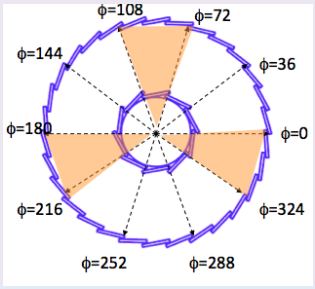
HFT-prototype BUR considerations for Run-13
Part-1

- Some preliminary thoughts **while awaiting for full simulation quantitative results**
  - We hope to have something at STAR Analysis meeting
- The main goal of the HFT engineering run will be system verification and correction; this includes the study of the collision environment, detector response, backgrounds, operational experience, first attempts on Alignment and basic detector performance (e.g. DCA resolution).
- At the same time (this presentation) we explore what physics is possible in Run-13 assuming some (prototype) sectors are there?
  - Relates to how long would be the AuAu run, if any.
  - How many sectors will be build -> can we change/afford changes in configuration?
  - Is there a possibility for a **high pt trigger** in prototype acceptance? (patch EMCal) to enhance Rcp at higher pt. What are the peripheral event (limiting, error defining) rates for a given threshold? This makes sense only for the Joined-configuration

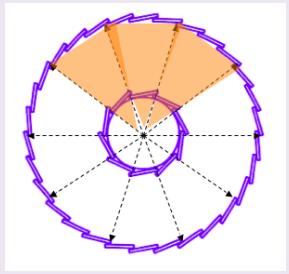
- Need realistic data-taking rates, duty factors, detector 'up' estimates

ASSUMPTIONS HERE:

- Only 3 PXL sectors will be instrumented with Si sensors (reality: 0-4 might be build)



Mercedes config. – low pt D0



Joined config. – higher pt D0

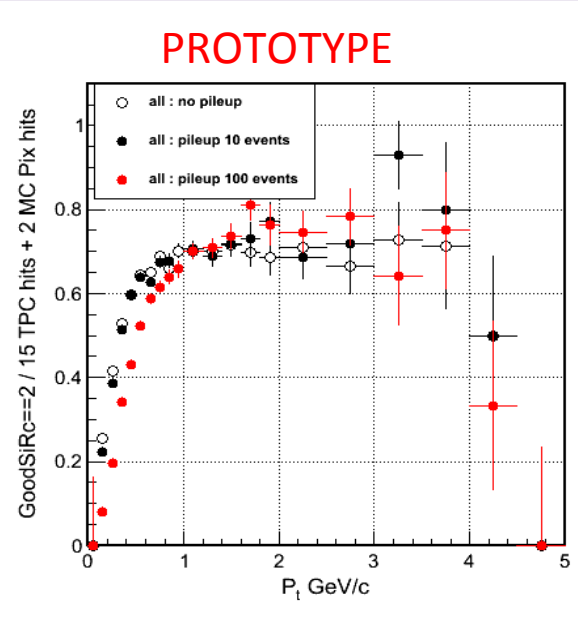
- To first-order Ghosting is not affecting combinatorial background **or** S/B (~N^2, N = #tracks in TPC with HFT hits) [if we require tracks to have HFT hits].
  - There will be second order, cut dependent effects though that might recover some signal from contaminated tracks. Here we ignore these effects and fully account for loss of signal due to ghosting (% loss of efficiency).

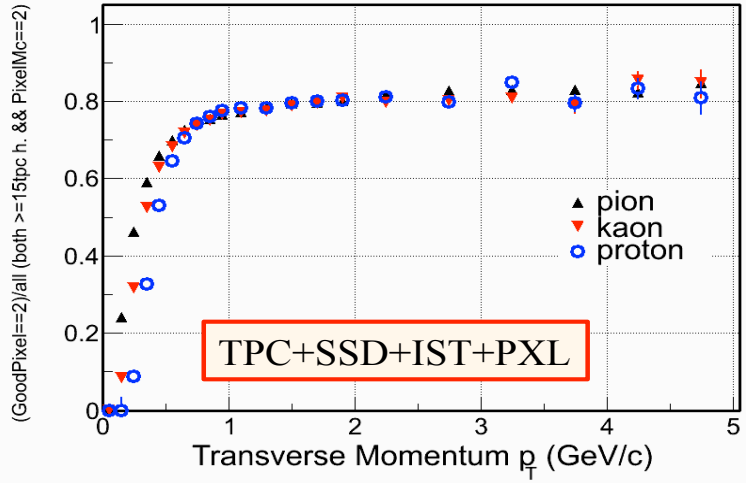
- For now we can rely on Yifei's CDR plots adapted/scaled for partial coverage using Jonathan's acceptance/single-track-efficiency (with pileup) simulation results.

http://www.star.bnl.gov/protected/lfspectra/yfzhang/hft/plots/CDR/

- Single track efficiency (STE) changes about ~10% for all pt (from ~80%->70%, see fig below), so impact on D0 signal is ~15% (or multiplication factor .85)

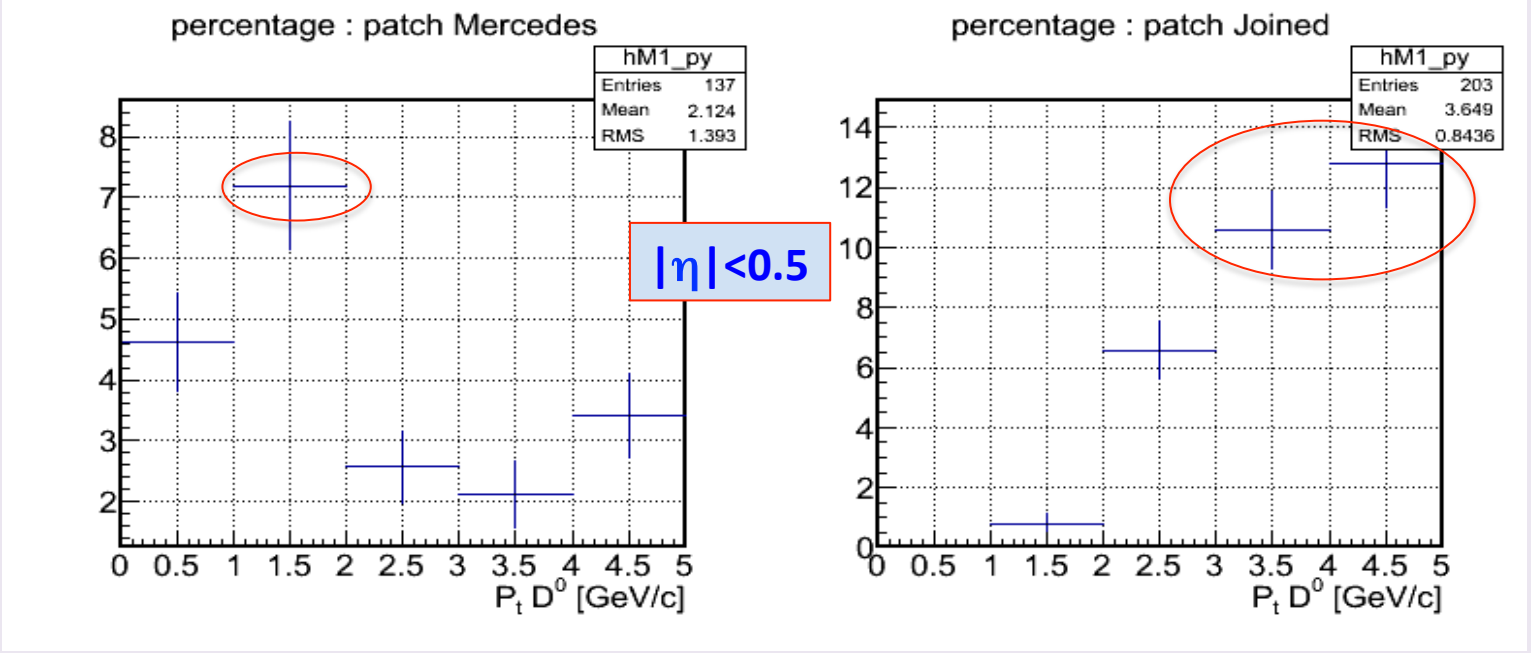
Jonathan's single track efficiency detailed





- Curves are for ALL particle species
- Red point are closer to real pileup

- For Mercedes/Joined configuration we have geometrical acceptance (ACC) penalty for D0s
  - Mercedes is to get <pt>~1 GeV/c, Joined for pt>=3 GeV/c
  - Hand wave estimation {ignoring decay angular correlations} $(3/10)^2$ = ~ 10% @ sweet spot of pt=1 GeV/c for Mercedes and 10% for pt=>5 GeV/c in Joined configuration **only.** In all other pt one needs to read the STE and ACC curves.
  - For Realistic/GEANT estimation from Jonathan (see plots below).
  - Hao will pin this down precisely with full simulations
  - Acceptance doesn't affect S/(S+B) but lowers signal significance S/sqrt(S+B) by ~3/10



Indeed sweet spots are about 10%

Rough estimates:

- For 500 Million AuAu 200 GeV events (CDR plot input).
  - This can be a couple of weeks running time in Run-13 provided things are not going to be terribly wrong.
  - Needs a VPD event vertex trigger to constraint it within +- 5cm
- The pt spectra plot errors should be increased @ 1 GeV **only** pt by a factor of **3-4** for the Mercedes prototype, and the same factor @ >= 5 GeV for the Joined prototype. This number results from evaluating the signal significance with the new penalties in track efficiency and acceptance combined for these two sweet spots.
- The number increases rapidly for pt other than 1 GeV(Mercedes) or <2-3 GeV for Joined configuration. If BOTH configs run then combined coverage is roughly flat for pt > 1 GeV/c.
- The above estimate is based on simulations with ideal TPC. For a more realistic approach with a TPC with distortions the factor to increase the errors is **6-7** !!
  - This is mainly due to sharp drop in TPC+PXL track matching efficiency as a function of distortions.
  - A vertex constraint in tracking might help improve this.

Example: 1% error on pt point. This will go down in reduced acceptance by a factor of ~4-8 (still very acceptable)

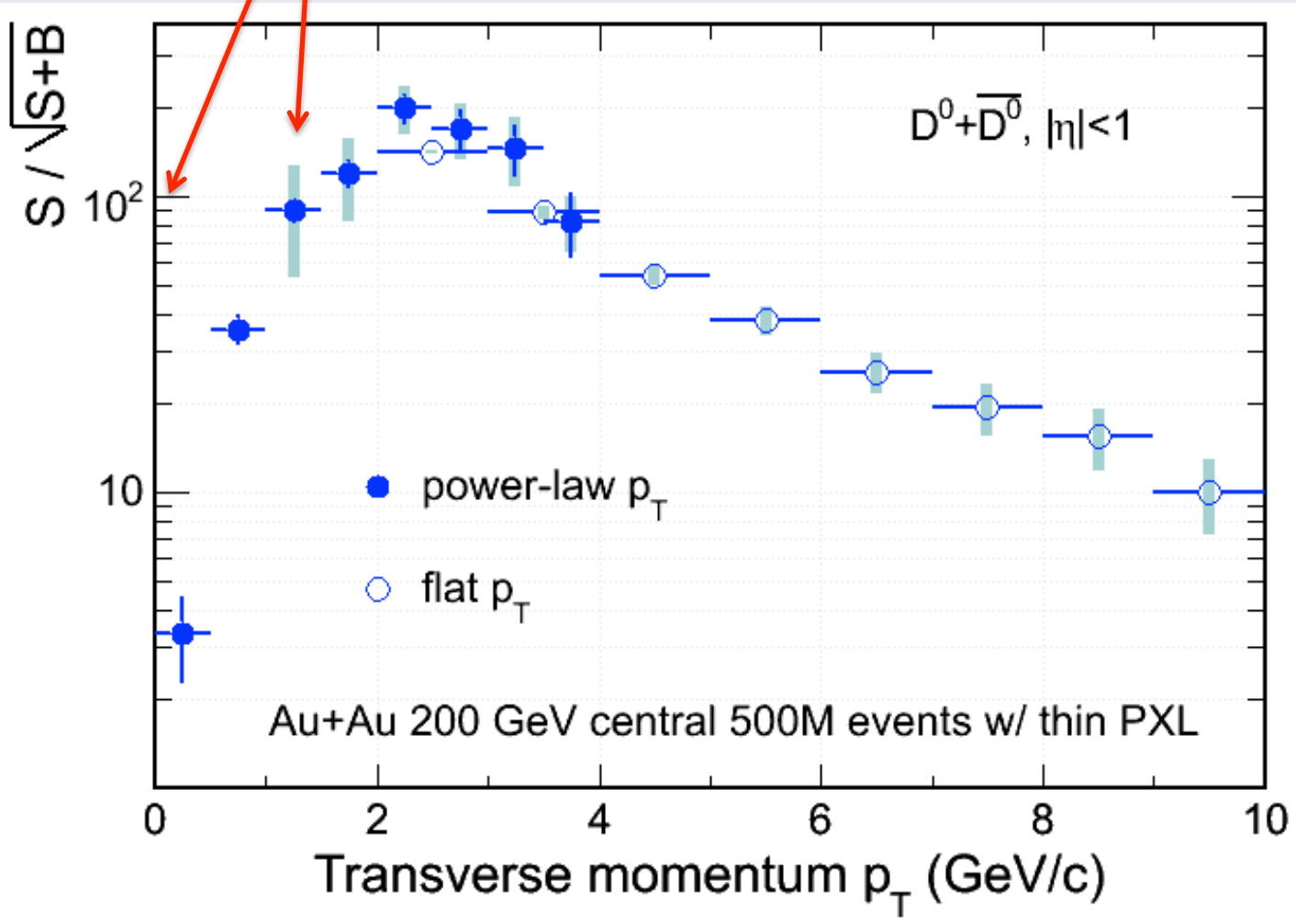
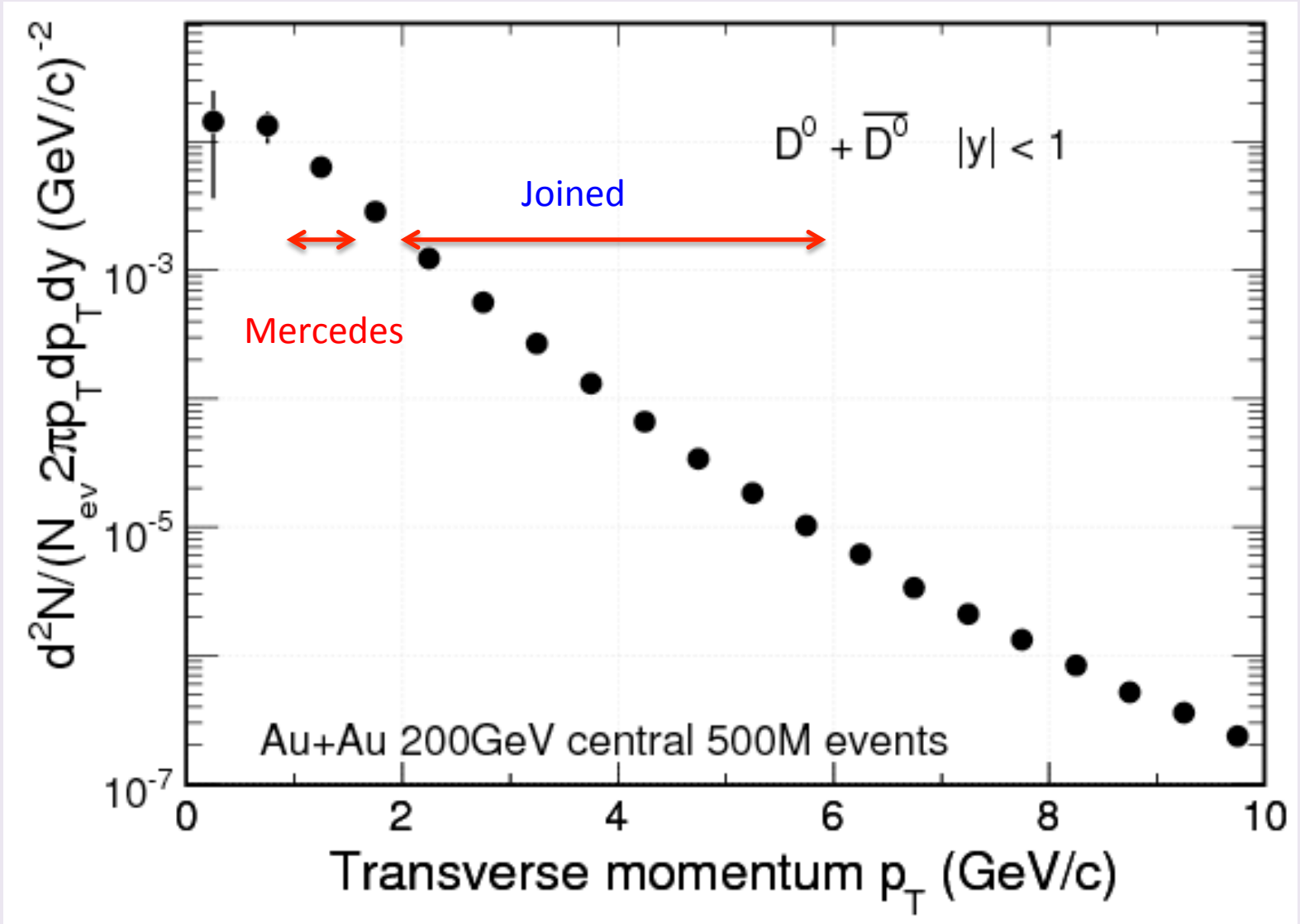
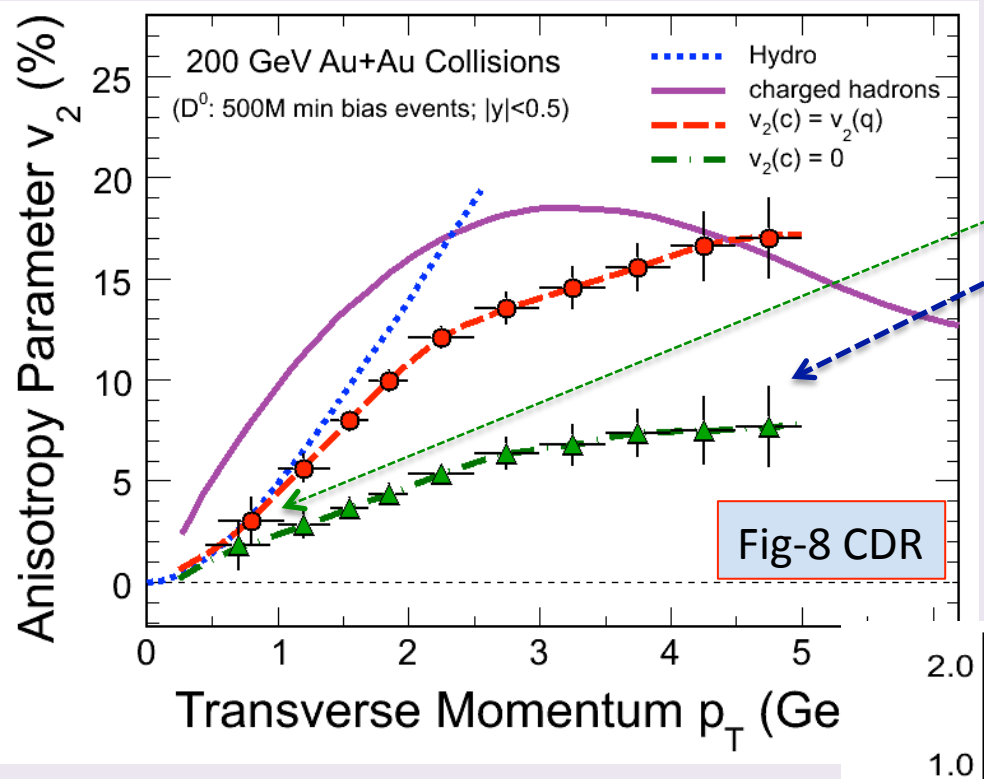


Fig-4 CDR Signal significance

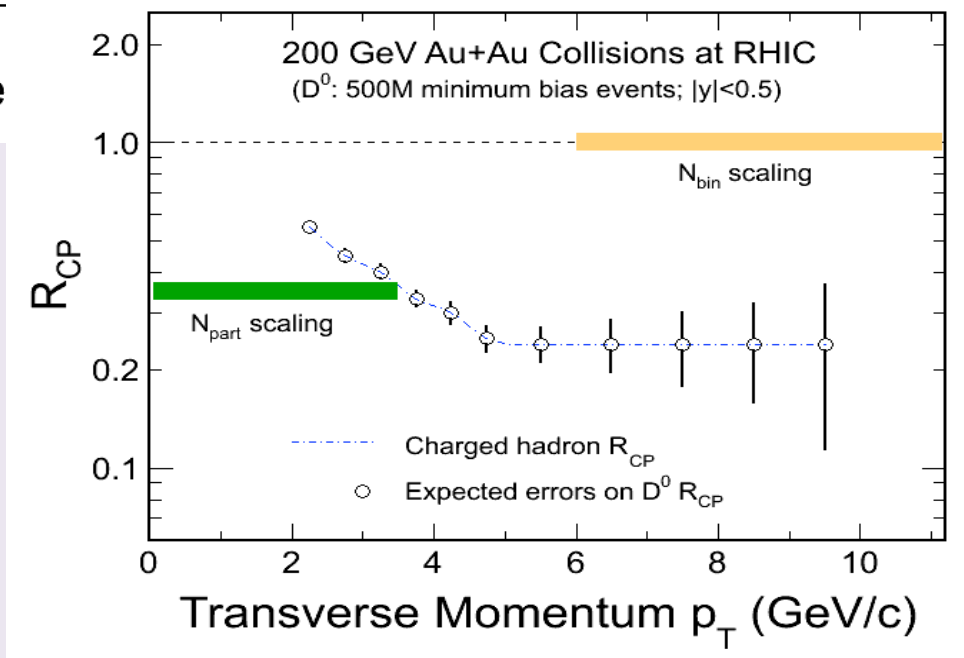
Fig-5 CDR



Even with larger errors seems doable



With larger errors lower pt is not useful and higher pt needs statistics



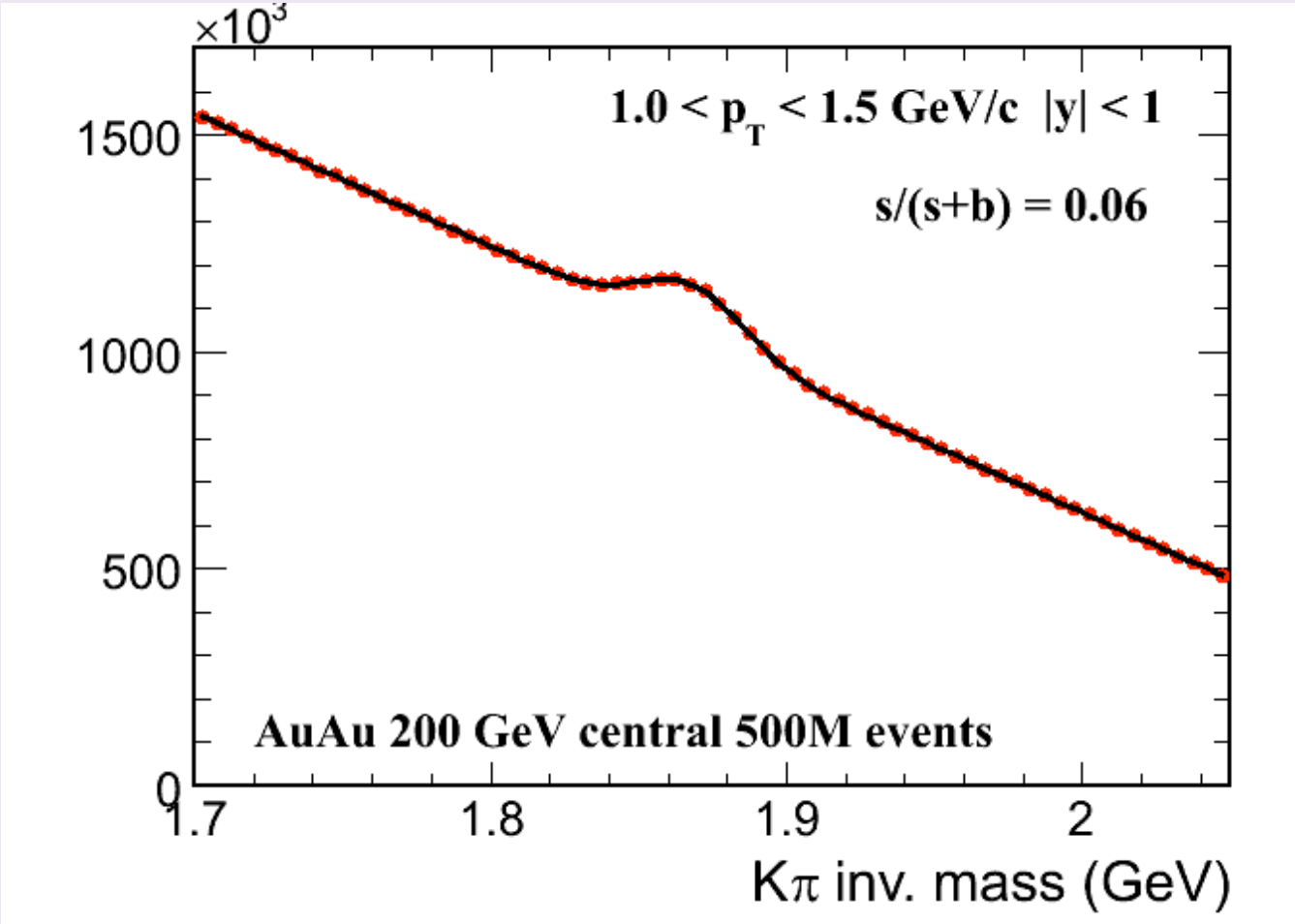
With larger errors higher pt needs statistics since TOF will do lower pt thoroughly

Summary

- Depending on events on tape AND # of sectors available AND %-detector alive AND … we should be able to get a x-section and a R_{CP} estimate
- Need detailed input, simulation studies (coming up soon)
- If only ONE configuration is allowed then Joined seems to be the one to run, since it explores the higher pt area which is also easier to reconstruct (high pt tracks).
- Several critical factors need to be defined

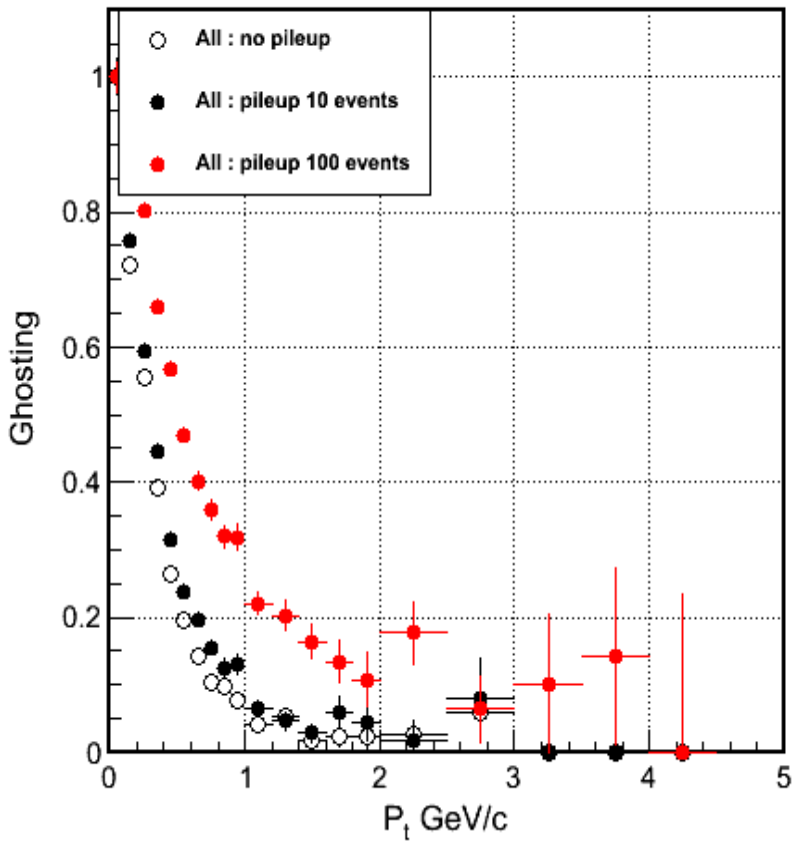
Back Up

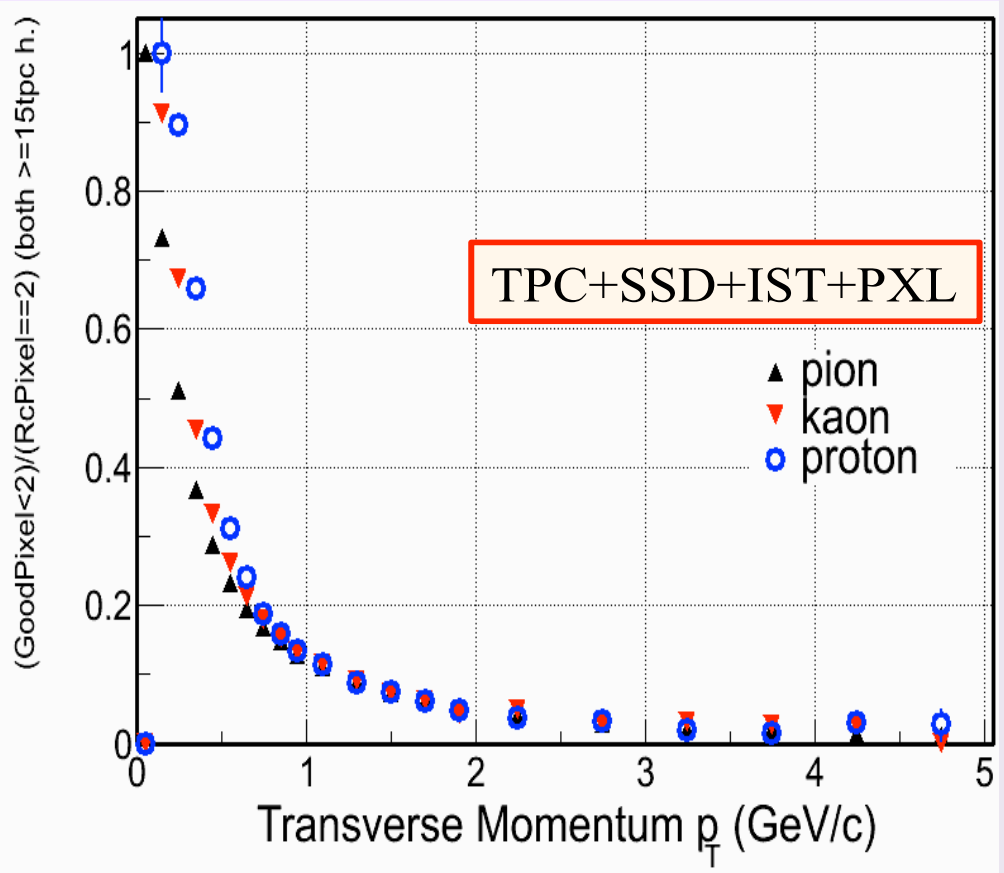
Fig-2 CDR


×10³
1500
1000
500
0
1.7
1.8
1.9
2
1.0 < p_T < 1.5 GeV/c |y| < 1
s/(s+b) = 0.06
AuAu 200 GeV central 500M events
Kπ inv. mass (GeV)

Jonathan's single track ghosting detailed

PROTOTYPE





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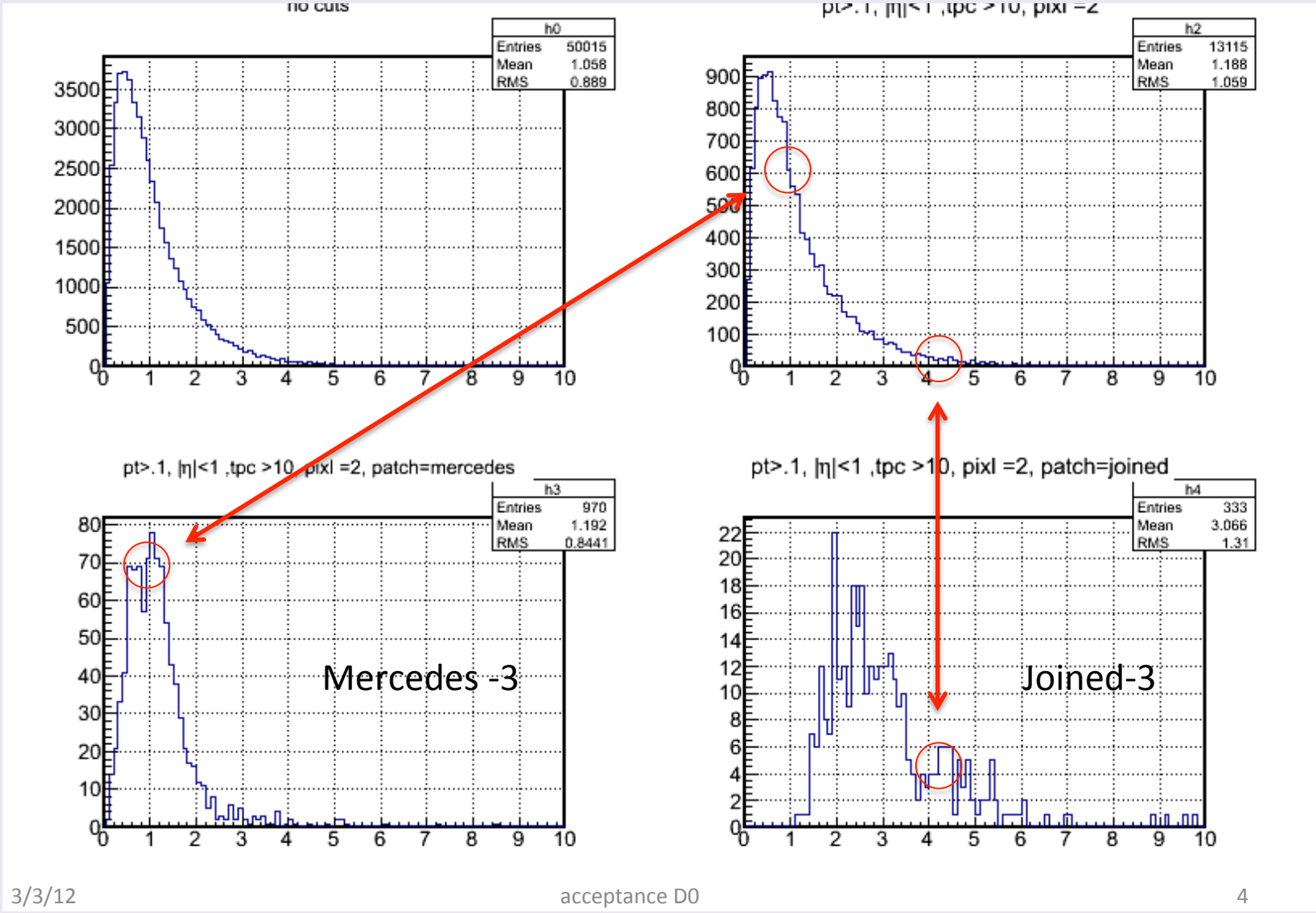
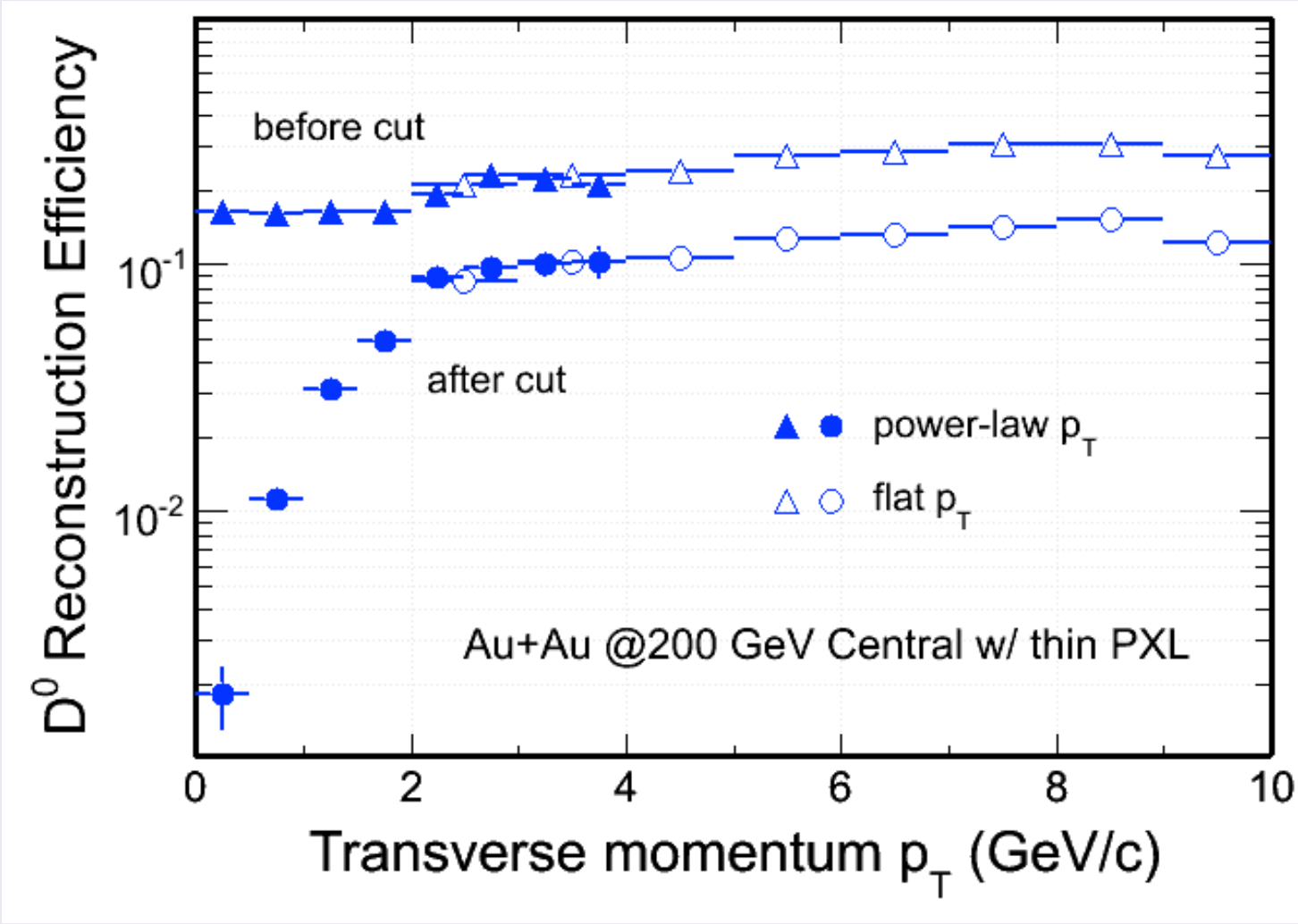
Jonathan's acceptances



See next slide for % (ratio) plots

Fig-3 CDR

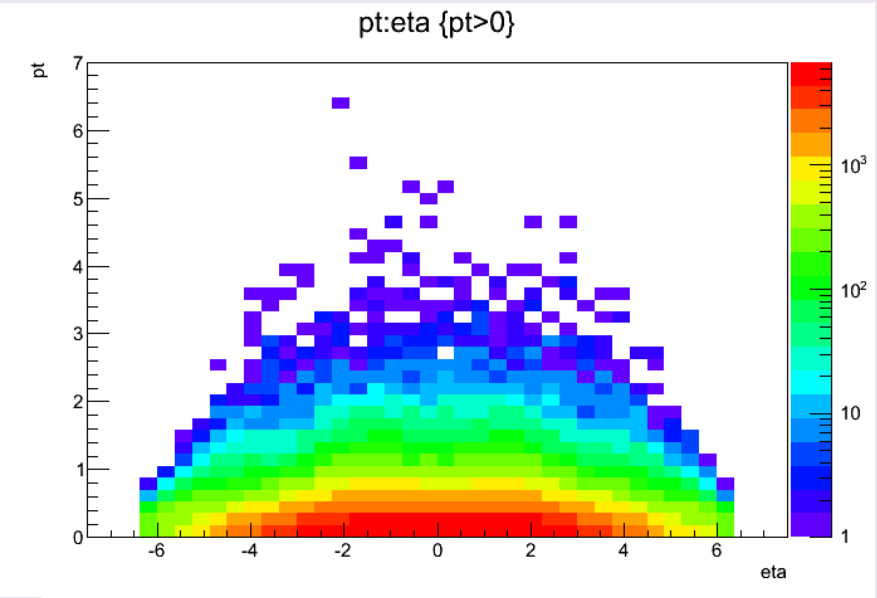

before cut
after cut
power-law p_T
flat p_T
Au+Au @200 GeV Central w/ thin PXL
D^0 Reconstruction Efficiency
10^{-1}
10^{-2}
0
2
4
6
8
10
Transverse momentum p_T (GeV/c)

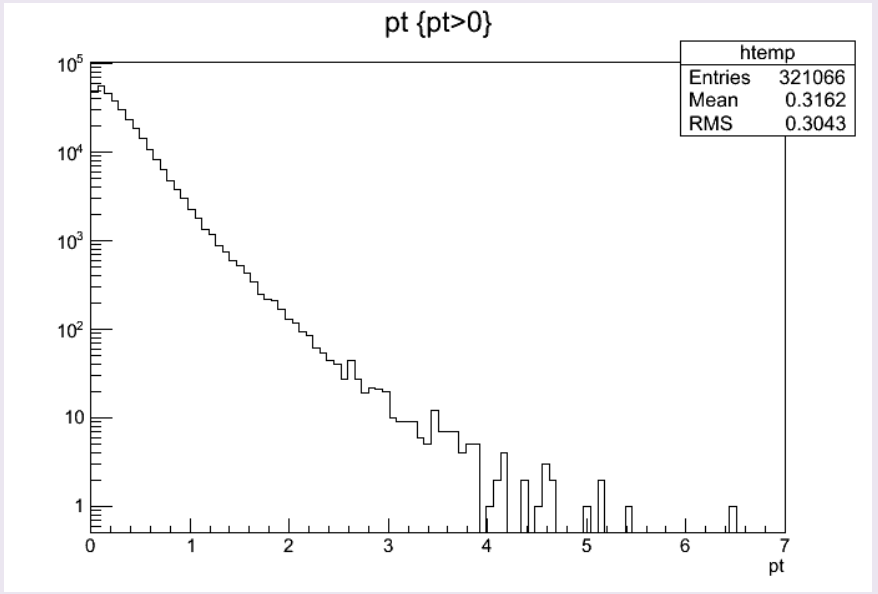
outline

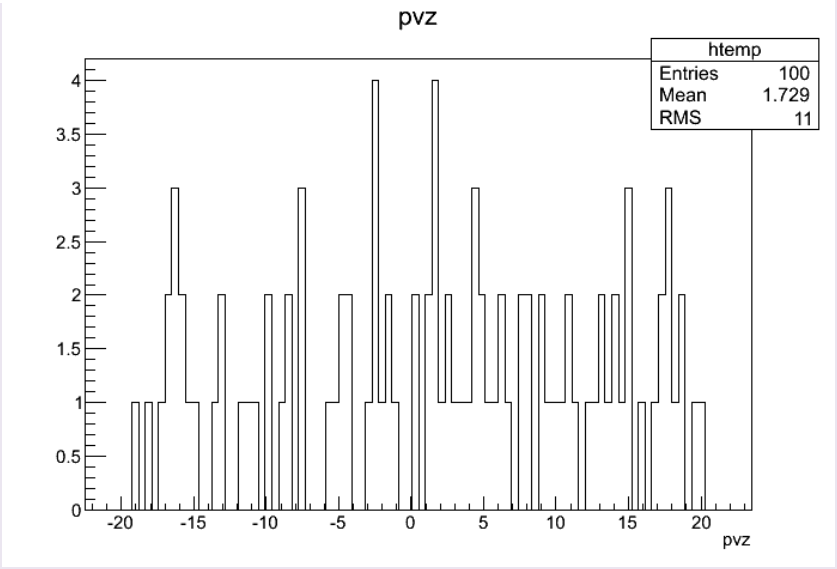
- Redo simulations with correct pileup file :
  - There was a mistake in the .kumac to generate the MinBias events (wrong Z vertex range)
  - Now the pileup files consist of :

# MinBias events	10	50 (not in these plots)	100	100 (first test)
# hits in inner layer	329	1658	3510	4900
#hits in outer layer	102	488	1028	1900

Checking the pileup







events are generated :

1) $0 < b < 20$ fm : impact parameter
2) $0 < Pt < 100$ GeV/c : transverse momentum
3) $-20 < Z_{vertex} < 20$ cm : vertex position
4) $\sigma_{xy} = 0.01$; $\sigma_z = 20$ cm : vertex distribution (beam diamond)