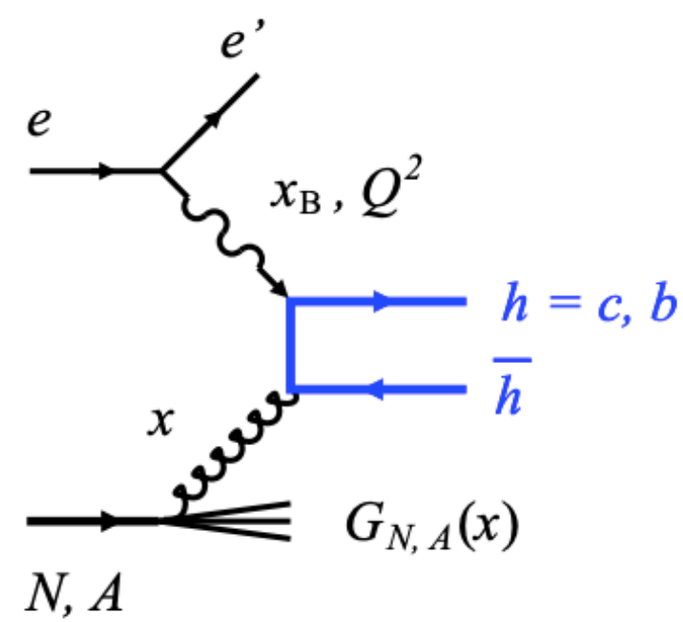
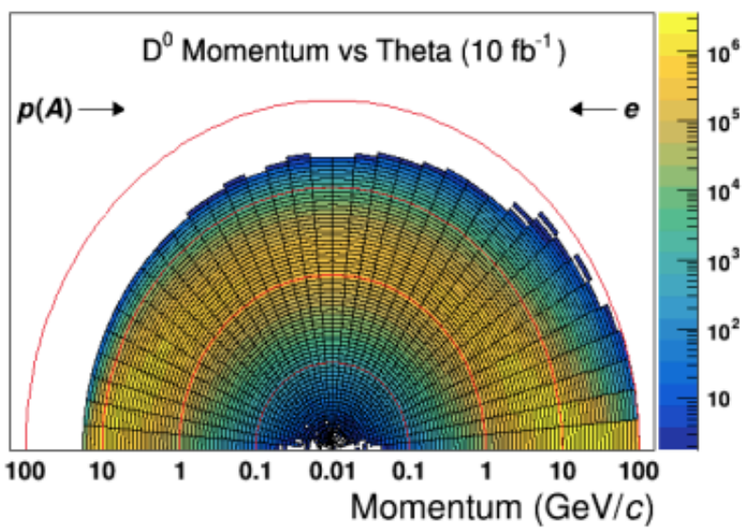
Detector Resolution Requirements for Heavy Flavor Measurements at EIC

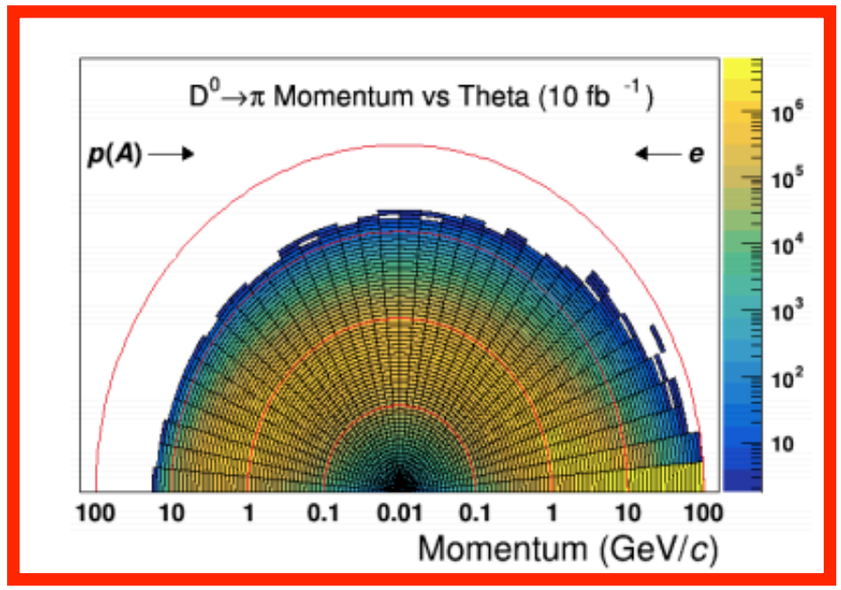
Xin Dong (LBNL)
Yuanjing Ji (LBNL/USTC)
Matthew Kelsey (LBNL)
Sooraj Radhakrishnan (KSU/LBNL)
Nu Xu (LBNL)

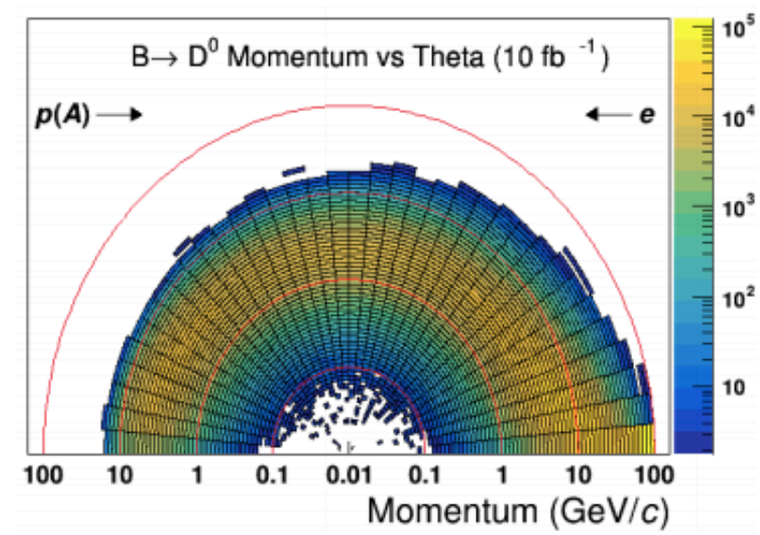


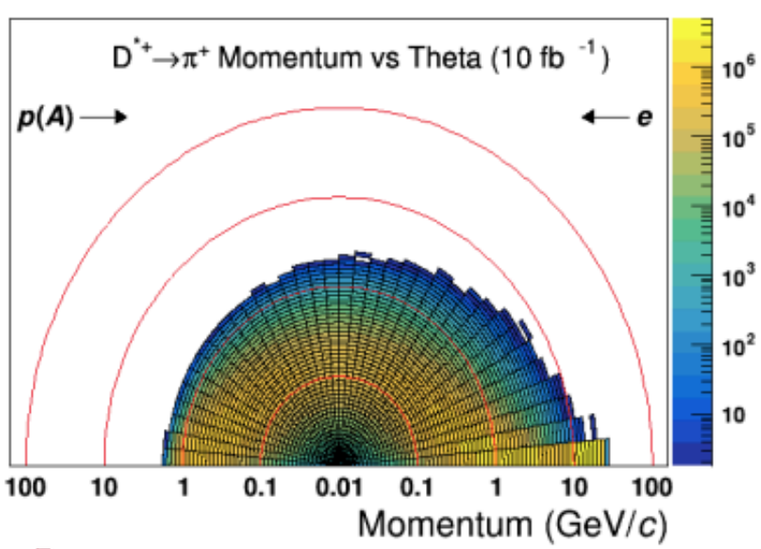
Physics Interests and Kinematics

- ***Inclusive*** heavy flavor measurement in e+p/A to constrain *gluon (n)PDF*, particularly at high x region
- ***D-Dbar pair*** reconstruction to access *gluon TMDs*
- Heavy flavor hadron (***D***, Λ_c etc.) in e+p/A for *hadronization* and *CNM* impact

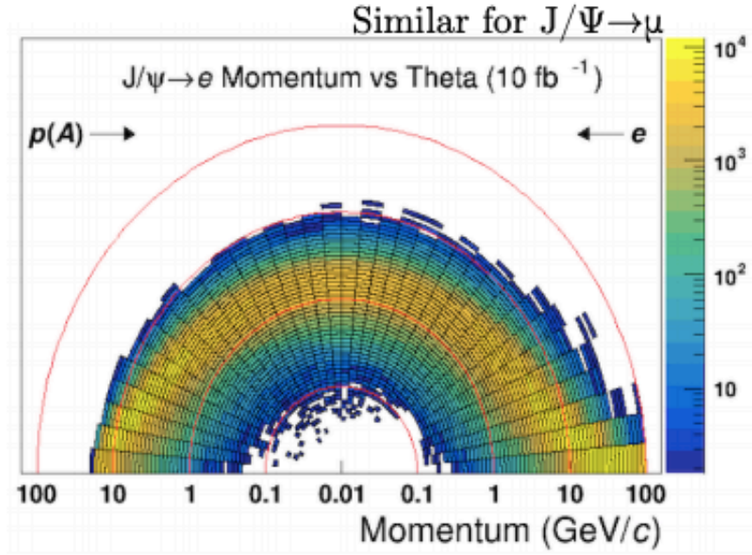


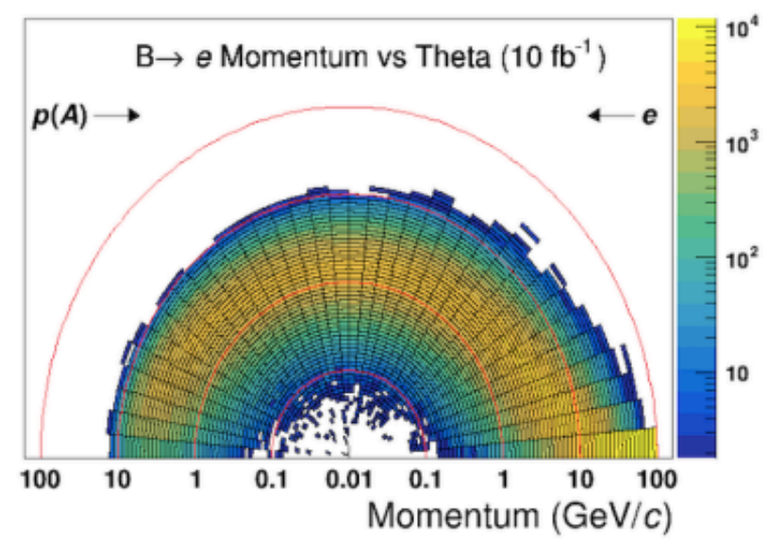






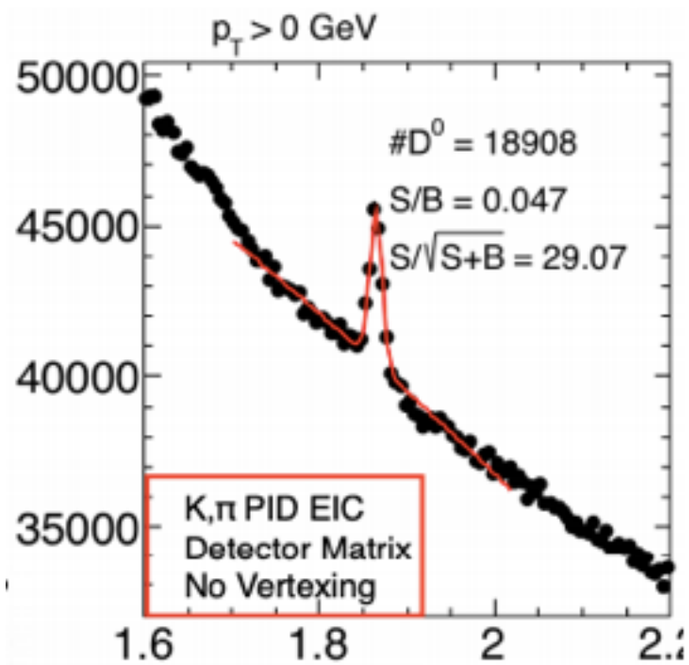
Similar for J/Ψ→μ

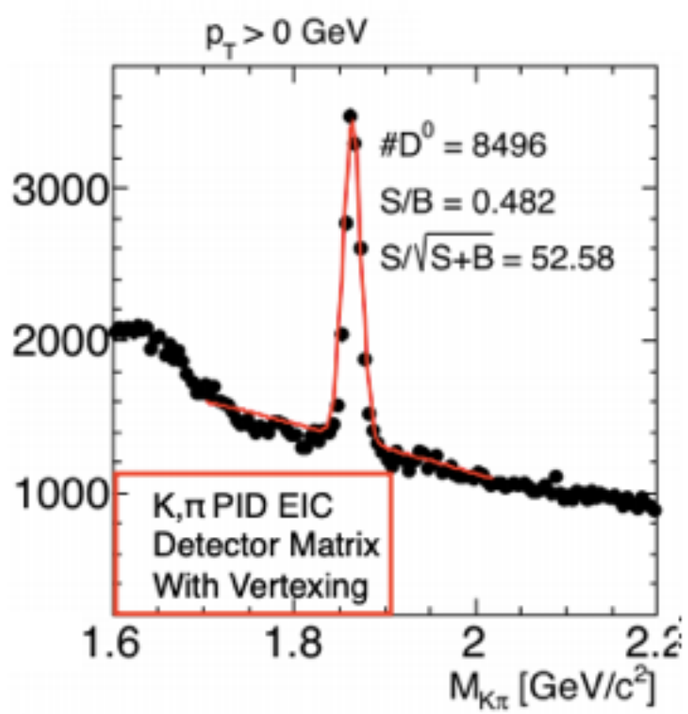




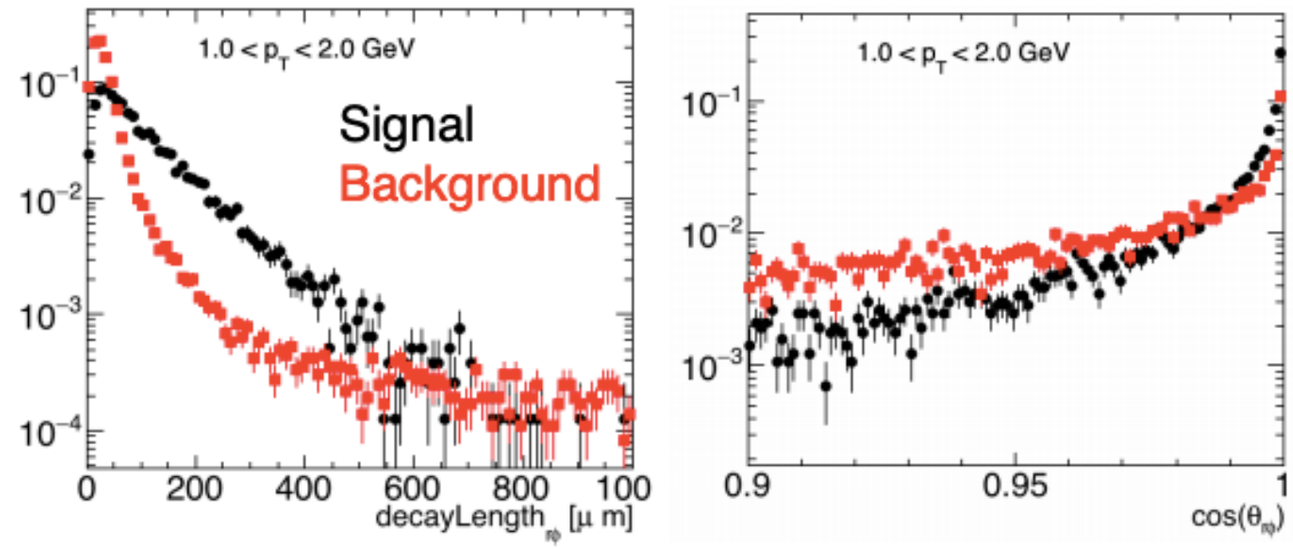
Fast Simulation w/ DMT Default

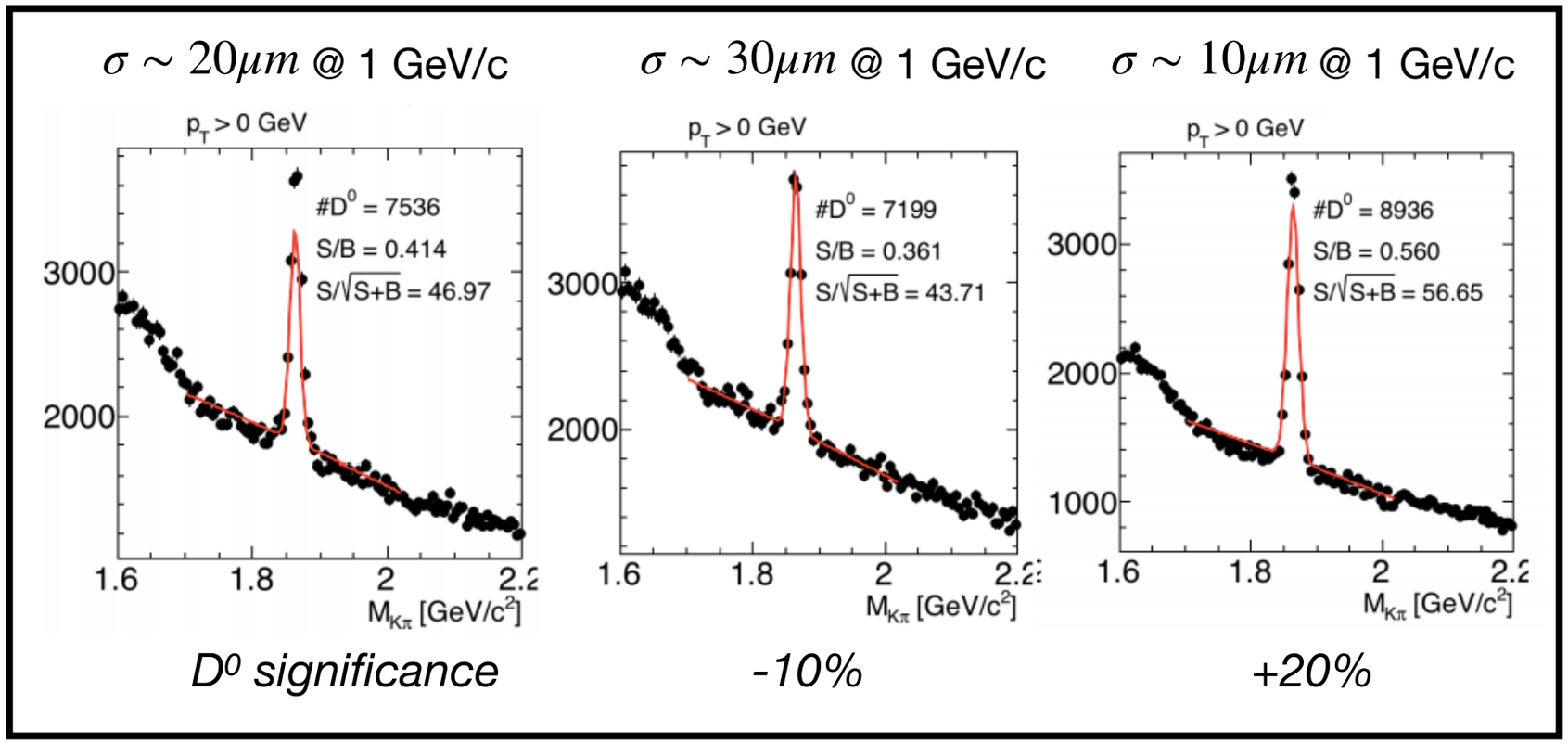
Default DMT parameters used
(pointing resolution at mid-y used for full-y)





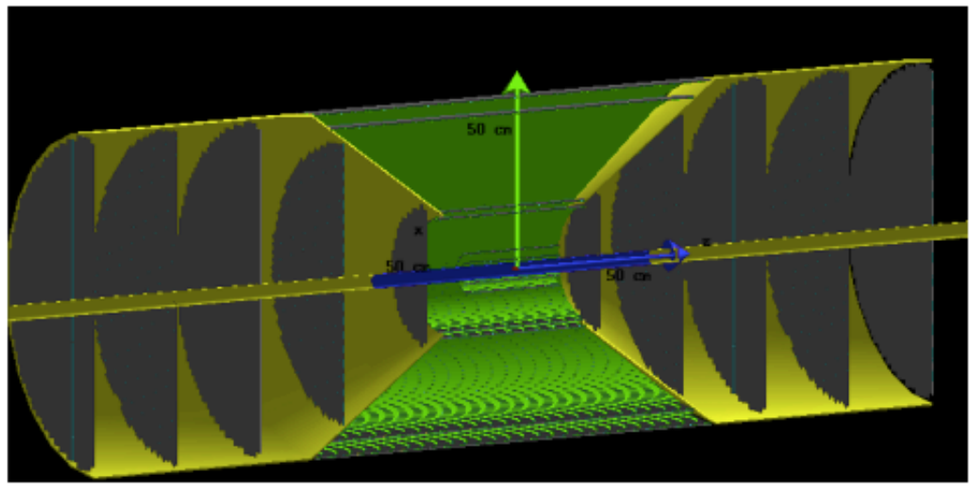
Topological Reconstruction

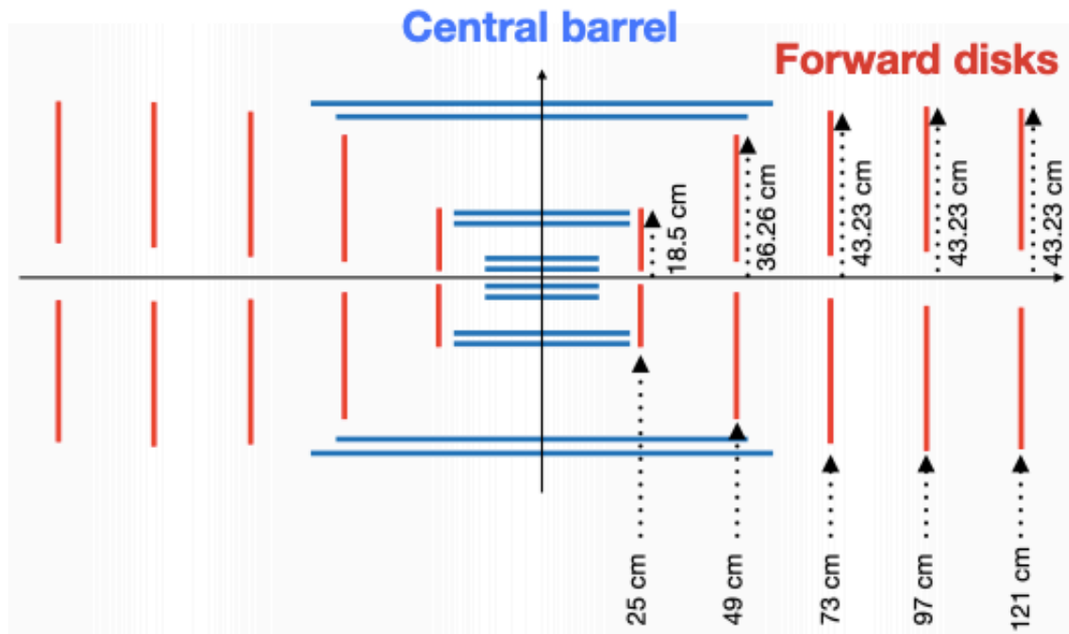


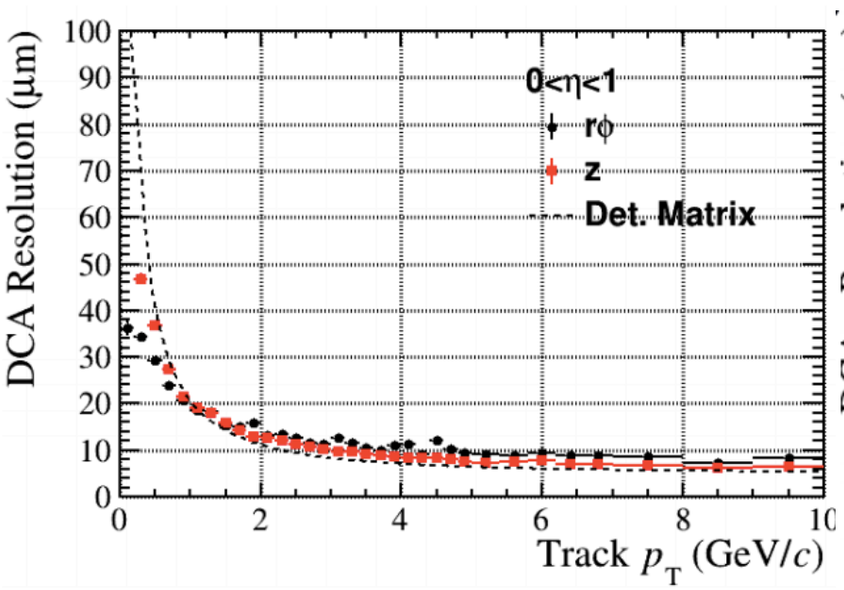


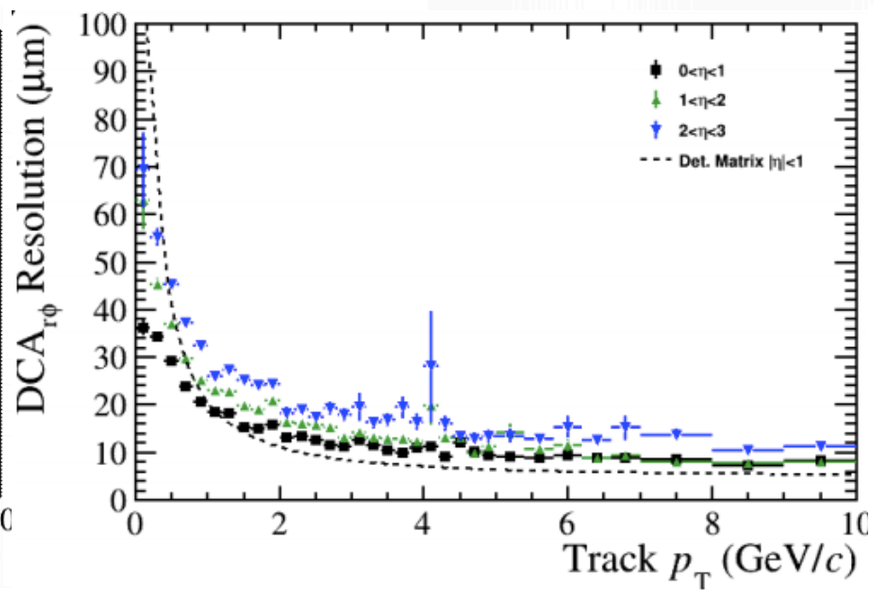
Full All-Si Detector Simulation in Fun4All

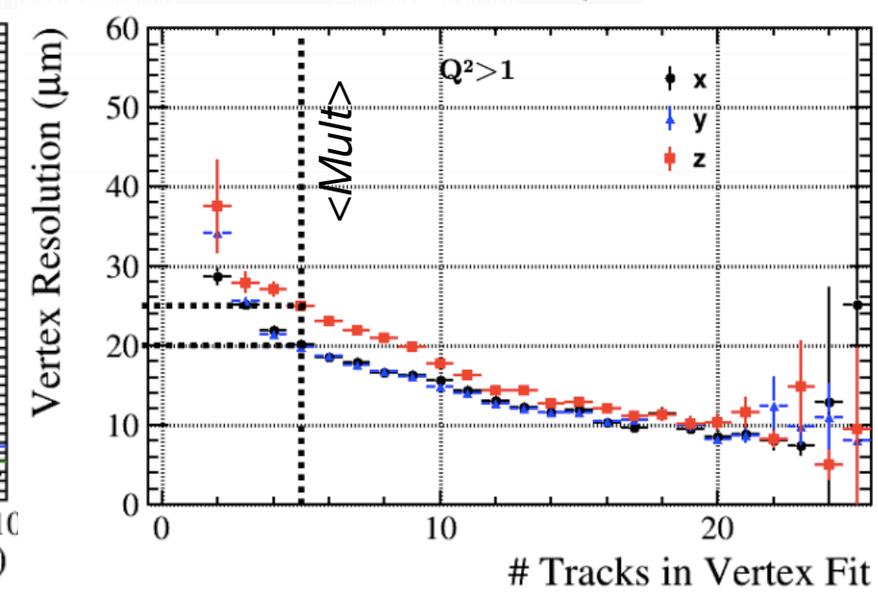
3T, beampipe + support cone included, 20x20 um











At mid-rapidity, DCA res. matches the DMT default parameters

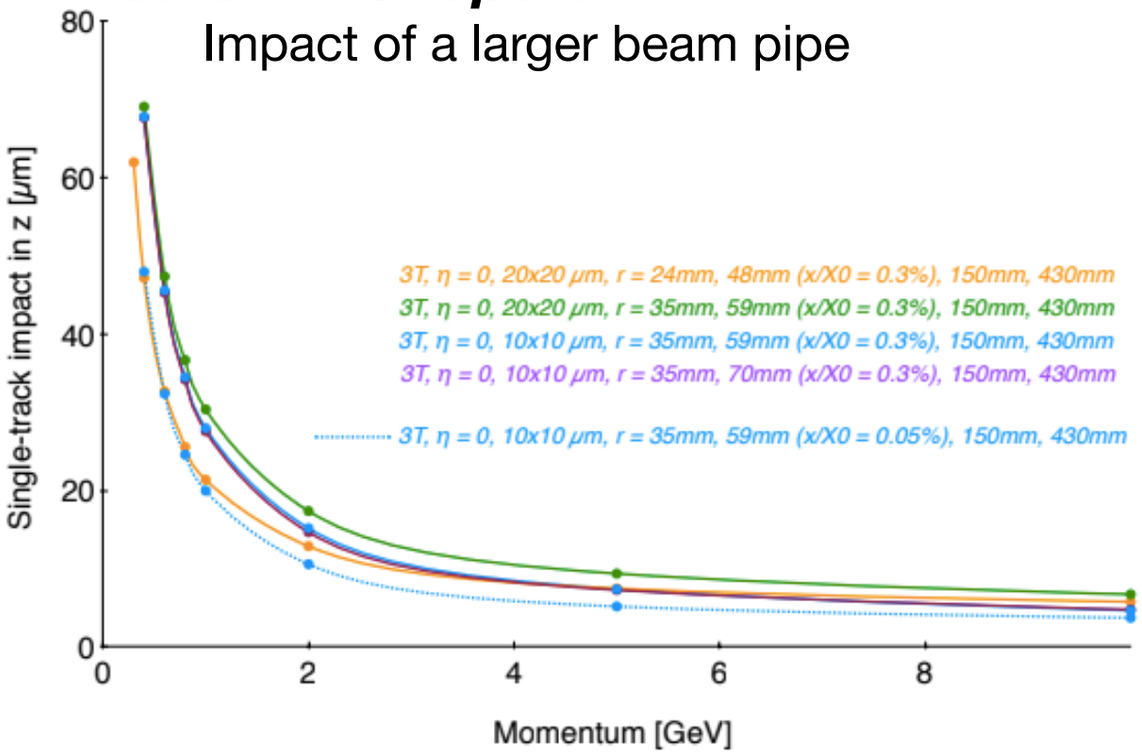
At forward rapidity, DCA_xy res.: 25 μm at p_T = 1 GeV/c at 1<|η|<2

30 μm at p_T = 1 GeV/c at 2<|η|<3

Vertex res: $\sigma_{X,Y} \sim 20\mu m, \sigma_Z \sim 25\mu m$ at <Mult>=5.2

Benefits of Ultra-thin Fine-pitch MAPS Design

Ernst: eRD25 report

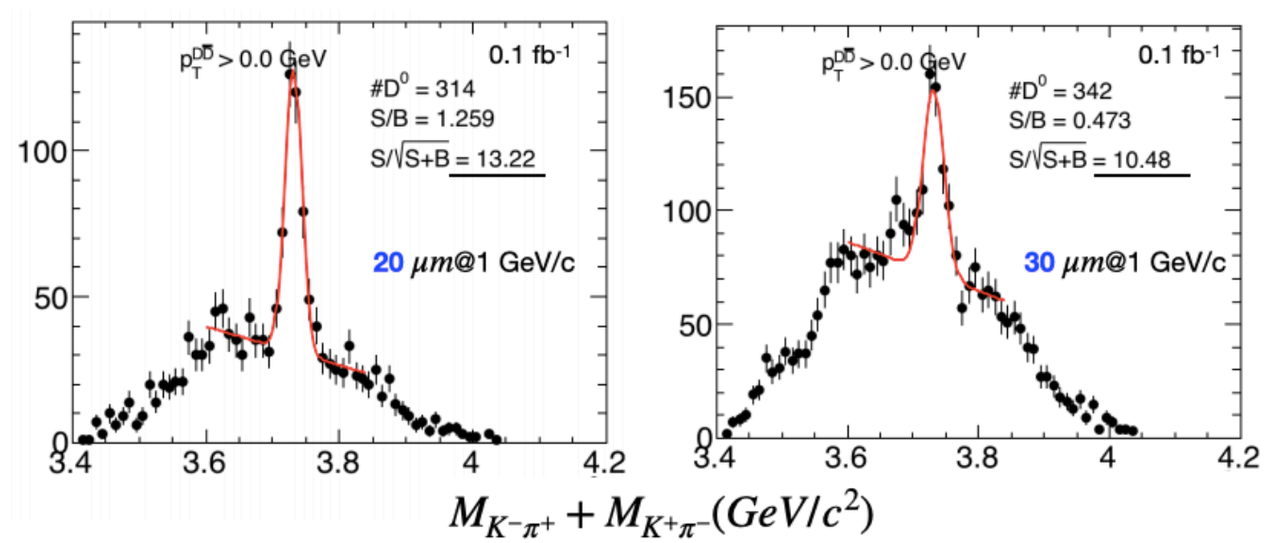


A larger beampipe leads to worsening of pointing resolution

- high mom region can be recovered with smaller pitch design (10x10 μm^2)
- low mom region can only be recovered with ultra-thin detector design (0.05%X_0)

<u>Physics benefits of ultra-thin fine-pitch MAPS design:</u>

- D-Dbar pair reconstruction
  - res. 20->30 μm
    1. significance reduced by >20%
    2. S/B ratio reduced by 2.5



- $\Lambda_c^+ \rightarrow pK^-\pi^+$ ($c\tau$~60μm)

  extremely short lifetime, multi-prong decay → critical requirement on single track pointing resolution (simu. to be followed up)