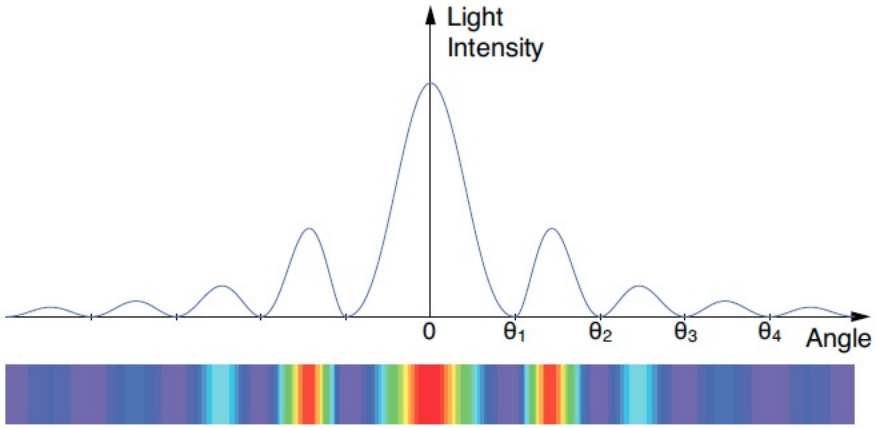
VM program in *eA* at the EIC – ATHENA



Series of study

I. Baselines and setups
II. PHP, ***t*** reco, and mass
III. Preliminary proposal of ϕ
IV. First attempt full simulation
V. Updates
VI. Full simulations on ϕ

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BNL

11. 15. 2021

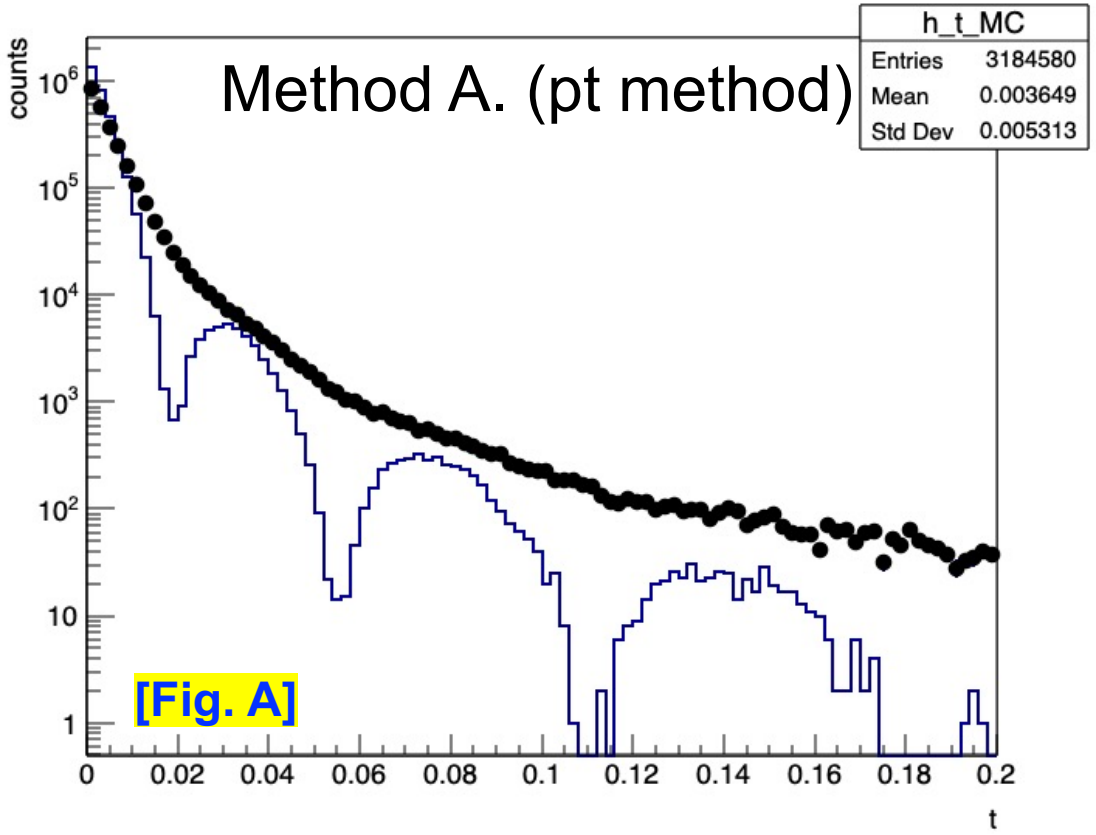
Shujie Li, LBL
*special help on Tracking

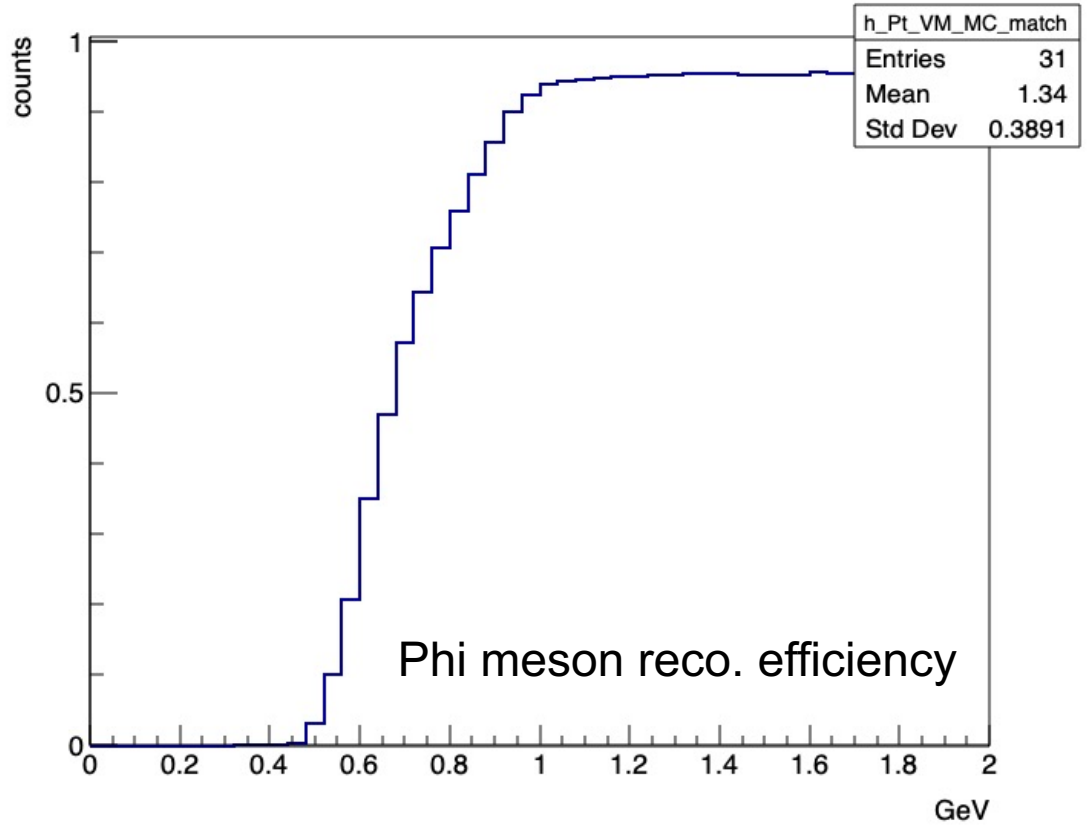
Full simulations on Sartre

- Sartre events were prepared in the following ways:
  - Replace all Ion PDG (only Au.) to proton (2212)
  - Separate coherent and incoherent events to different Hepmc outputs
  - Sent to B. Page for after-burner (crossing angle & beam effects)
  - Clear all vertices information.
  - Split the input to small chunk of samples
  - Run full simulations at BNL with condor
  - ~10h running time for 5k events, a couple of M samples are generated.

Note: BeAGLE events need all the above steps + some “status code” changed in order to work

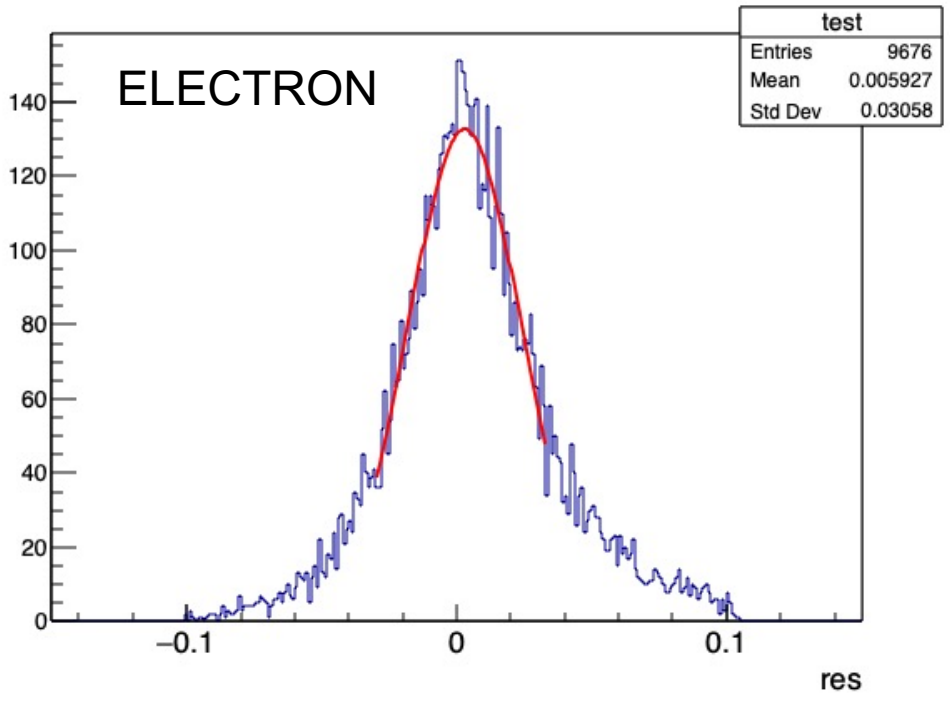
First look at t distribution



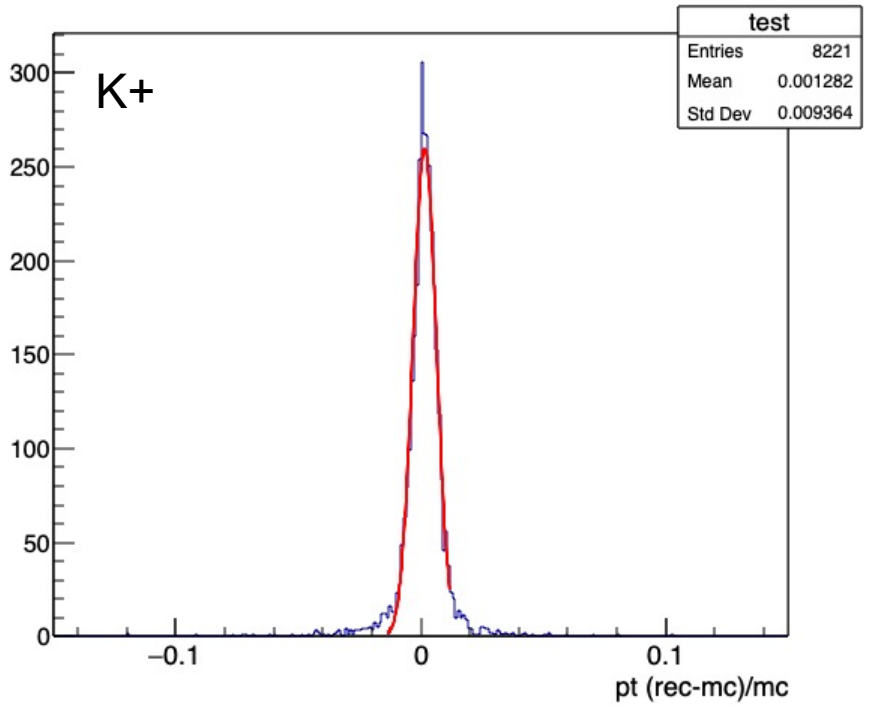


No signal at all! Resolution is not good enough!

Tracking resolution



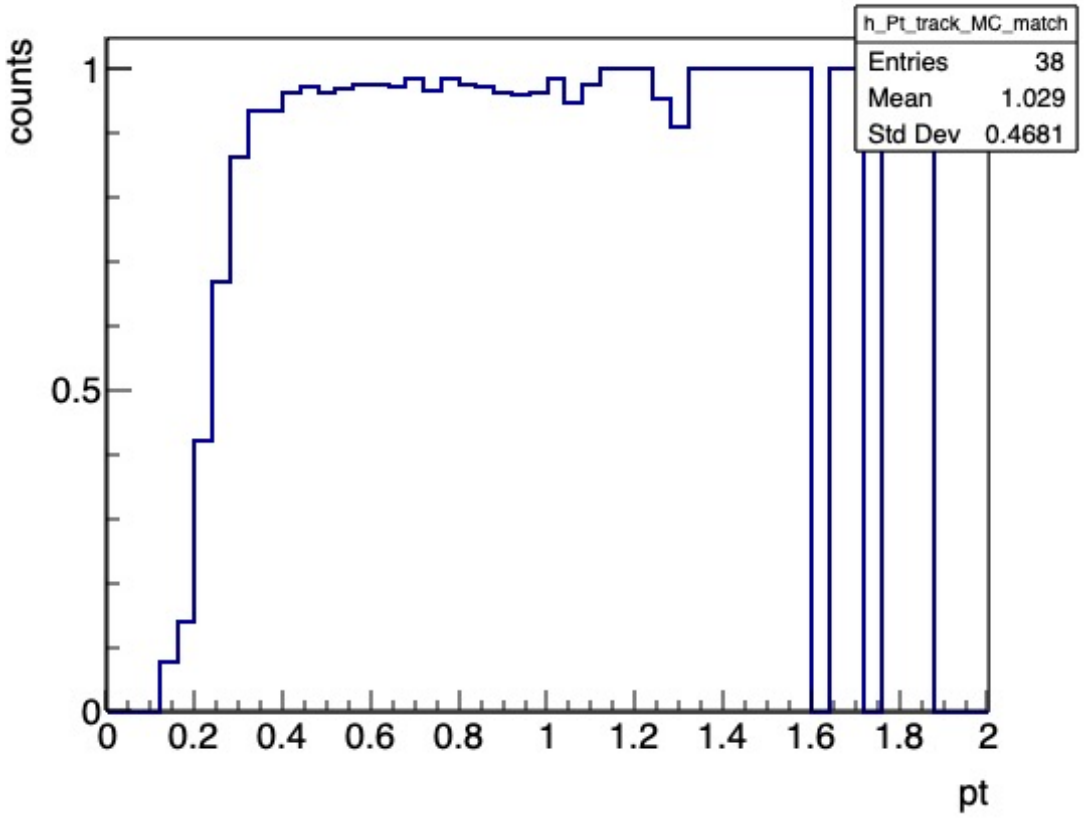
- Scattered electron, all pT
- pT resolution ~ 2.08%

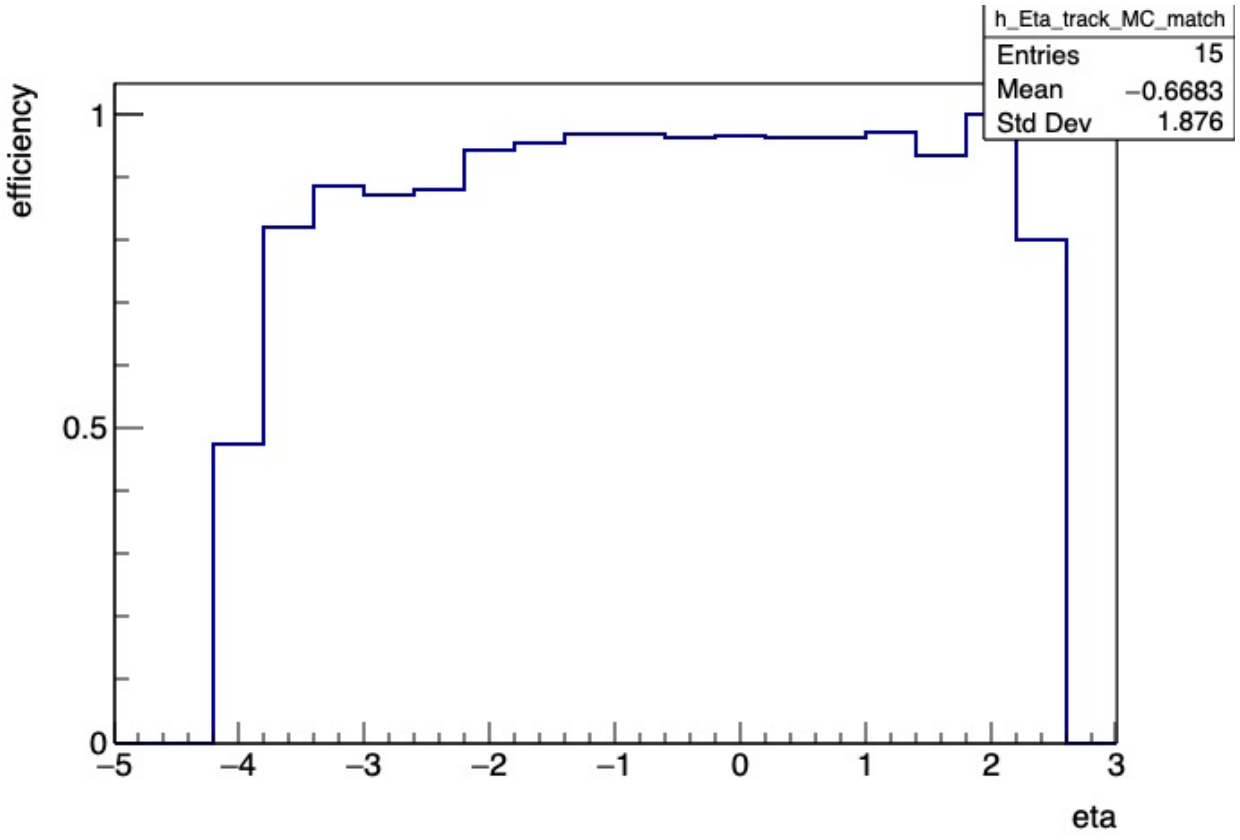


- Kaon daughter, all pT
- pT resolution ~ 0.48%

[Huge thanks to Shujie Li's help from tracking group!! These numbers were confirmed.]

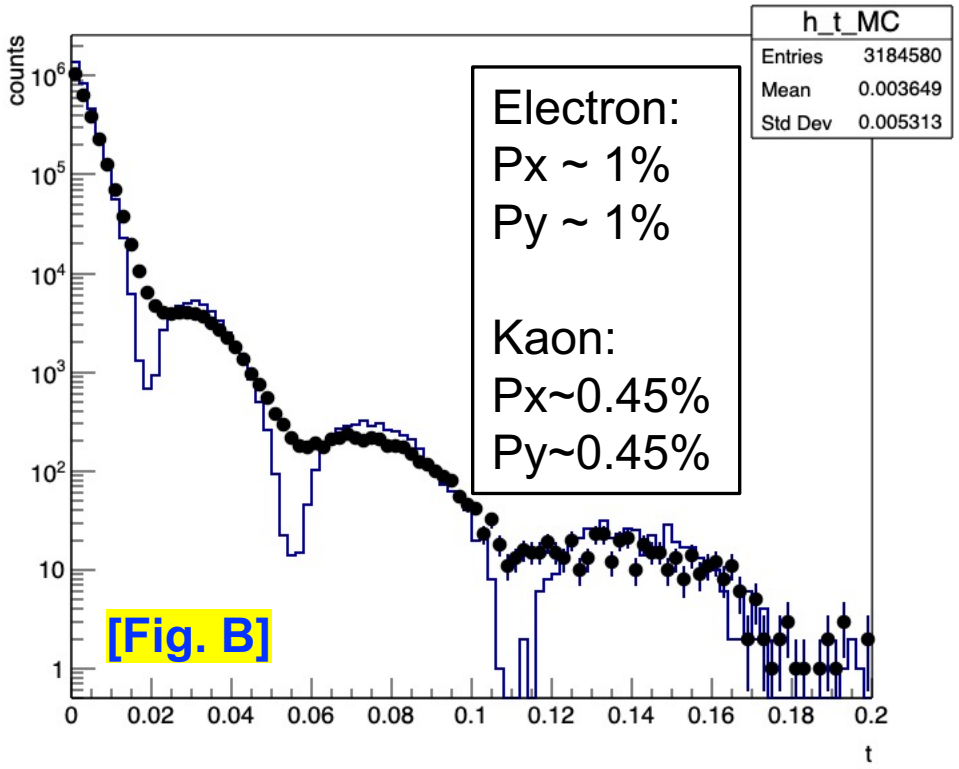
Tracking efficiency





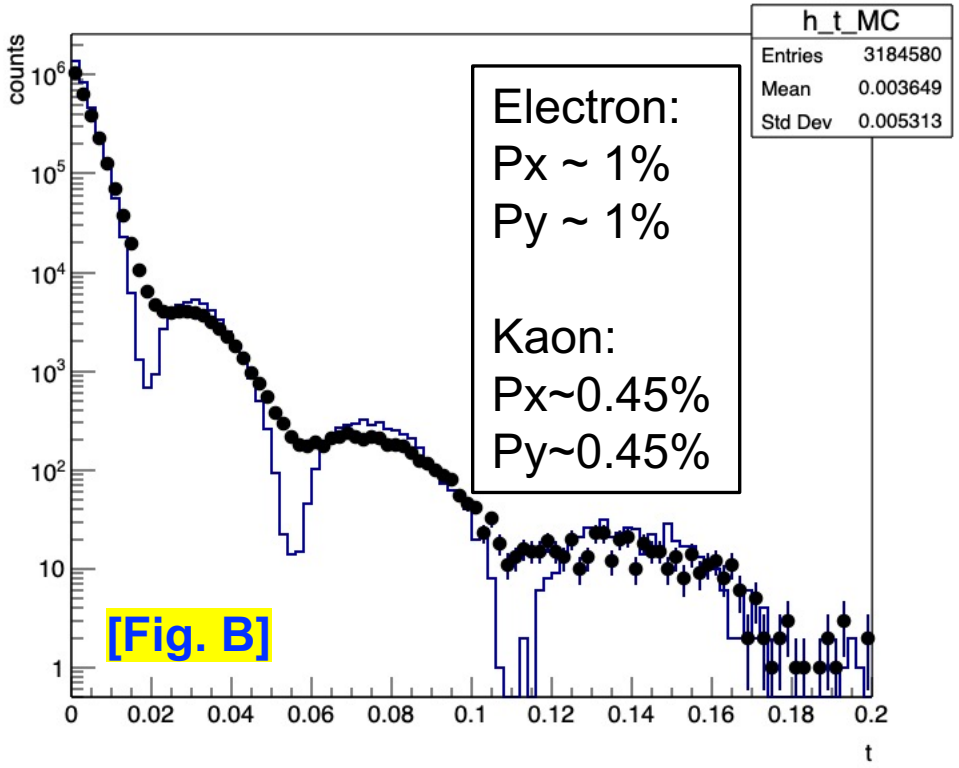
Efficiency of single particle K^+

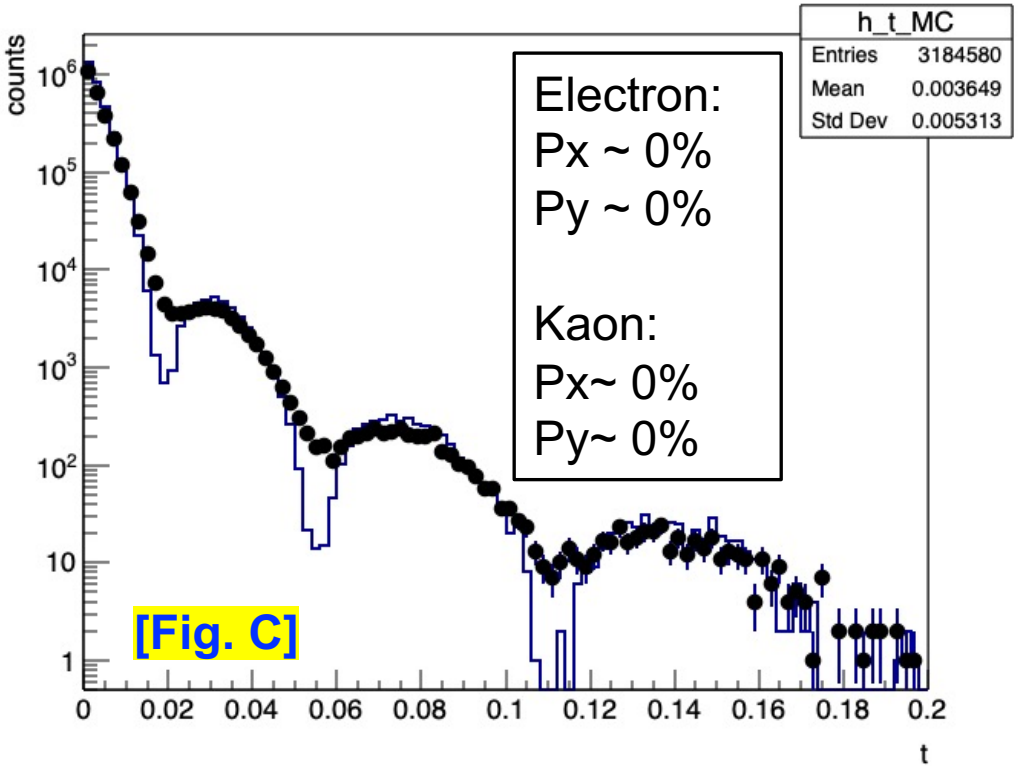
Hand smearing with pt resolution



- I used the acceptance from full reco but only replace the e' and phi with MC four-vectors.
- Then I smeared them with some resolution on px, py.

Hand smearing with pt resolution

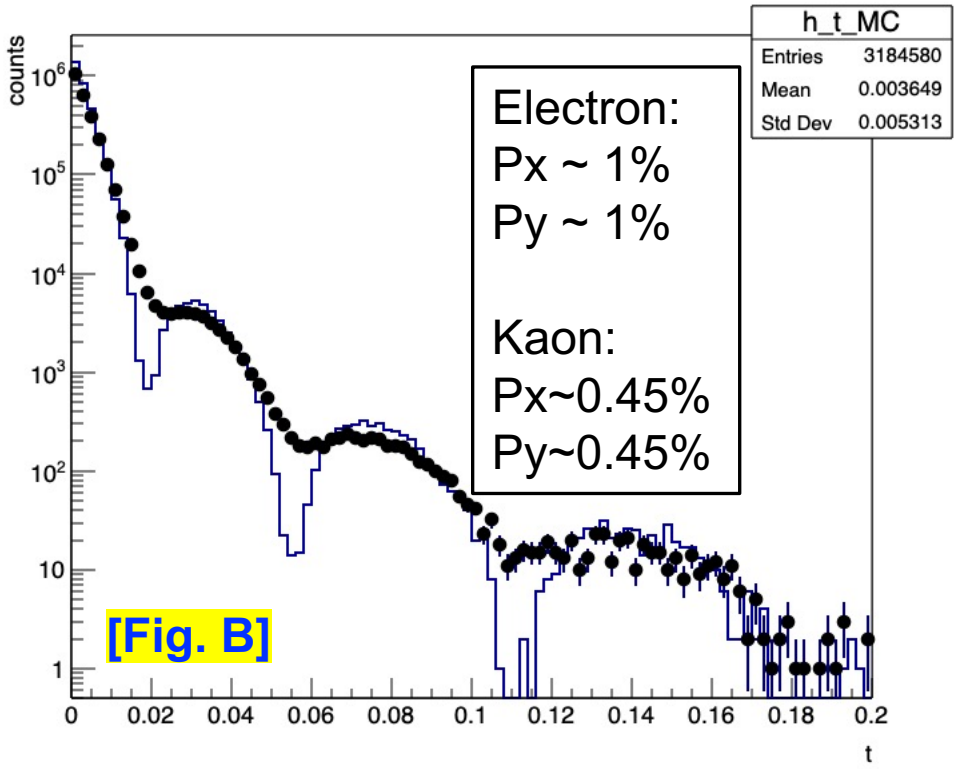


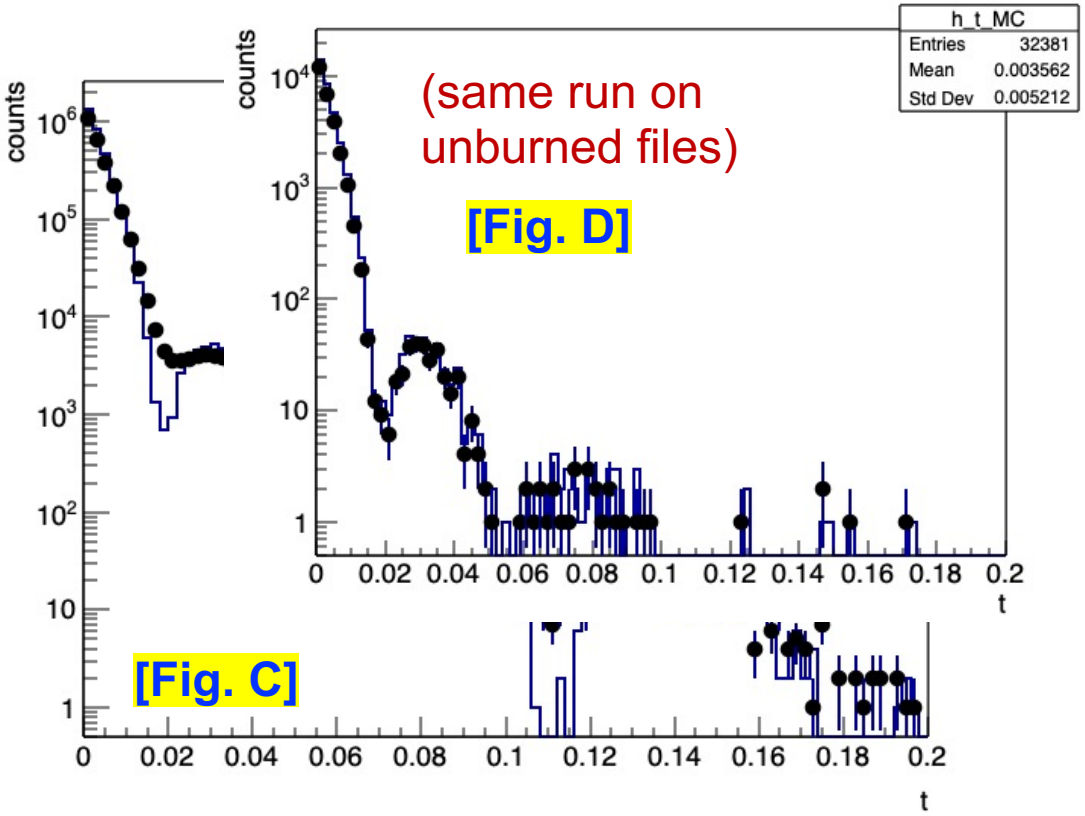


- I used the acceptance from full reco but only replace the e' and phi with MC four-vectors.
- Then I smeared them with some resolution on px, py.

MC four momentum to construct t but with reco. Acceptance.
*[Differences are coming from beam and crossing angles]

Hand smearing with pt resolution





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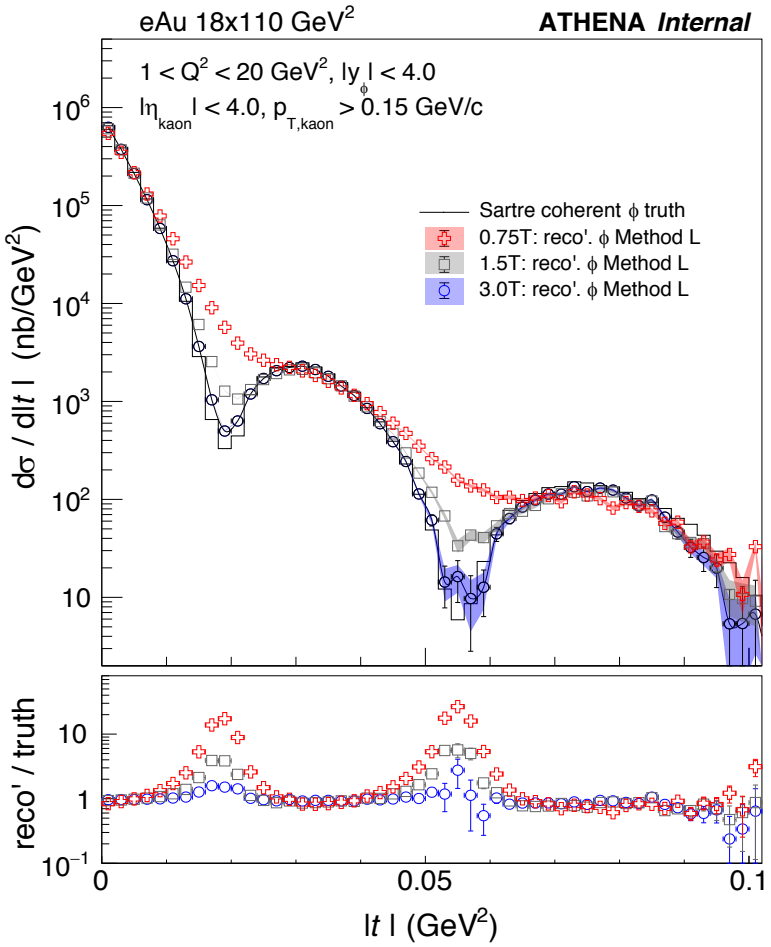
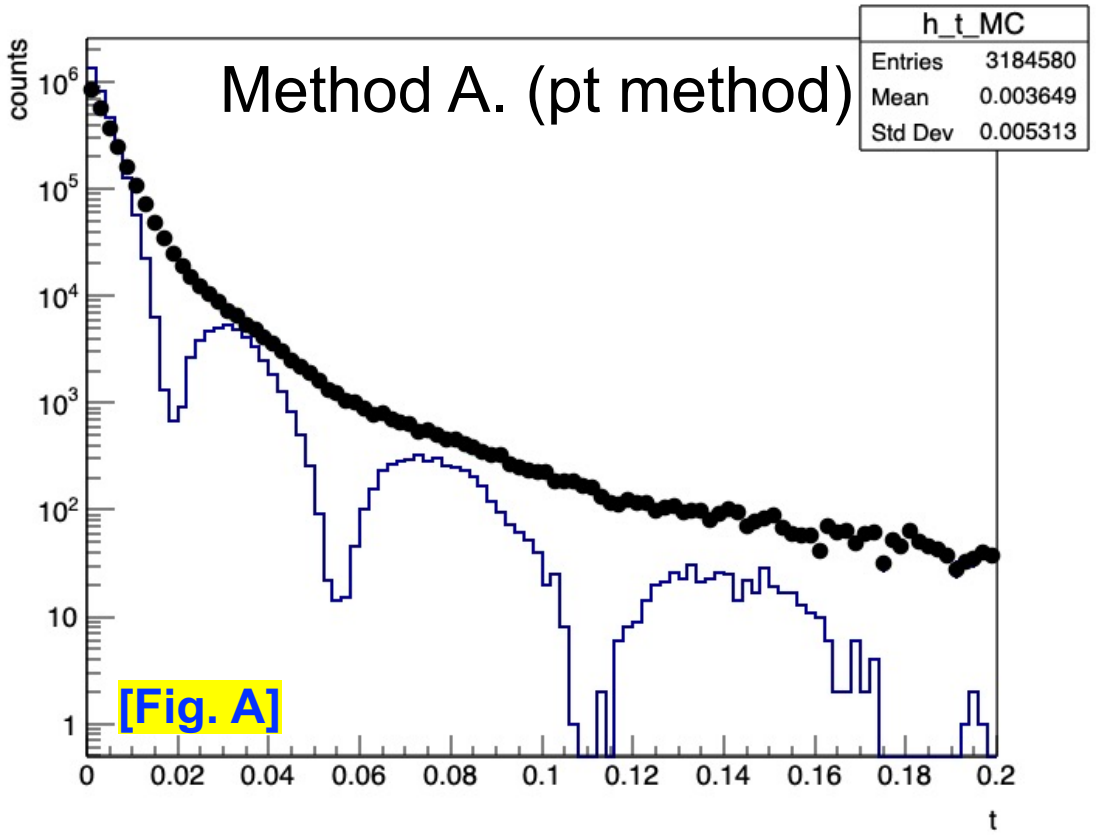
MC four momentum to construct t but with reco. Acceptance.
*[Differences are coming from beam and crossing angles]

Proposal plots



(This is currently in the proposal, which is far too good!)

(PS: I confirmed this with hand smearing as well)



(All effects are included but without incoherent, without rho contaminations)

YR requirements

(T. Ullrich)

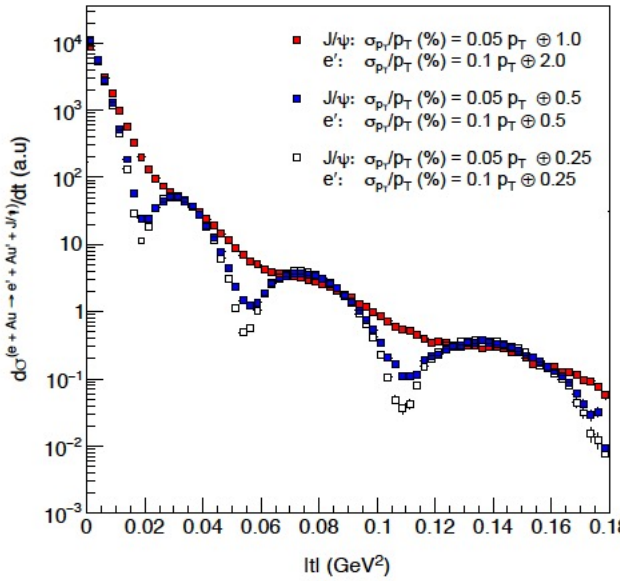


Figure 8.85: Illustration of the impact of different p_T resolutions on duction cross section, $d\sigma/dt$, for $1 < Q^2 < 10\,\mathrm{GeV}^2$.

(PS: I confirmed this with hand smearing as well)

Method A. (pt method)

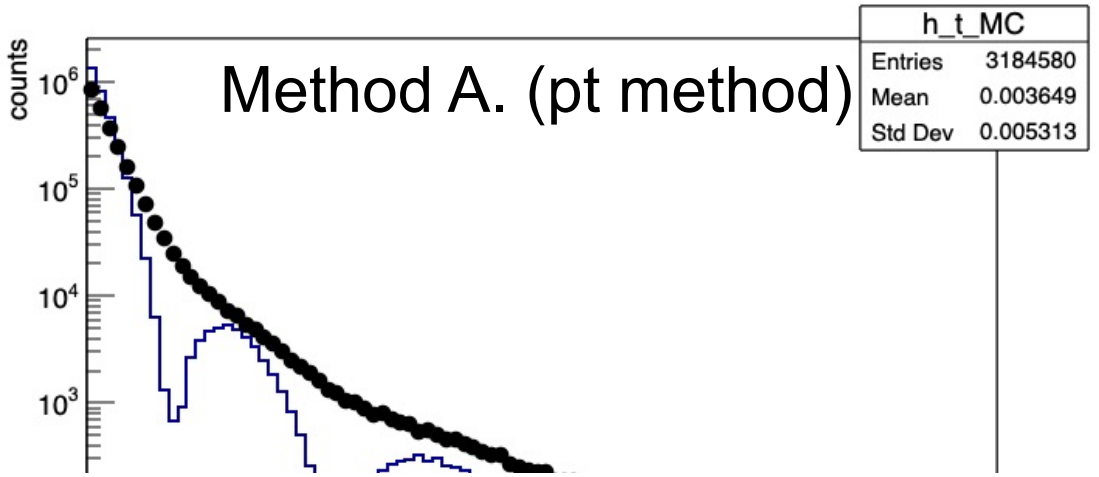


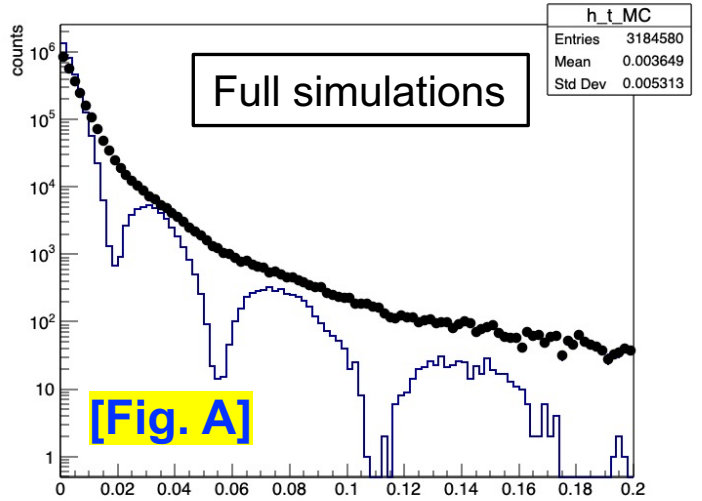
Table 11.2: Requirements for the tracking system from the physics groups.

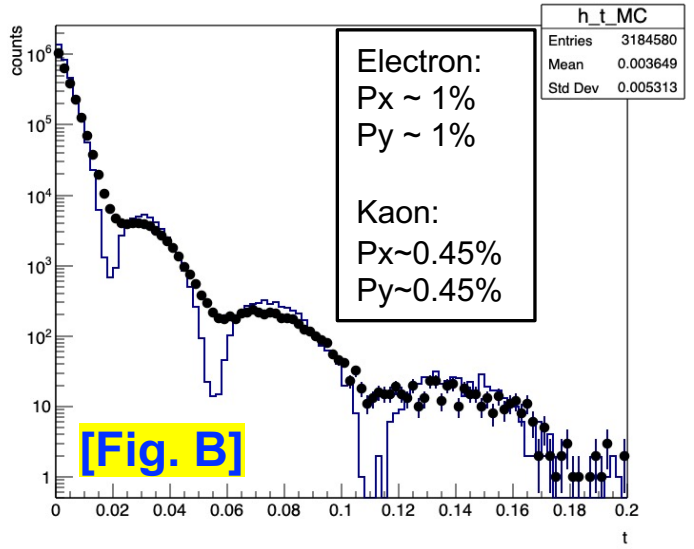
Tracking requirements from PWGs						
			Momentum res.	Material budget	Minimum pT	Transverse pointing res.
η						
-3.5 to -3.0	Central Detector	Backward Detector	σp/p ~ 0.1%×p ⊕ 0.5%	~5% X0 or less	100-150 MeV/c	
-3.0 to -2.5					100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 40 μm
-2.5 to -2.0			σp/p ~ 0.05%×p ⊕ 0.5%		100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 20 μm
-2.0 to -1.5					100-150 MeV/c	
-1.5 to -1.0					100-150 MeV/c	
-1.0 to -0.5		Barrel	σp/p ~ 0.05%×p ⊕ 0.5%		100-150 MeV/c	dca(xy) ~ 20/pT μm ⊕ 5 μm
-0.5 to 0						
0 to 0.5						
0.5 to 1.0						
1.0 to 1.5		Forward Detector	σp/p ~ 0.05%×p ⊕ 1%		100-150 MeV/c	
1.5 to 2.0					100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 20 μm
2.0 to 2.5					100-150 MeV/c	
2.5 to 3.0			σp/p ~ 0.1%×p ⊕ 2%		100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 40 μm
3.0 to 3.5					100-150 MeV/c	dca(xy) ~ 30/pT μm ⊕ 60 μm

Summary

- What should we do???
  (shall we use Fig.B ?)
- Electron pt resolution is the bottleneck…
- Beam effects are also playing a big role.
- Are we planning to improve tracking together with the tracking group

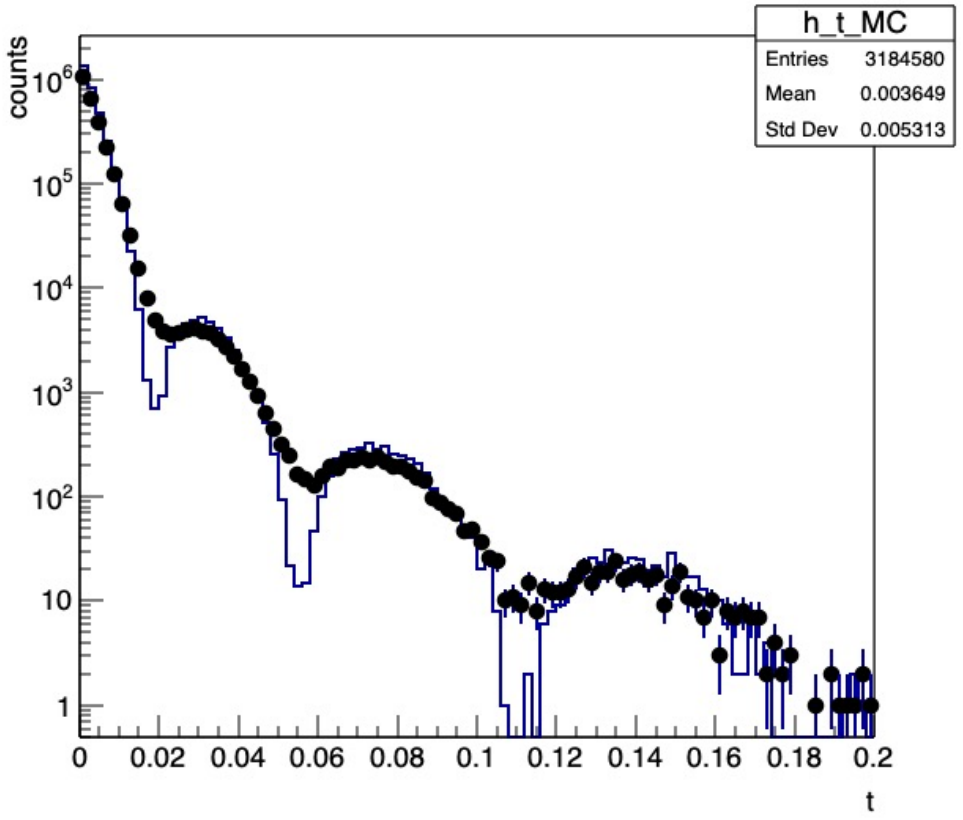
(All effects are included but without incoherent, without rho contaminations)





t ~ {0,0.01,0.04,0.07,0.1,0.13,0.18}
t resolution ~ {45%,31%,18.7%,14.5%,12.6%,9.6%}

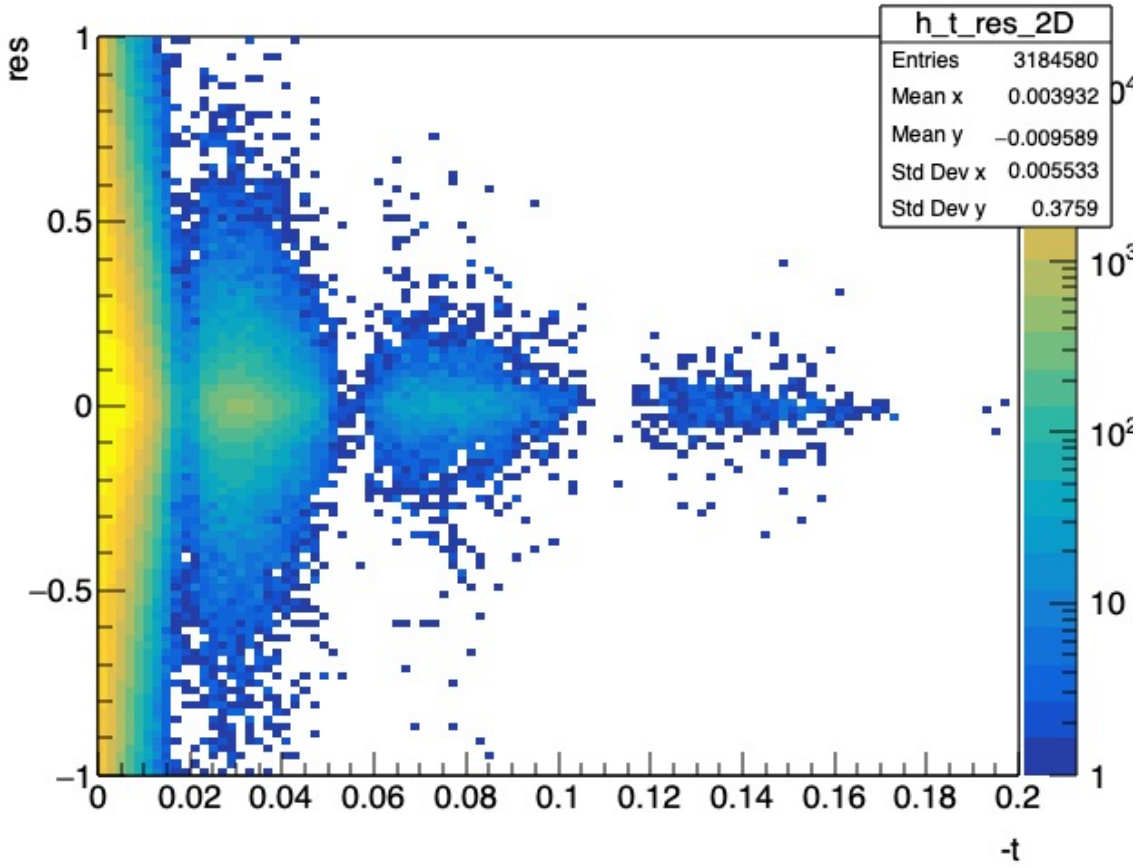
Backup



t ~ {0,0.01,0.04,0.07,0.1,0.13,0.18}
t resolution ~ {38%,24%,15%,11%,9%,7%}

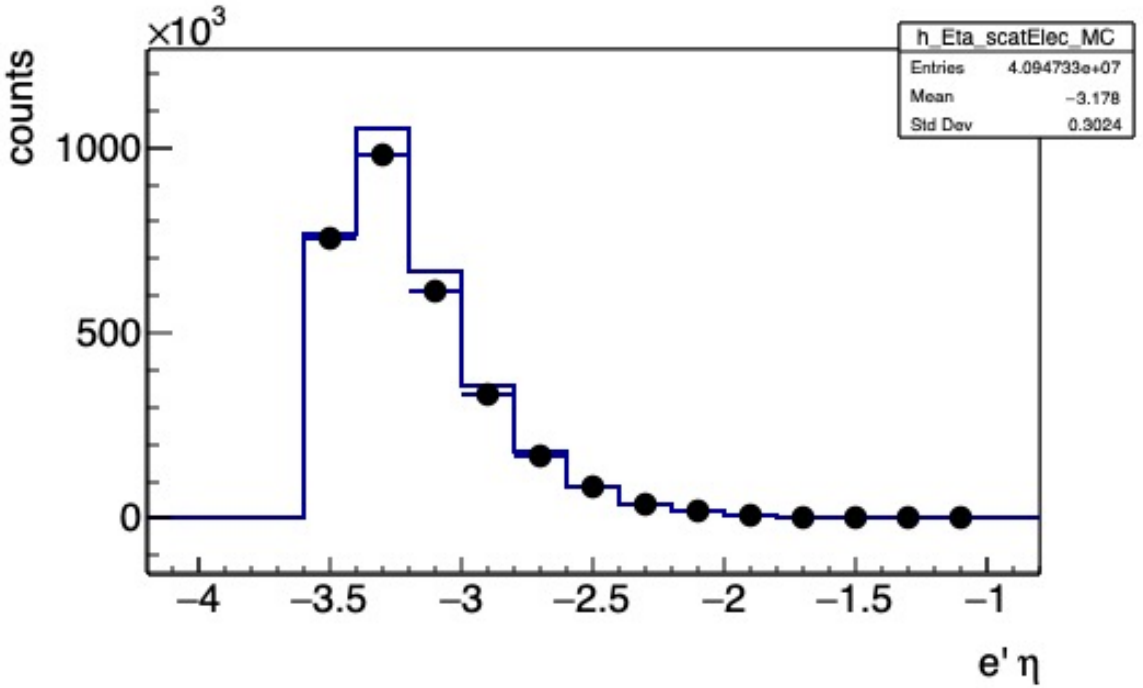
0.5% pt resolution for both K and electron

Resolution



t ~ {0,0.01,0.04,0.07,0.1,0.13,0.18}
t resolution ~ {38%,24%,15%,11%,9%,7%}

e’ reco.


h_Eta_scatElec_MC
Entries 4.094733e+07
Mean −3.178
Std Dev 0.3024
×10^3
counts
1000
500
0
−4
−3.5
−3
−2.5
−2
−1.5
−1
e' η