sPHENIX performance studies Based on Hijing Sample and Data-Driven Fast Simulation

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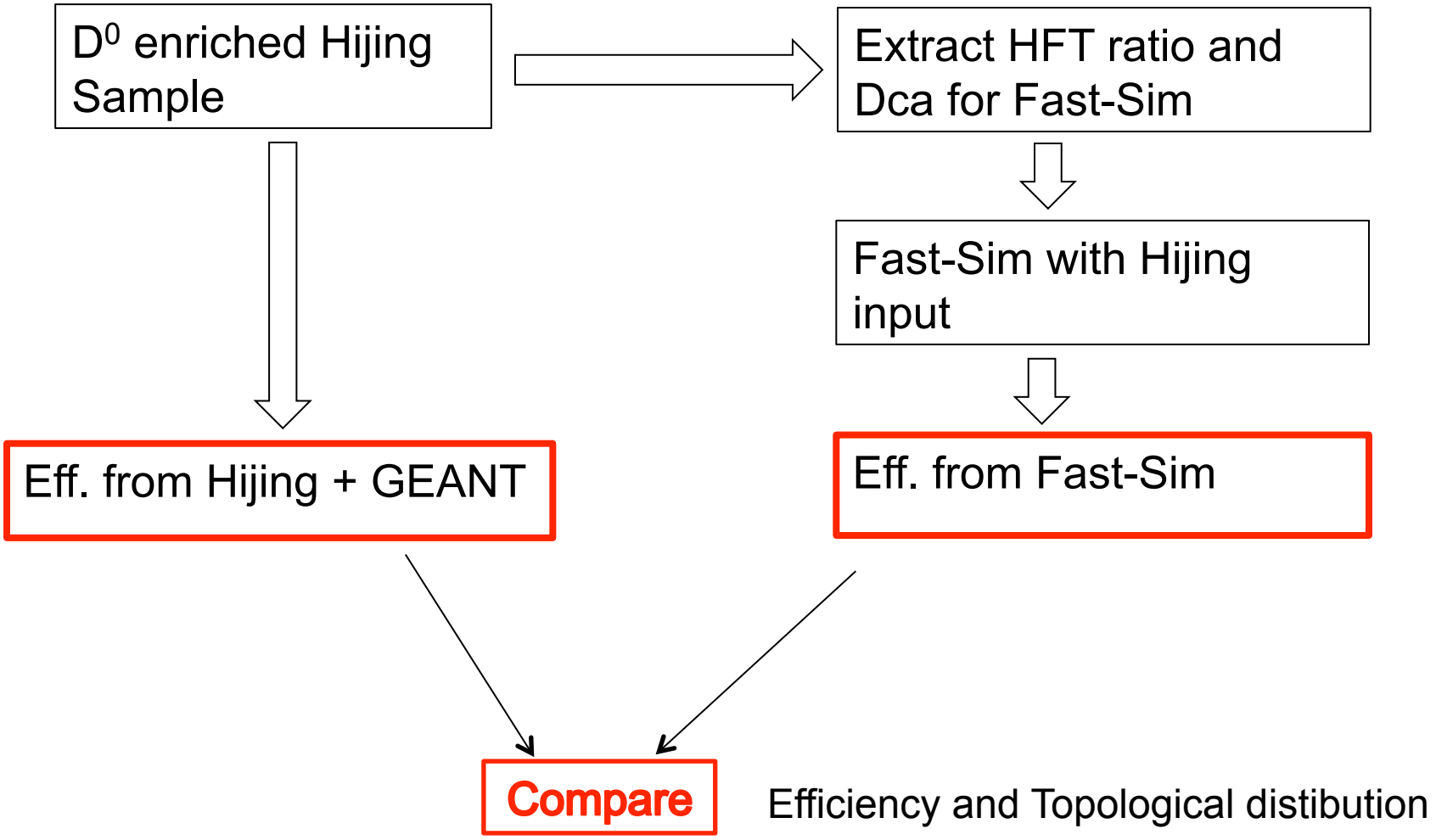
Content

- Package setup, based on STAR D^0 Hijing sample
  - Signal part, efficiency
  - Background part
- sPHENIX performance input for the package
- Estimation for sPHENIX
  - D^0
  - B->D^0

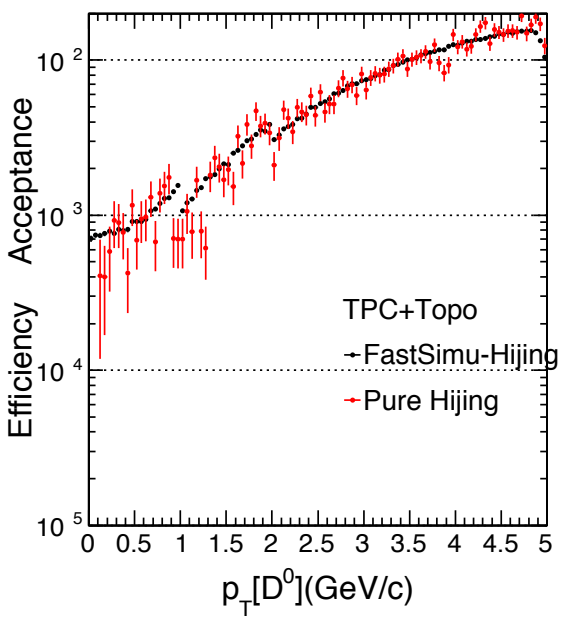
Validate Signal Simulation

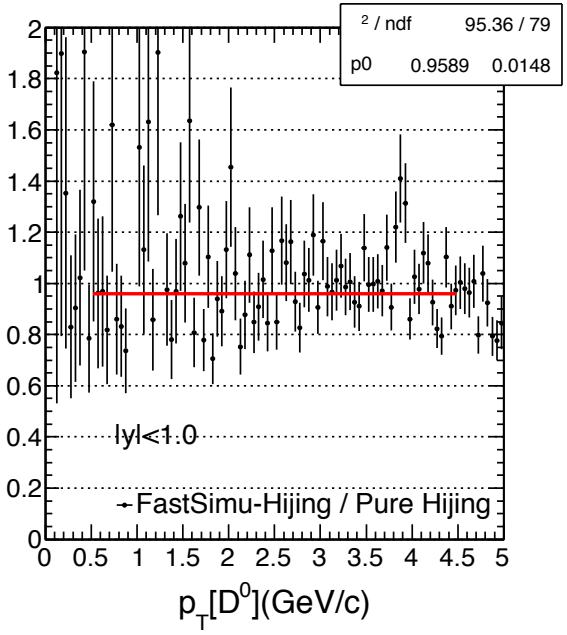
0-10% centrality



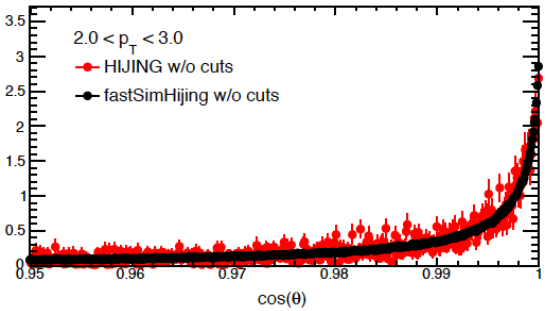
Signal Comparison

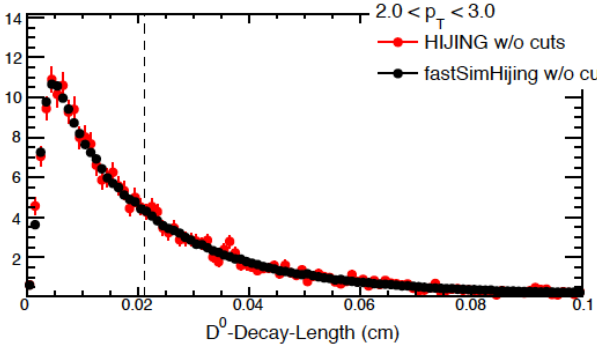
0-10% centrality

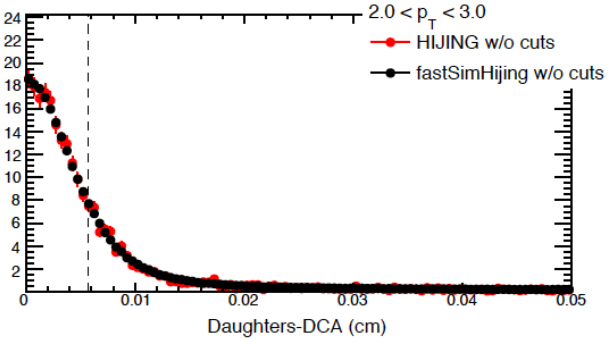




Eff. from GEANT and Topological variables matches well with that from Fast Sim.

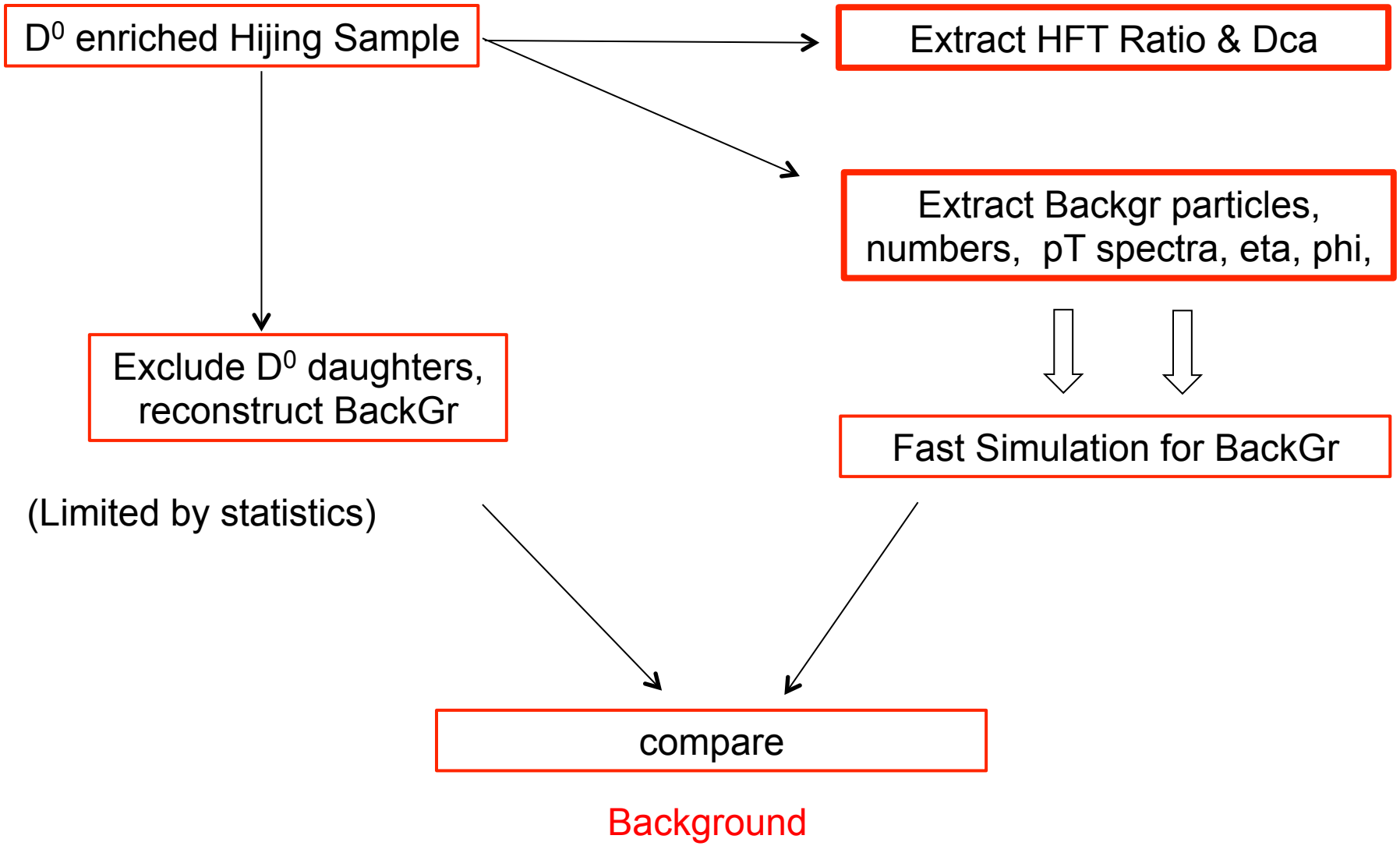






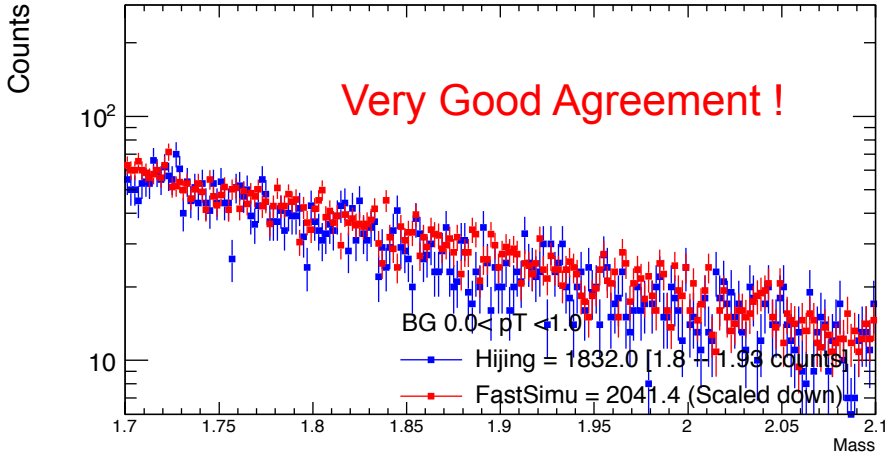
Validate Background Simu.

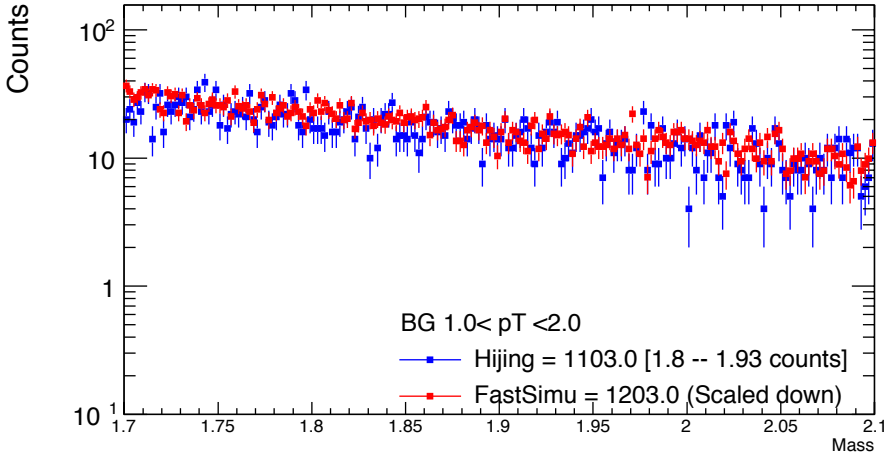
0-10% centrality

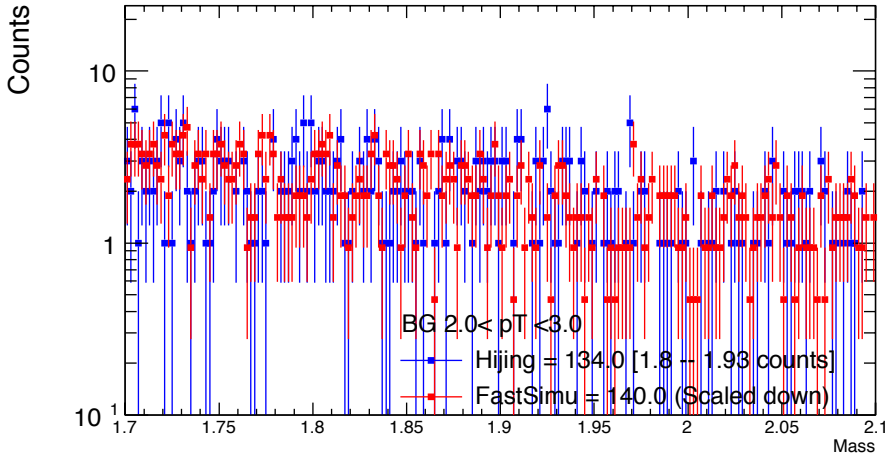


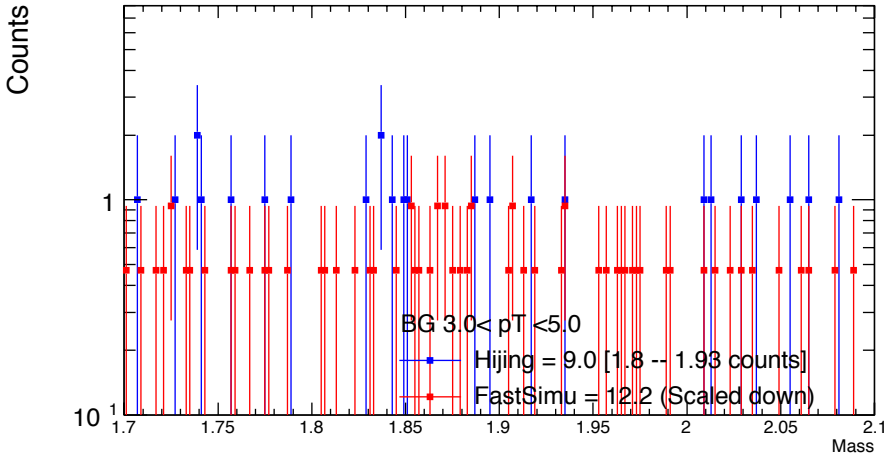
Comparison of D^0 BG

The cuts were very loose since limited by Hijing statistics , otherwise there is no BG counts for Hijing. For FastSimu the statistics can be as much as we want



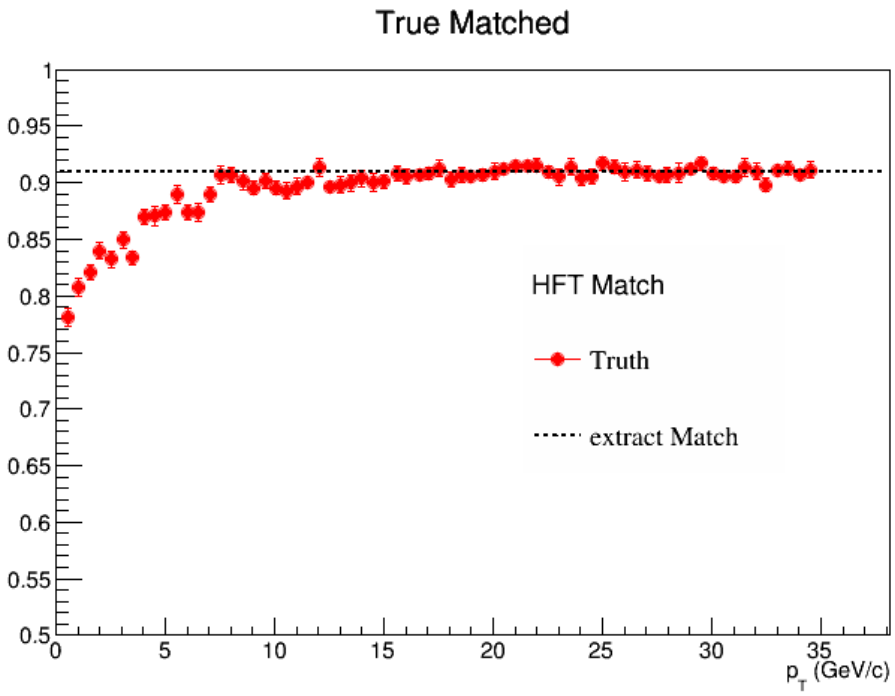






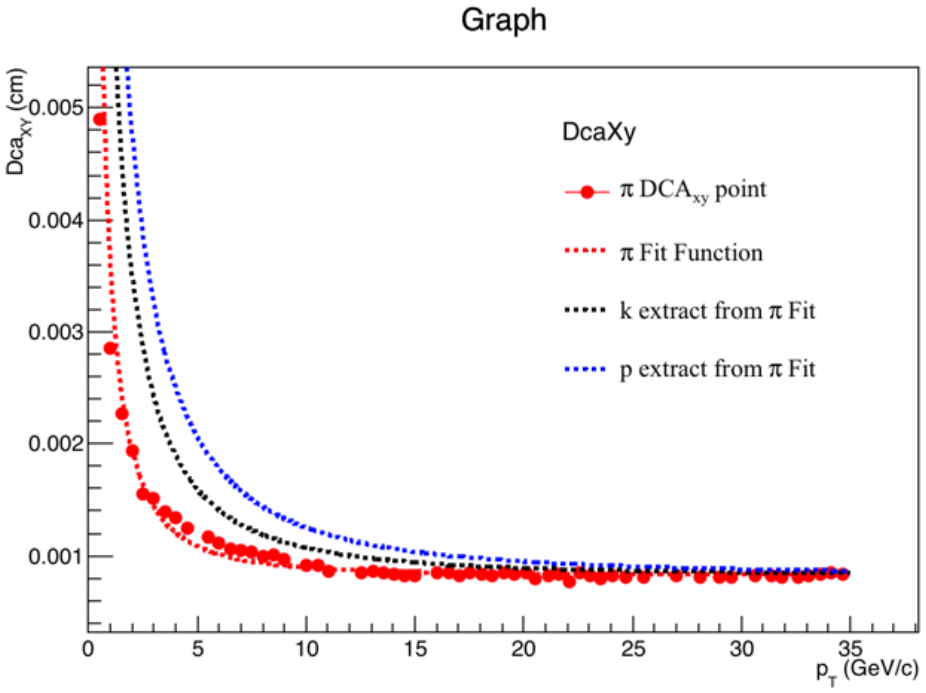
sPHENIX input : HFT Match Ratio

Data point from Tony Frawley's talk



- Red one is truth match, determine the Dca RealMatch ratio
- Black line is so call Match ratio, can be measured by data, including mismatch
- Black line was fixed, w/o particle/Eta/Vz… dependence

sPHENIX input : Dca resolution

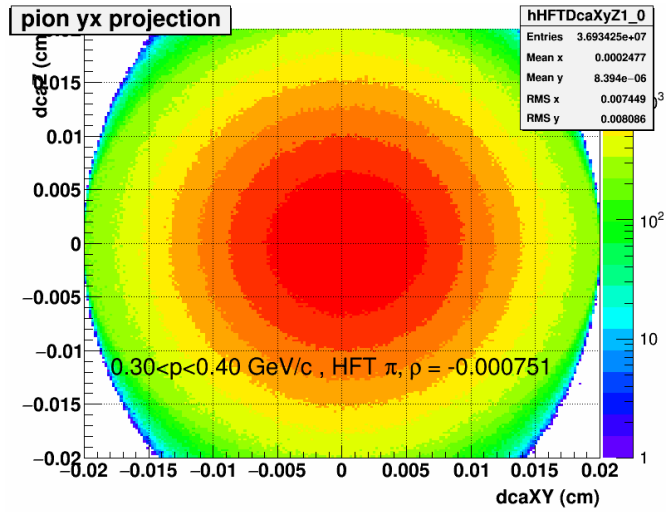


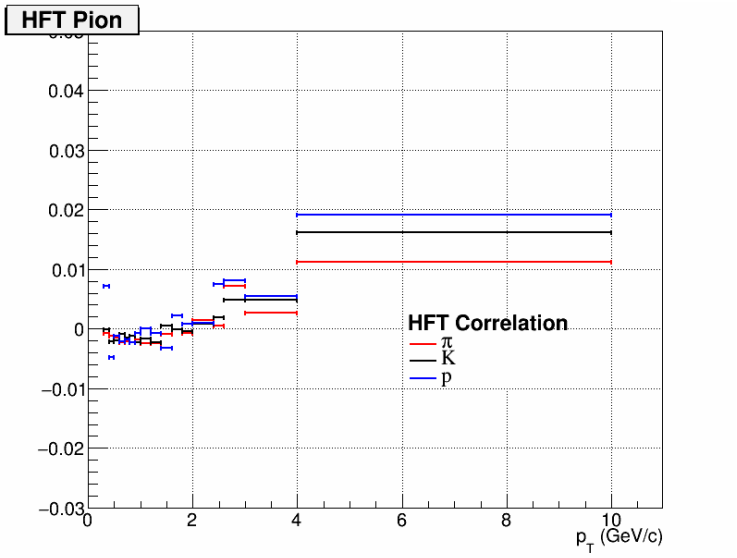
- Pion was extracted from Tony Frawley's talk, then fit with the function

$$y = \sqrt{a^2 + \frac{b^2}{x^2}}$$

- Fix a value, extract the function for Kaon and Proton
- Assuming DcaZ have the same resolution

Dca correlation for HFT track

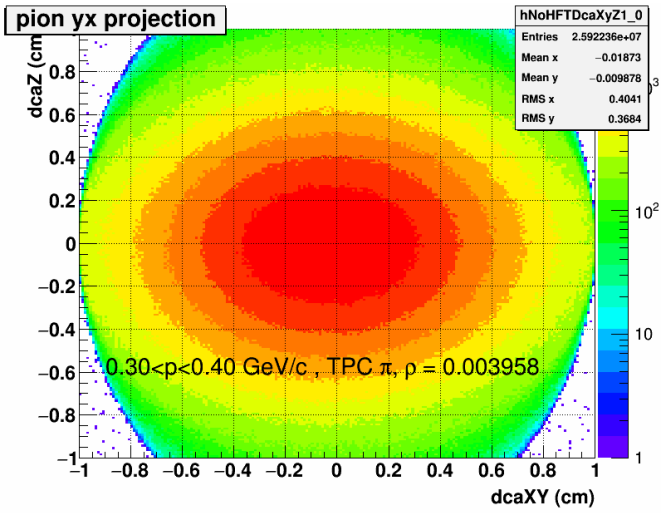


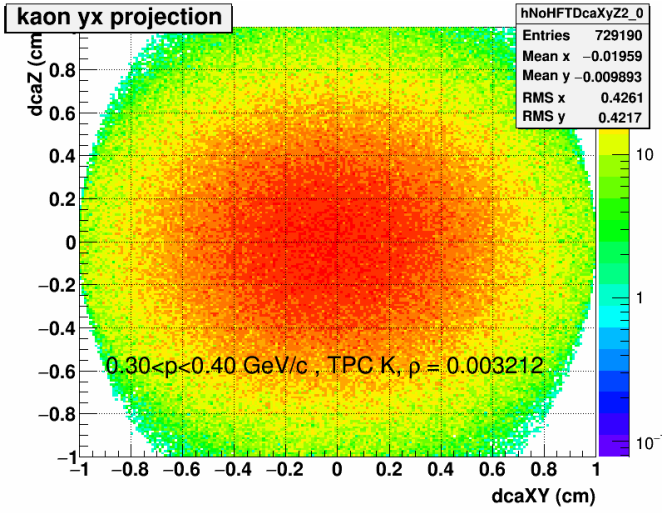


HFT track

- Assume DcaXy DcaZ follow Gaussian distribution and have correlation
- Based on STAR real data. Run14 AuAu 200GeV 0-10% centrality, extract the correlation value vs. pT
- Extract 2-dimension Gaussion for DcaXy and DcaZ

Dca for TPC



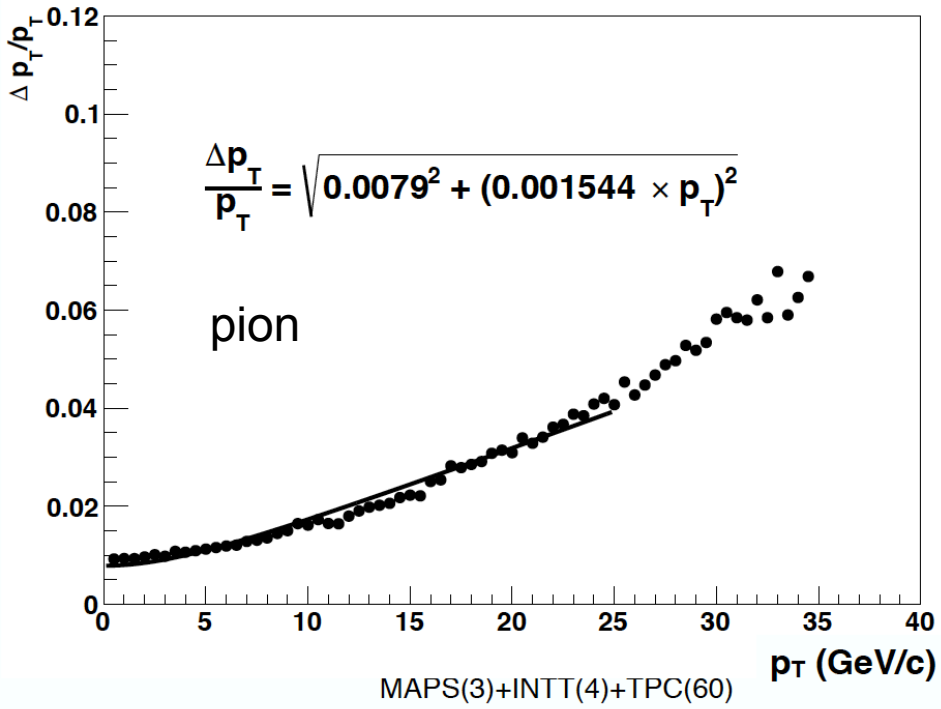


TPC track

- Directly sample from STAR real data. Run14 AuAu 200GeV 0-10% centrality
- The ratio of TPC/HFT Dca was determine from Real Match (sldie 5)

sPHENIX input : Momentum resolution

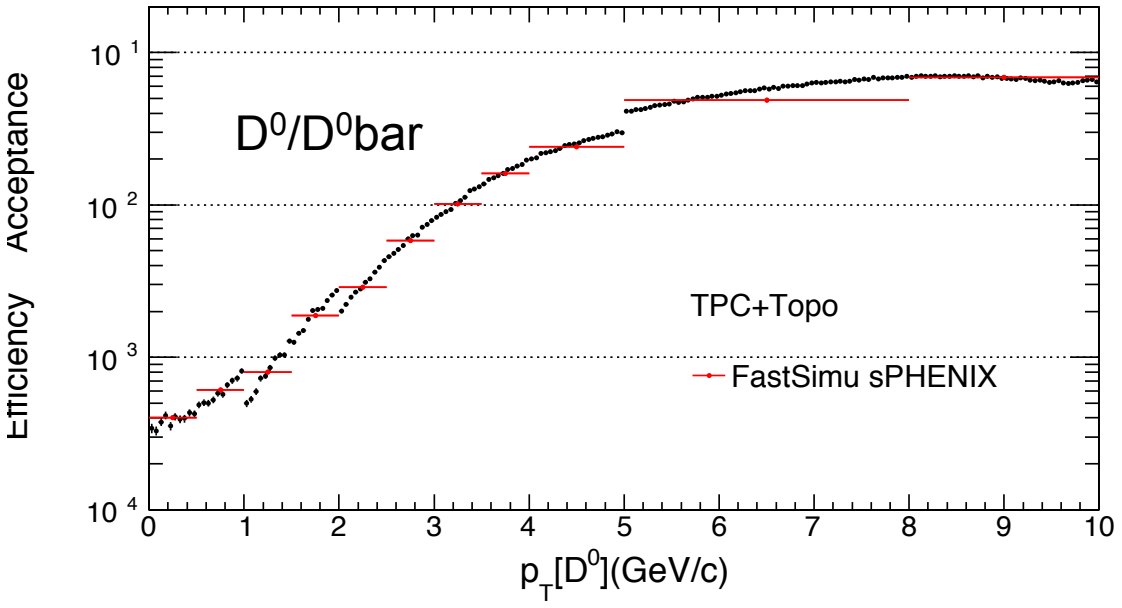
Data point from Tony Frawley's talk



Directly use the same function for pi/K, did not consider particle differential

For TPC tracking, use STAR Hijing performance

D^0 Signal Efficiency

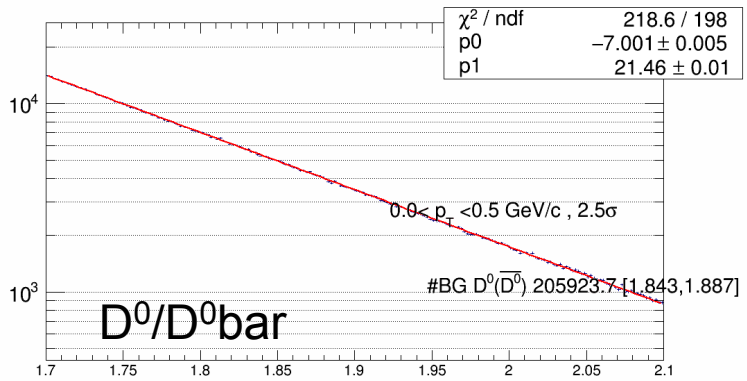


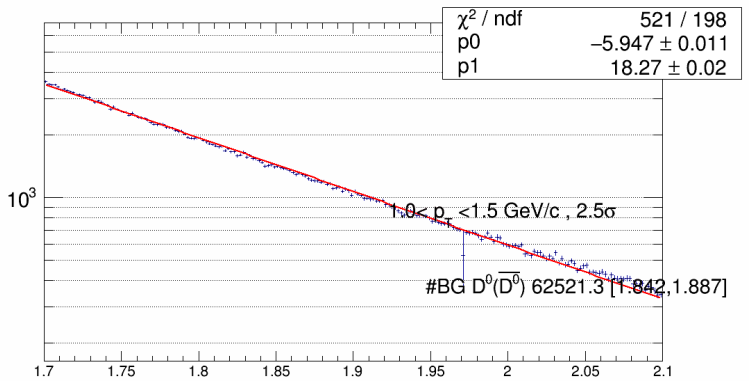
With sPHENIX performance. The cut was from our STAR Run14 Ultimates2+0.3GeV

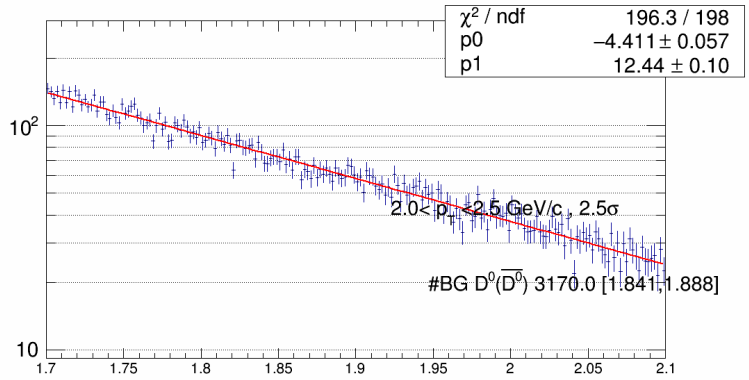
Rely on published spectra, we can estimate observed signals

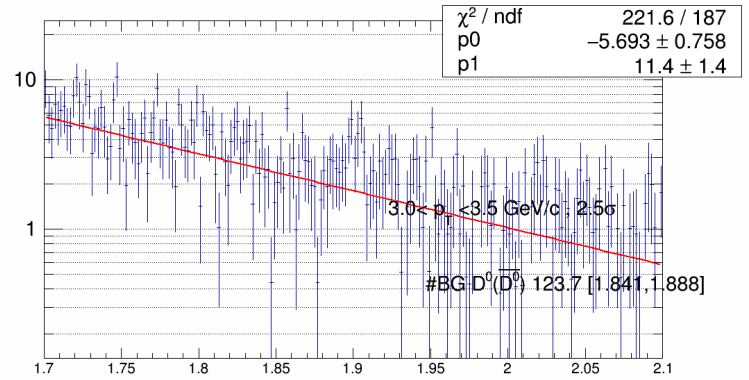
Tof Clean PID, pT<1.6 GeV/c from STAR

D^0 BackGround Shape







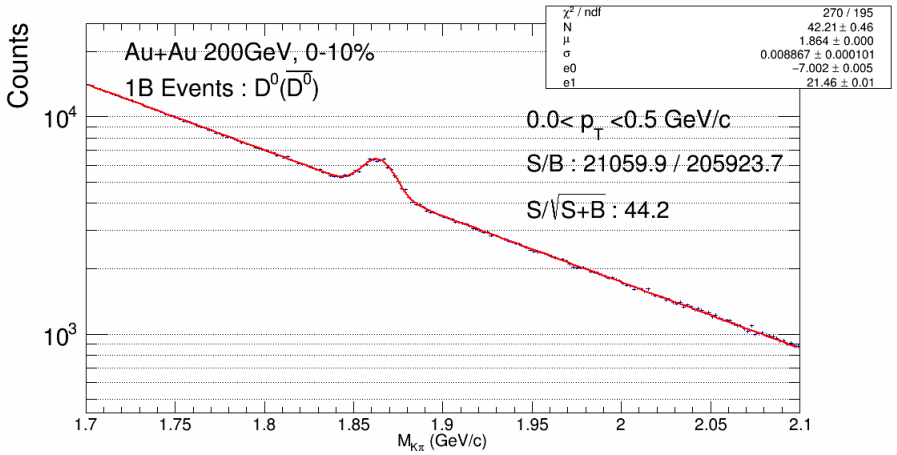


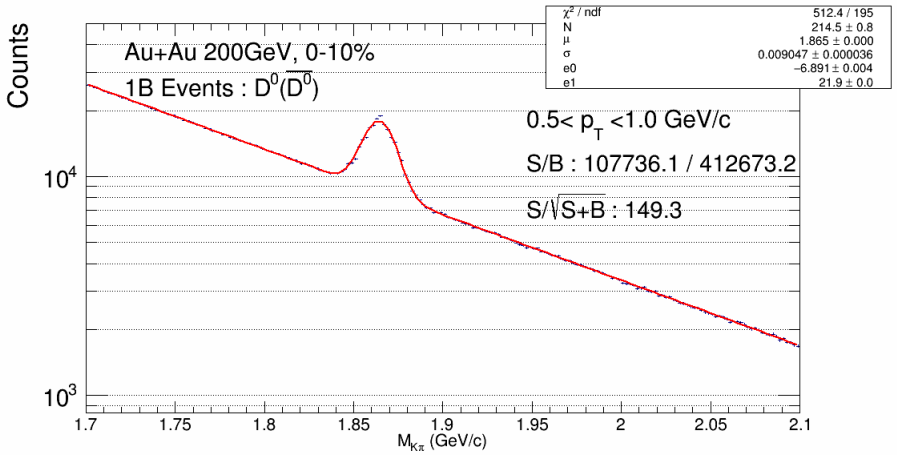
1B events (0-10%centrality), With sPHENIX performance.
The cut was from STAR Run14 Ultimates2+0.3GeV

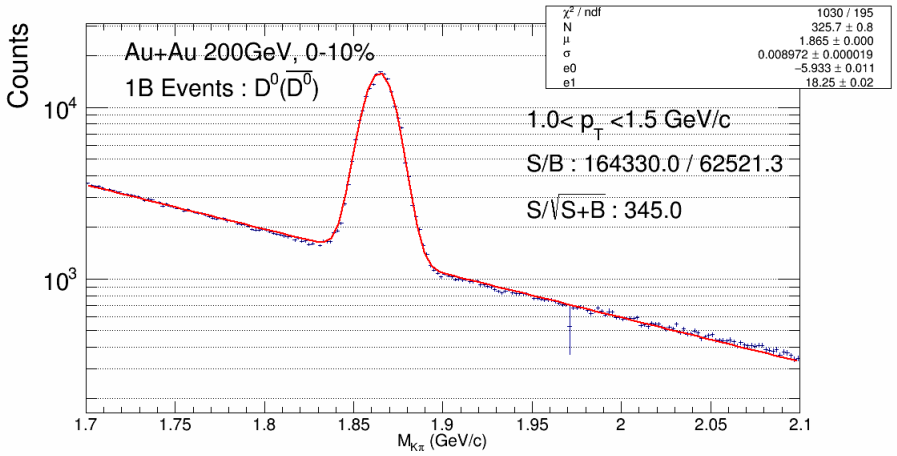
Tof Clean PID at pt<1.6GeV, after 1.6GeV, missed-PID

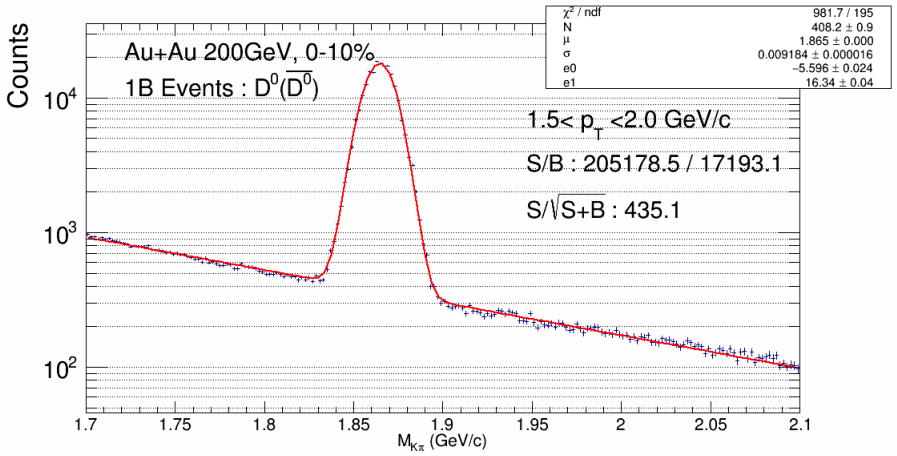
With PID

D^0 Foreground vs. pT



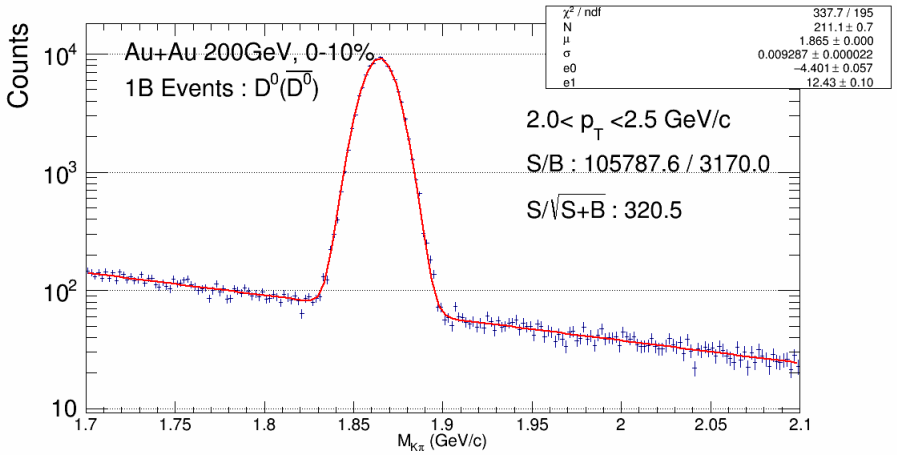


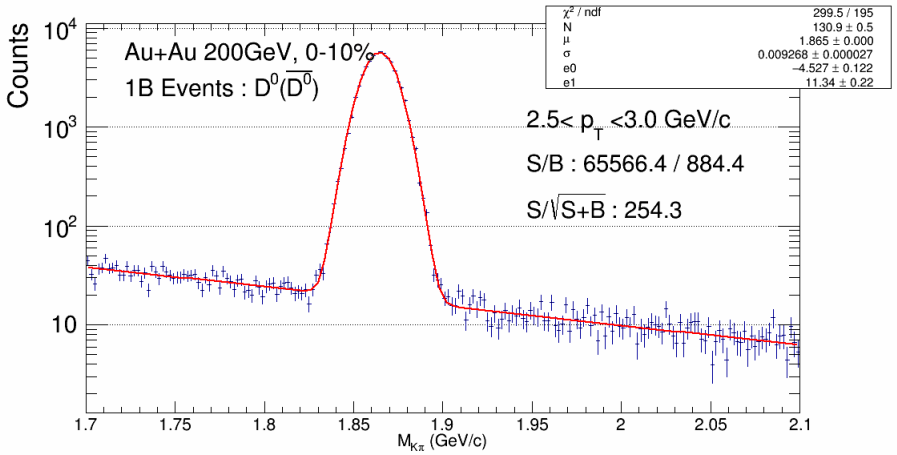


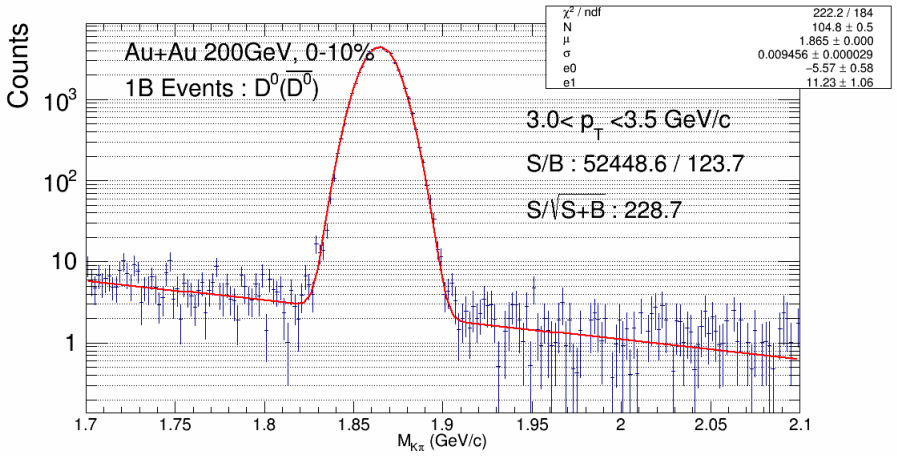


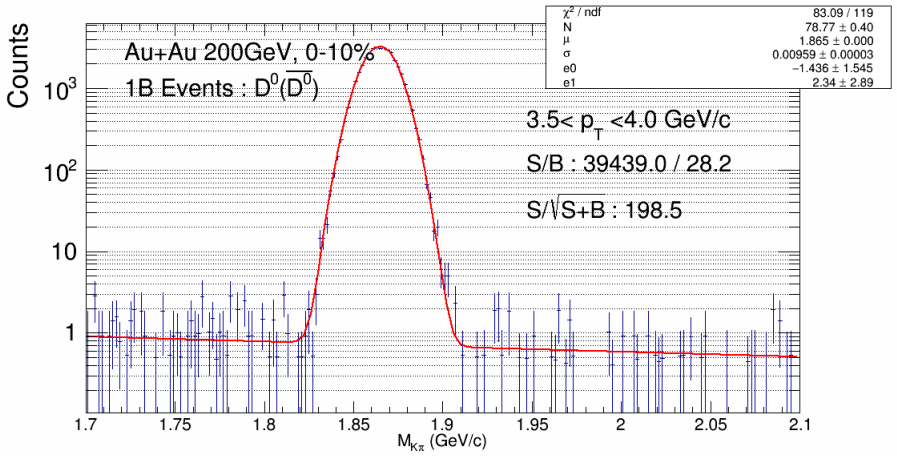
With PID

D^0 Foreground vs. pT



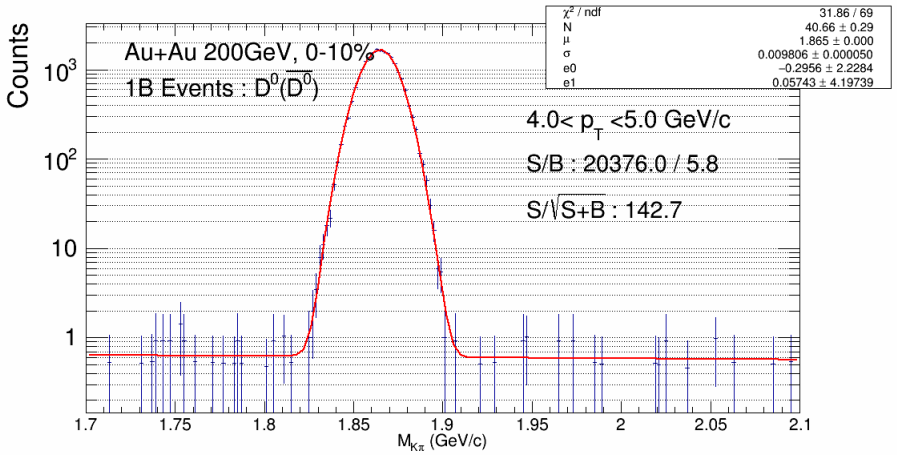


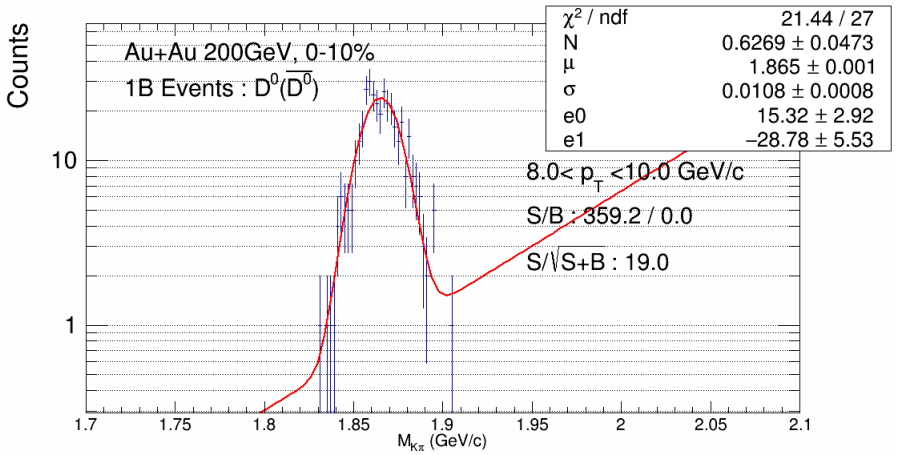


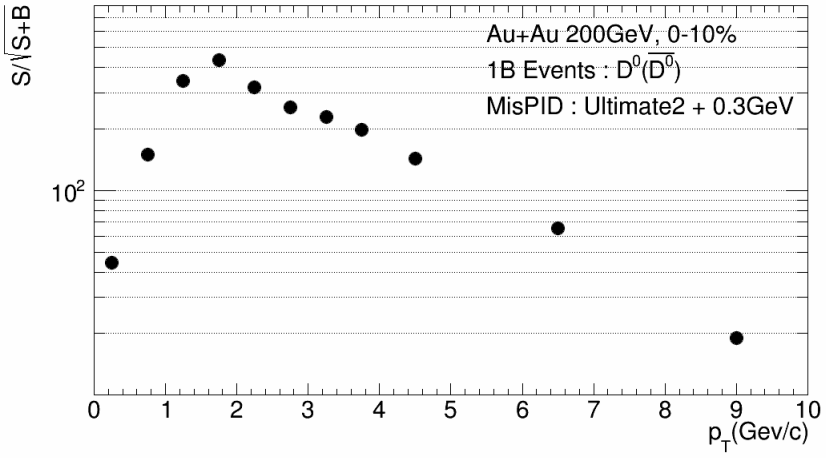


With PID

D^0 Foreground vs. pT



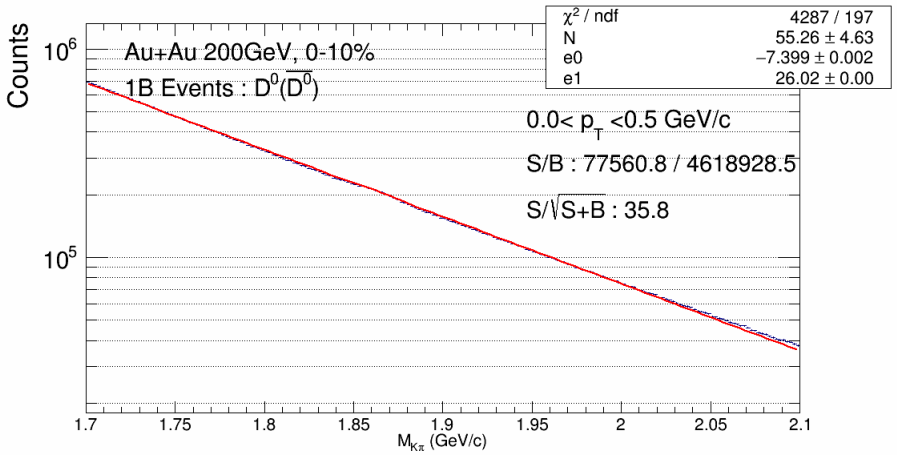


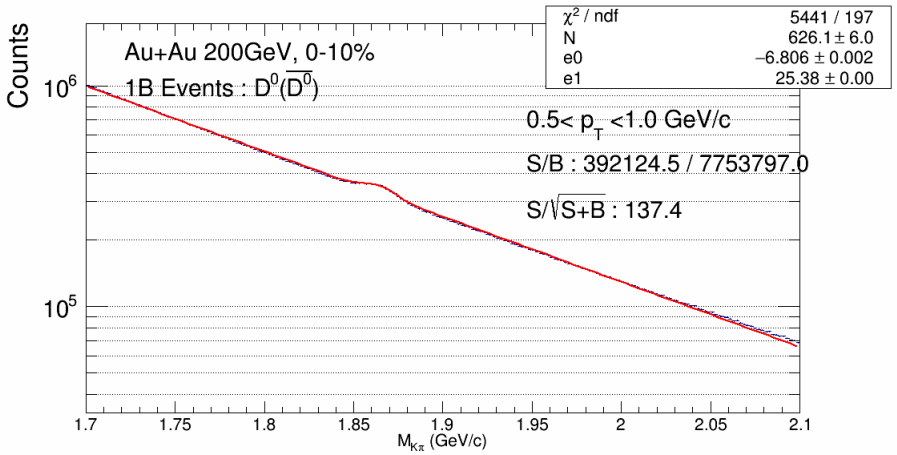


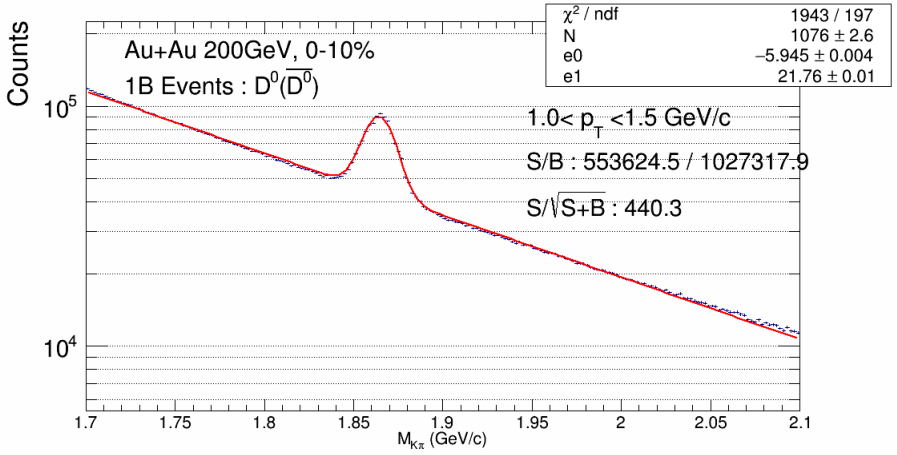
1, Signal based on published spectra, and efficiency from Fast-Simulation
2, Background was estimated by Fast-Simulation relay on Hijing
3, For D0(D0bar), with misPID

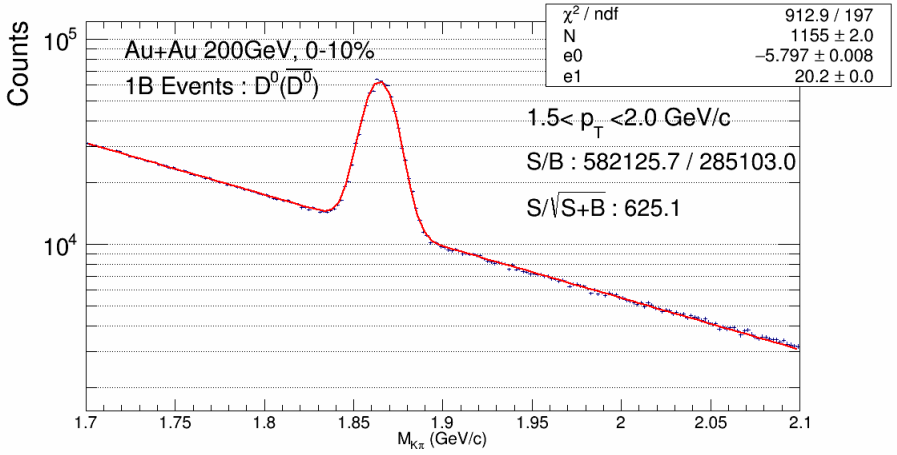
w/o PID

D^0 Foreground vs. pT



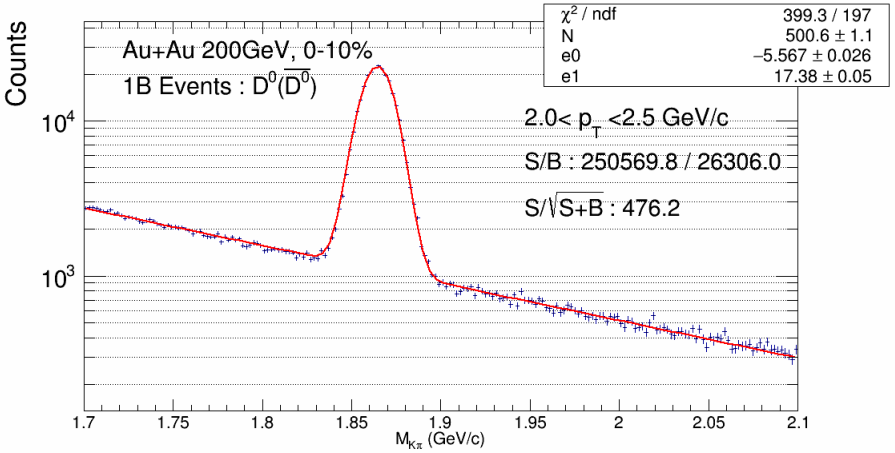


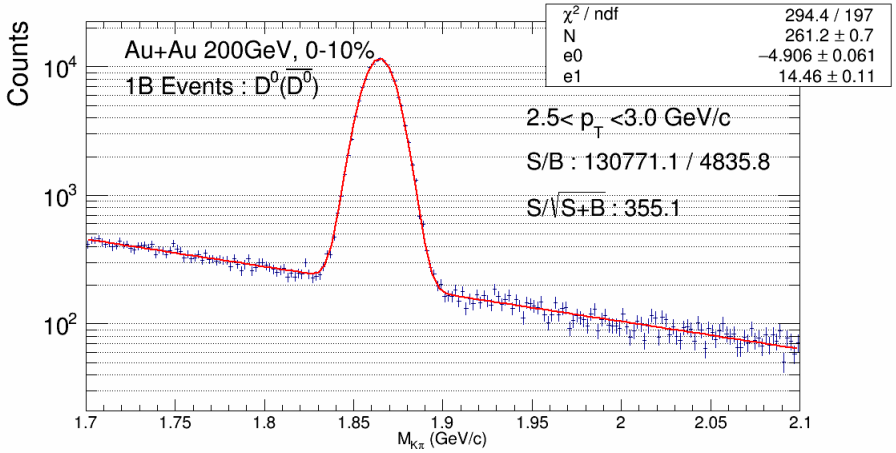


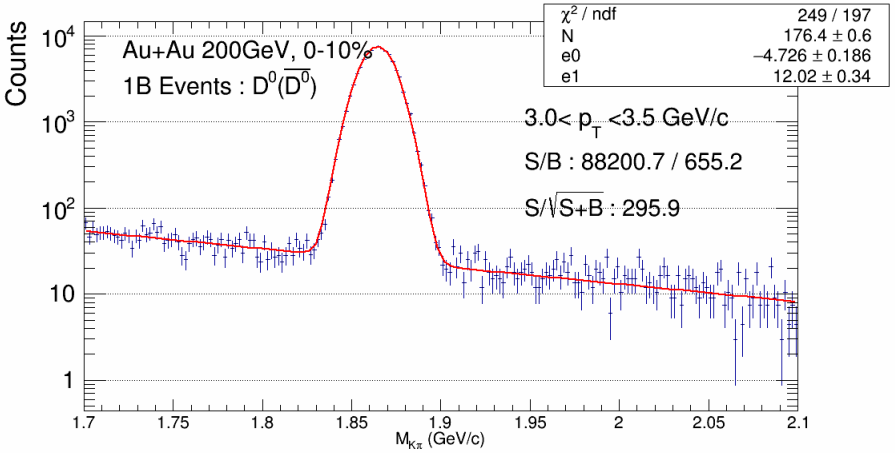


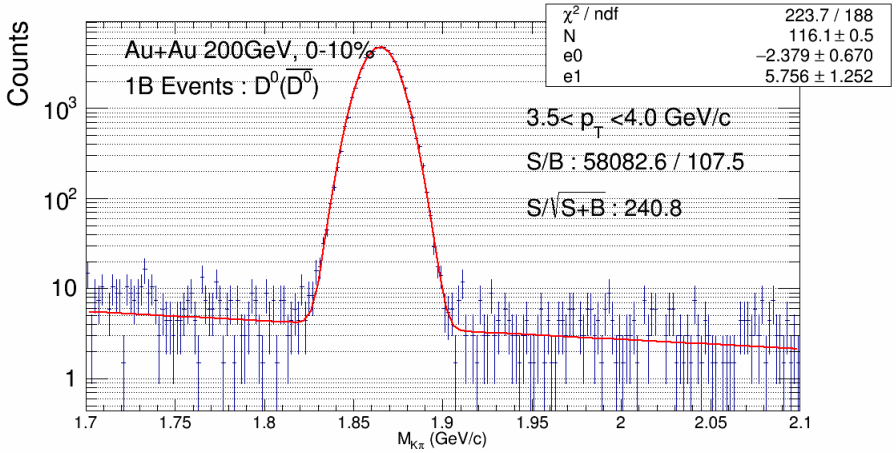
w/o PID

D^0 Foreground vs. pT



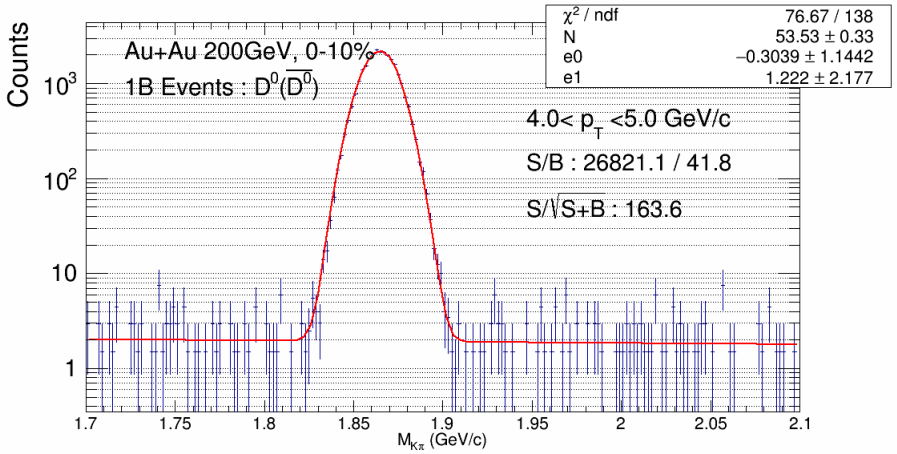


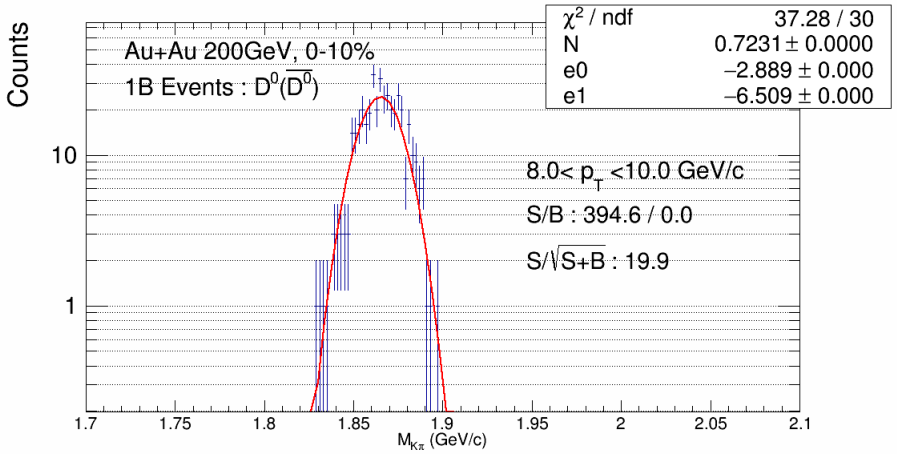


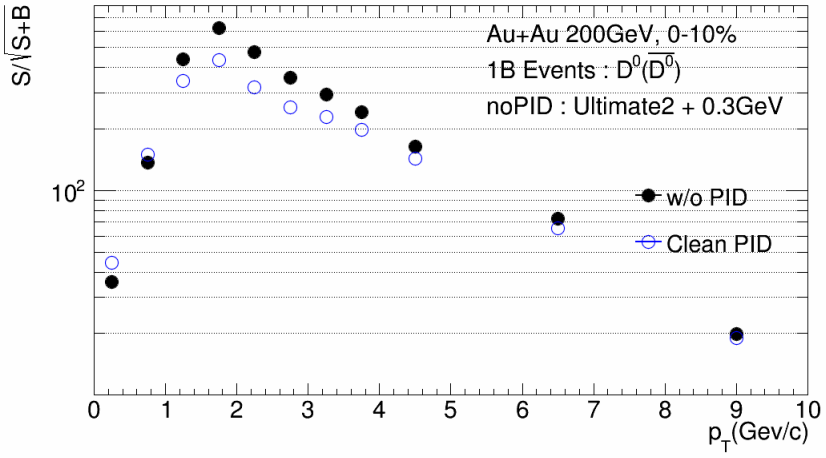


w/o PID

D^0 Foreground vs. pT







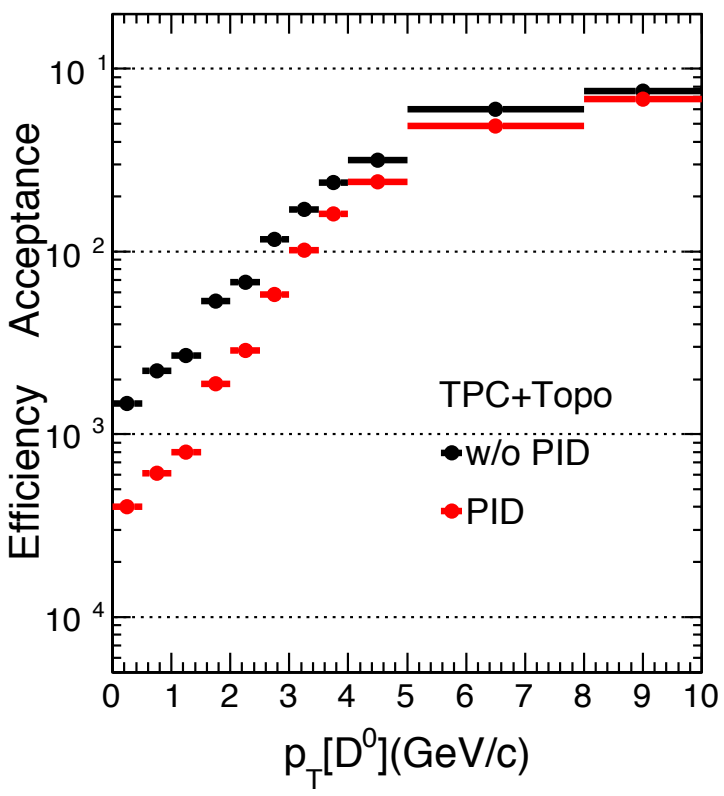
1, Signal based on published spectra, and efficiency from Fast-Simulation
2, Background was estimated by Fast-Simulation relay on Hijing
3, For D0(D0bar), this is without PID

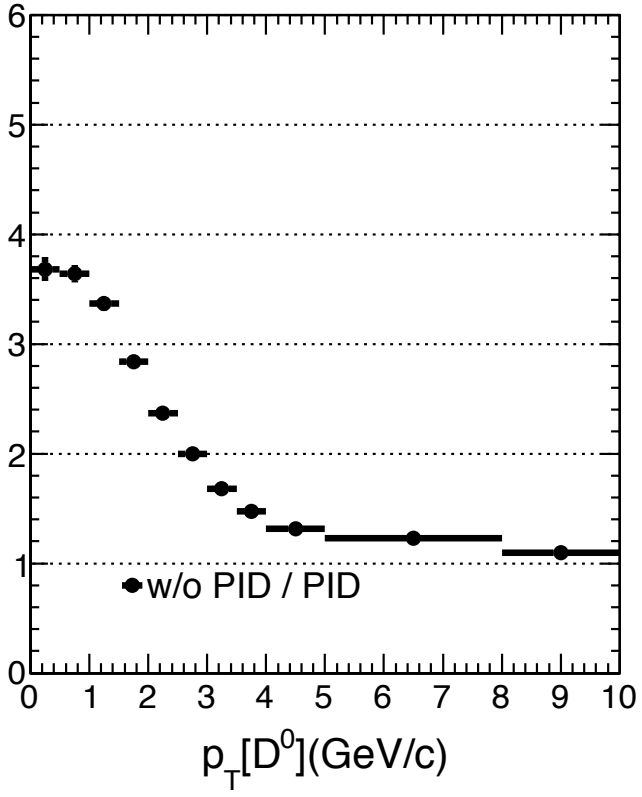
Summary and Next

- The package was ready for sPHENIX Signal and Background study
  - https://github.com/GuannanXie/sPHENIX_FastSimu
- Based on sPHENIX performance, D0 and B to D0 significance was estimated for with & w/o PID
- Still need improve for Correlated Background and Hybrid PID

Back up

D0 Efficiency





Overview

- Technology
  — smear Mc k/pi position (Dca) and momentum
  — consider tpc tracking, hft matching, (tof matching),…
- Signal
  — D0 cross section is fixed from Run14 HFT
  — B to D0 ratio is fixed from Fonll
- Background
  — from Hijing
  — primary k/pi now, other particle can be included
  — now no correlated background
  — need scale 0.5 (++,- -, +-, -+)
- Reconstruction (S and B)
  — Clean pid: <1.6GeV use tof, >1.6GeV no pid
  — no pid
- Aim
  — efficiency estimation
  — prompt and non-prompt D0 significance
  — the error of B to D0 ratio