kawtar, Ralf Seidl		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 nu dependence of interest there)

Quark Sivers, 3D momentum structure, TMD evolution

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
quark Sivers/other TMD measurements using single hadrons: quark Sivers, TMD evolution, 3D momentum structure, Tensor charge	Alexey Vladimirov , Miguel Echevarria, Xiaqing Li, RCS, Alexei Prokudin, Elke, Harut, Andrea Signori, Filippo Delcarro, Daniel Pitonyak, Pavia group, JAM, Calgiari, Osvaldo, Leonard, Elena, Ted Rogers, Hayan	3D image (x,kt) of the Sivers Function, Evolution test of Sivers at intermediate x	pseudo-3D Sivers function as a function kt for various x bins, Value of Tensor charge uncertainties + plot vs x, Q ² dependence of Sivers function or AUT at fixed x	eta acceptance for hadrons, angular resolution, granularity of the detector (central to forward -1 to 4), pi/K/p identification	start with Sivers function, then Collins, also need unpolarized TMDs, combined fits for unpol and pol TMDs/FFs	extraction of Qiu/Sterm an function and uncertainties

Use of existing simulations at Elke's group + semaring + weights originating from theorists. Theorists agreed on common database for various fits/parameterizations. Preparation of fitting experimental pseudo-data

Gluon Sivers via di-jets/di-hadrons

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
Gluon Sivers via di-hadron/di-jet measurements () --> check overlap with jet/HF group	Bowen , JH Lee, Elke, Pavia gluon Sivers model, Cagliari, Zhongbo	Probing the size of the gluon Sivers function	Size of the asymmetry as a function of x	acceptance for back-to-back dihadrons	Likely model independent, could use generic generator	

Spectroscopy possibilities

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
Representative spectroscopy channel : $X, Y \rightarrow J/\psi \pi\pi$, $DD^* \rightarrow$ check with exclusive and HF groups	Justin , JLab, FSU, JPAC, Indiana, Edinburgh/Glasgow	Demonstrate opportunities in spectroscopy	Kinematic coverage for decay particles in representative channels	Particle ID, Vertex (open charm),	Generator, EICsmear for mass resolution etc., bkgd. estimation	Expected limits on coupling vs mass for $J/\psi \pi\pi$, DD^* final states

Di-hadron correlations in eA \rightarrow low x

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
Di-hadron correlations in eA for onset of saturation effects \rightarrow WW gluons	Bowen , JH Lee, Elke, etc	Probing the onset of saturation phenomenon	decorrelation plot as in white paper	backward hadron acceptance, granularity		

Di-hadron FF for Tensor charge/Boer-Mulders

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
Di-hadron fragmentation related Tensor charge/ Boer Mulders measurements	Anselm , Chris Dilkes,+Duke Grad, Marco Radici, Alessandro Bacchetta,Valerio Bertone		Tensor charge uncertainties for dihadron extraction, BM asymmetry projections based on MC	likely similar to quark Sivers, coverage to low momenta (for partial wave decomposition)		

Lambda related spin measurements

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
<u>Lambda related spin structure measurements</u>	Chris Dilks, Jinlong, Daniel Boer, Werner, Feng, Leonard, Schlegel, Anselm	Twist 3 function, TMD, but also D_{LL}, D_{TT}	Uncertainty estimates for polarization dependent variables	Vertex requirements? proton ID, low momentum coverage, mass resolution (feed down)	Λ vs anti Λ ratio (fragmentation check)	

Hadron in jet measurements

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
Hadron in jet and jet only measurements for TMDs (in close collaboration with jet/HF working group)	Miguel Arratia, Alexei Prokudin, Zhongbo, Felix, Nobuo, HF/jet working group	possibility of cleaner Sivers extraction, substructure measurements				

Heavy flavor pair measurements for gluon Sivers

Channel	Workforce (responsible co-convener in red)	Goals	Money plot	Detector requirements	Comments /strategy	bonus plots
HF pairs to access gluon Sivers	HF/jet working group, Cagliari, Alessandro,	Gluon Sivers function				