Semi-Inclusive WG Detector Discussion

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Generic guidance from handbook

EIC Detector Requirements

η	Nomenclature			Tracking			Electrons		π/K/p PID		HCAL	Muons
				Resolution	Allowed X/X_0	Si-Vertex	Resolution σ_E/E	PID	p-Range (GeV/c)	Separation	Resolution σ_E/E	
-6.9 — -5.8	↓ p/A	Auxiliary Detectors	low-Q^2 tagger	$\delta\theta/\theta < 1.5\%$; $10^{-6} < Q^2 < 10^{-2}$ GeV^2								
…												
-4.5 — -4.0			Instrumentation to separate charged particles from photons				2%/√E					
-4.0 — -3.5												
-3.5 — -3.0		Central Detector	Backwards Detectors	$\sigma_p/p \sim 0.1\% \times p + 2.0\%$	~5% or less	TBD		π suppression up to 1:10^4	≤ 7 GeV/c	≥ 3σ	~50%/√E	
-3.0 — -2.5												
-2.5 — -2.0				$\sigma_p/p \sim 0.05\% \times p + 1.0\%$								
-2.0 — -1.5							7%/√E					
-1.5 — -1.0												
-1.0 — -0.5			Barrel	$\sigma_p/p \sim 0.05\% \times p + 0.5\%$		$\sigma_{xyz} \sim 20$ μm, $d_0(z) \sim d_0(r\phi) \sim 20/p_T$ GeV μm + 5 μm	(10-12)%/√E		≤ 5 GeV/c		TBD	TBD
-0.5 — 0.0												
0.0 — 0.5												
0.5 — 1.0												
1.0 — 1.5			Forward Detectors	$\sigma_p/p \sim 0.05\% \times p + 1.0\%$		TBD			≤ 8 GeV/c		~50%/√E	
1.5 — 2.0												
2.0 — 2.5									≤ 20 GeV/c			
2.5 — 3.0				$\sigma_p/p \sim 0.1\% \times p + 2.0\%$								
3.0 — 3.5									≤ 45 GeV/c			
3.5 — 4.0	↑e	Auxiliary Detectors	Instrumentation to separate charged particles from photons									
4.0 — 4.5												
…												
> 6.2			Proton Spectrometer	$\sigma_{intrinsic}(\lvert t\rvert)/\lvert t\rvert < 1\%$; Acceptance: $0.2 < p_T < 1.2$ GeV/c								

- Good starting point, but need to be more specific

General semi-inclusive themes

- **Tracking:** B-field choice affects
  - Minimum p cutoff: di-hadron PW, Λ (slow pions)
  - Momentum resolution: forward rapidity hadrons, CC
  - Is B-field "tuneable" for different beam energies?
- **Particle ID:** π/K/p separation affects
  - Purity of flavor separation in SIDIS (helicity/TMD)
  - Background for spectroscopy and open charm
- **Displaced vertices:** important for open charm and Λ reconstruction and purity

Software interface between Physics/Detector WGs

Need fast-smearing (eic-smear) which implements:

- Expected performance for baseline detector(s)
- **Reasonable variations** we can qualitatively test:
  - Consistent options for B-field (1.5 vs 3 T), with associated momentum resolution
  - PID assumptions for different detectors: turn on/off RICH, DIRC, TOF, etc.
  - Displaced vertex resolutions assumptions

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Who will implement, document and communicate these design variations, so we use consistent parametrization within and between WGs?

Some thoughts/suggestions

Who will implement, document and communicate these design variations, so we use consistent parametrization within and between WGs?

- **One responsible Detector WG expert for each detector concept in eic-smear: validates parametrization and implements variations**
- **Software WG documents and tags versions in GitHub and sends out e-mail updates on eicug-software list to inform everyone**

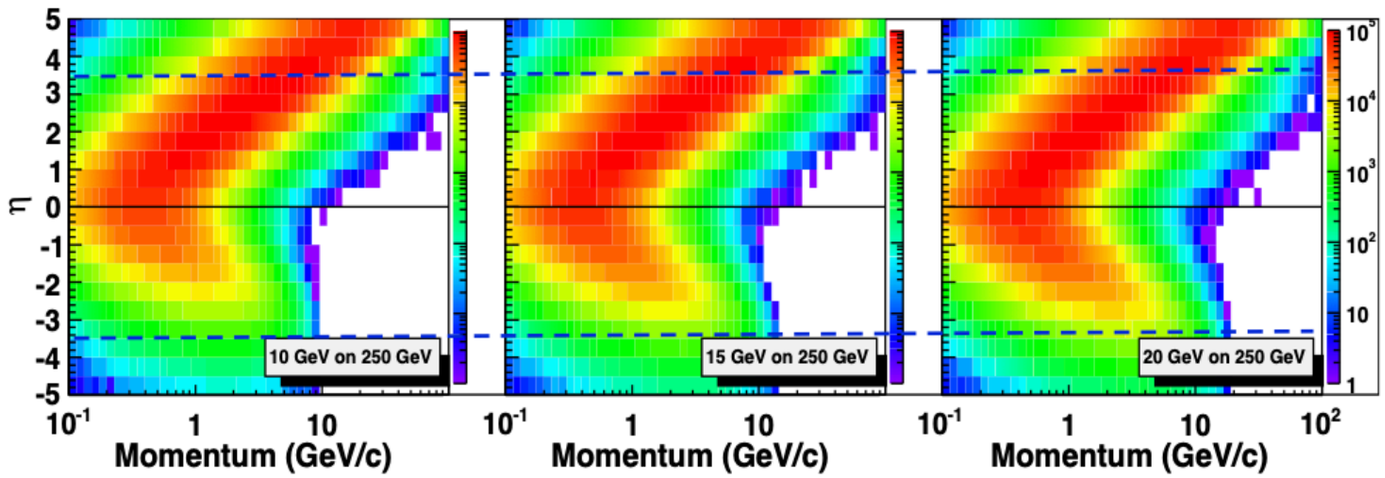
Backup

Some reference plots

Kinematics of SIDIS pions

Cuts: $Q^2>1$ GeV^2, $0.01<y<0.95$, $z>0.1$

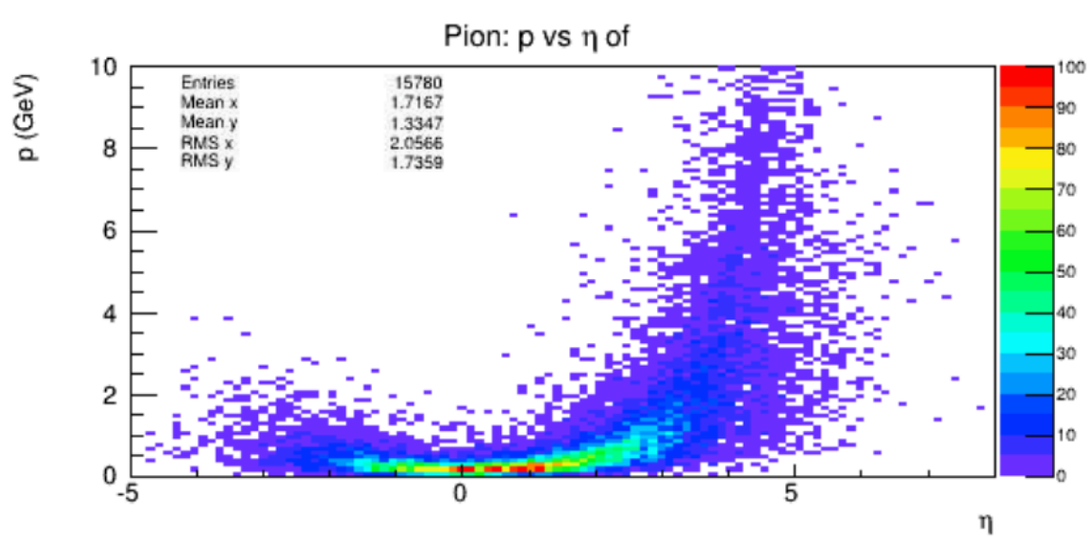
($\pi^\pm$, $K^\pm$, $p^\pm$ look similar)

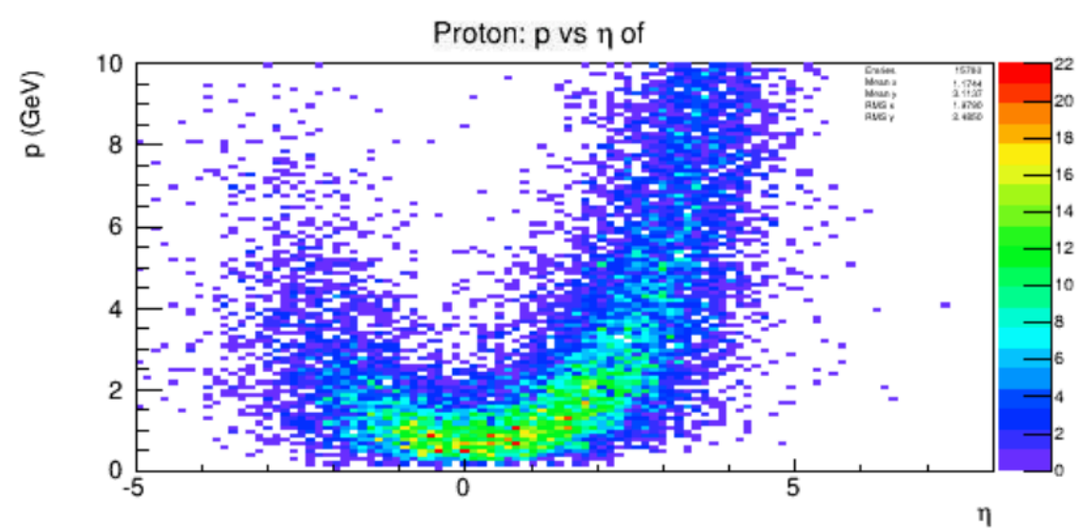


Increasing lepton beam energy boosts hadrons more to negative rapidity

Kiselev et. al.

Slow pions from Λ: Jinlong Zhang et. al.





e± and π+ from spectroscopy: $Z_c(3900)$

$$\frac{\Delta p}{p} = \frac{p_{reco} - p_{gen}}{p_{gen}}$$

e±

BeAST missing e smearing?

Smearing η > 3.5?

π+