SIDIS Update for Draft MIE

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SoLID Collaboration Meeting
March 5-6, 2017

From preCDR to draft MIE

- Simulation
  - all sub-systems in GEMC
  - acceptance updated
- Generator
  - model from our new fit to world data
- Projection
  - systematic uncertainties
  - current fragmentation cut (R cut) built in the generator
- Physics impact
  - transversity and tensor charge
  - Sivers function
- Tracking
  - one sample readout from APV25
  - Kalman-Filter algorithm for track finding and track fitting
- Kaon identification
  - TOF: 20ps resolution required (MRPC?)

From preCDR to draft MIE

Table 2: Detector Summary for Approved Experiments [preCDR]

Experiments	PVDIS	SIDIS-^{3}He	SIDIS-Proton	J/ψ
Target	LH_2/LD_2	^{3}He	NH_3	LH_2
Length	40 cm	40 cm	3 cm	15 cm
Target Polarization	N/A	~60%	~70%	N/A
Target Spin Flip	N/A	$\leq$20 mins	$\leq$4 hours	N/A
GEM Tracking Chambers	5 chambers	6 chambers	6 chambers	6 chambers
E&M Calorimeter	Forward angle	Forward + Large angle	Forward + Large angle	Forward + Large angle
Light Gas Čerenkov	1 m long	2 m long	2 m long	2 m long
Baffles	Yes	N/A	N/A	N/A
Heavy Gas Čerenkov	N/A	1 m long	1 m long	N/A
MRPC (TOF)	N/A	100 ps resolution	100 ps resolution	100 ps resolution
Beam Polarimetry	0.4% determination	$<$ 3%	$<$3%	N/A
Target Polarimetry	N/A	$\sim$ 3%	$\sim$ 3%	N/A
DAQ	Single trigger	Coincidence trigger	Coincidence trigger	Coincidence trigger

From preCDR to draft MIE

Table 3: Summary of Key Parameters for Approved Programs [preCDR]

Experiments	PVDIS	SIDIS-^{3}He	SIDIS-Proton	J/ψ
Reaction channel	$p(\vec{e},e')X$	$(e,e'\pi^{\pm})$	$(e,e'\pi^{\pm})$	$e+p\rightarrow e'+J/\Psi(e^-,e^+)+p$
Approved number of days	169	125	120	60
Target	LH_2/LD_2	^{3}He	NH_3	LH_2
Unpolarized luminosity ($cm^{-2}s^{-1}$)	$0.5\times10^{39}/1.3\times10^{39}$	$\sim 10^{37}$	$\sim 10^{36}$	$\sim 10^{37}$
Momentum coverage (GeV/c)	2.3-5.0	0.8-7.0	0.8-7.0	0.6-7.0
Momentum resolution	~2%	~2%	~2%	~2%
Polar angle coverage (degrees)	22-35	8-24	8-24	8-24
Polar angle resolution	1 mr	0.6 mr	0.6 mr	0.6 mr
Azimuthal angle resolution	-	5 mr	5 mr	5 mr
Trigger type	Single e^-	Coincidence $e^-+\pi^{\pm}$	Coincidence $e^-+\pi^{\pm}$	Triple coincidence $e^-e^-e^+$
Expected DAQ rates	~20 kHz × 30	<100 kHz	<100 kHz	<10 kHz
Backgrounds	Negative pions,photons	$(e,\pi^-\pi^{\pm})$ $(e,e'K^{\pm})$	$(e,\pi^-\pi^{\pm})$ $(e,e'K^{\pm})$	B-H process Random coincidence
Major requirements	Radiation hardness 0.4% Polarimetry π^- contamination Q^2 calibration	Radiation hardness Detector resolution Kaon contamination DAQ	Shielding of *sheet-of-flame* Target spin flip Kaon contamination	Radiation hardness Detector resolution

Resolution: SIDIS-^{3}He one-sample and 100% background (will be updated)

	Δp/p	Δθ	Δφ	Δz
forward angle	1.28%	1.22 mrad	5.36 mrad	0.86 cm
large angle	1.05%	1.08 mrad	2.19 mrad	0.45 cm

[Weizhi Aug2016]

Resolution: SIDIS-NH_3 (on-going)

Physics rate

- Pseudo-data
  - model from new fit to world data
  - acceptence updated
  - current fragmentation cut (R cut) [Tianbo Dec2016]
    - without R cut for general use: rate, systematic …
    - with R cut for TMD physics impact studies
- SIDIS rate

  cut applied: $Q^2 > 1$ GeV^2, $W > 2.3$ GeV, $W' > 1.6$ GeV, $0.3 < z < 0.7$

  SIDIS-^{3}He

E_{beam}	hadron	without R cut	with R cut
11 GeV	π^+	2.34 kHz	1.30 kHz
11 GeV	π^-	1.55 kHz	0.84 kHz
8.8 GeV	π^+	1.73 kHz	0.94 kHz
8.8 GeV	π^-	1.13 kHz	0.60 kHz

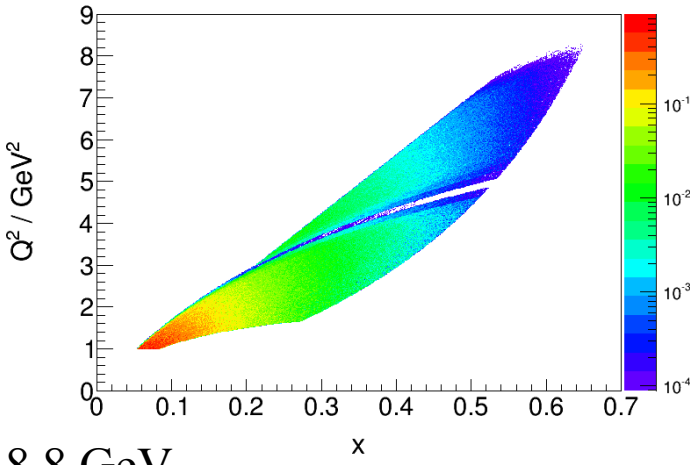
  SIDIS-NH_3

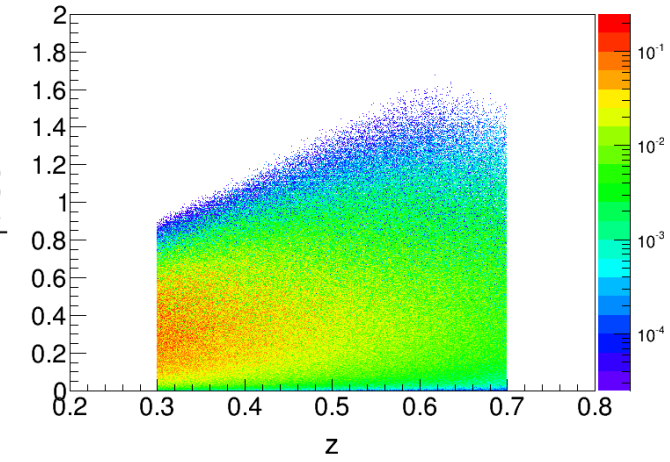
E_{beam}	hadron	without R cut	with R cut
11 GeV	π^+	0.68 kHz	0.37 kHz
11 GeV	π^-	0.57 kHz	0.32 kHz
8.8 GeV	π^+	0.41 kHz	0.21 kHz
8.8 GeV	π^-	0.29 kHz	0.16 kHz

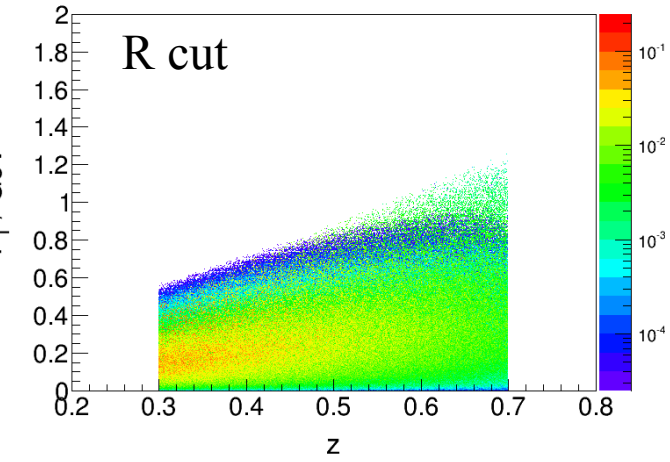
Physics rate

- SIDIS-^{3}He (π^+)

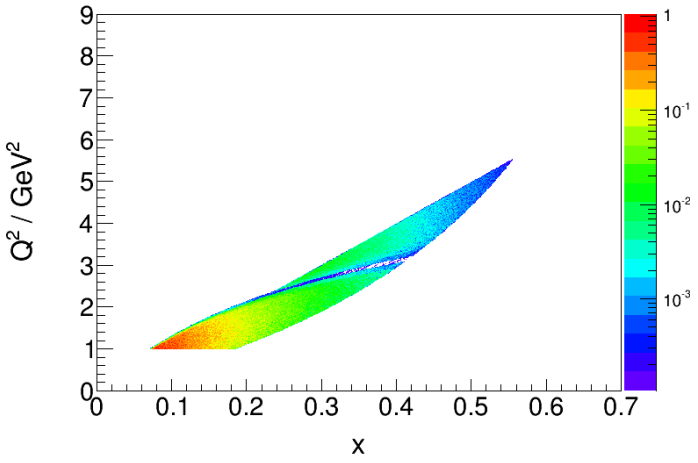
11 GeV

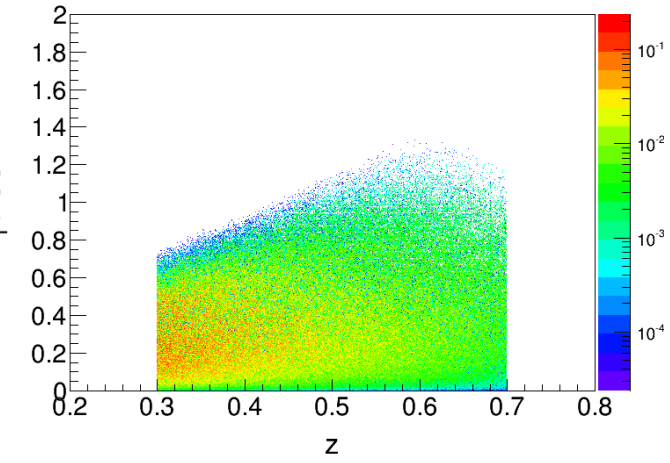


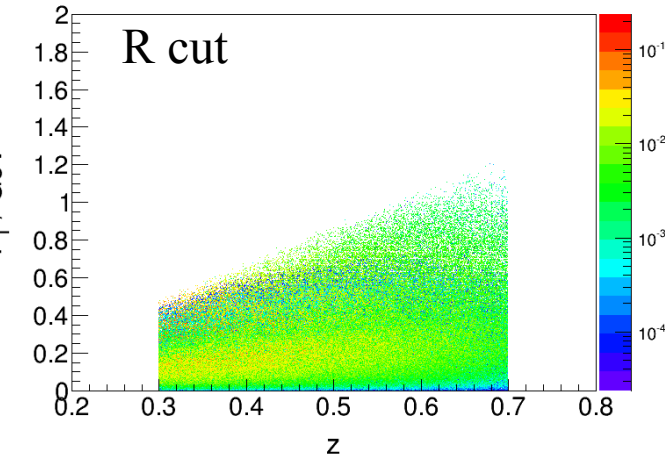




8.8 GeV



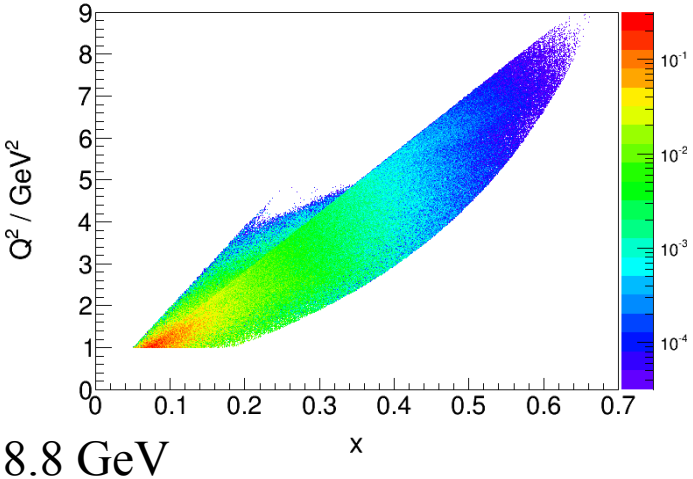


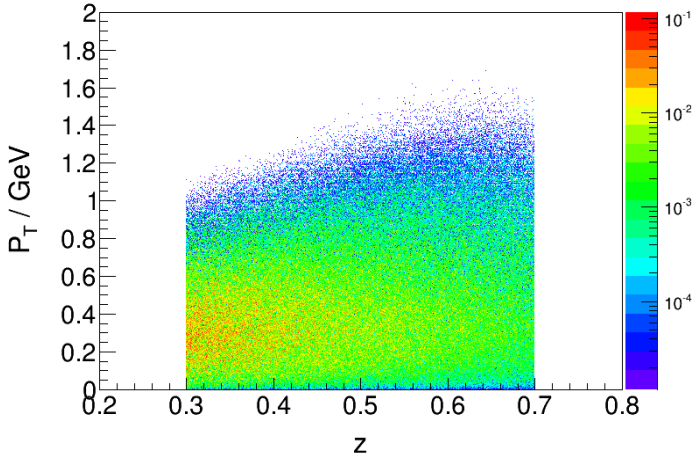


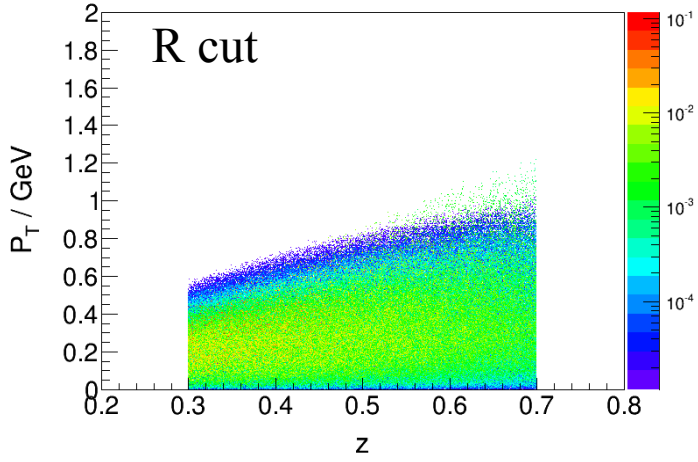
Physics rate

- SIDIS-NH_3 (π^+)

11 GeV







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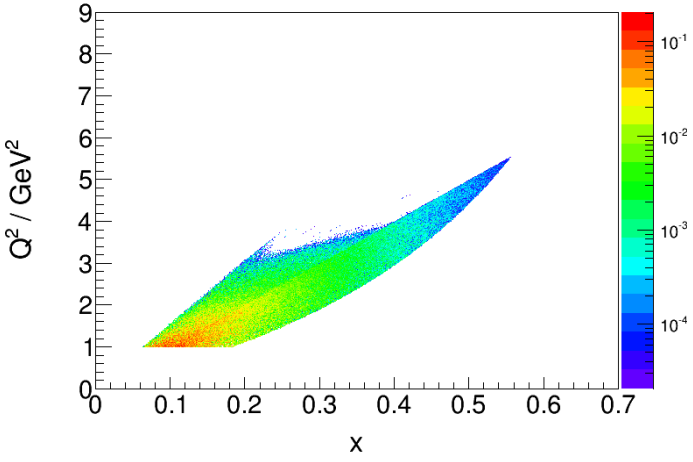
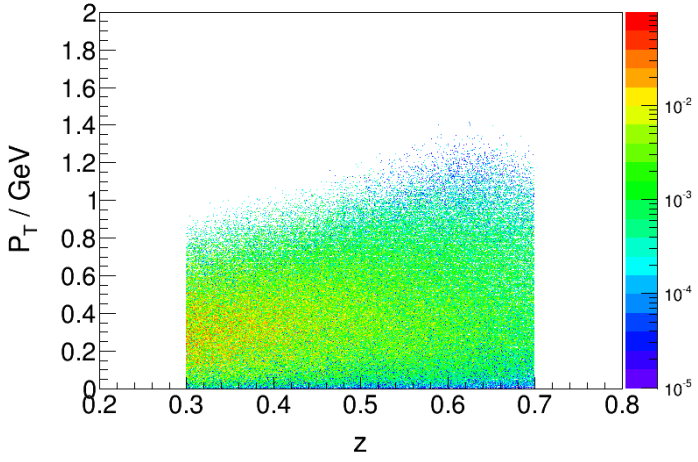
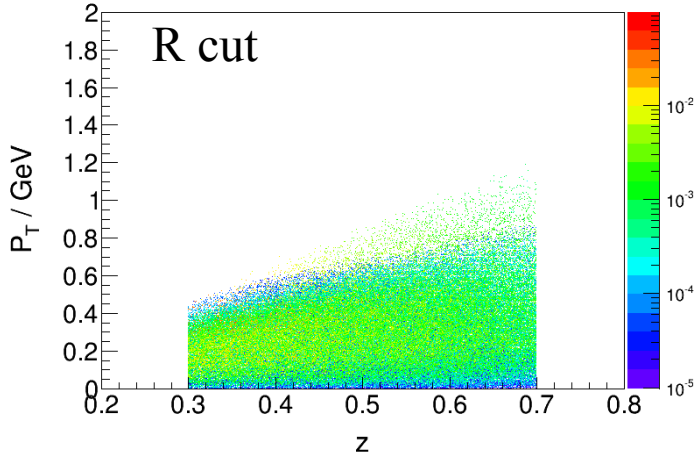


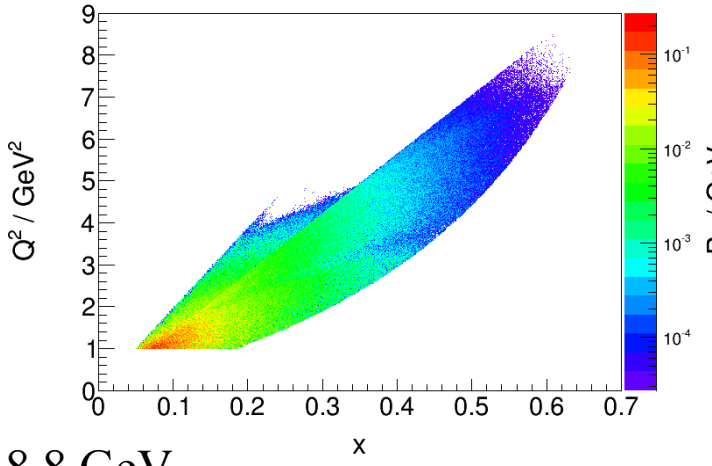


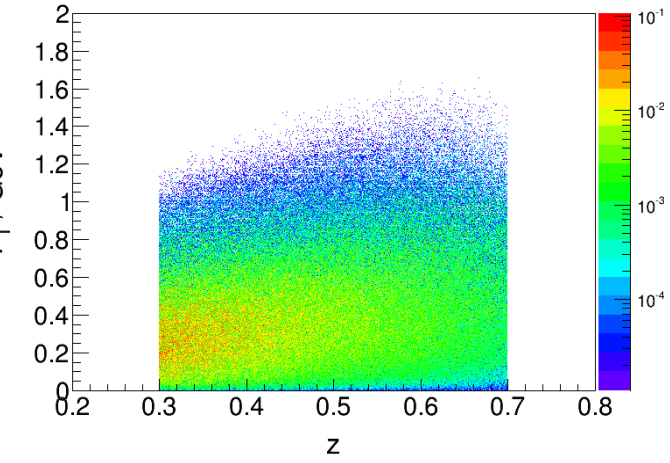


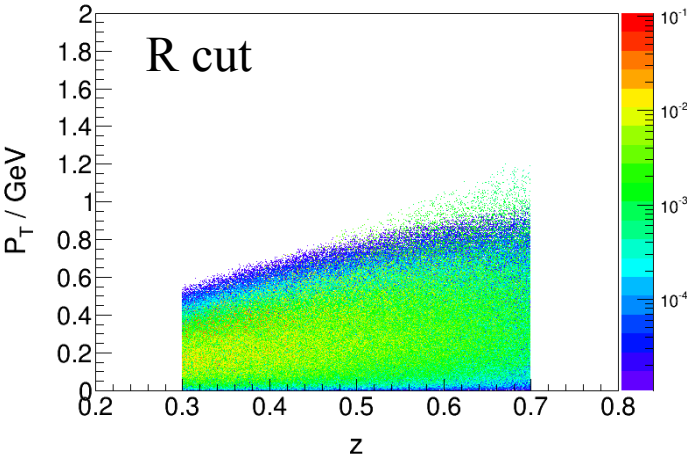
Physics rate

- SIDIS-NH_3 (π^-)

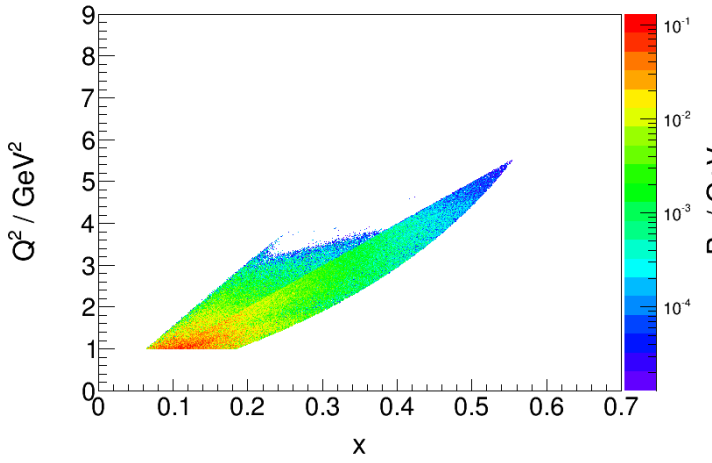
11 GeV

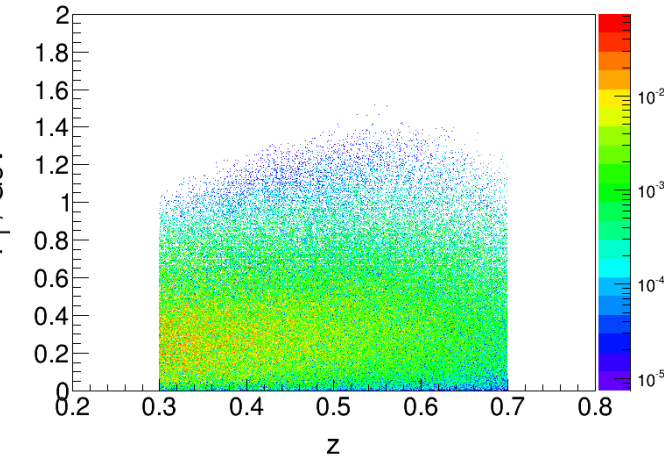


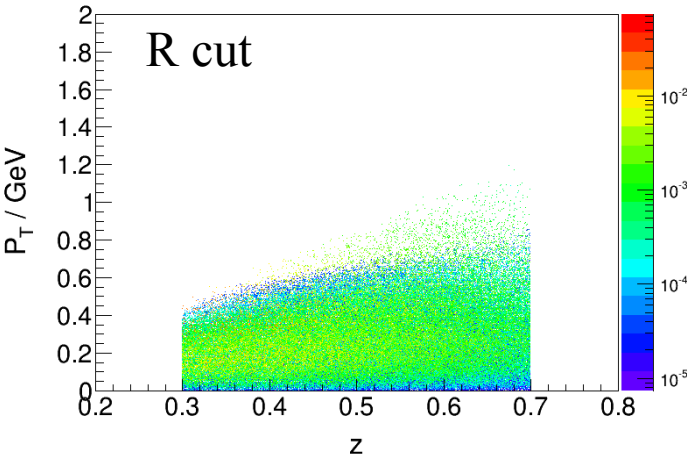




8.8 GeV

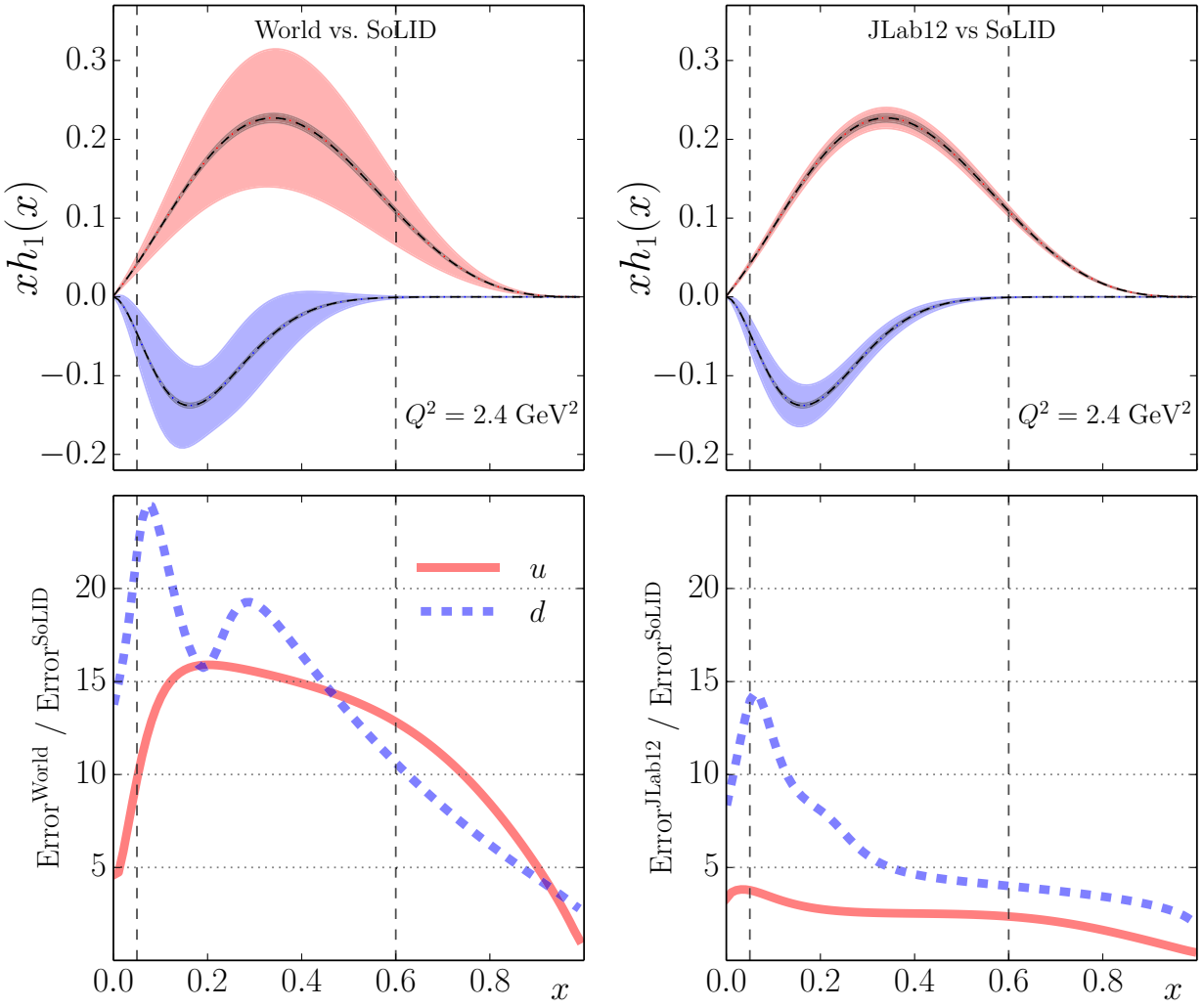






Physics Impact

- Transversity and Tensor charge [in reply to director's review]



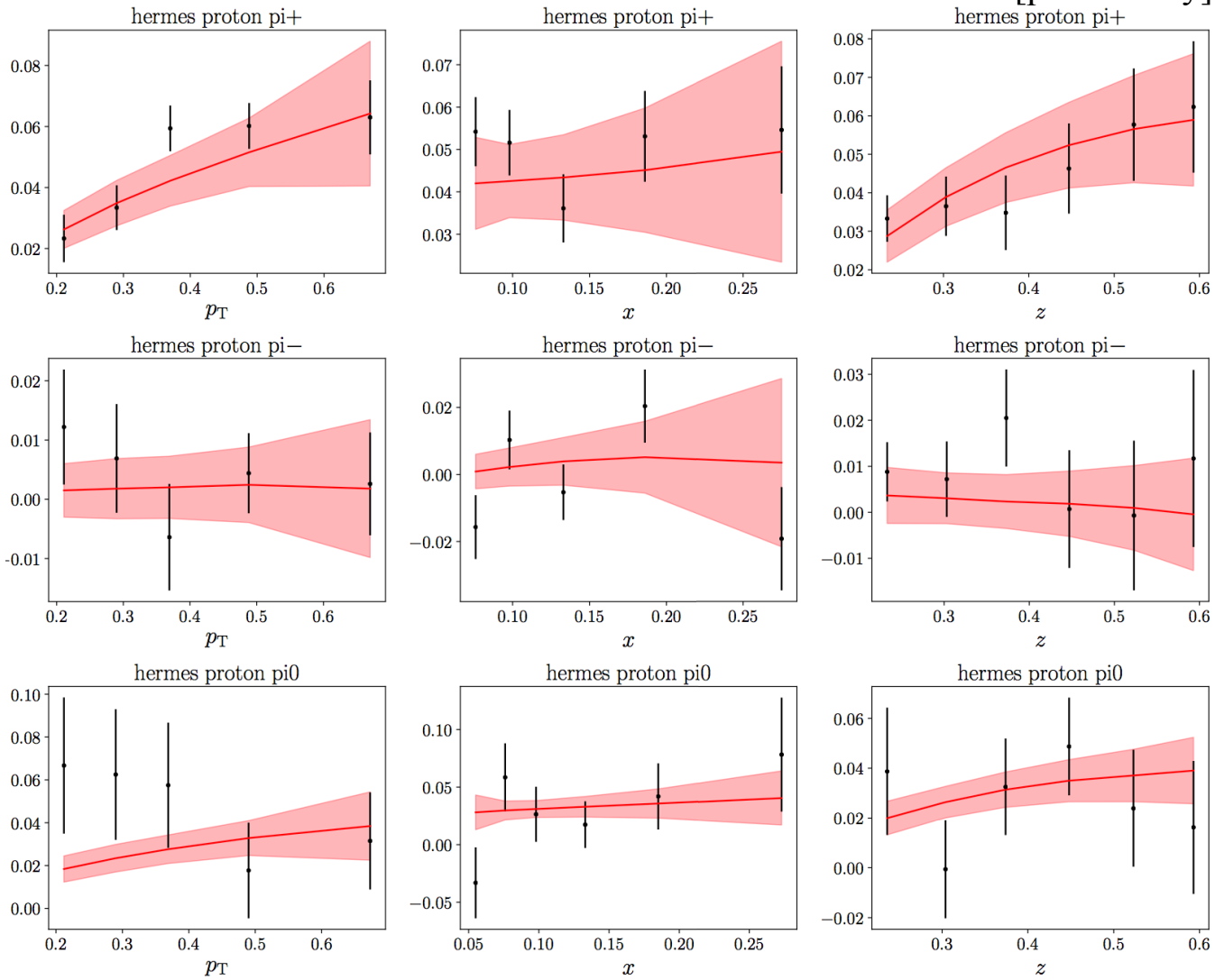
Measured: [0.05, 0.6] improvement		
	SoLID vs. World	SoLID vs. JLab12
u	16	2.8
d	17	9.3

Full: [0, 1] improvement		
	SoLID vs. World	SoLID vs. JLab12
u	16	3.0
d	17	10

Physics Impact

- Sivers (on-going, expected done in March)

[preliminary]



Systematic uncertainties

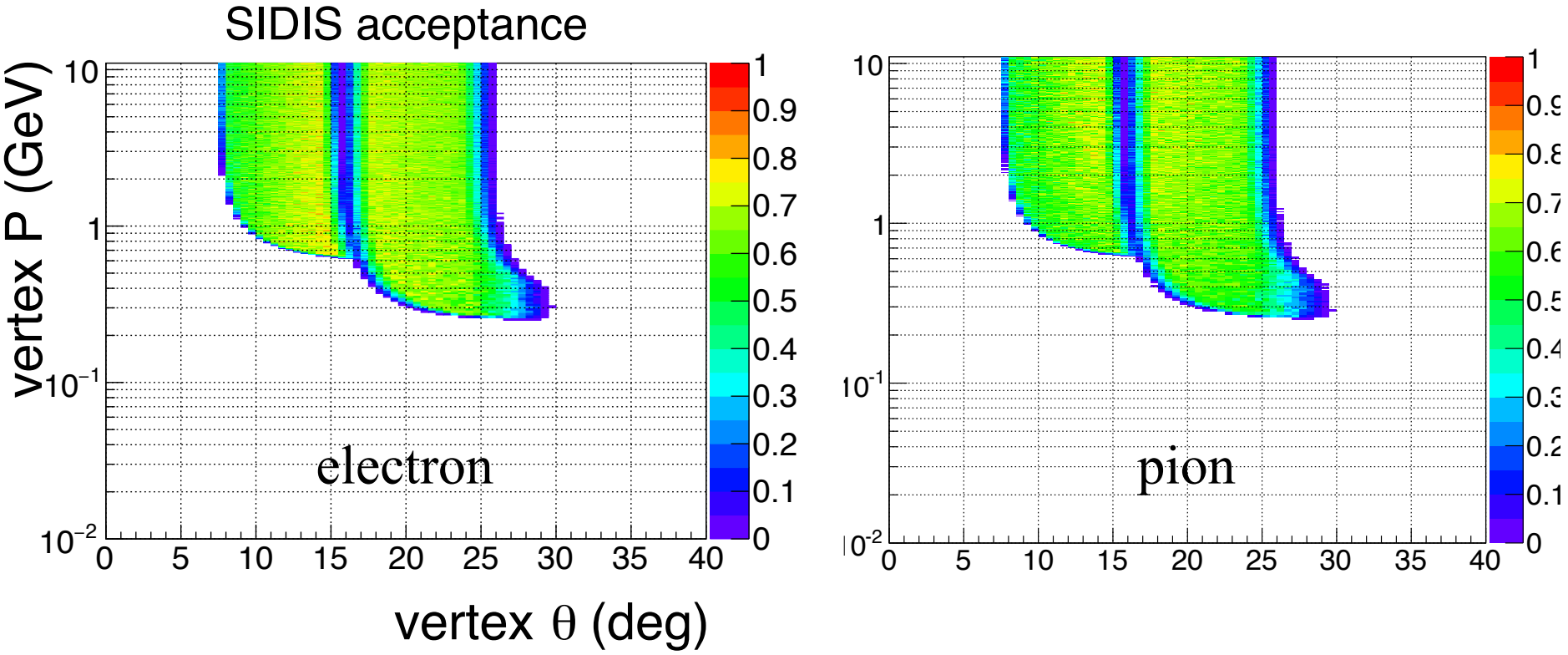
[in reply to director's review]

Statistical (abs.)	Systematic (abs.)		Systematic (rel.)	
	Raw asymmetry	0.0014	Target polarization	3%
	Detector resolution	< 0.0001	Nuclear effect	$4 \sim 5\%$
			Random coincidence	0.2%
			Radiative correction	$2 \sim 3\%$
			Diffractive meson	3%
0.0067	Total	0.0014	Total	$6 \sim 7\%$

Backup

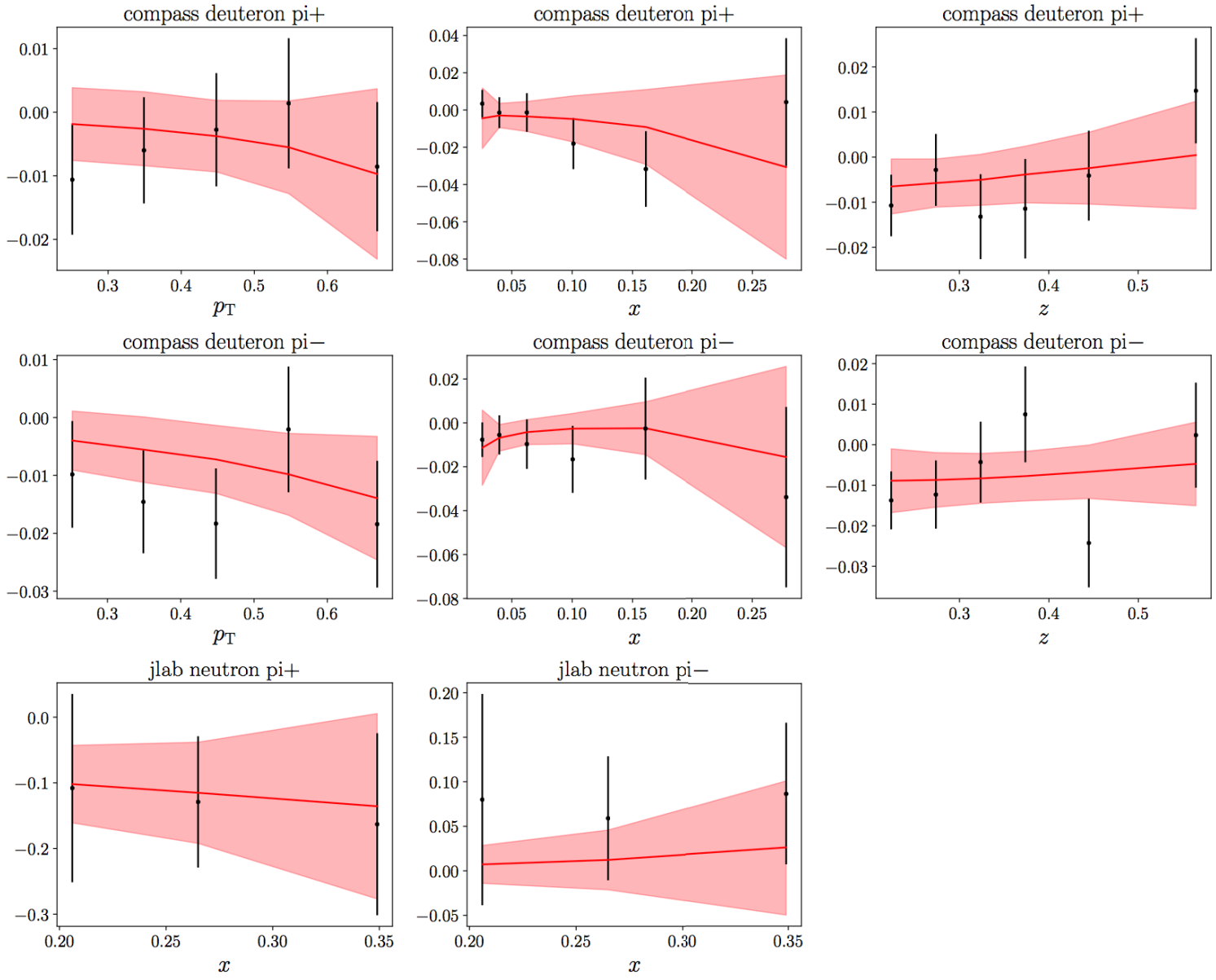
Acceptance

- SIDIS-^{3}He



Sivers asymmetry fit

[preliminary]



Sivers function

[preliminary]