Tasks and Issues in SIDIS SW

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Duke UNIVERSITY

Jefferson Lab

Tasks and Issues

- Main task of the SIDIS group is to produce projections for the Athena proposal
  - Exemplary physics channels
  - ‘golden’
  - Should showcase the strength of the detector
- Also need to benchmark/Q&A detector simulations and give input to the SW and detector groups
  - →can be standalone or in CI framework of the SW group

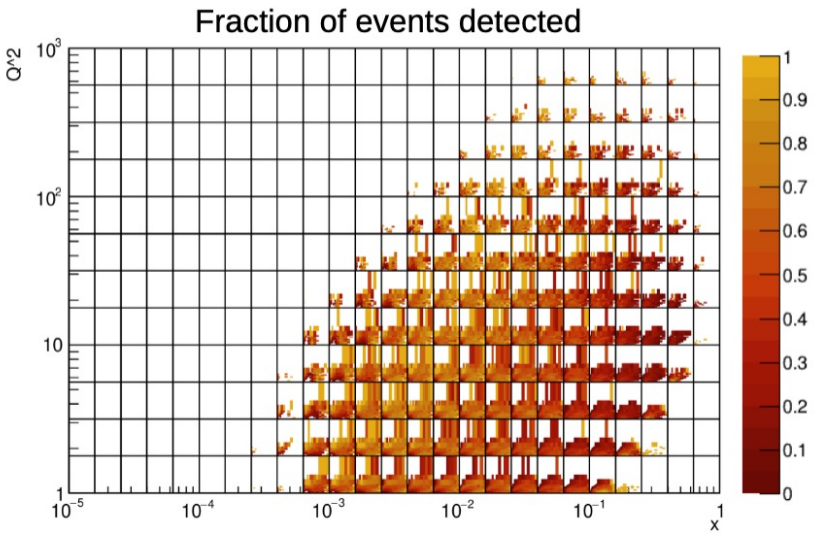
- Current issues
  - Software framework well underway <u>but</u>
    - ”details’ missing, i.e. concrete plots and studies

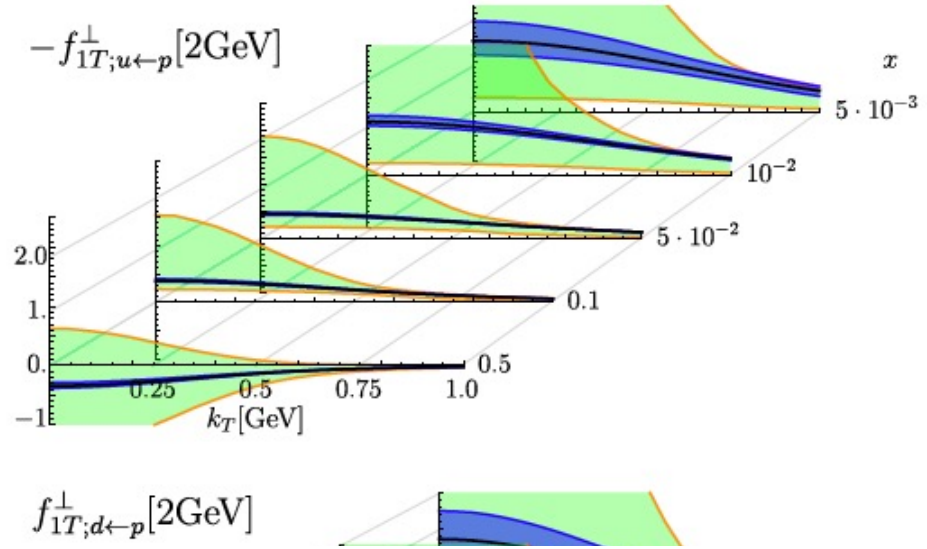
SIDIS PWG

Physics Process	Key Measurement	Key Plots	Physics Message	Detector Performance Tests
SIDIS	Multiplicities of charged π, K in $x, Q^2, p_\perp, z$	Coverage orr projected statistical uncertainties for asymmetries (maybe compared with theory uncertainties) in $x, Q^2, p_\perp, z$	Athena has a large lever arm, extends in previously unmeasured region	PID at high p_T (in particular in the barrel). If we include areas where kinematics have to be reconstructed with hadronic methods→Detector hermiticity
Sivers & TMD evolution	Azimuthal asymmetries of charged π (could also do kaons, but theory models lacking)	Impact plots or experimental uncertainties vs theoy uncertainties. Plots vs k_T for different x bins	Lever arm in Q^2. This is a must-do measurement, so we should show that we can do it well.	Using existing models, our studies show that the impact of moderate energies (e.g. 10x100) is largest. So no particular detector performance requirements. If one shows projected uncertainties, then coverage, similar as plot above can be showcased.
Sea quark helicities	A_{LL} for charged kaons	Impact on sea quark helicities (similar as previous publication)	Very high impact on sea quark helicities	PID, x –coverage

SIDIS PWG

SIDIS coverage plots





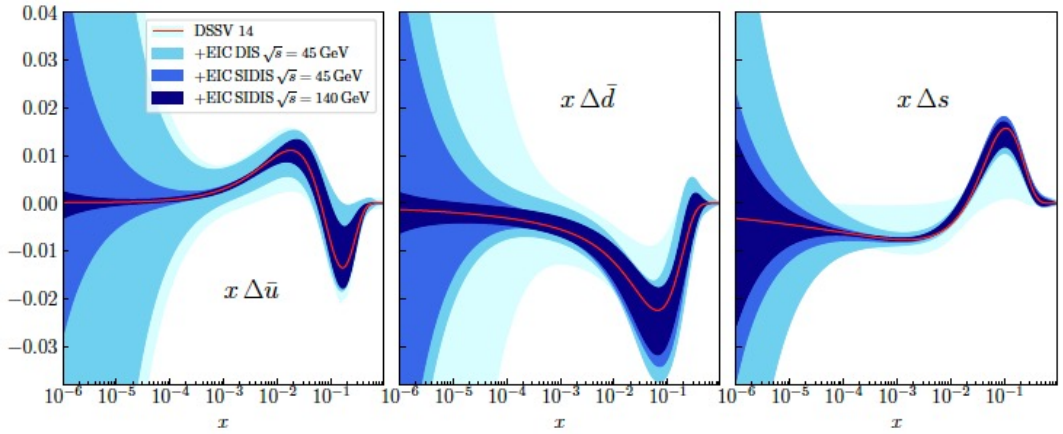
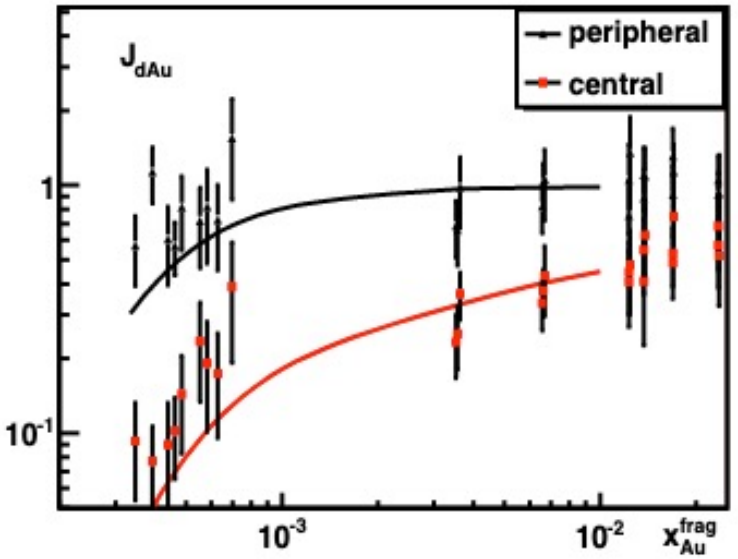


Figure 7.19: Impact of SIDIS measurements at the EIC on the sea quark helicities $x\Delta\bar{u}$, $x\Delta\bar{d}$ and $x\Delta s$ as a function of x at $Q^2 = 10\,\mathrm{GeV}^2$.



Tasks/Milestones -- 10k feet view

- Eventually we will need pseudodata in x, Q^2, p_T, z bins
  - Azimuthal asymmetries
  - Counts (A_{LL})
  - Di-hadron correlations
- To estimate systematics we need to check how a true signal is reconstructed
  - Needs weighting
  - Connection between true and reconstructed kinematics (does this work for fast/full simulations?)

In a first step we have to

a) understand the quality of the simulation

b) look in more detail on the mapping of the physics to the detector (i.e. where to 'interesting' events end up and how can we highlight the performance of the detector)

People

- Chris Dilks (Duke) →SW liason, framework maintainer, …
- Sanghwa Park (MSU)→full simulations
- Duane Byer (Duke)→ fast simulations, weighting
- Connor Pecar (Duke) → Plots, di-hadrons for eA

Tasks/Milestones – more details

- Kinematic distributions from full/fast simulations
  - →general distributions implemented
  - →resolutions, full/fast comparison missing
  - Need QA on all standard distributions (kinematics, multiplicities, angles)
    - →might make sense to implement in Athena CI framework
  - Need a closer look at critical physics regions and how those map to the detector
- Electron id/efficiency determination in full simulations
  - Some prelim method implemented, should be looked in in more detail
- Track quality in full simulations?
- PID parametrization
  - To my knowledge, PID parametrization not included in the full simulation yet.
  - Need provision in the sw to implement PID parametrization (e.g. confusion matrix)
- Pythia6/Pythia8 comparison
  - Currently using pythia8, but this is known to miss some processes. Comparison between p6/8 standard tunes might be a good idea but beam crossing only implemented as after burner in Pythia6

Tasks/Milestones – more details, cont

- Need to implement cross-section weighting to combine different MC sets
- Need to produce pseudodata
  - A_{LL}: counts in bins→straightforward but has to be done
- Azimuthal asymmetries
  - Stat uncertainties can be deduced from counts, but maybe better from fits

- Need to produce weighted asymmetries for systematics
  - Implement theory models (A_{LL}, Sivers, Collins, di-hadron saturation)
  - Spin assignment/weighting →Duane implemented for fast simulations, needs to be translated for full?
- For all of the above, data has to be run, nice plots produced …

Possible beginning task list..

- Implement resolution plots to get to know the framework,
- Investigate distributions, compare full, fast and with jet group to get an idea for the data quality
- Look more detailed at kinematics and detector mapping
- Implement cross-section weighting
- (Truth-reconstructed connection?)

- Implement theory models
- ….

Discussion…