SIDIS Detector Matrix

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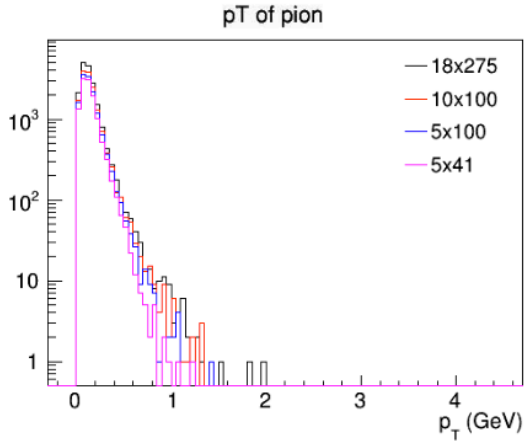
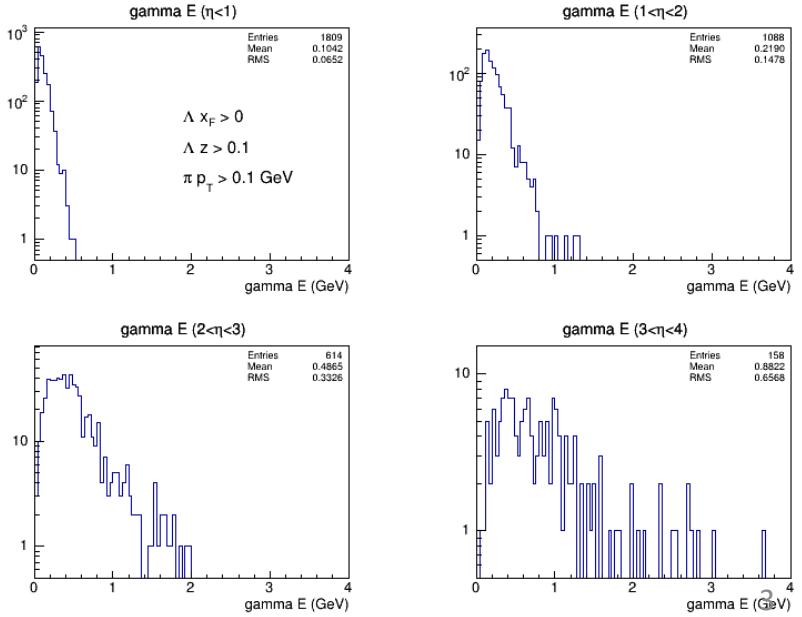
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1					Tracking				Electrons		Photons	π/K/p		HCAL			
2	η	Nomenclature			Resolution	Allowed X/X0	Si-Vertex	minimum-pT	Resolution σE/E	PID	min E	p-Range (GeV/c)	Separation	Resolution σE/E	Muons		
3	-6.9 to -5.8		Auxiliary Detectors	low-Q2 tagger	σθ/θ < 1.5%; 10-6 < Q2 < 10-2 GeV2												
4	...																
5	-4.5 to -4.0	↓ p/A		Instrumentation to separate charged particles from photons					2%/√E								
6	-4.0 to -3.5																
7	-3.5 to -3.0		Central Detector	Backward Detector	σp/p ~ 0.1%⊕0.5%	~5% or less X	TBD			π suppression up to 1:104		≤ 7 GeV/c	≥ 3 σ	~50%/√E	TBD		
8	-3.0 to -2.5																
9	-2.5 to -2.0				σp/p 0.1%⊕0.5%				2%/√E								
10	-2.0 to -1.5				σp/p 0.05%⊕0.5%			< 100 MeV	7%/√E								
11	-1.5 to -1.0							< 100 MeV	7%/√E								
12	-1.0 to -0.5			Barrel	σp/p ~0.05%×p+0.5%		σxyz ~ 20 μm, d0(z) ~d0(rΦ) ~ 20/pTGeV μm + 5 μm	< 100 MeV	(10-12)%/√E		< 200 MeV	≤ 8 GeV/c					
13	-0.5 to 0.0																
14	0.0 to 0.5																
15	0.5 to 1.0																
16	1.0 to 1.5			Forward Detectors	σp/p ~0.05%×p+1.0%		TBD	< 100 MeV		3σ e/π	< 200 MeV	≤ 20 GeV/c					
17	1.5 to 2.0							< 100 MeV									
18	2.0 to 2.5							< 100 MeV				≤ 30 GeV/c		~50%/√E			
19	2.5 to 3.0				σp/p ~ 0.1%×p+2.0%			< 100 MeV									
20	3.0 to 3.5							< 100 MeV			< 400 MeV	≤ 45 GeV/c					
21	3.5 to 4.0													~50%/√E			
22	3.5 to 4.0	↑ e	Auxiliary Detectors	Instrumentation to separate charged particles from photons													
23	4.0 to 4.5																
24	...			Neutron Detection													
25	> 6.2			Proton Spectrometer	σintrinsic(|t|)/|t| < 1%; Acceptance: 0.2 < pt < 1.2 GeV/c												
26																	
27																	

Min track pT and photon energies

- Min track p_T studies concentrated on needs for Λ analysis and partial waves for di-hadrons
- For Λ analysis, need p_T resolution $\leq$ 100 MeV
  →better resolution → more lambdas
- For PWs 100 MeV is good, lower not much of an improvement (but 50% worse at 300 MeV)
- Min γ Energy requirement driven by $\Sigma \rightarrow \Lambda\gamma$ →should be better than 200 MeV

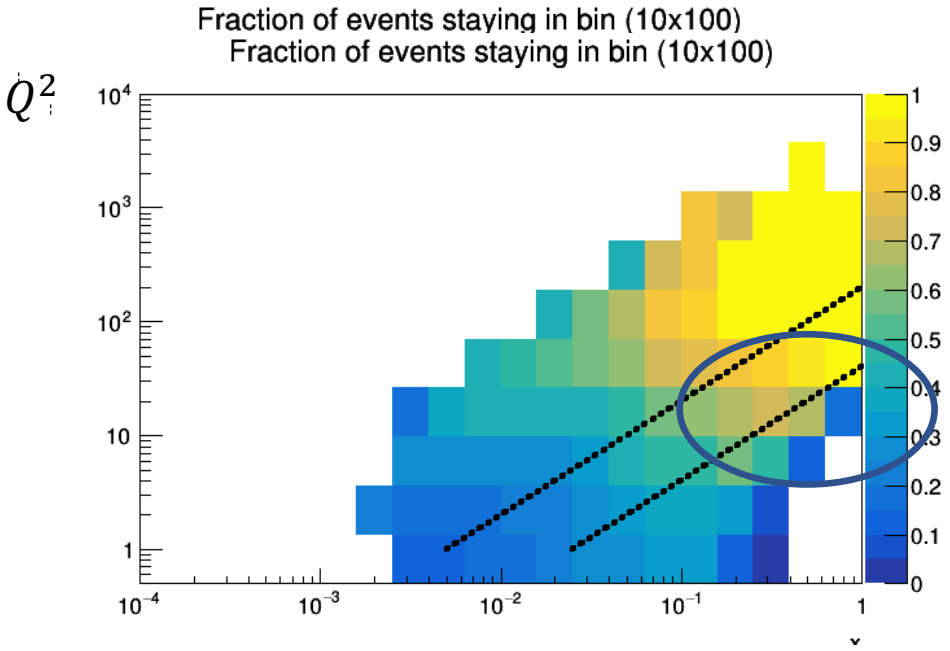


5x41 but other options similar

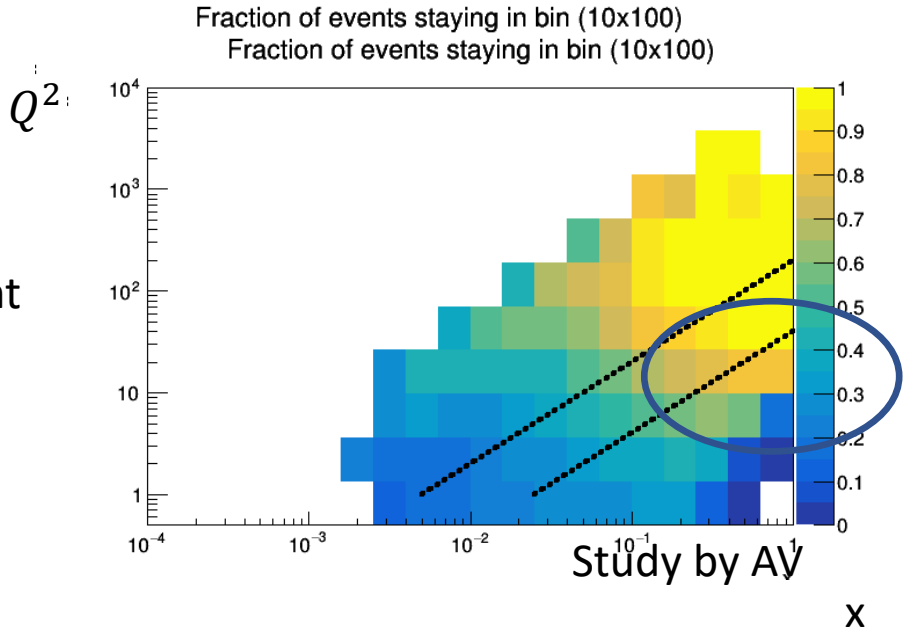


Study by Jinlong Zhang

Extended coverage to eta of 4



Some improvement
At low x high Q^2

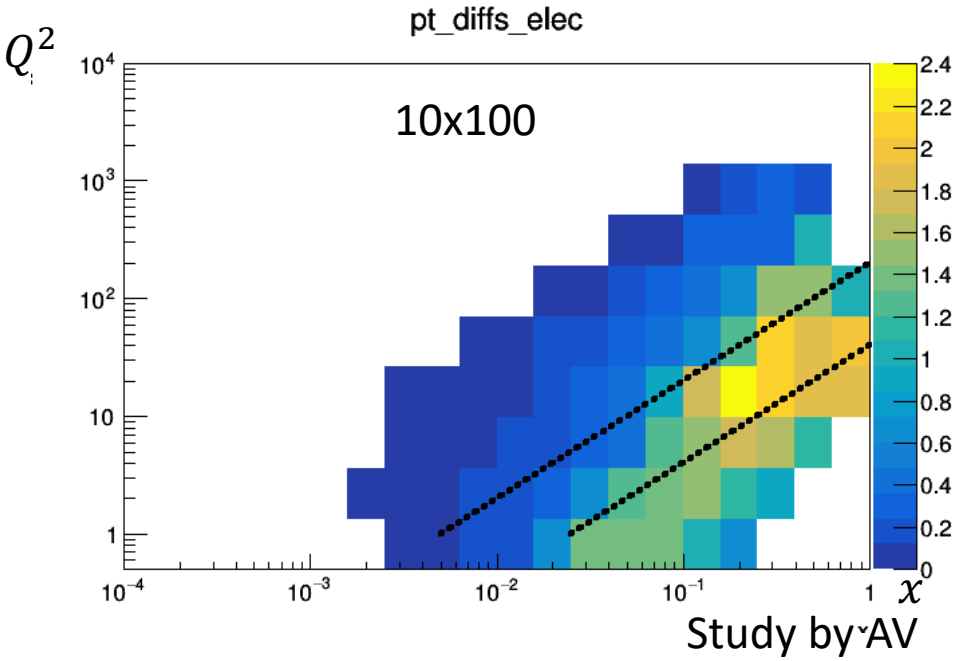


Study by AV

- Extending coverage will help with extending kinematic range with hadronic methods

Tracking resolution

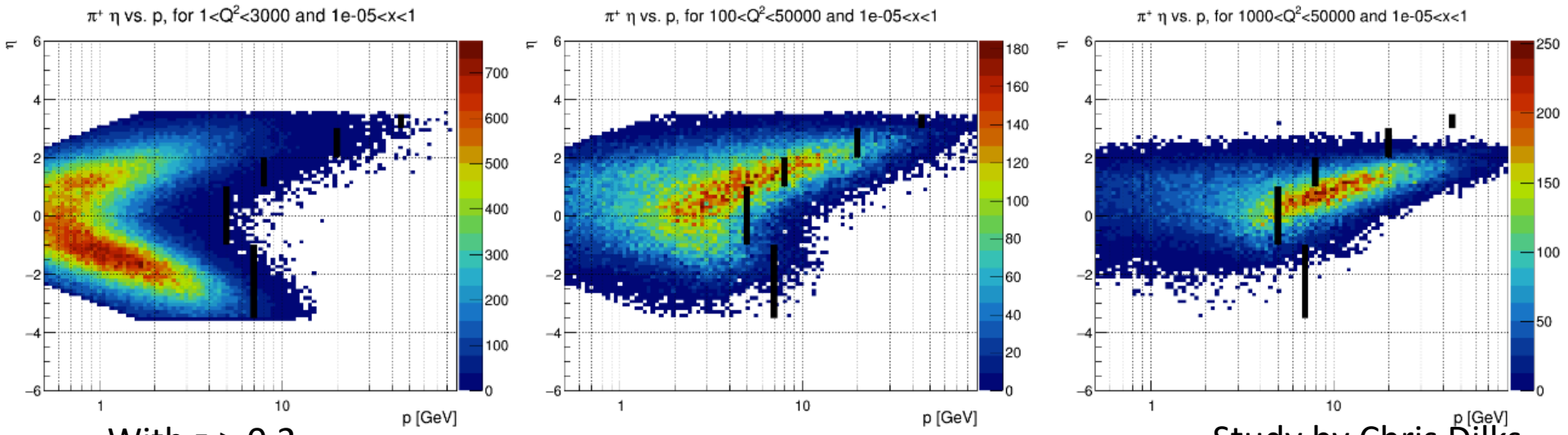
- Tracking resolution sufficient on hadron side
- Momentum resolution on electron side limits access to high x /low Q^2



PID → arguably most important change

- PID of utmost importance in SIDIS (in particular π/K)
- Original matrix cuts severely in high Q^2, moderate to high z
- NB: Electron/pion separation at forward η will be important for spectroscopy program, but details still being investigated

$Q^2 > 1$ GeV^2 | $Q^2 > 100$ GeV^2 | $Q^2 > 1000$ GeV^2



With z > 0.2

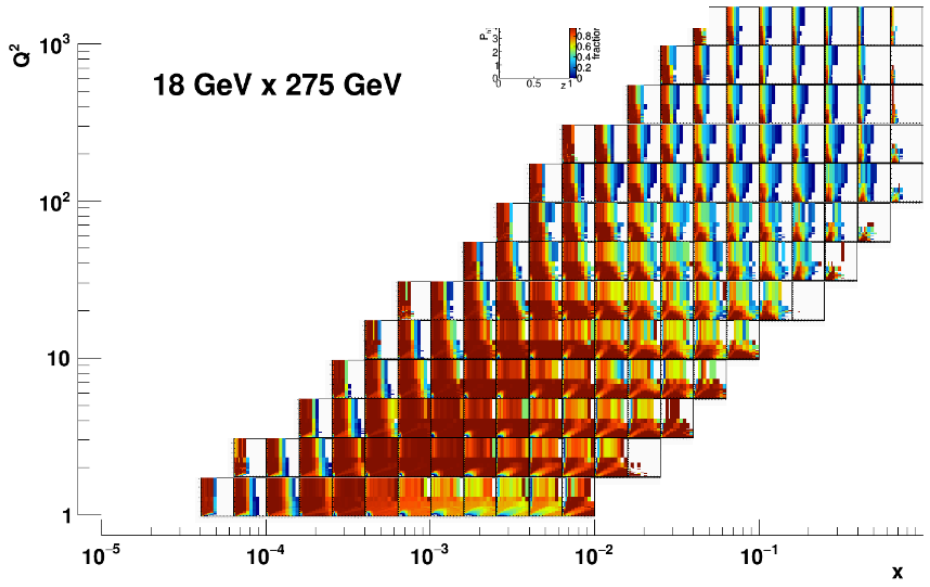
This is equal counts, not equal $lumi$!!

Study by Chris Dilks

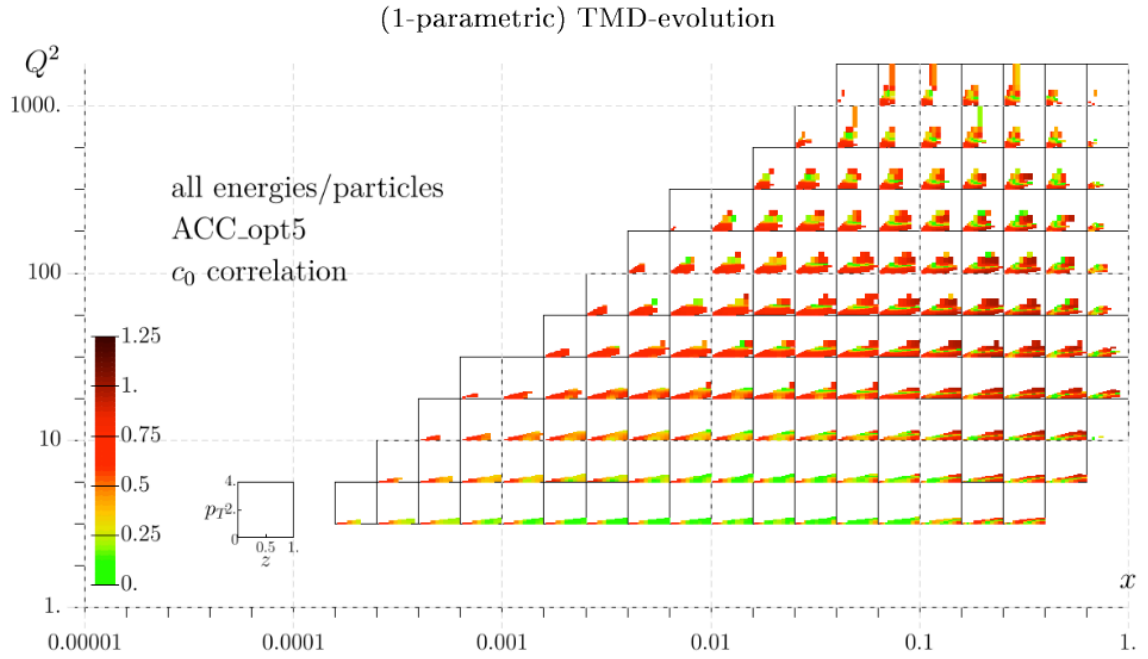
Original PID has low efficiency at high x/high Q^2

- Impact of data in this region large!

4D ratios (PID acc/perfect):



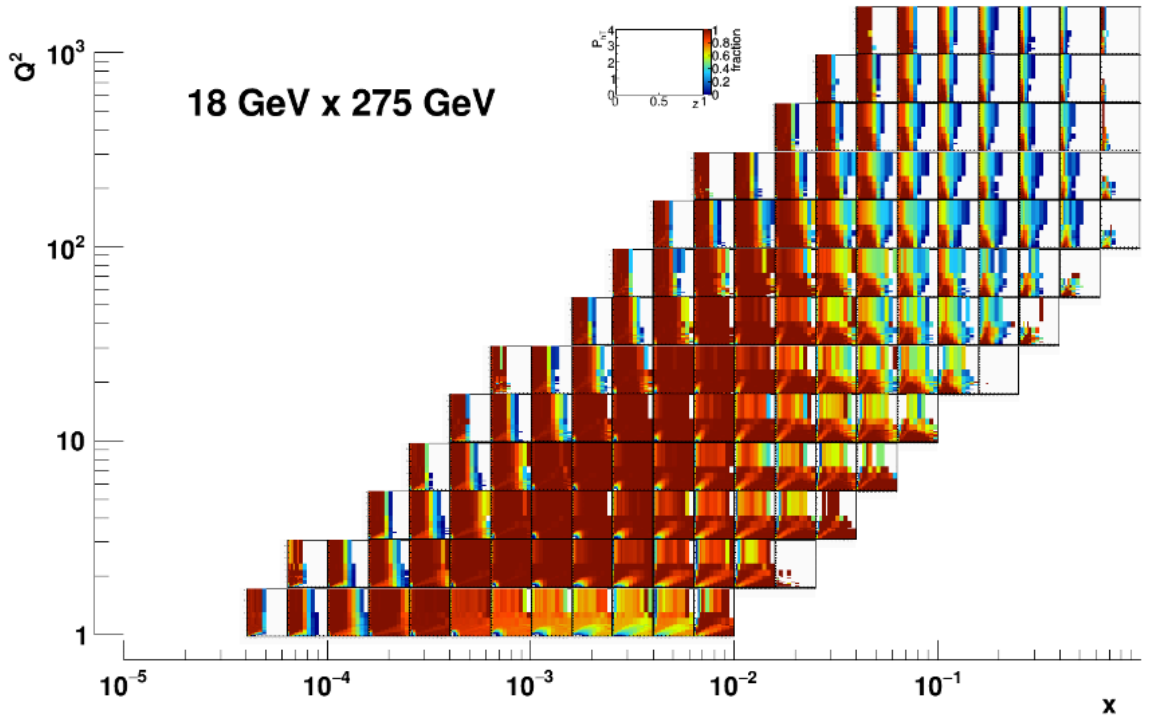
Study by Ralf Seidl

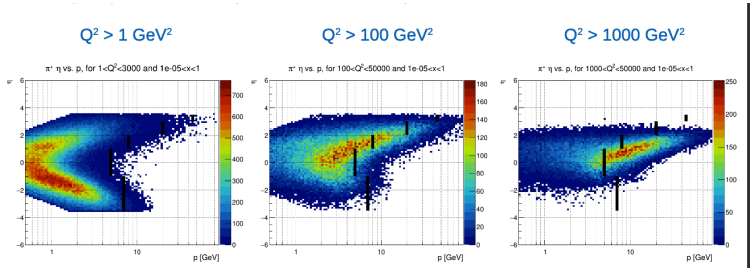


Study by Alexey Vladimirov

SIDIS request improves high x/high Q^2

- Request driven by our understanding of detector limitations

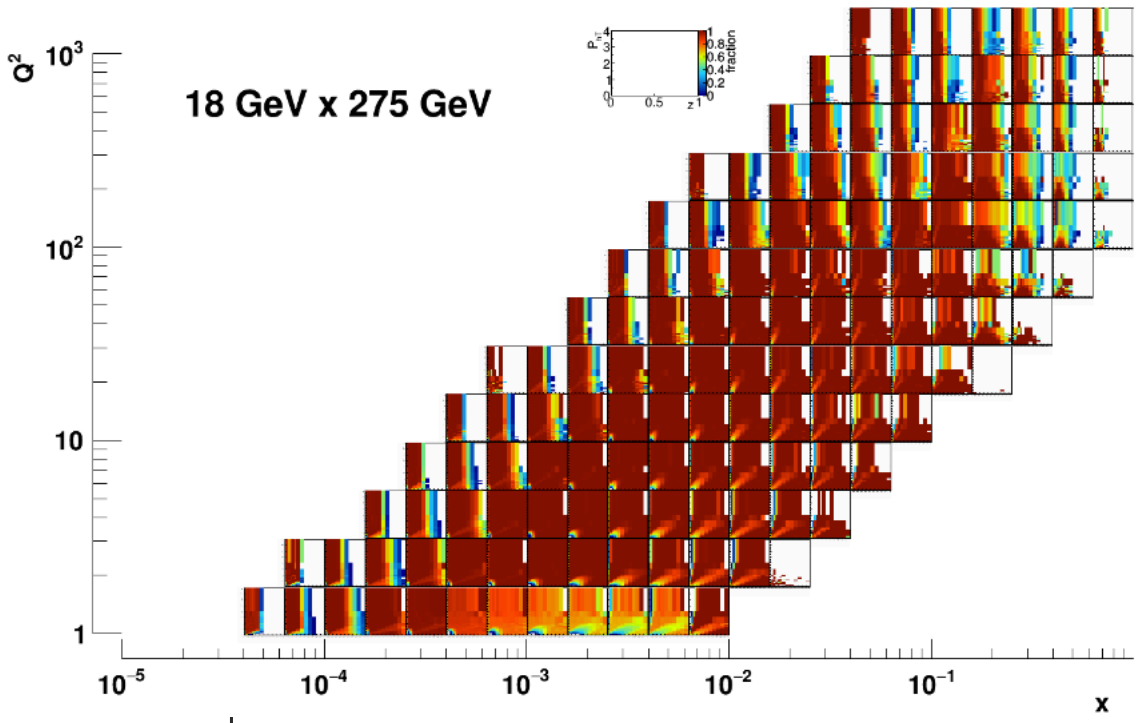


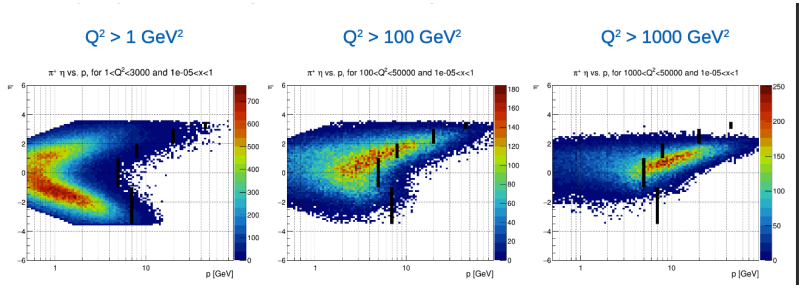


Study by Ralf Seidl

SIDIS request	π/K/p
-3.5 - -1.0	0.2 - 7
-1.0 - 1.0	0.2 - 8
1.0 - 2.0	0.2 – 20
2.0 - 3.0	0.5 – 30
3.0 - 3.5	0.5 – 45

What we would like in a better world:

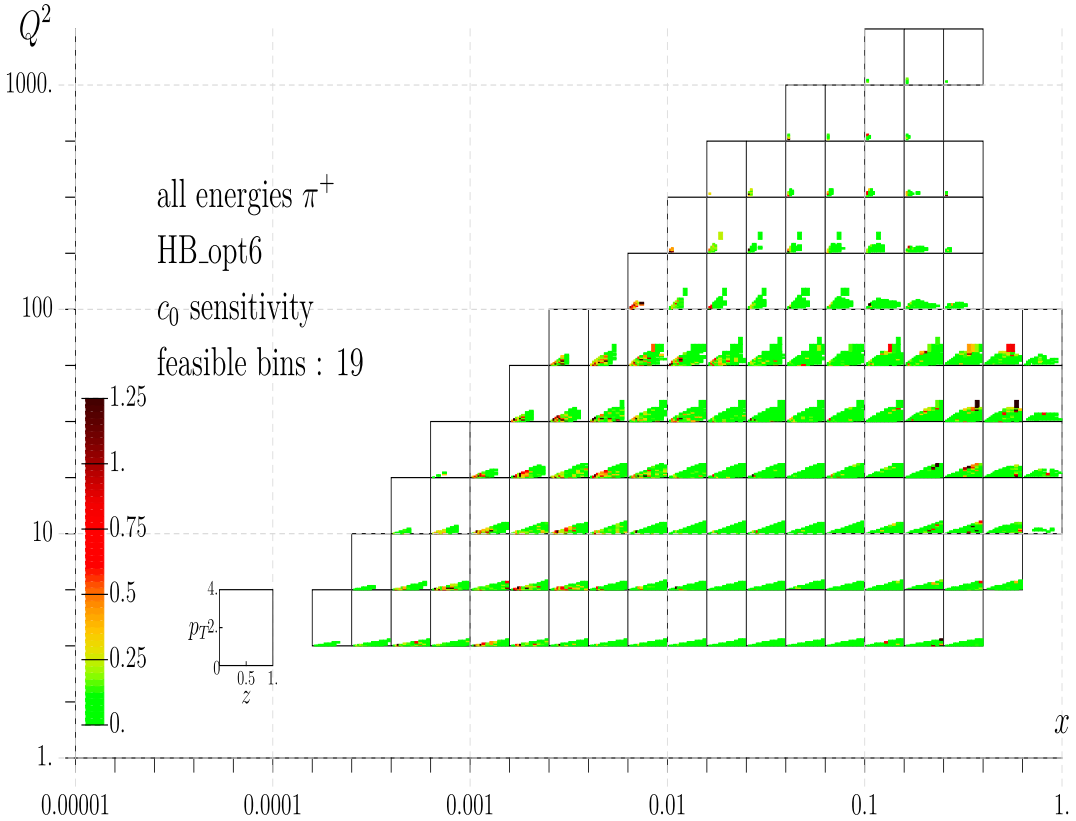


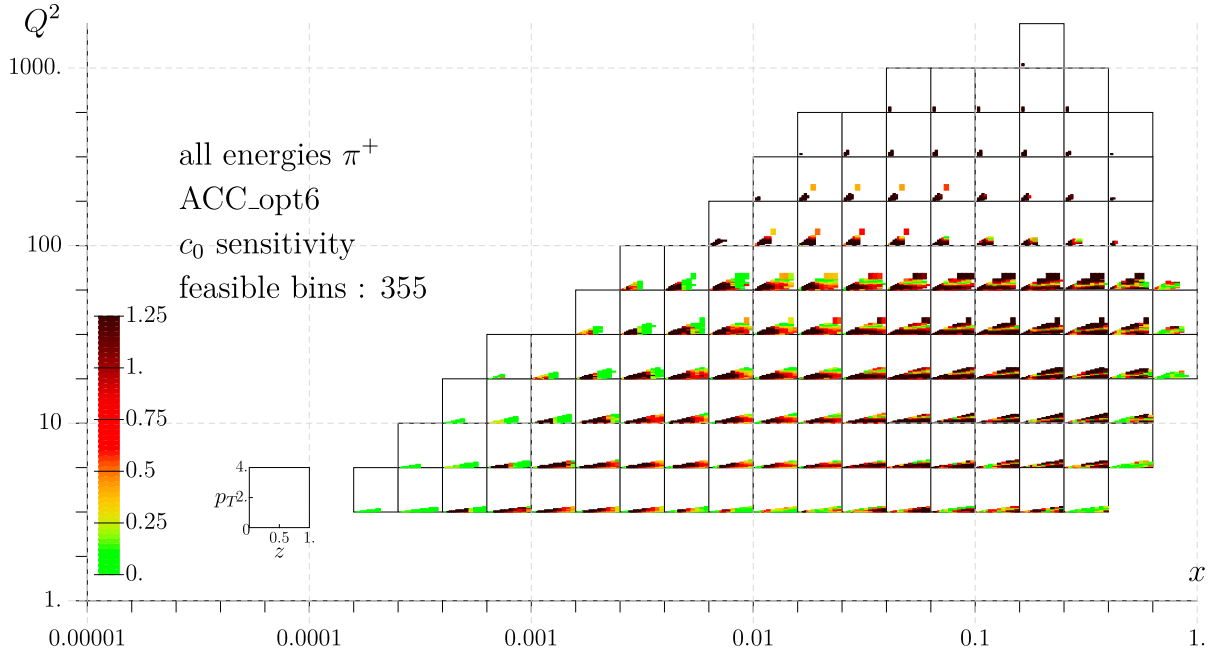


Study by Ralf Seidl

Anselm special	π/K/p
-3.5 - -1.0	0.2 - 7
-1.0 - 1.0	0.2 - 10
1.0 - 2.0	0.2 – 40
2.0 - 3.0	0.5 – 45
3.0 - 3.5	0.5 – 50

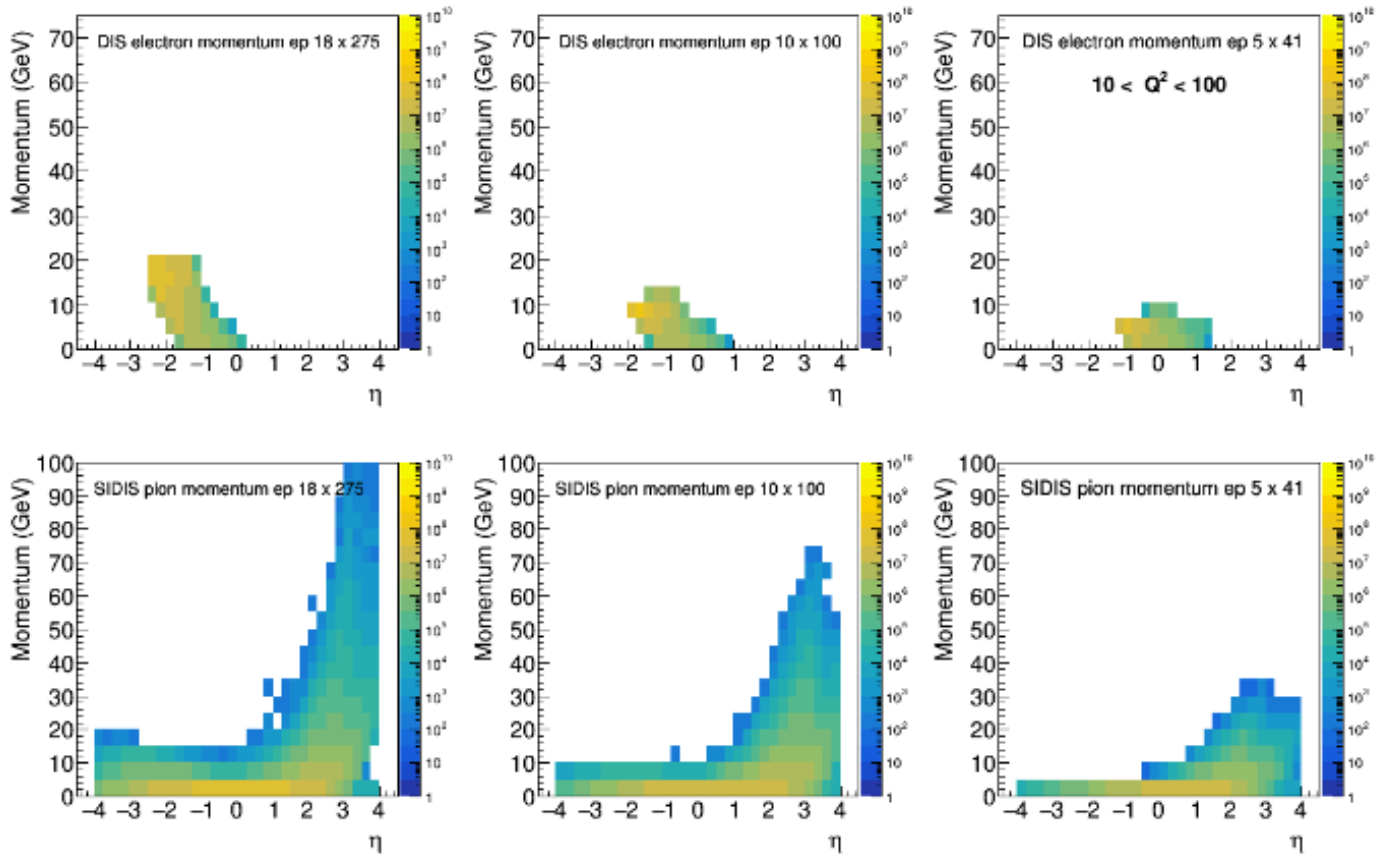
Hot off the press





Summary

- SIDIS requests
  - Min track $p_T < 100\ MeV$
  - Min photon energy < $200\ (mid/forward)$, $400\ (far\ forward)\ MeV$
  - Extend coverage to $\eta = 4$
  - Significantly improve PID with focus on forward region →SIDIS request should be seen as minimum


DIS electron momentum ep 18 x 275
DIS electron momentum ep 10 x 100
DIS electron momentum ep 5 x 41
10 < Q² < 100
SIDIS pion momentum ep 18 x 275
SIDIS pion momentum ep 10 x 100
SIDIS pion momentum ep 5 x 41
Momentum (GeV)
η