pVPD and TOFp Calibrations Status

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STAR Analysis Meeting, BNL, 10/22-24/2002

Outline:

- The Goal
- The Start, Stop, and Drift Corrections in central Au+Au data
- PID performance in central Au+Au data
- Closer look at PID'd masses *vs.* momentum, by charge and polarity
- -/+ Ratios *vs.* momentum for PID'd π, K, p

- First look at Start correction in min. bias data, need new method!
- Centrality dependence of start resolution

- To-do list for improvements...

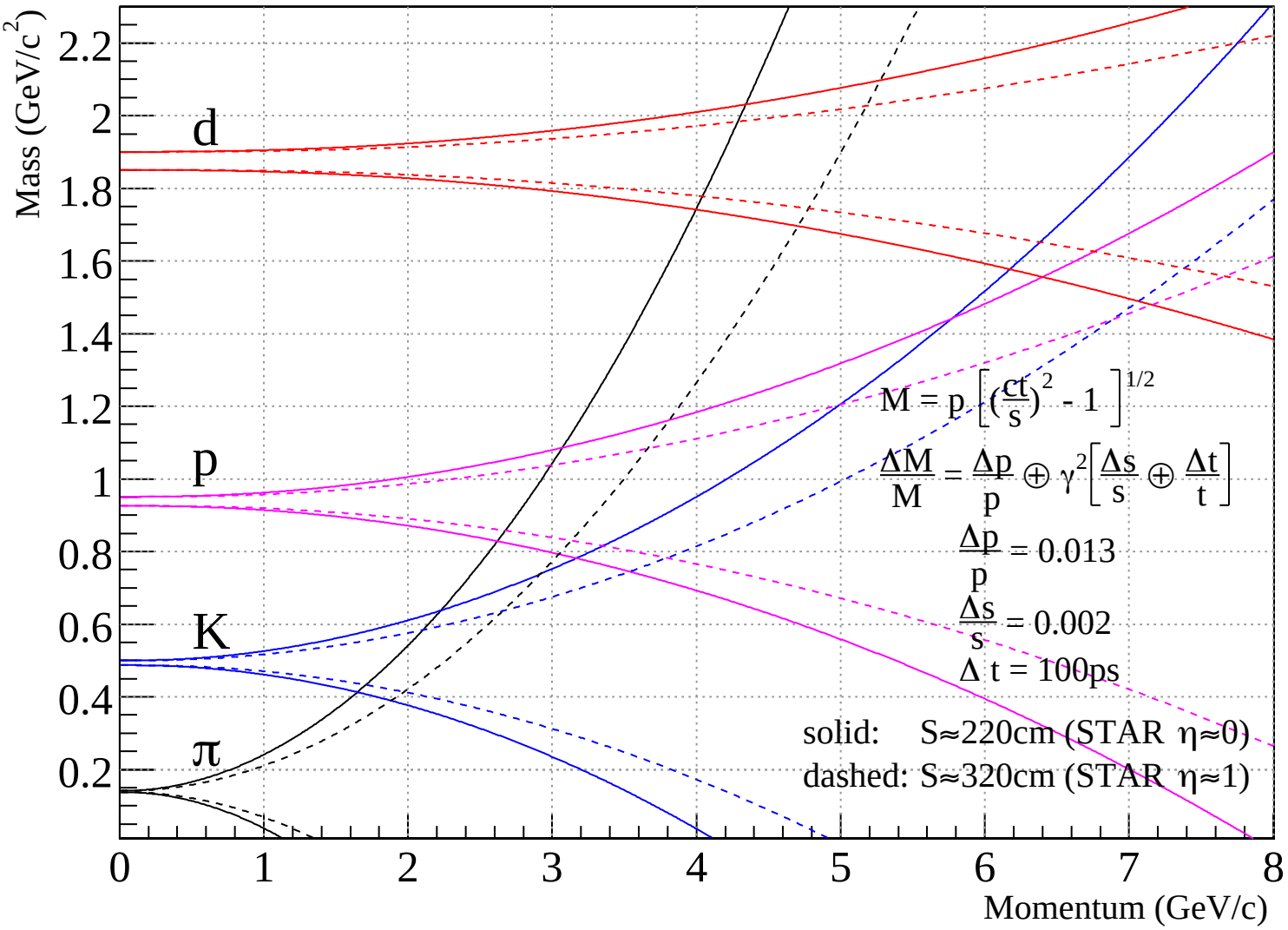
The Goal

a 100ps TOF system

i.e. $\sigma(t\_start) \oplus \sigma(t\_stop) \oplus \sigma(corrections) < 100ps$

in STAR

i.e. STAR geometry, & TPC provides **p**, **s** w/ resns $\Delta\mathbf{p}$ and $\Delta\mathbf{s}$ should have these PID capabilities:

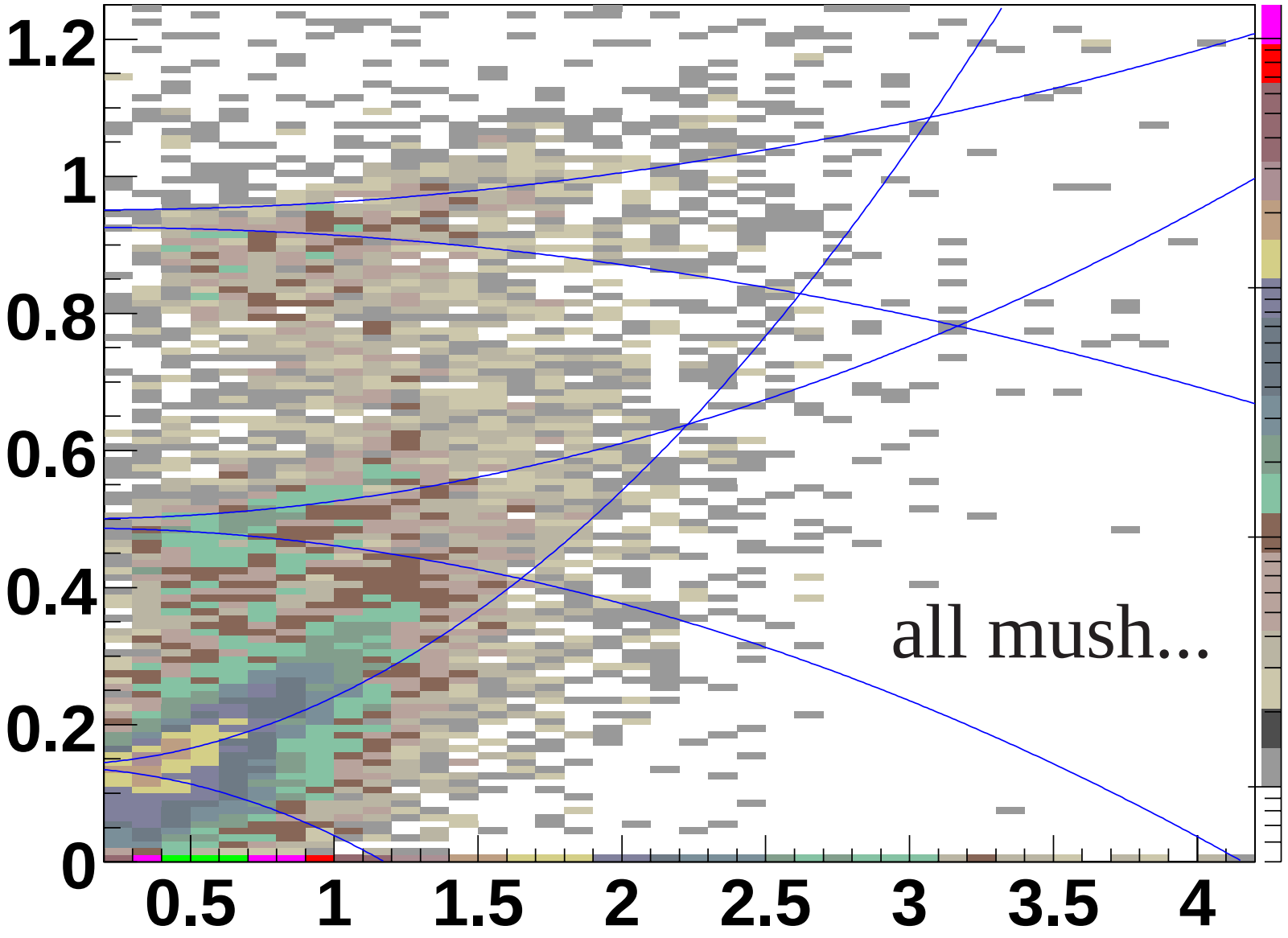


→ 2σ π/K/p direct PID to ~1.6(2.0) GeV/c @ η~0(1)

→ 2σ (π+K)/p direct PID to ~2.6(3.1) GeV/c @ η~0(1)

Totally Uncalibrated Mass versus momentum

~27k matches to one slat from ~530k central Au+Au events 2001 run



First Step: Start Correction

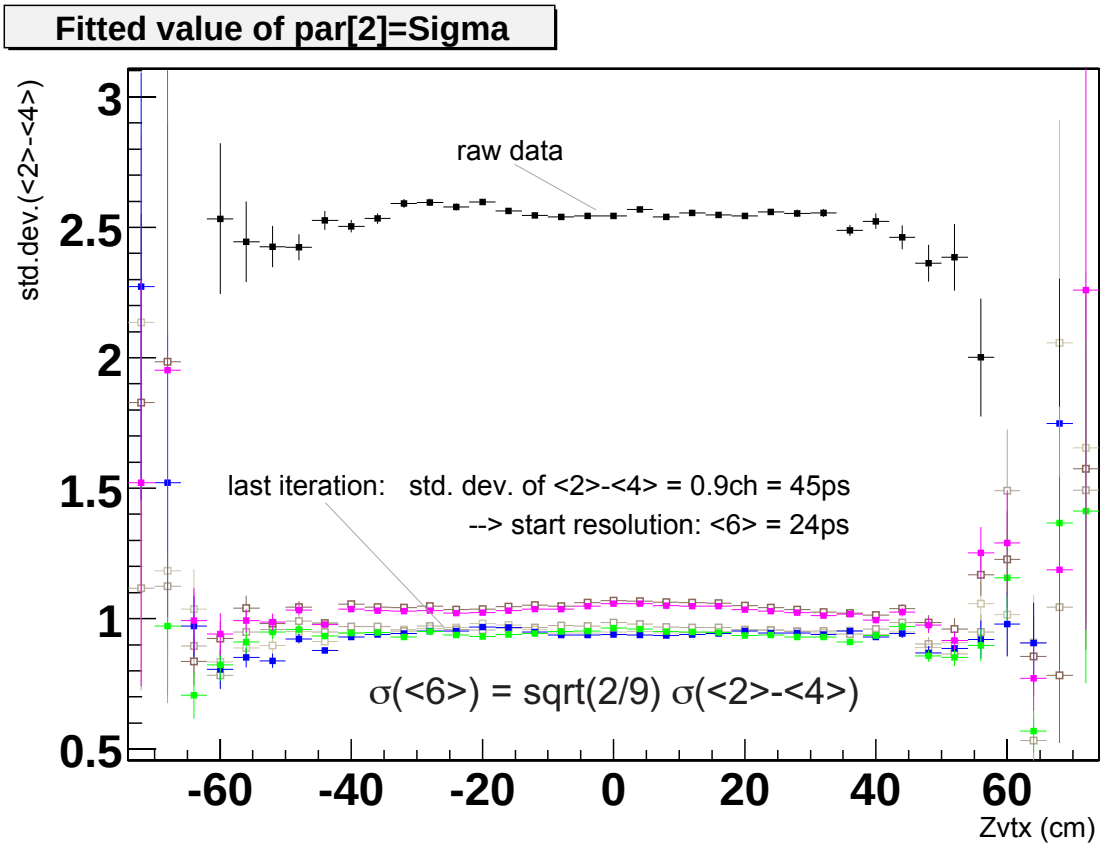
central Au+Au data all six pVPD chs fire in every event to 99% level....

the details:

in each event:
<2> = average of TDCs from one east ch and one west ch
<4> = average of other 4 TDCs.

pass 1: <2> from east1 & west1,
fit TProfile2D of <2>-<4> vs ADC(east1) and ADC(east2)
pass 2: <2> from east2 & west2
<4> now includes corrected values of <2> from prev pass.
fit TProfile2D of <2>-<4> vs ADC(east2) and ADC(east2)
and so on...
each pair of PMTs corrected 3 times in 3 passes, 9 steps total.

next pass through data use the nine 2D functions to remove all of the ADC dep...
correction algorithm outputs three variables for each event
<2>''' for east1 and west1,
<2>''' for east2 and west2,
<2>''' for east3 and west4,
the start time we need for each evt is then: **<6> = [<2>'''+<2>'''+<2>''']/3**



Start resolution in central Au+Au is excellent - σ(<6>) ~ **24ps**...

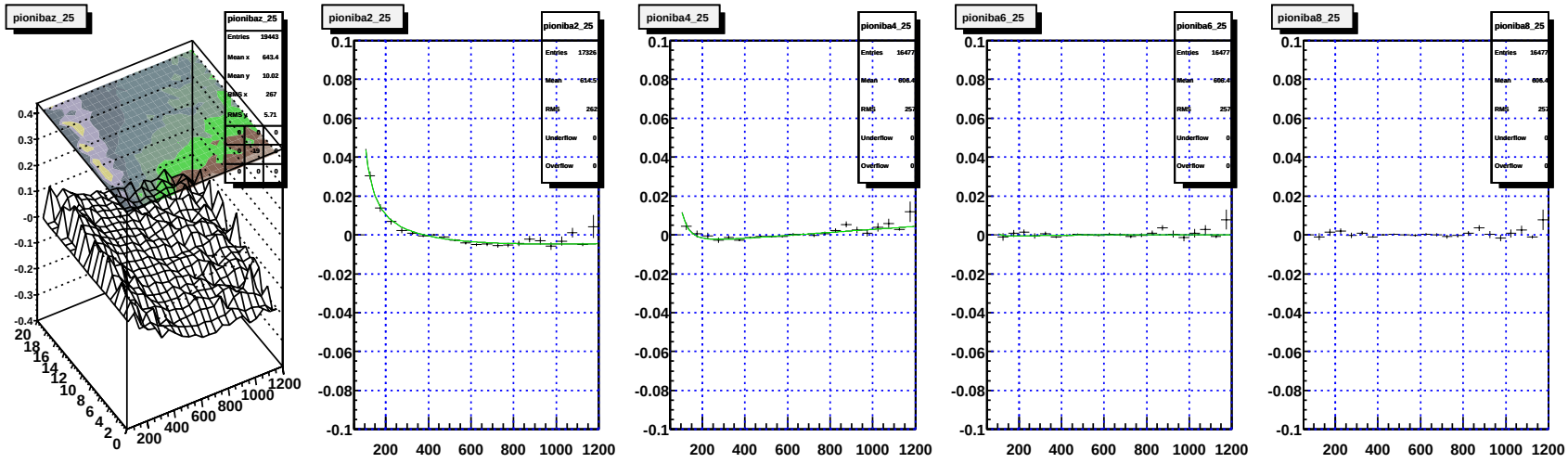
But:

How does the start resn degrade for larger impact pars in min. bias?
(will come back to this later in this talk...)

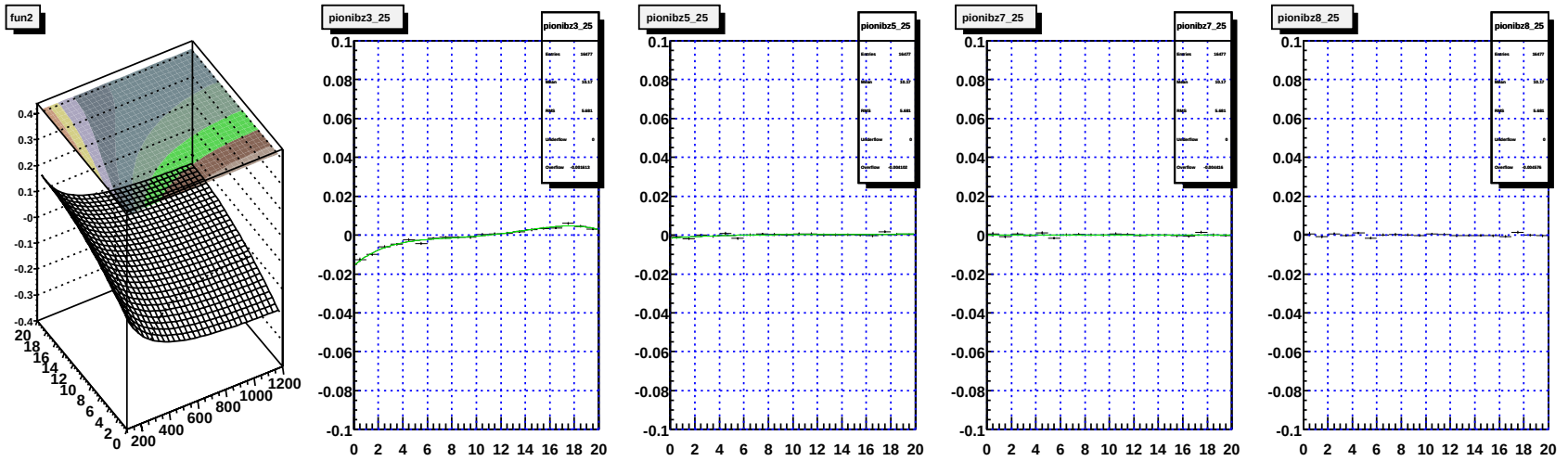
Note,by definition, this method can't provide corrected Zvtx
via <left>–<right> timing...

Second Step: Stop Correction

Zhit and ADC smearing is **not** simply *const**Zhit and *const*/sqrt(ADC) for many reasons...
use iterative technique here too...
minimize 1/β - 1/β(expected) versus momentun for each slat for pions.
apply these functions to all matches in next pass through the data



vs. ADC..



vs. Zhit...

Third Step: Corrections for long term drifts

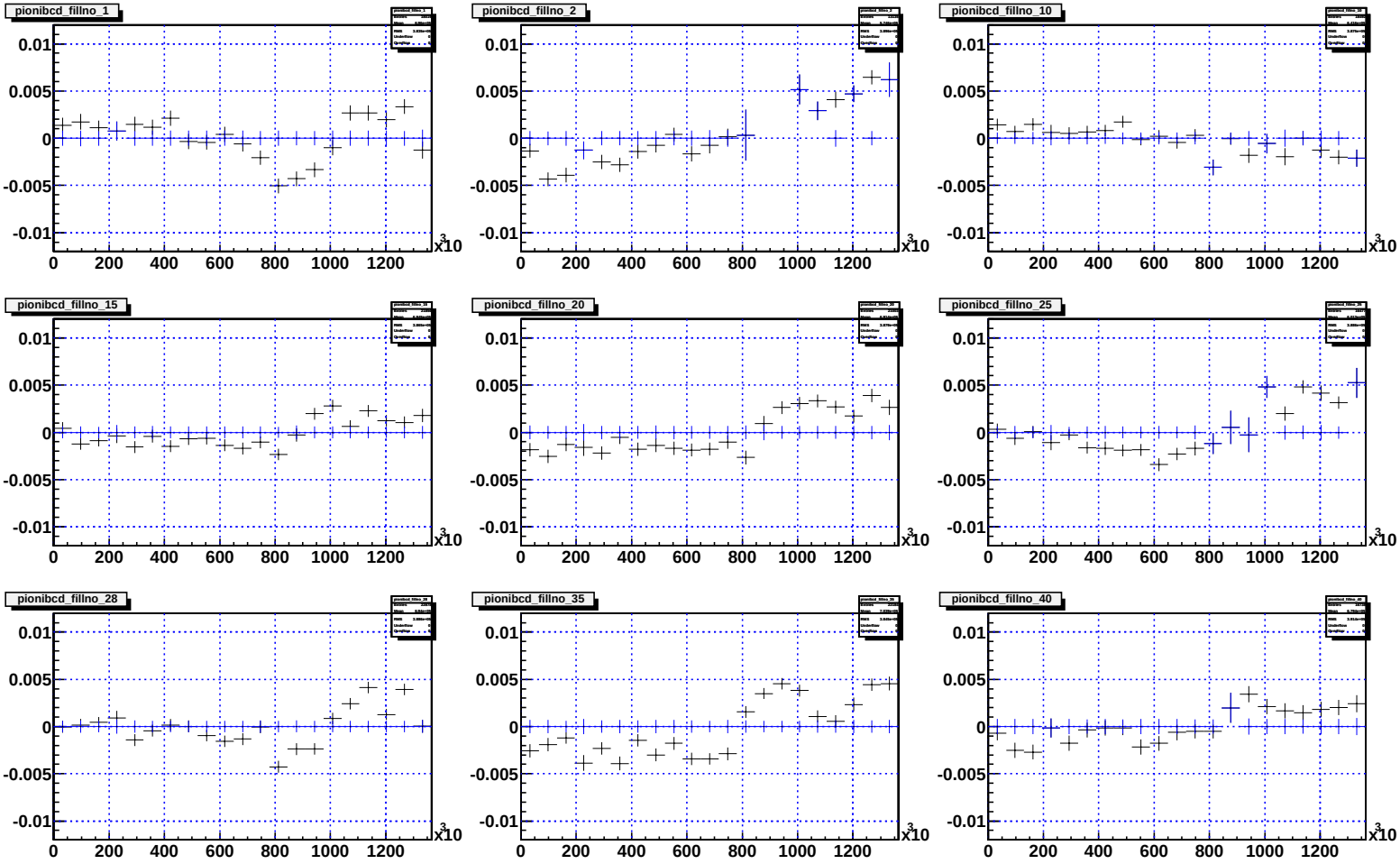
60000 events per bin, time dependence of 1/β(meas)–1/β(expected)
drifts in 1/β from drift of overall timing offsets of +/-0.005 or less...

black after start and (Zhit,ADC) correction & before drift correction

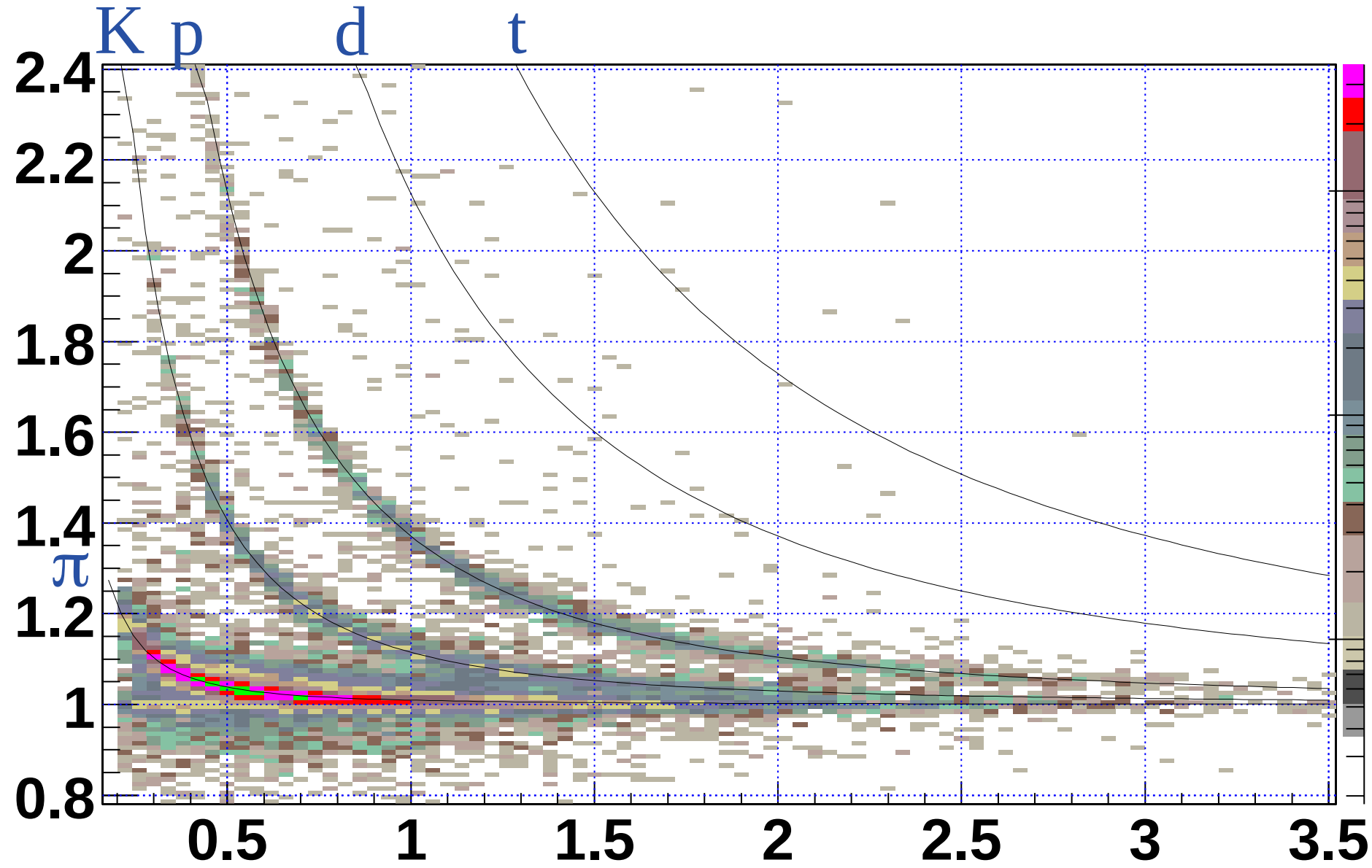
blue after drift correction

(blue pts not at 0.000 are time bins w/ too few matches to use avg)

a sampling of slats vs. time:

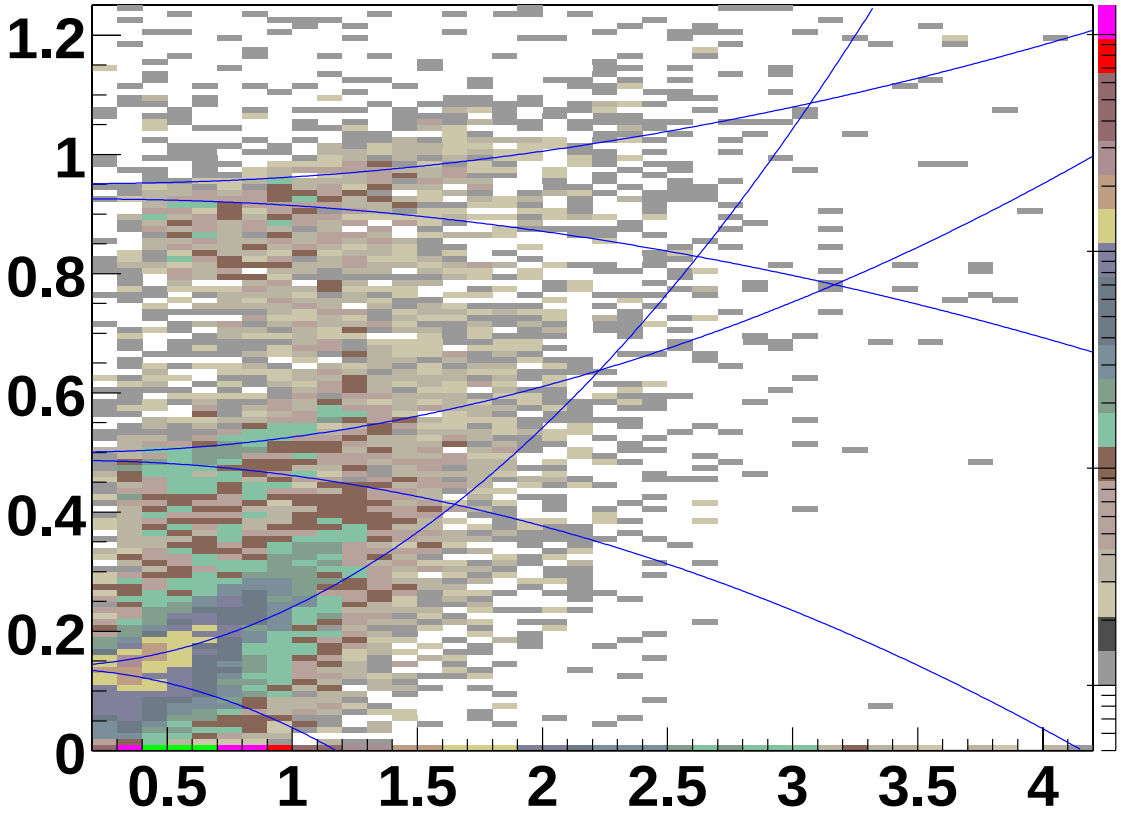


After these three steps:

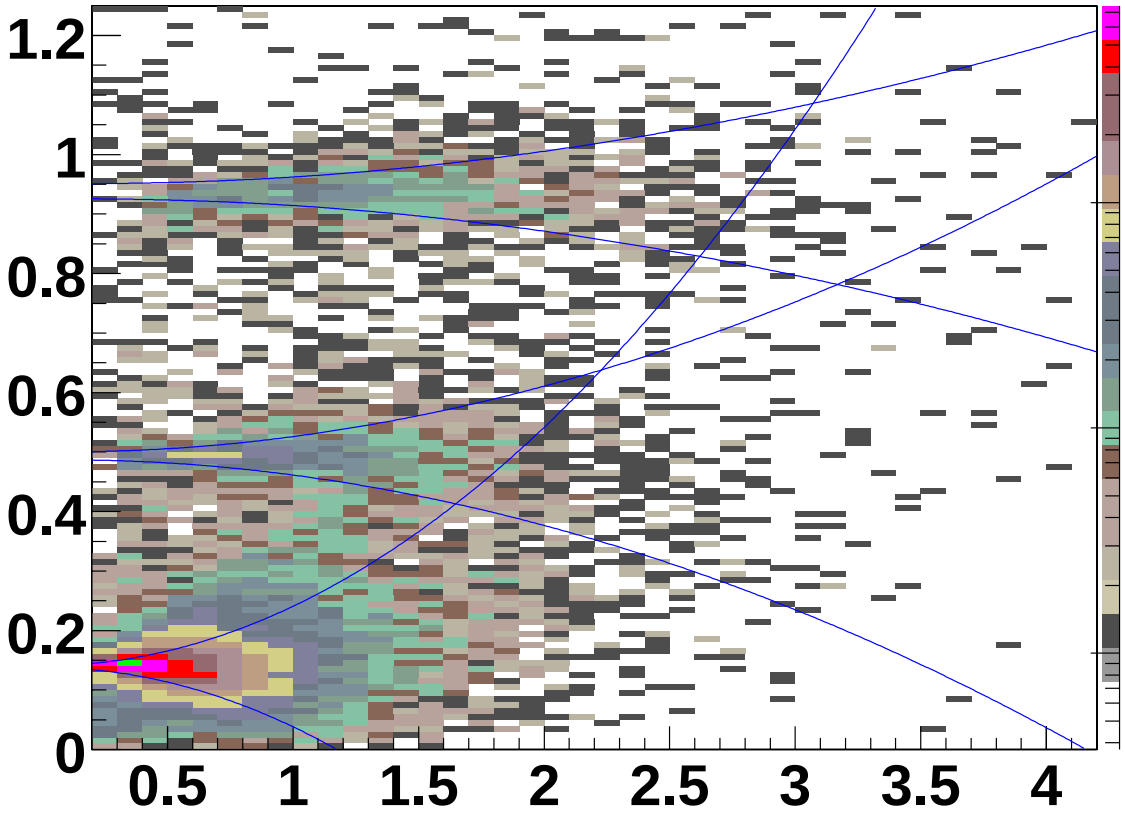


→ strong bands in 1/β vs p for different particles w/ expected resolution...

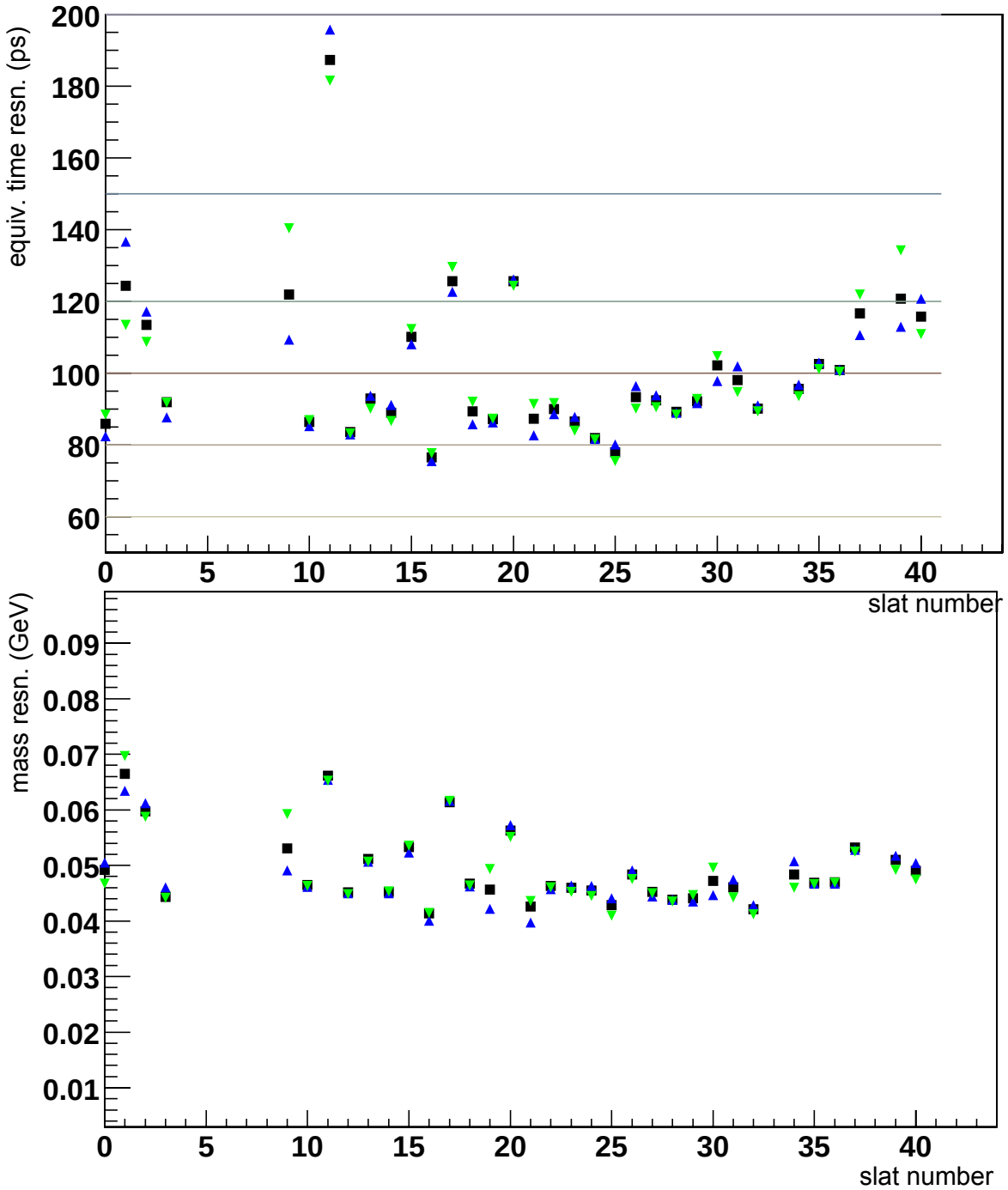
masses, before calibrations



masses, after calibrations

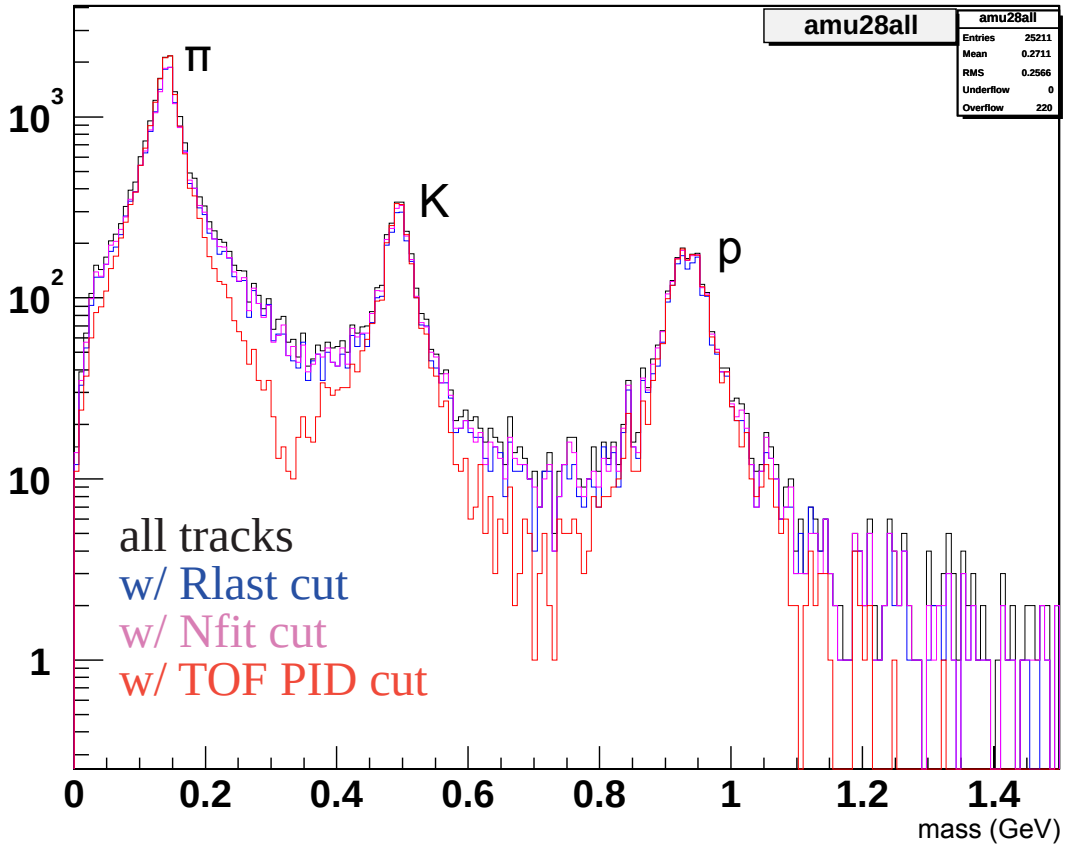


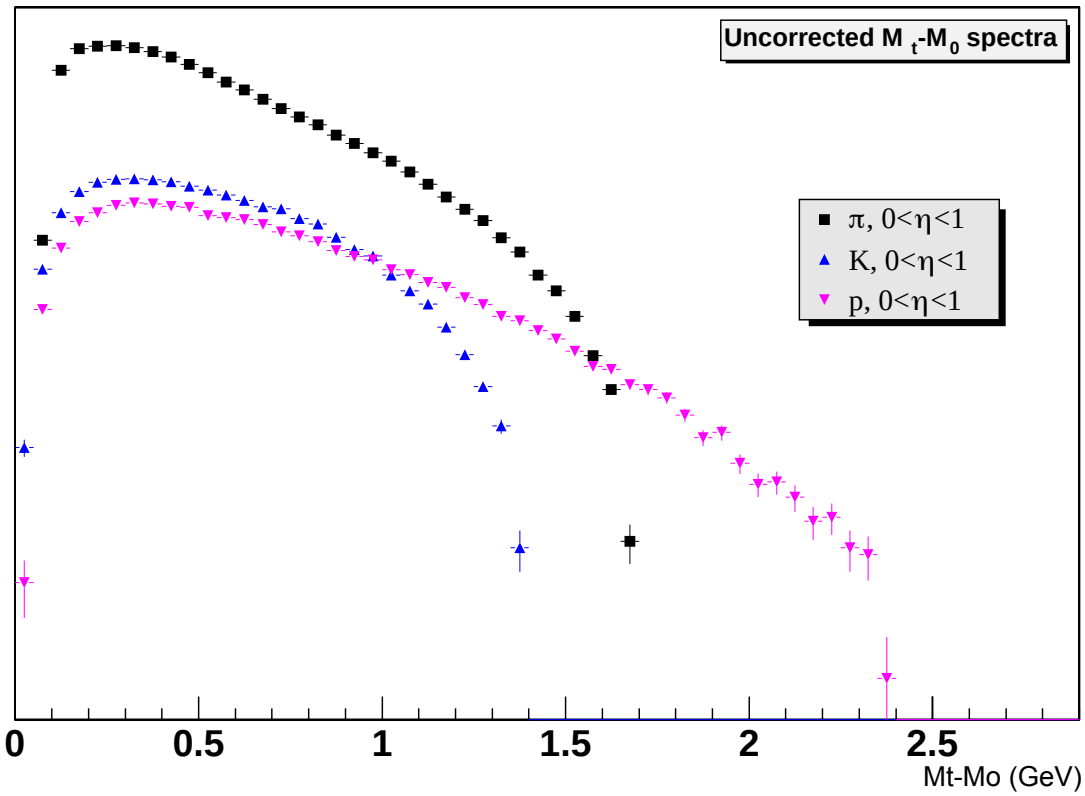
mass and equivalent time resn across the wall....

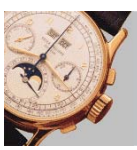


~6 slats w/ ID<20 w/ ~120ps resn might still be improvable...
120ps is only ~200 MeV/c worse than 100ps in terms
of the PID momentum cutoffs for these slats → still useful slats!

equivalent time resn degrades to 120ps also in last row of tray...
expected due to large average angles of incidence for this row...
but mass resn not significantly degraded here
compensated by longer average flight path to these slats...

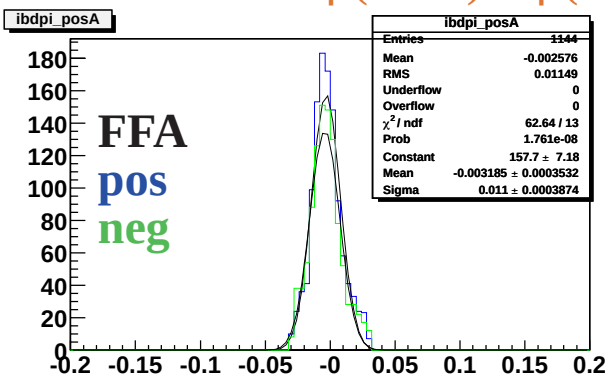

amu28all
amu28all
Entries 25211
Mean 0.2711
RMS 0.2566
Underflow 0
Overflow 220
π
K
p
all tracks
w/ Rlast cut
w/ Nfit cut
w/ TOF PID cut
mass (GeV)

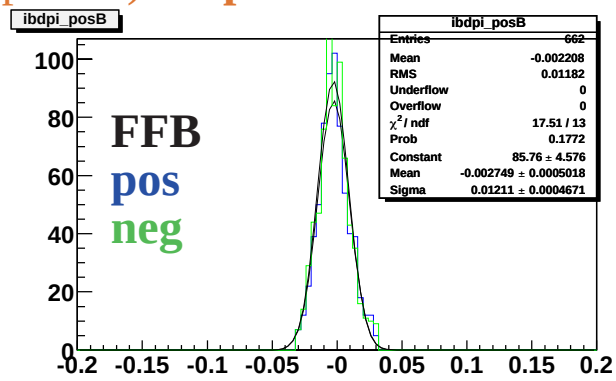

Uncorrected M t-M0 spectra
π, 0<η<1
K, 0<η<1
p, 0<η<1
Mt-Mo (GeV)

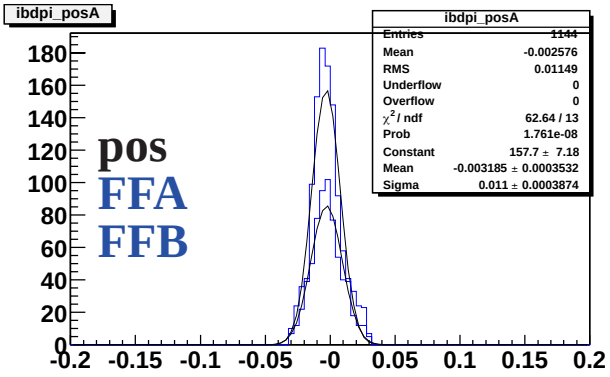


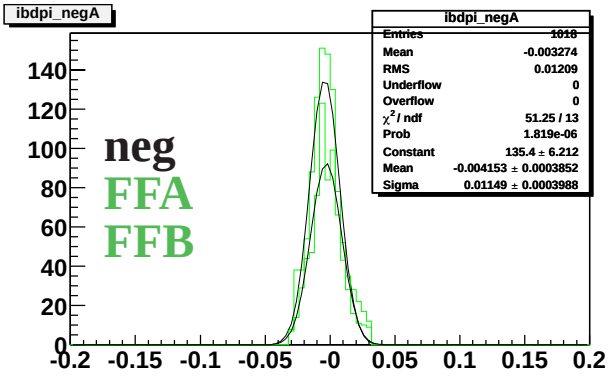
Polarity Dependence

1/β(meas)-1/β(expected) for **pions**

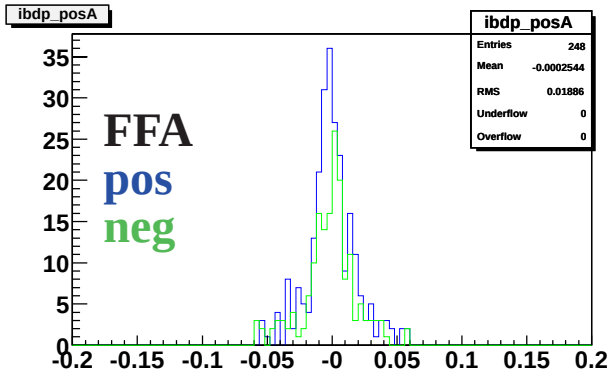


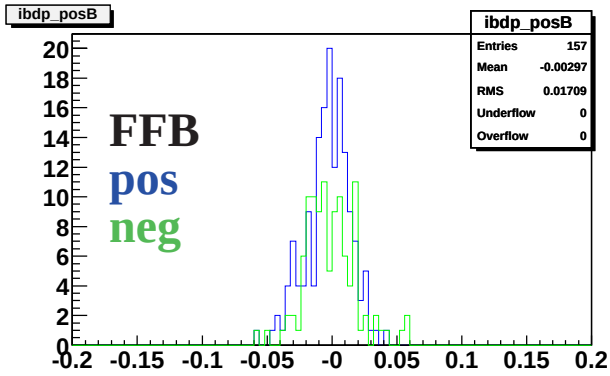


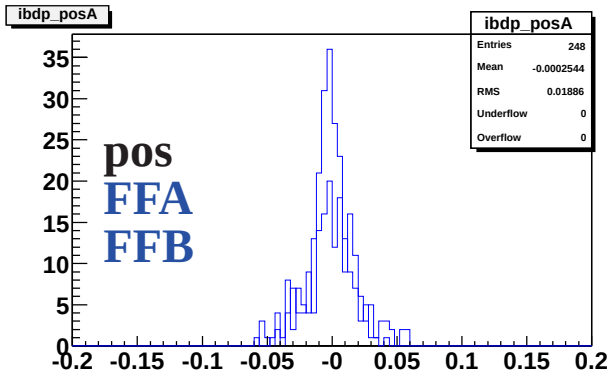


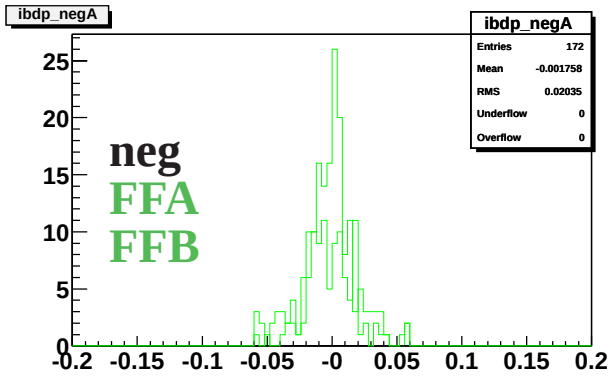


1/β(meas)-1/β(expected) for **protons**



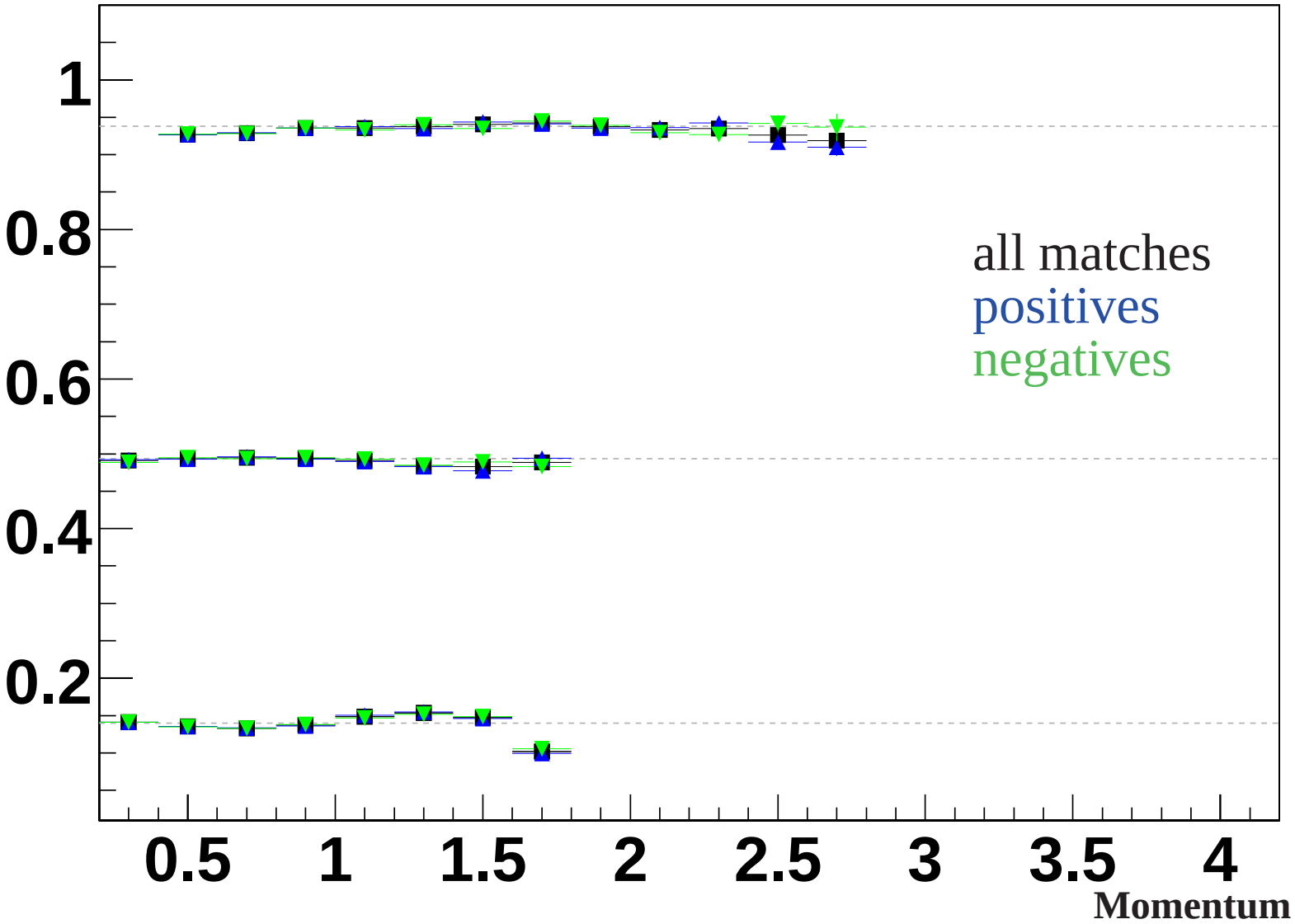






1/β offsets & widths don't seem to depend strongly on [charge,polarity], but still looking into all this..... (but see later in talk...)

mean mass (GeV) vs momentum

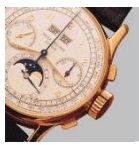


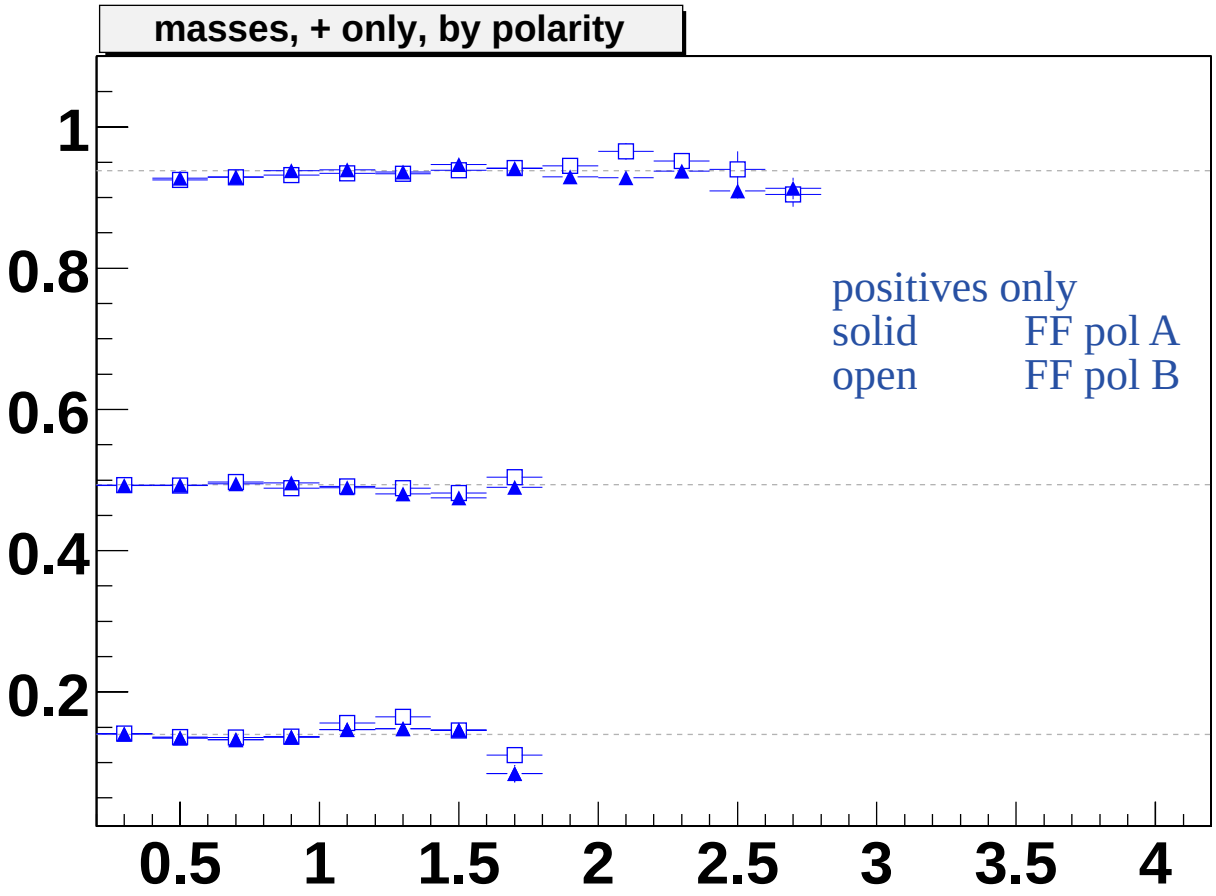
no dramatic differences between Mass from p*sqrt(1/β/β - 1) and from PDG...

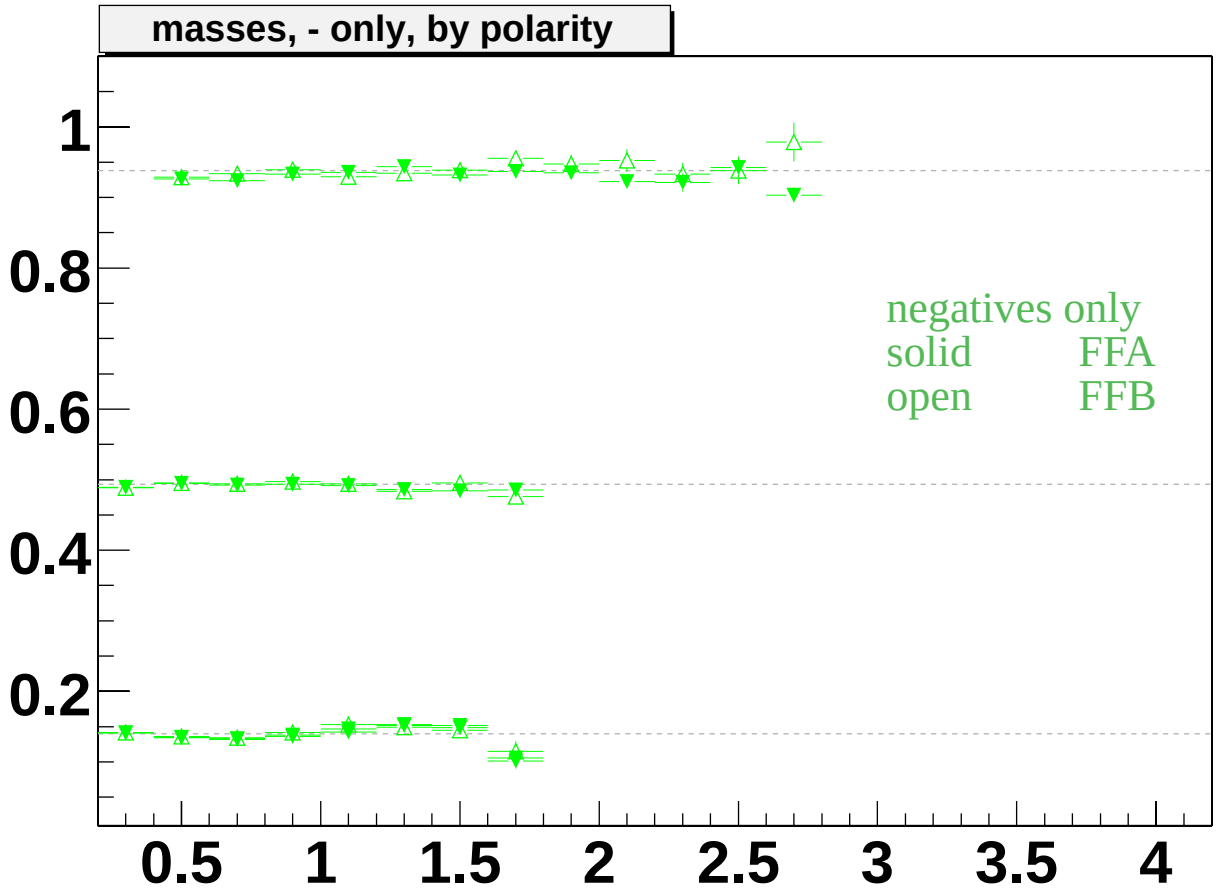
...still looking into the subtle few-percent effects

...at low mom'n for protons...

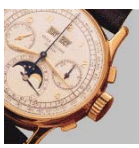
...at high mom'n for pions....



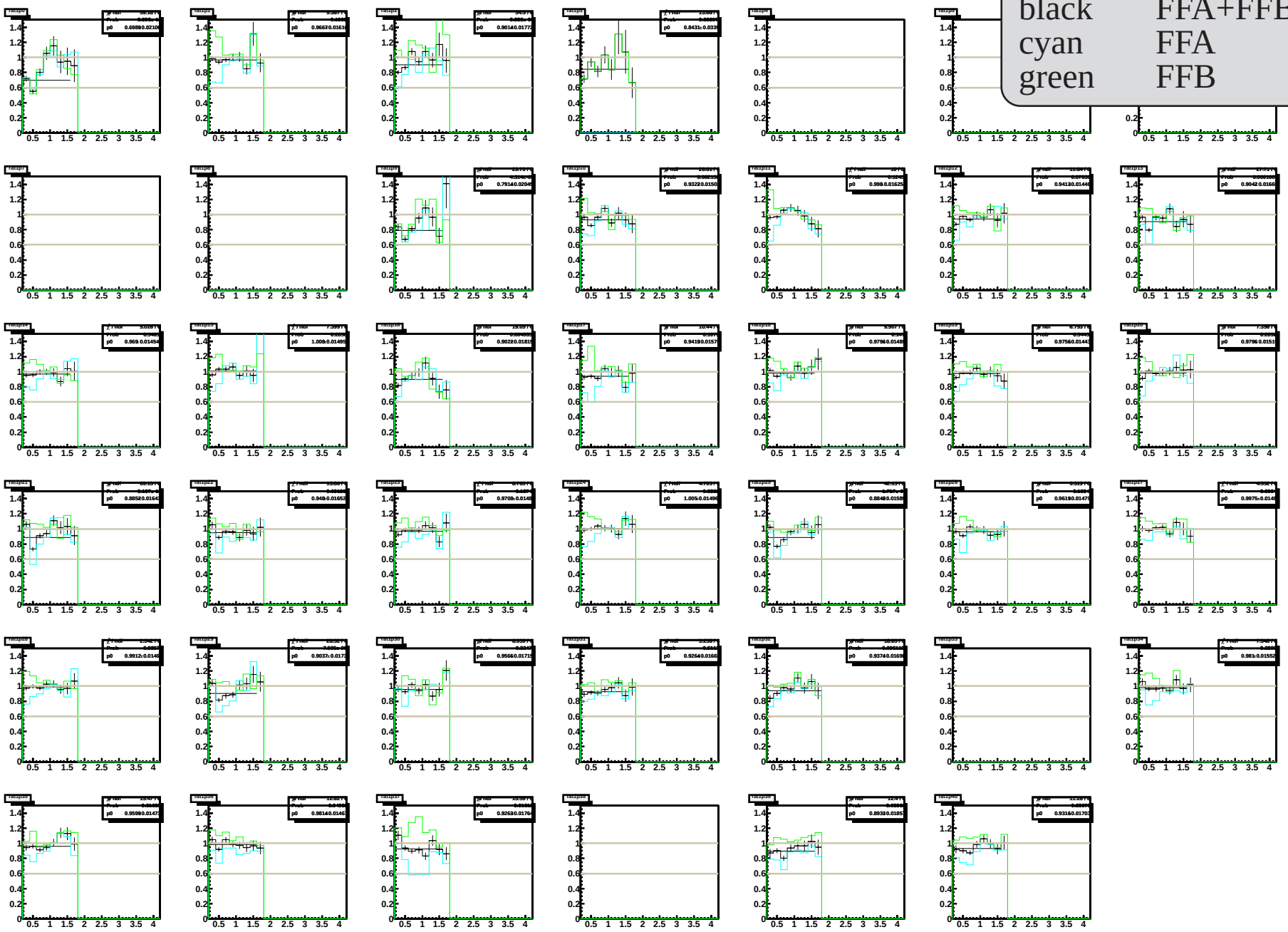




masses don't much depend on polarity....



-/+ Ratios versus Momentum for each slat for **Pions** from TOFp PID



black	FFA+FFB
cyan	FFA
green	FFB

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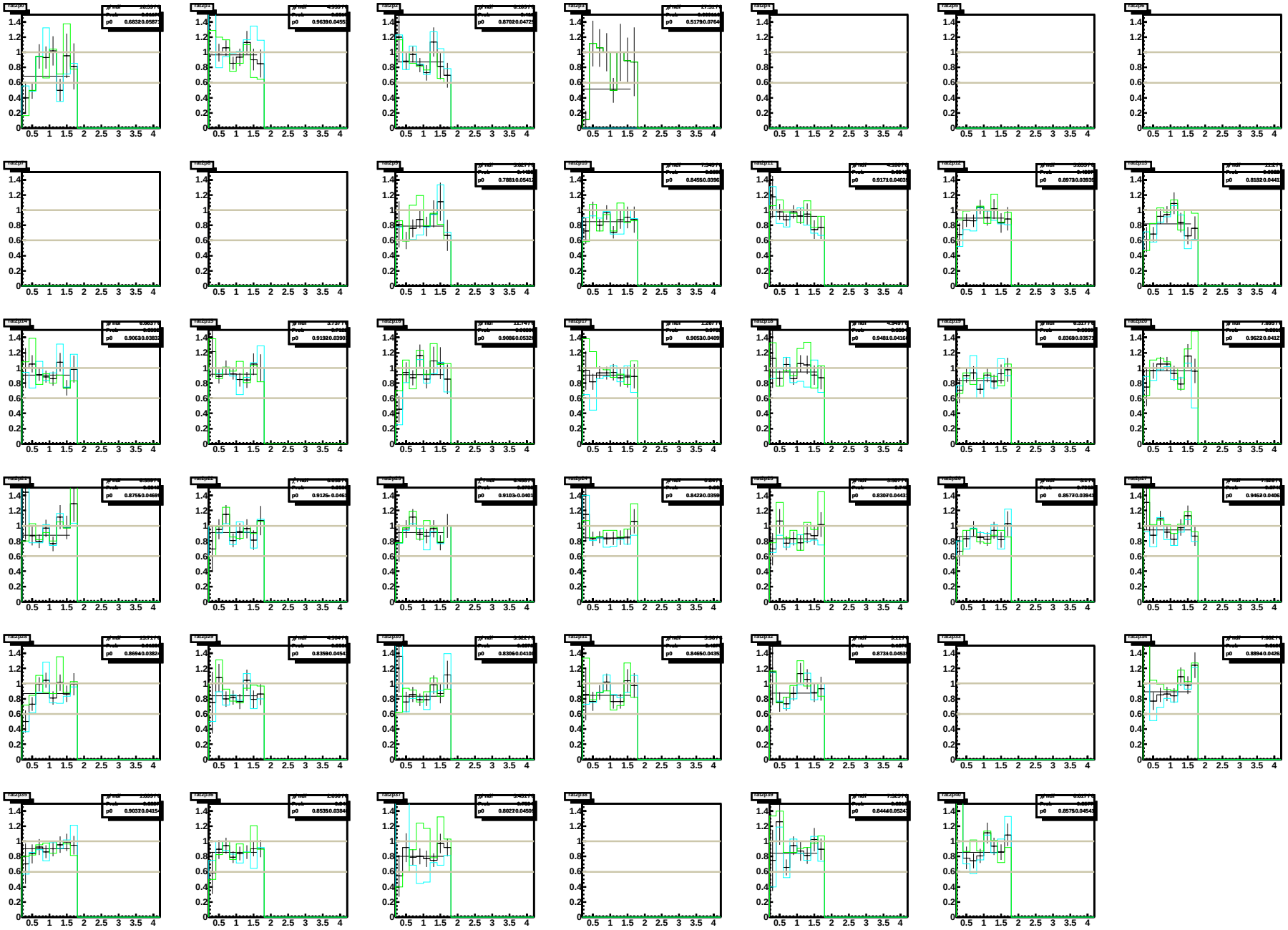
resulting -/+ ratios ***do*** depend on polarity for p < ~1 GeV/c!!!

-/+ Ratios versus Momentum for each slat for **Kaons** from TOFp PID



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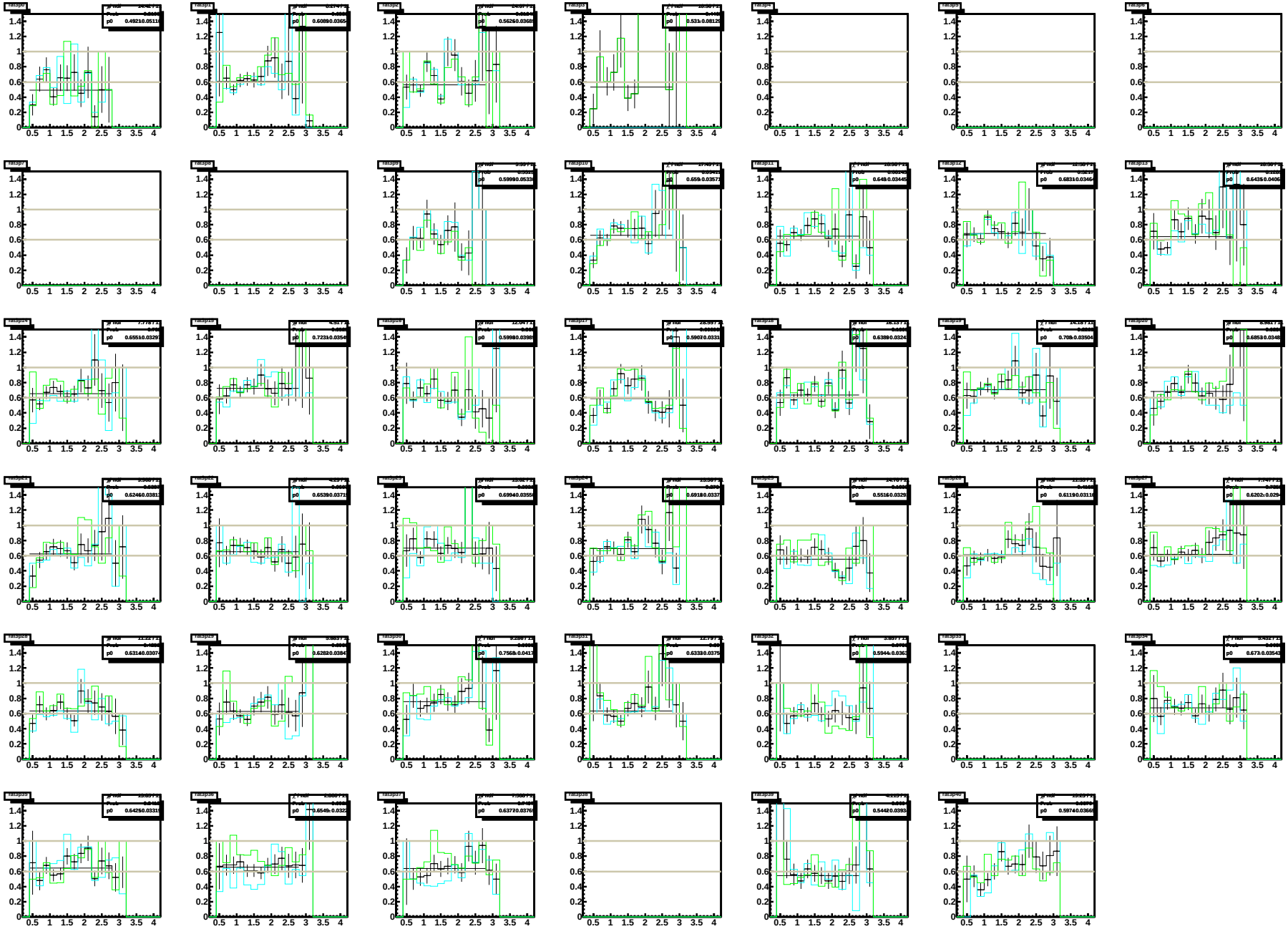
-/+ Ratios versus Momentum for each slat for **Protons** from TOFp PID



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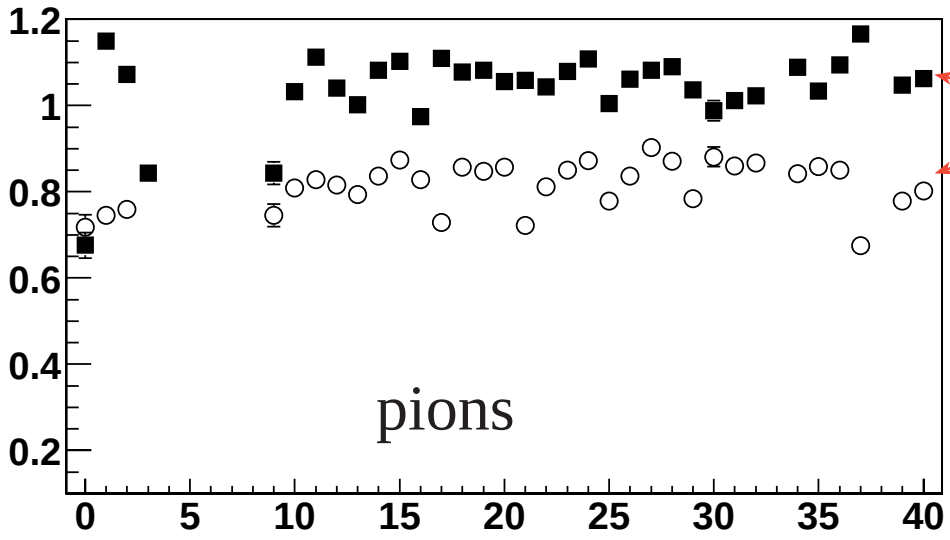
uncorrected -/+ ratios for FFA (solid) vs FFB (open), **all momenta**



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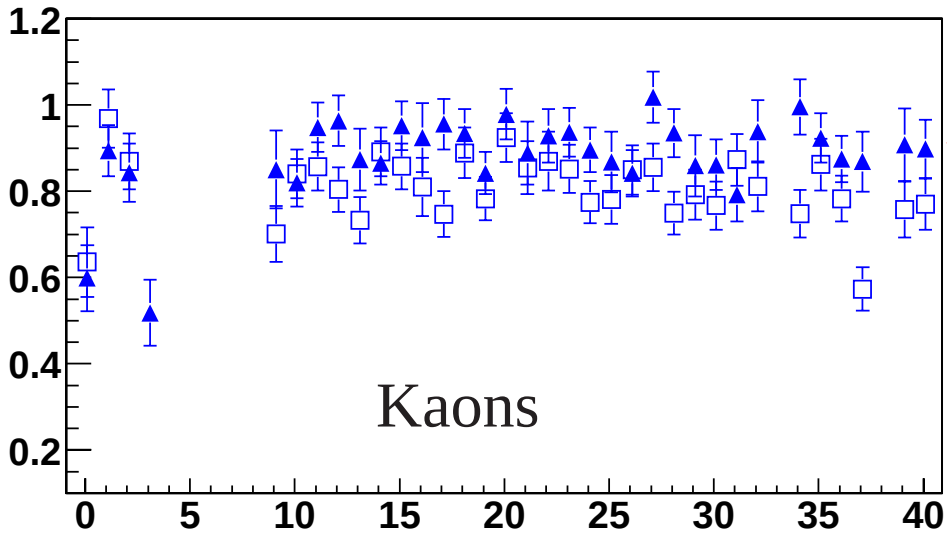
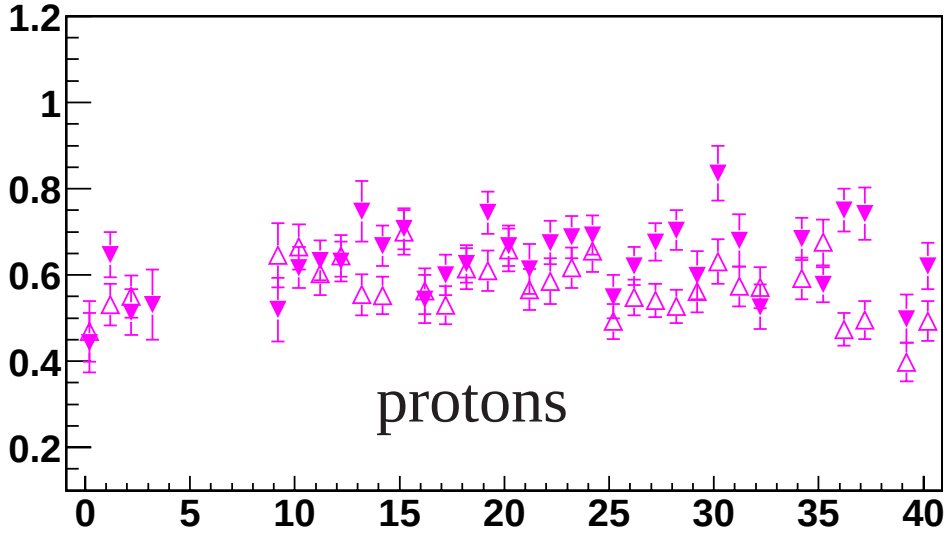
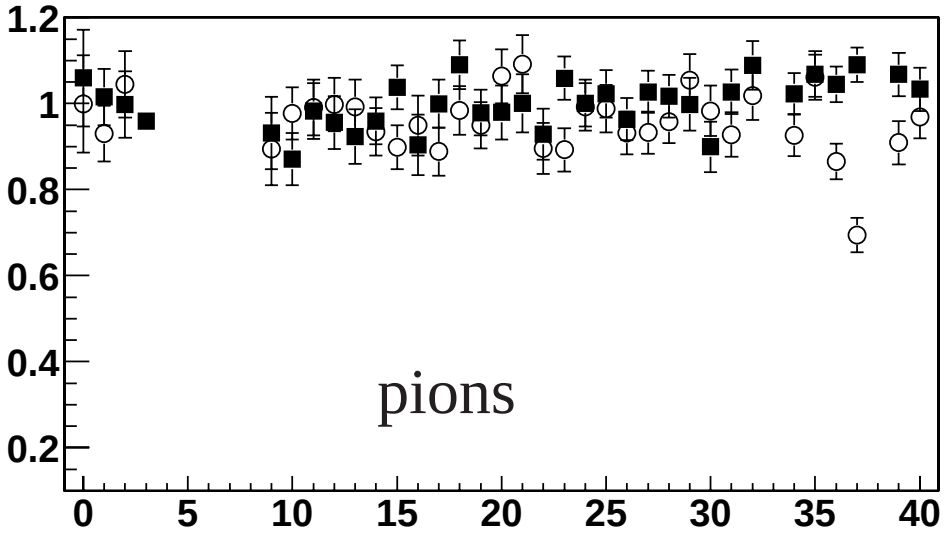
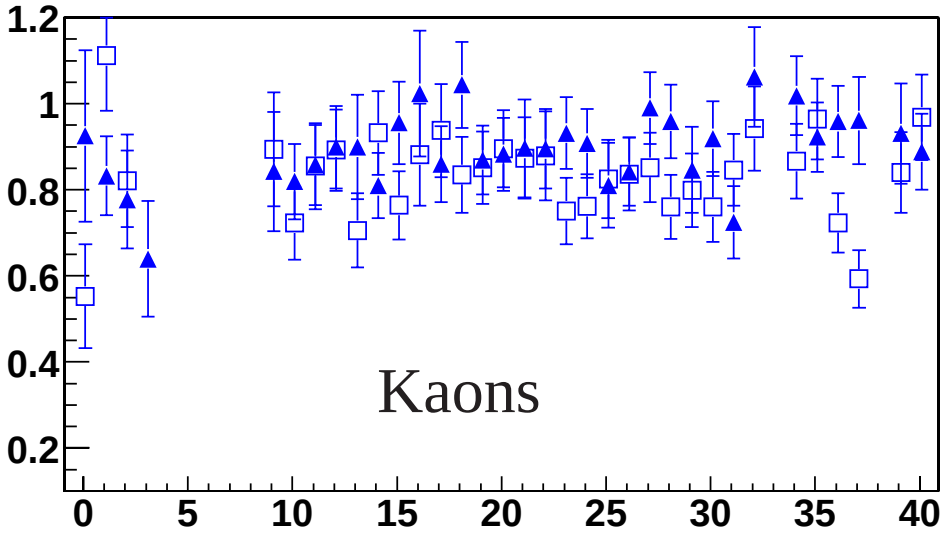


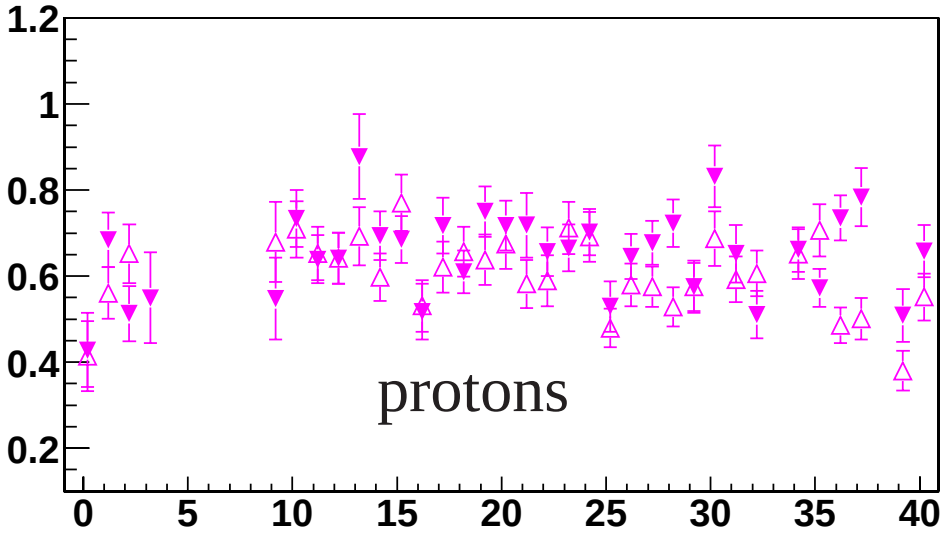
!!



uncorrected -/+ ratios for FFA (solid) vs FFB (open), **p>1.0 GeV/c**



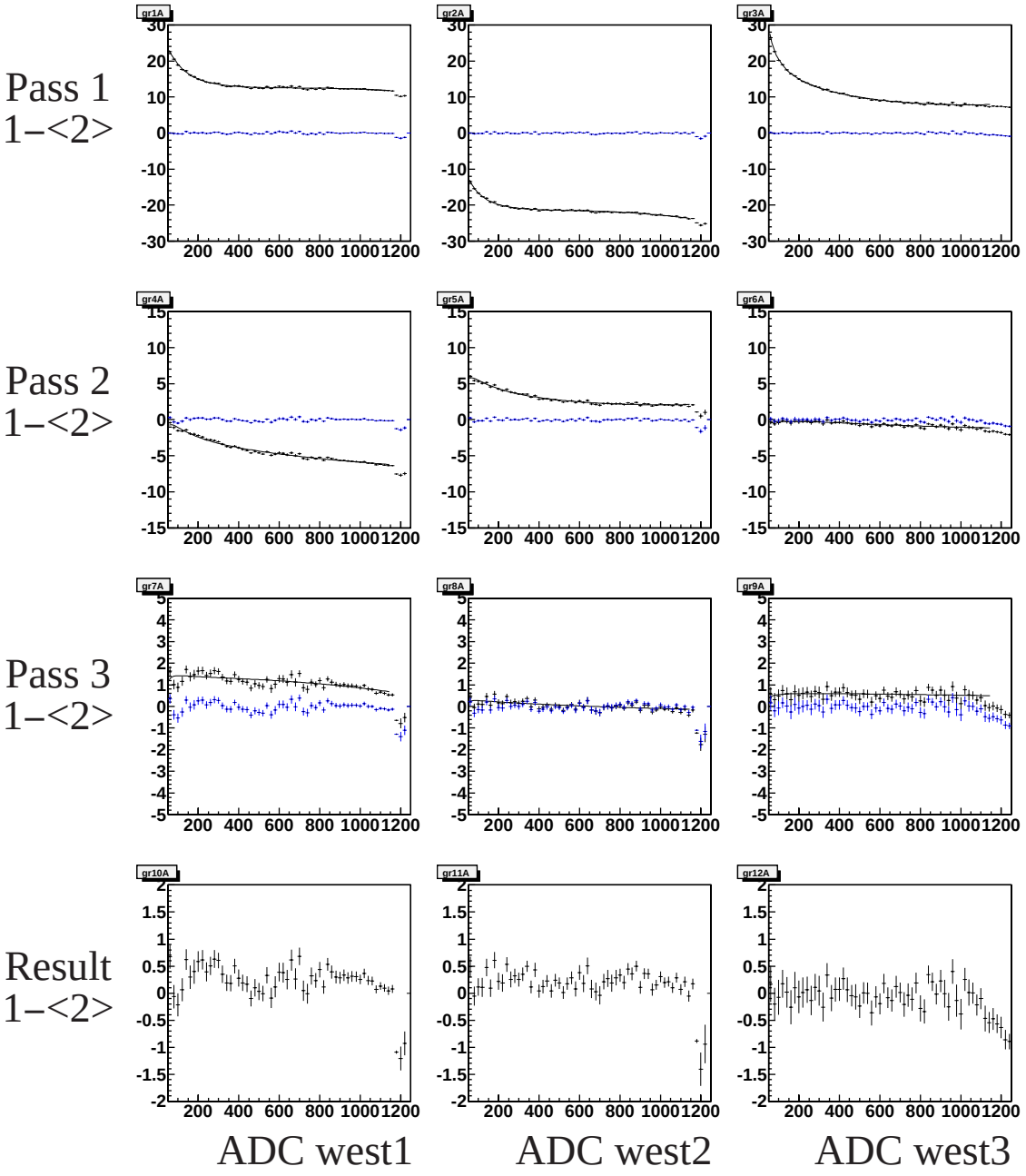




Min. Bias Data - Start Correction

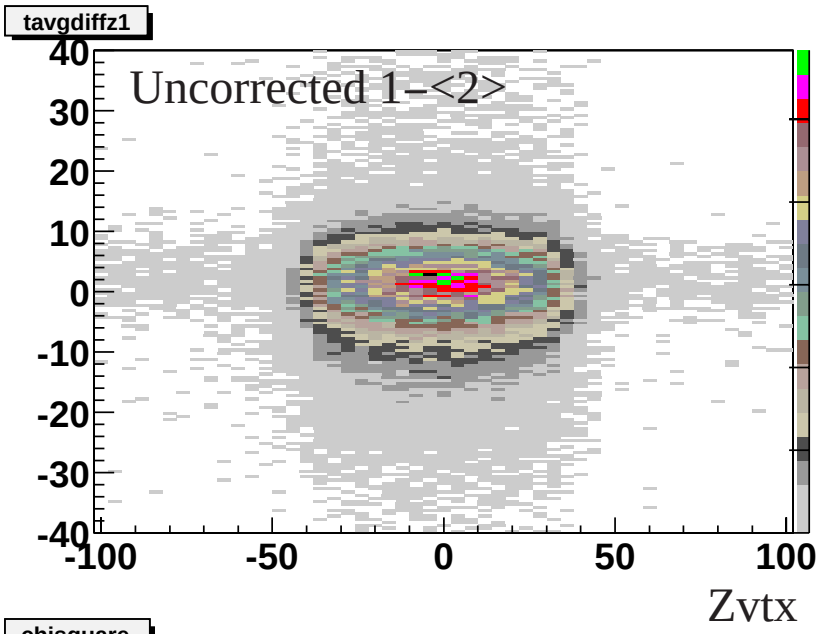
For most of our 2001 min. bias data, pVPD East was asleep (sigh).
→ Should still be able to do PID (now need to use Zvtx in Stop corrections)
→ Start correction can't minimize <2>-<4> "across STAR" any more....

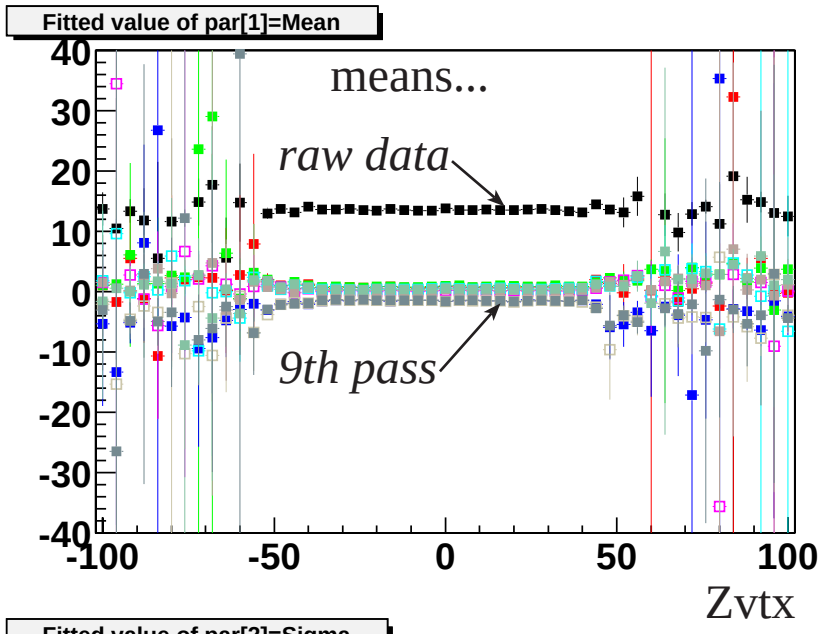
but *can* minimize 1–<2> "around the pipe"
as before 3 passes, each west ch is corrected vs. its ADC value 3 times....

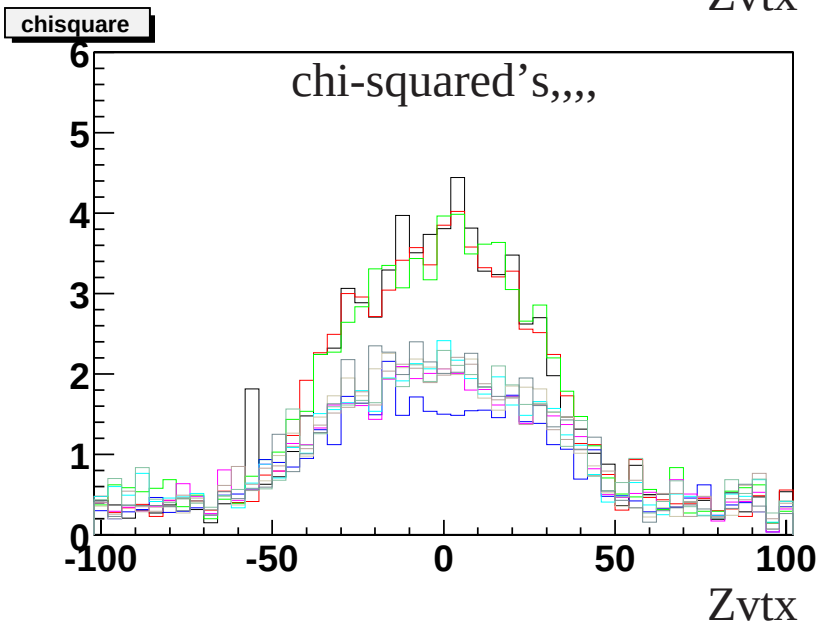


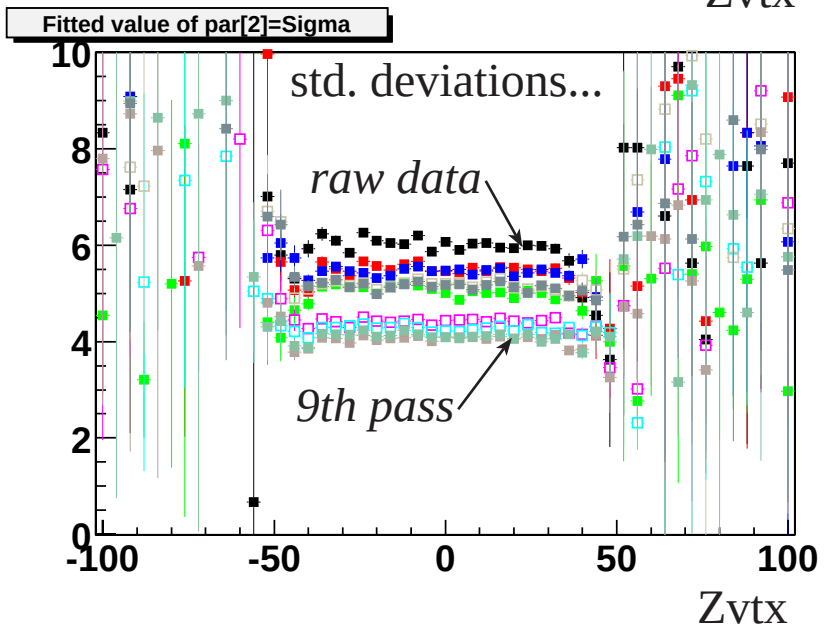
Factor ~20 improvement but **can still be better** obviously...
Advantage over <2>-<4> is each PMT is corrected individually!
→ provides a pVPD Zvtx measurement w/ full (corrected) resn...
→ need try this approach in the central Au+Au data & compare....

Performance of each pass of “1-<2>” method in min. bias data



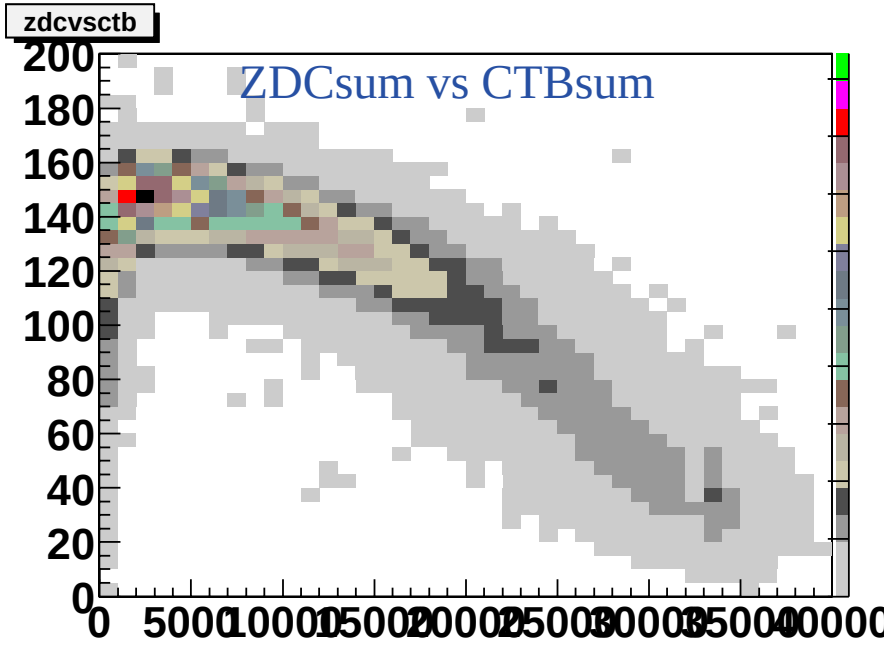


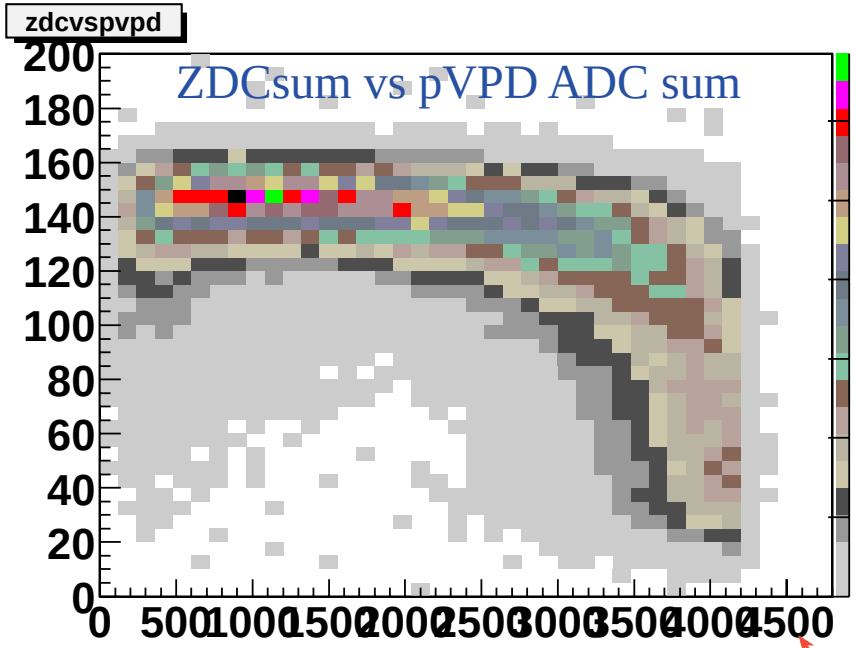


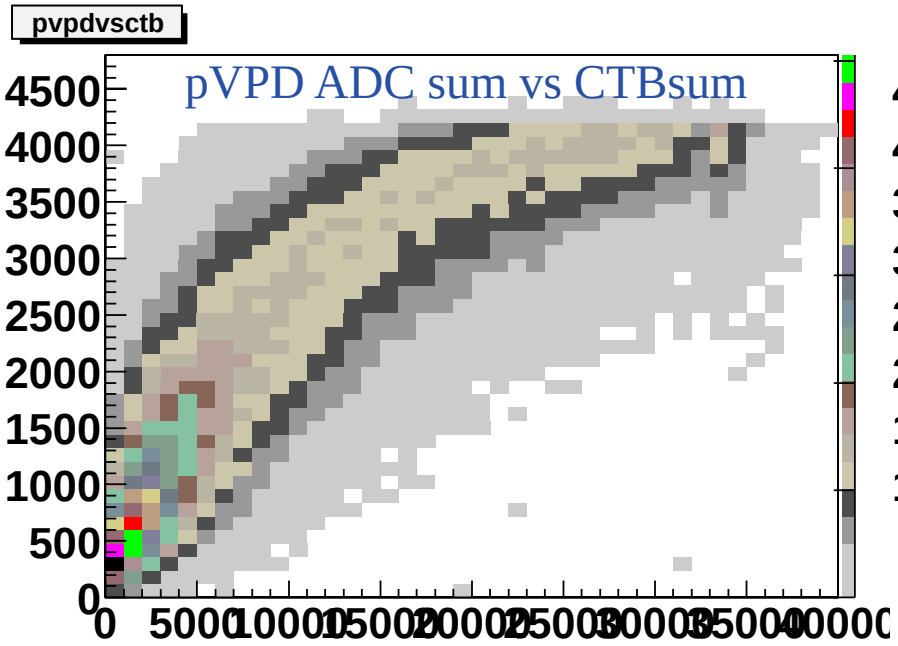


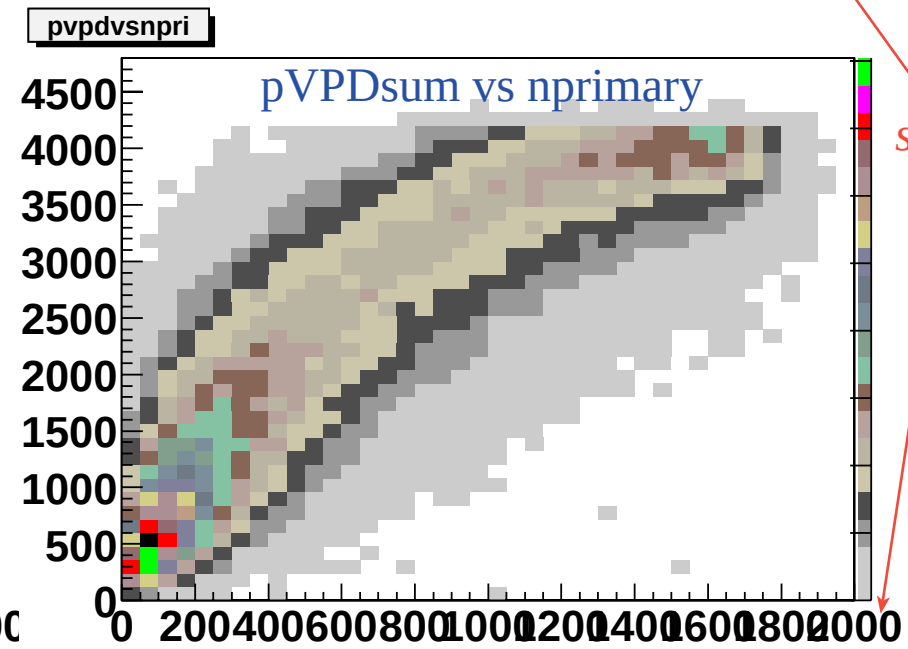
(all centralities included here)

“Centrality” variables.....



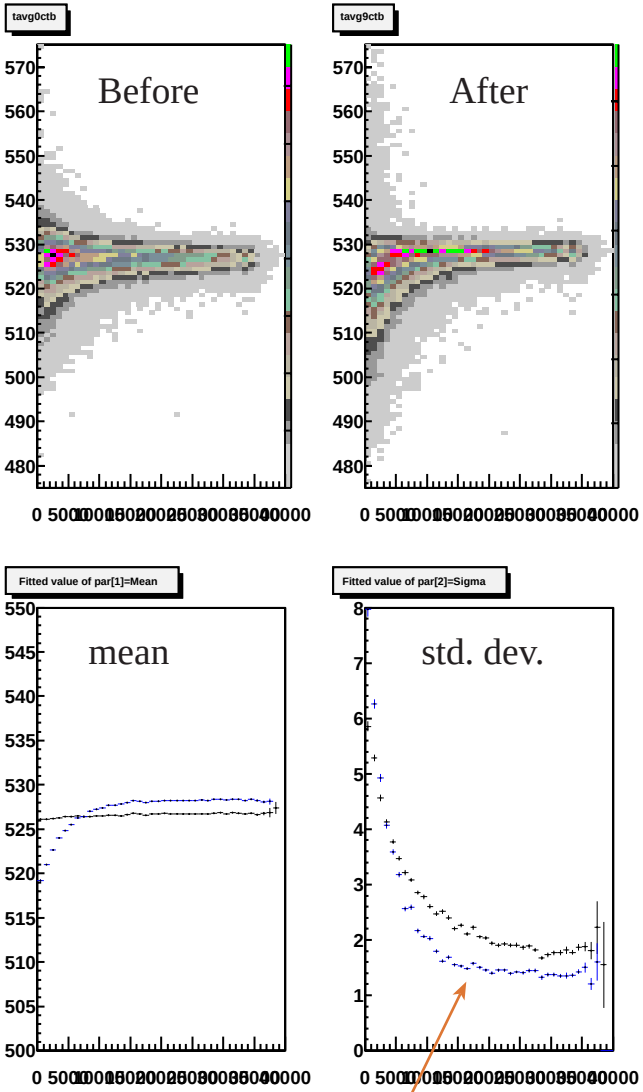




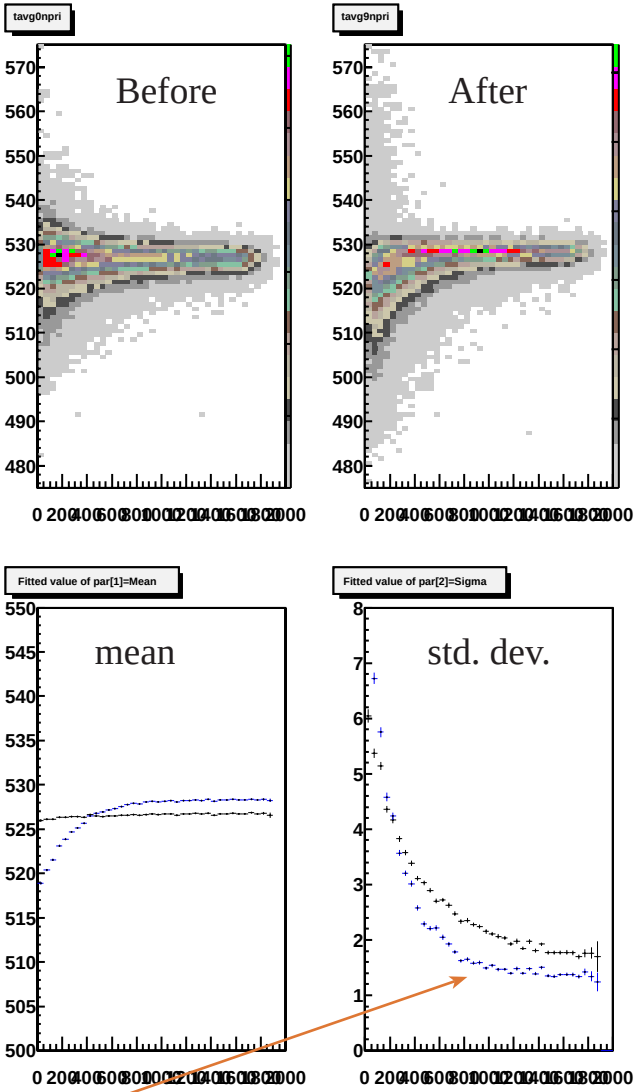


sorry!

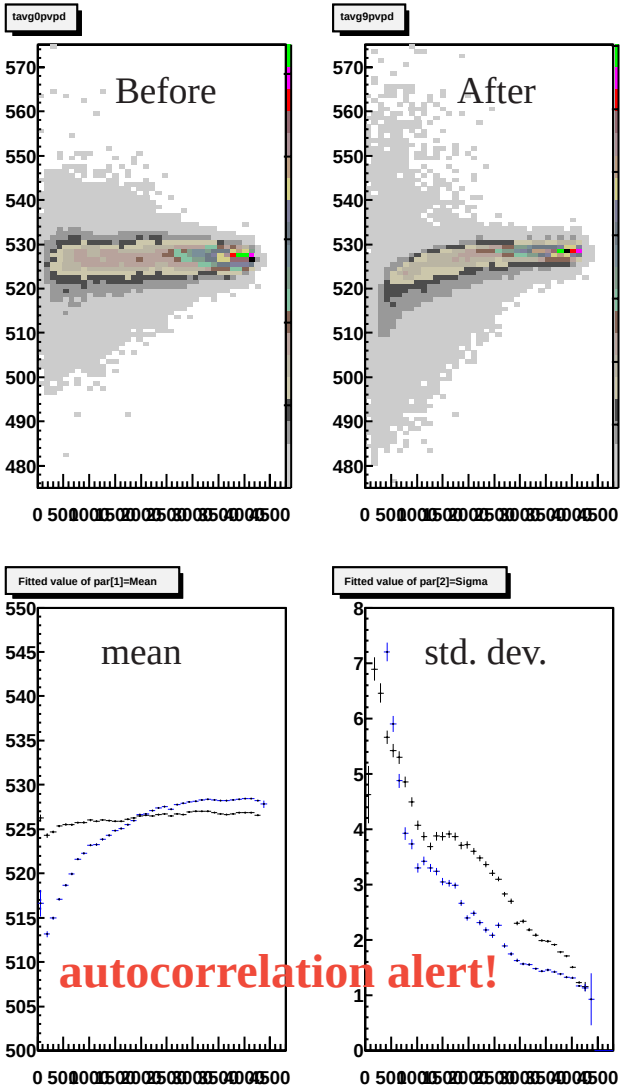
<3> vs CTBsum



<3> vs nprimary



<3> vs pVPD ADC sum



(black: uncorrected, blue: corrected)

Start resolution appears to remain at quite good for a wide range of the cross-section!!!

equivalent <6> → ~40ps
(*i.e.* 1-<2> Method can still be improved)

Joblist:

- Polarity issues in **-/+ ratios for p<1GeV** needs further investigation...
- need to **improve 1-<2> approach** for start correction in min. bias data set...
- need to apply on both sides of STAR in the (6ch pVPD) central data...
  compare to <2>-<4> approach
  extract Zvtx resn in these data using dual 1-<2> approach
- need to do stop-side corrections in the Au+Au min. bias data.
- TDC "ps/ch" calibrations need more work for both data sets ....

→ 2001 run Au+Au calibrations pretty much done at this point...

Then:

- Install counters and tabulate run number dependence of my calibrations efficiencies.
- Combine w/ efficiencies up to the N-tuple (from frank) obtained from counters and Embedding

→ first *Efficiency-Corrected* spectra and ratios from TOFp... (**#1 priority**)

Longer term (but in progress already):

- calibration of our **13M min. bias p+p** events, and **~200k min. bias ~20 GeV Au+Au** events...

This-coming run,
we'll have ~72 chs of TOFr data in addition to the TOFp/pVPD data.....
can use exactly these same calibrations approaches for the TOFr data...
(TOFr has similar slewing and Zhit smearing as in TOFp)