Semi-Inclusive WG
Detector Discussion

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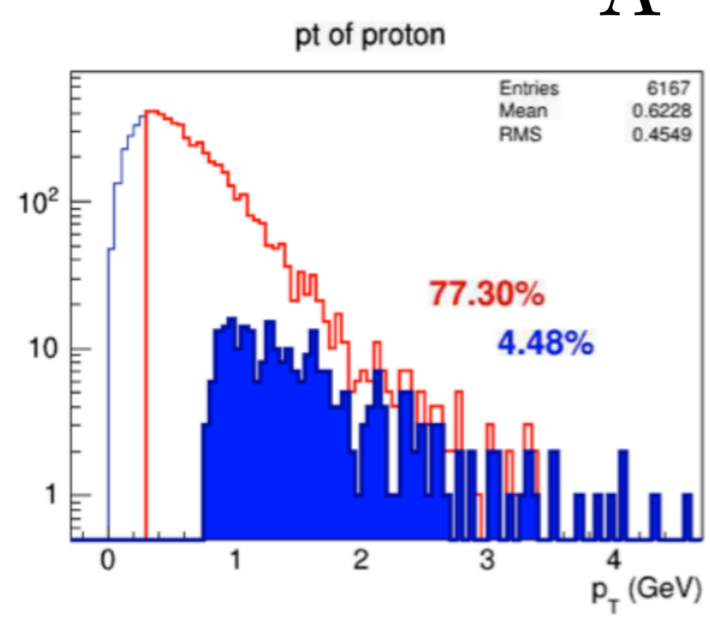
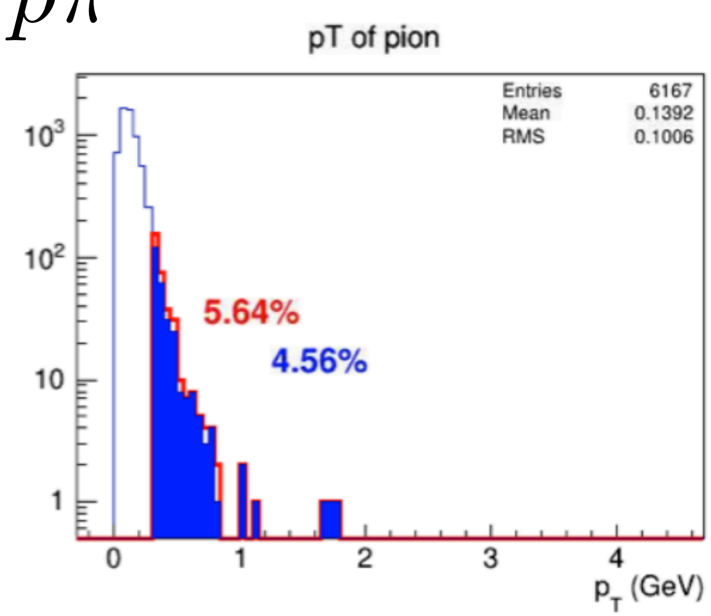
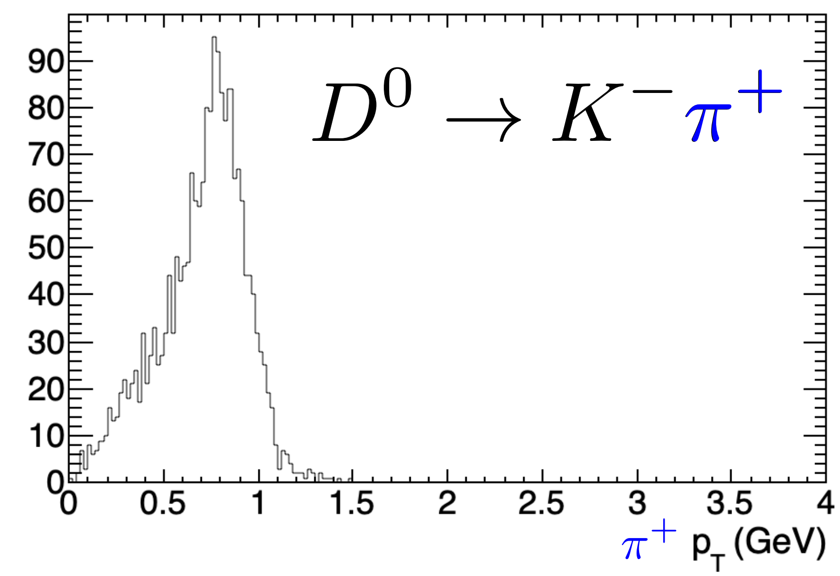
Low momentum

- Acceptance for low pions and soft photons from hyperon and heavy flavor decays

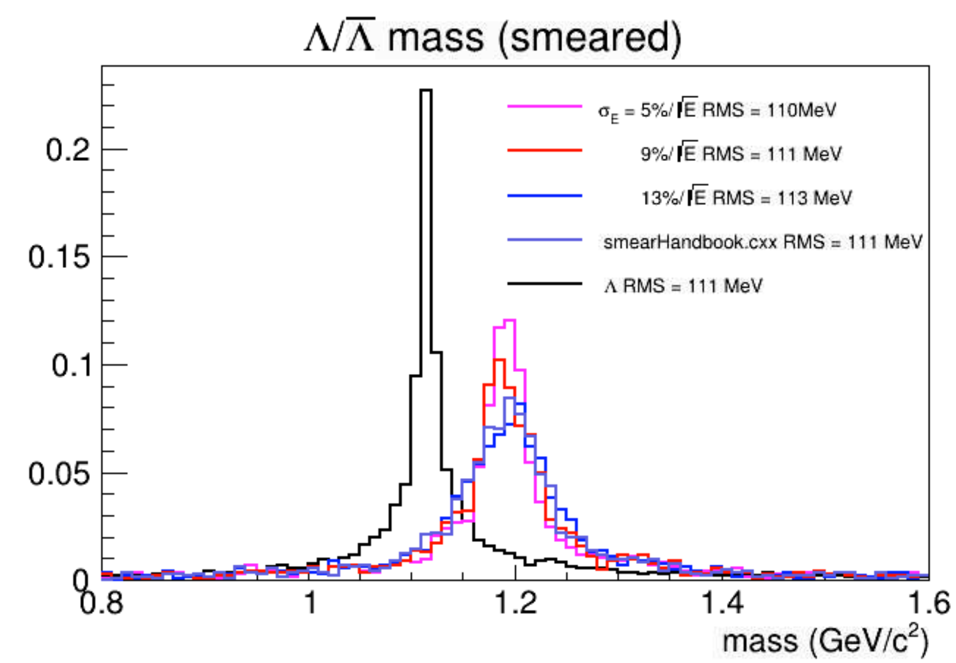
$$\Lambda \rightarrow p\pi^-$$





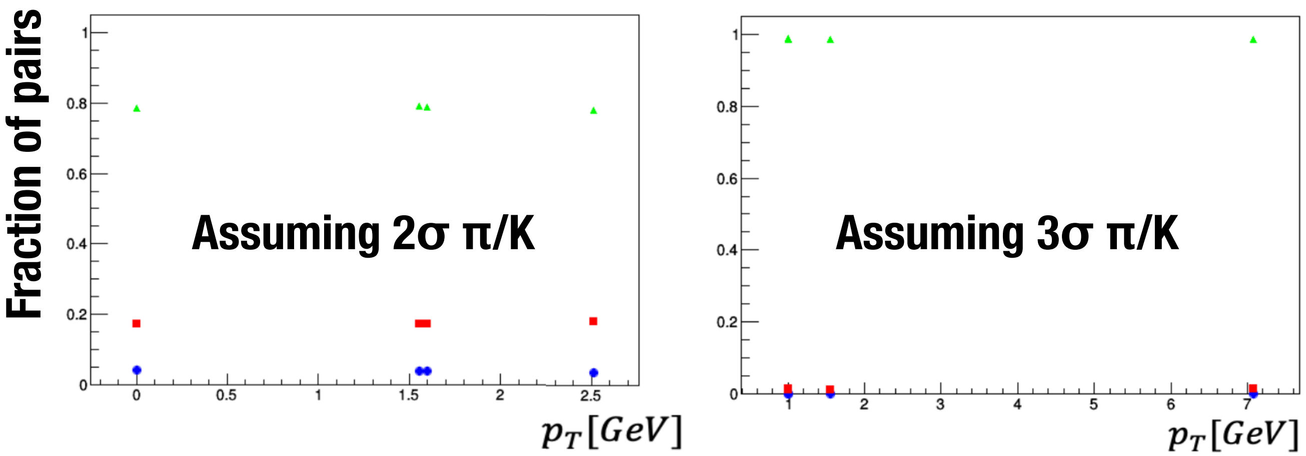


- Calorimeter resolution/ granularity may be limiting factor for separation from feeddown?



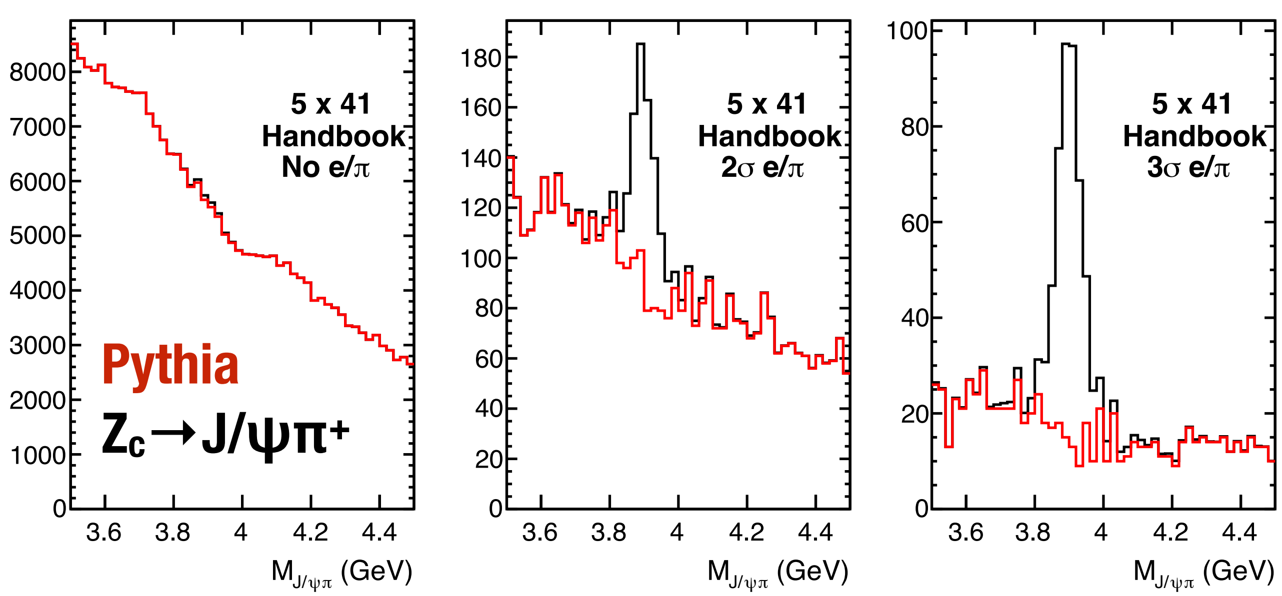
Particle ID

Di-hadron (seleting KK pairs)

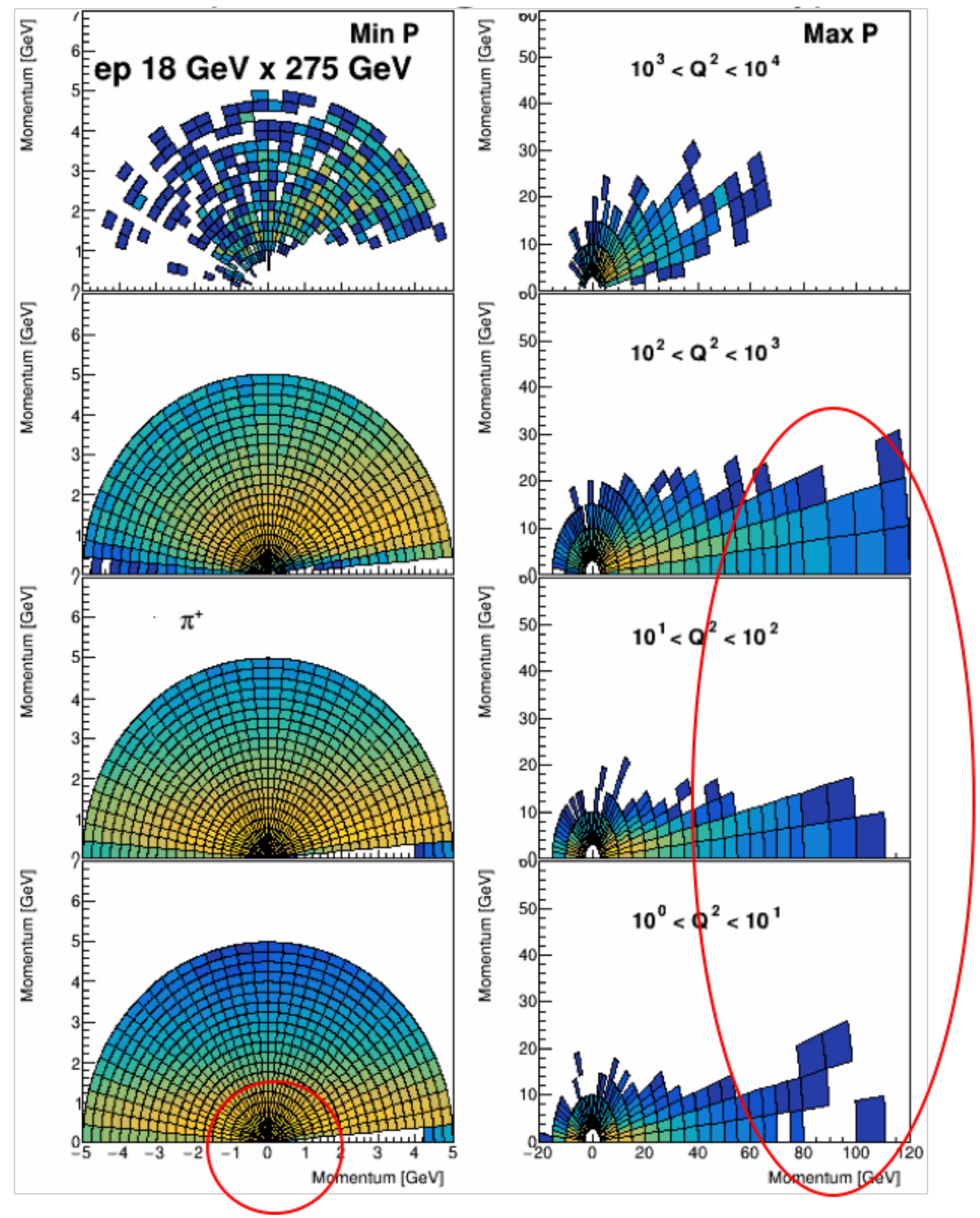


ππ pairs πK pairs KK pairs

Spectroscopy (e/π separation)



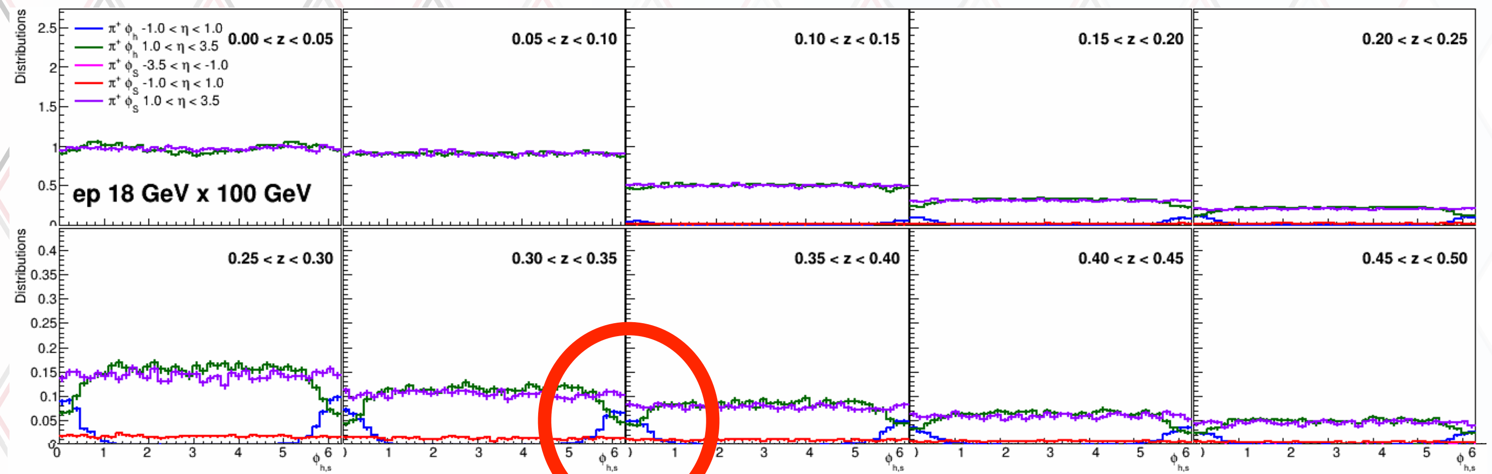
Single-hadron SIDIS π/K separation



Homogeneity across rapidity regions

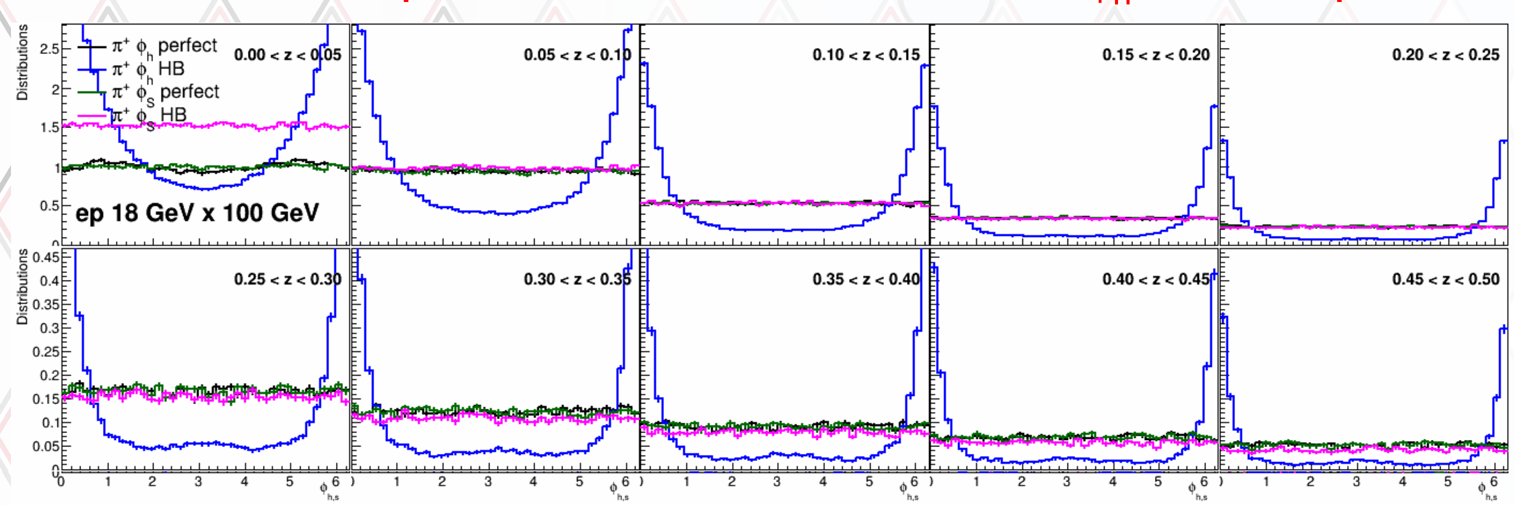
Perfect detector angles in two eta regions

Smooth azimuthal coverage over different rapidity regions is important!!!



Angles in perfect detector and HB **= HandBook**

Smeared scattered lepton causes different boost→ ϕ_h often in-plane

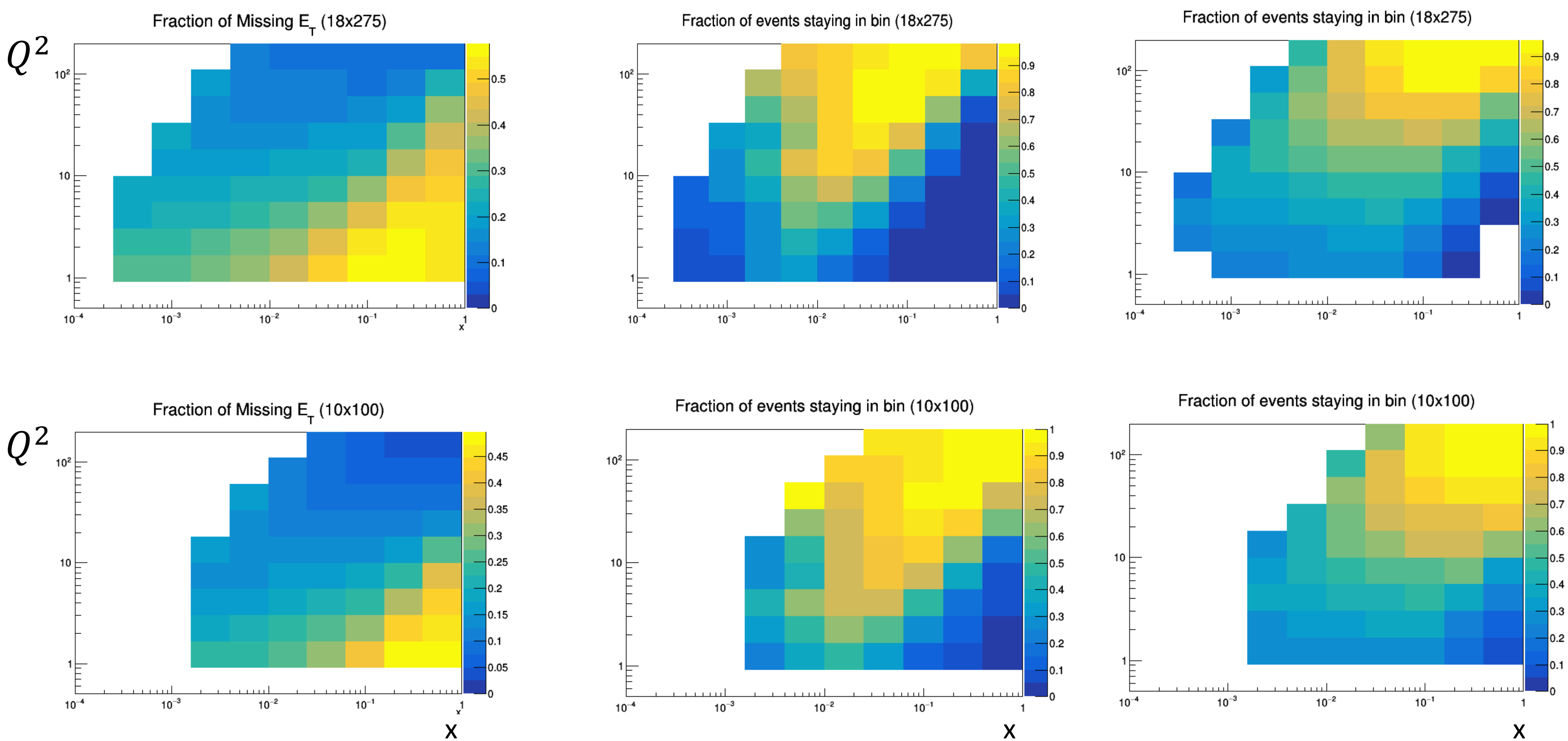


More details: https://indico.bnl.gov/event/8549/contributions/37691/attachments/28154/43213/2020_05_18_YR_RCS.pdf

Hermiticity requirements

Mixed Method

Double Angle Method



- Combination of mixed and double angle method perform significantly better than electron method at high x low Q^2
- Might be used to expand phase space to Resolution strongly correlated with missing E_T:
  →Explore impact of expanding coverage beyond η =3.5 (handbook)
- Caveat: p, E information not optimally used. Explore in Delphes with particle flow

General semi-inclusive detector themes

- Most studies now using "Handbook" detector as implemented in eic-smear
- **Tracking:** B-field choice affects
  - Minimum p cutoff: di-hadron PW, Λ/HF (slow pions)
  - Momentum resolution: forward rapidity hadrons, CC
- **Particle ID:** e/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

Fast simulation wishlist:

- Expected performance for handbook detector ✔
- **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 resolution assumptions
  - Far forward detector implementation?

Backup

Generic guidance from handbook

EIC Detector Requirements

η	Nomenclature			Tracking: Resolution	Tracking: Allowed X/X_0	Tracking: Si-Vertex	Electrons: Resolution σ_E/E	Electrons: PID	π/K/p PID: p-Range (GeV/c)	π/K/p PID: Separation	HCAL: Resolution σ_E/E	Muons
-6.9 — -5.8	↓ p/A	Auxiliary Detectors	low-Q² tagger	$\delta\theta/\theta < 1.5\%$; $10^{-6} < Q^2 < 10^{-2}$ GeV²								
…												
-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								

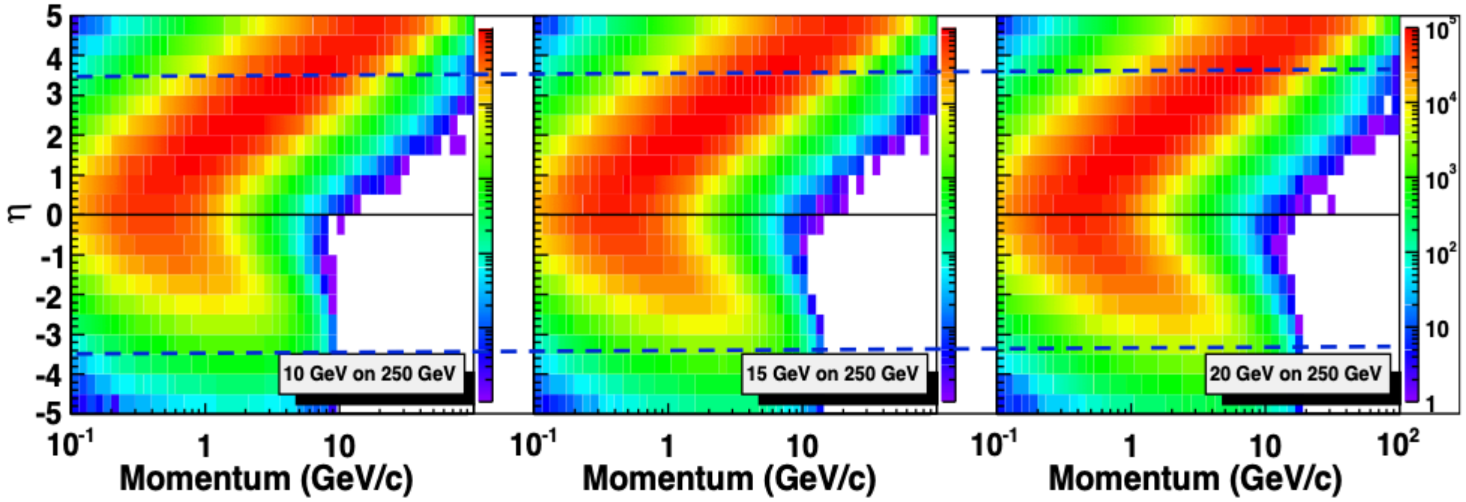
- Good starting point, but need to be more specific

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.