Issues on the RICH efficiency

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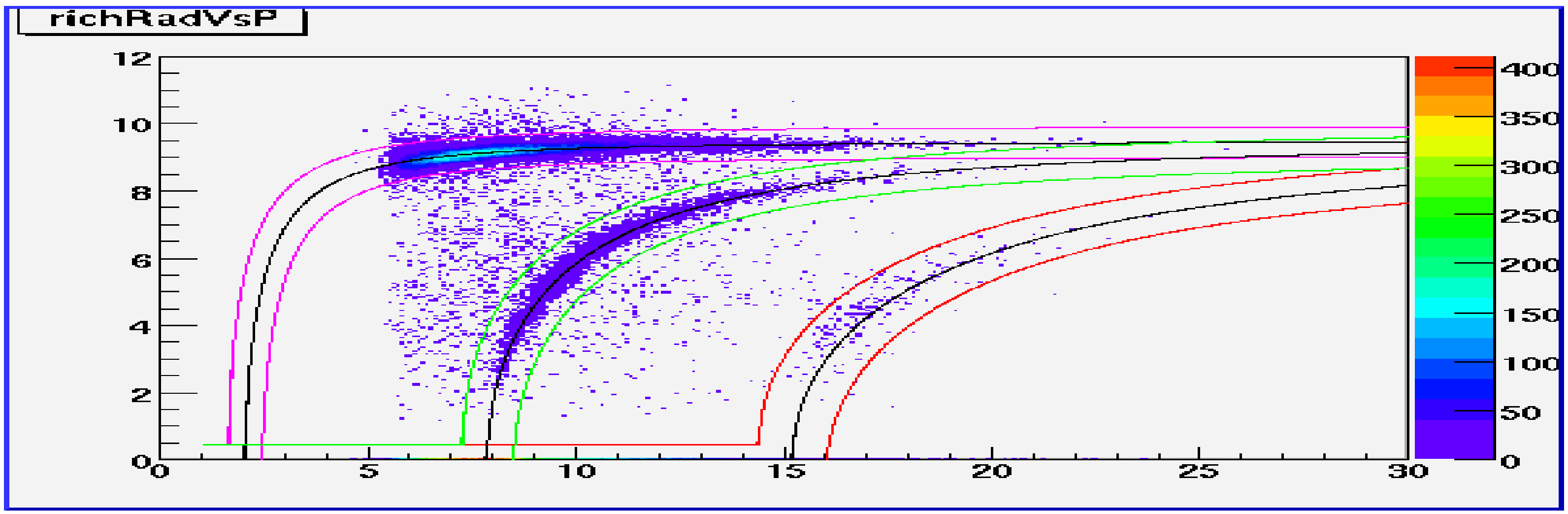
This investigation was inspired by e-mail exchanges with Peter who I believe first saw in mass-sq spectra that there must be a contamination of pion/kaons in the protons.

Rich effeciencies.

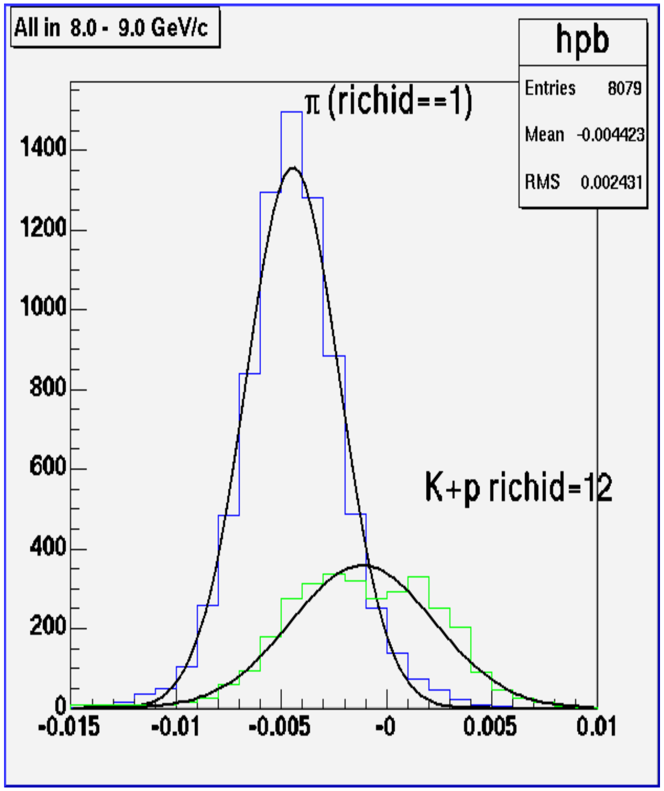
- The RICH operates in two mode
- Positive identification I.e. on a well defined radius vs. p curve. The issue here is how many are lost due to
  - Ring finding efficiency

    Too small number of p.e. in a ring
- As a threshold counter I.e. identifying protons by having NO signal in the range p>Pth(Kaon) < Pth(protons) ~ 10 to 16 GeV/c. The issue here is how many other tracks results in no ring radius I.e. some of those comes from the pions and kaons not identified.



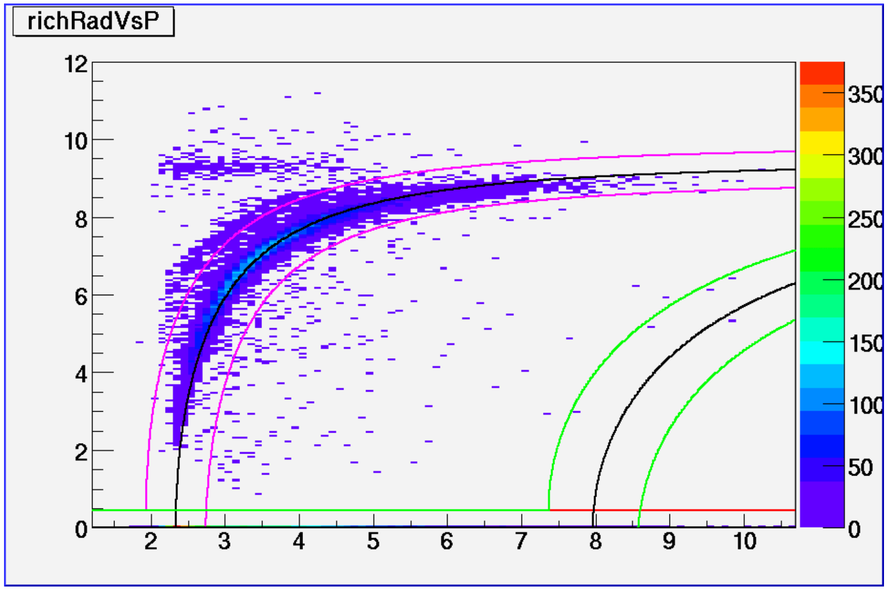
Using H2 t.o.f to identify contamination

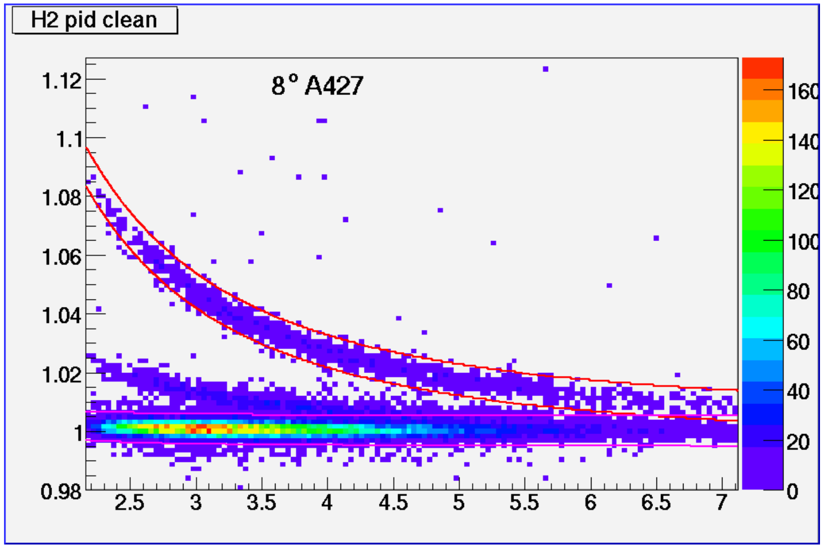
- At low p there is a clear separation from the time spectra from H2. Plotted here is the quantity 1/beta-1/beta(proton) where the second term comes from evaluating based on momentum. This is plotted for particles where left is richpid==1 I.e. pions, and either kaon/protons (below threshold for Kaons [richpid==12])
- Note the double hump structure in the k-p indicating both species seen here as should be)



Method check at low p..

- Just to confirm the methods to be looked at for high P consider a low field setting where both pions/kaons etc are well separated in both rich and timing.



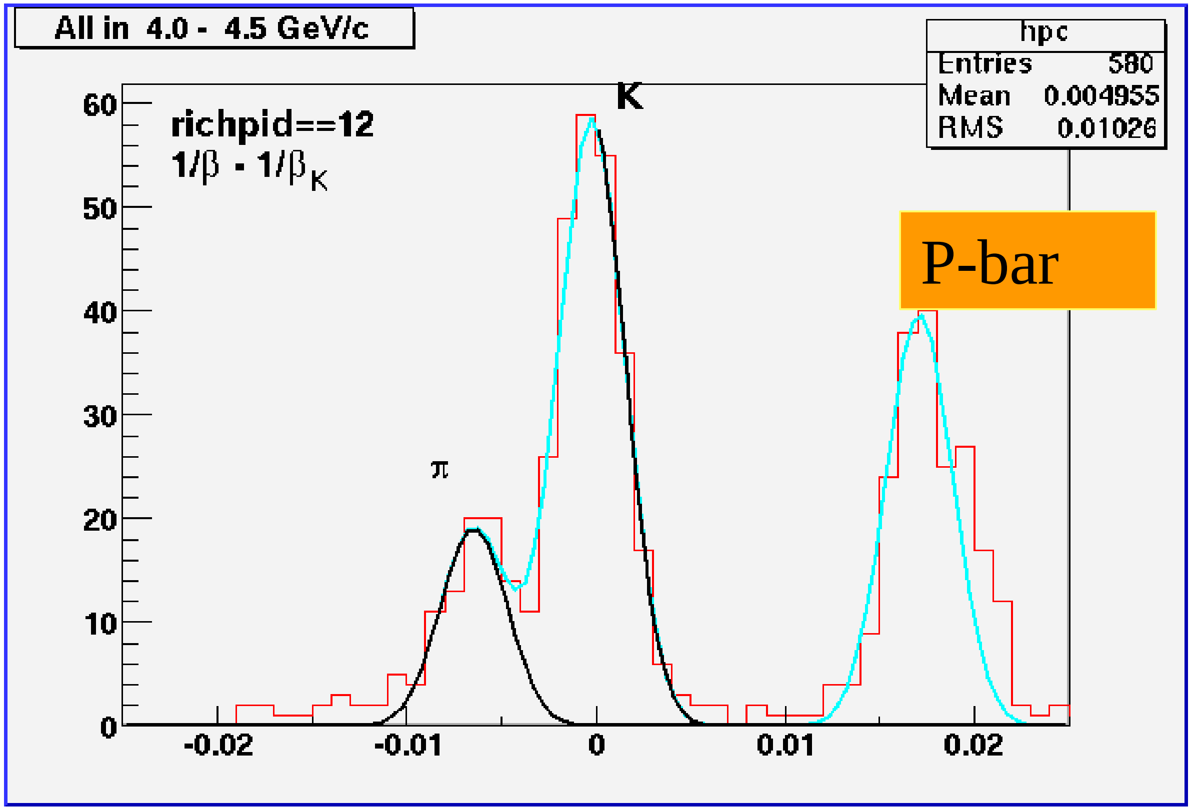


Checks

Richpid==12 means p>p_{cut} and richrad=0 I.e. no ring found.

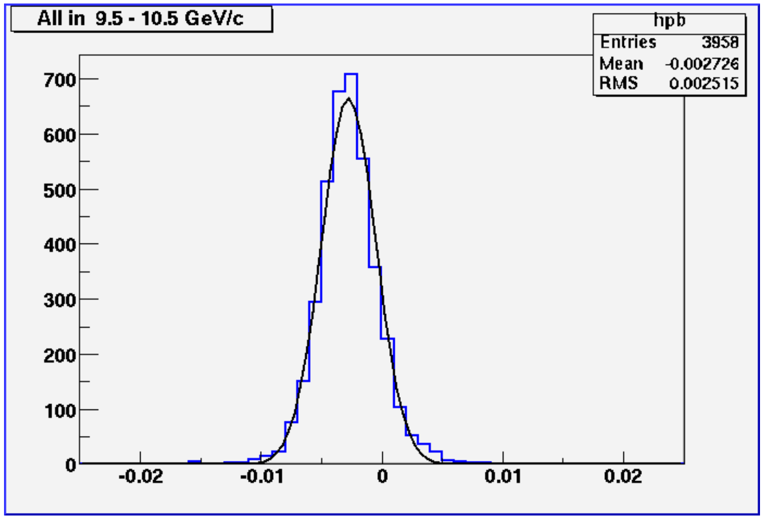
The degree of pion cont is ~ 3.2% as determined from fitting I.e 3% of pions ends up as looking like vetoed (p/k)

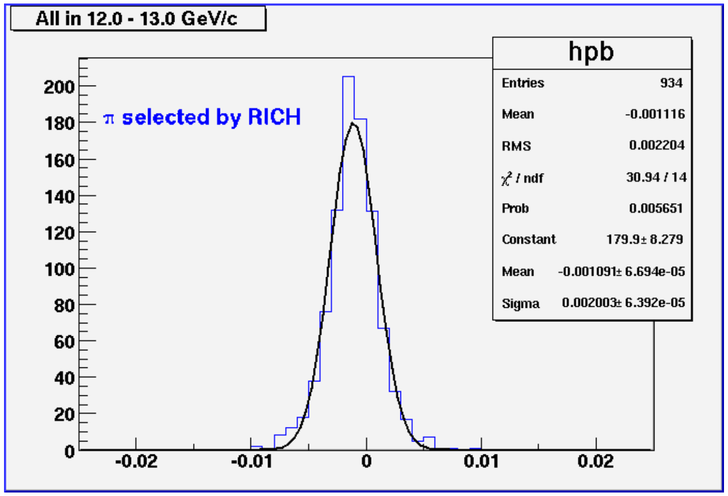
This setting is for p-bar favored.



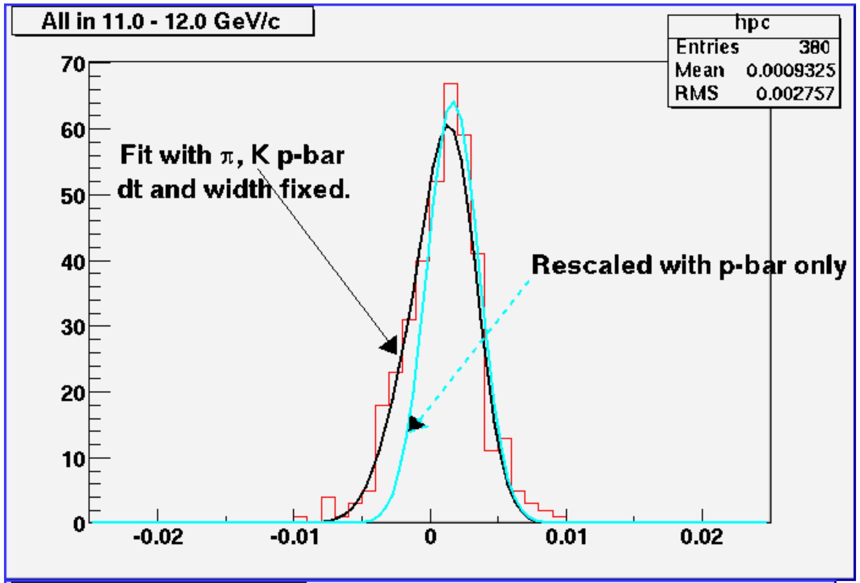
1/beta – 1/beta(p)

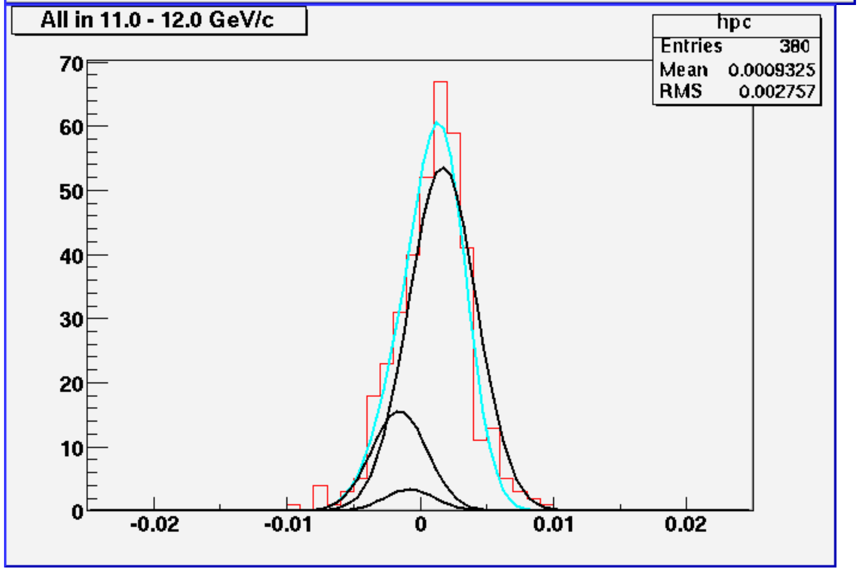
- Apply this method for higher momentum settings.
- Timing for well identified particles (pion's)
- Two examples 9.5-10.5 Gev/c and 12-13
- At all setting this quantity is almost Gaussian, and the width stays essentially constant with p! (dominant resolution is the dt).





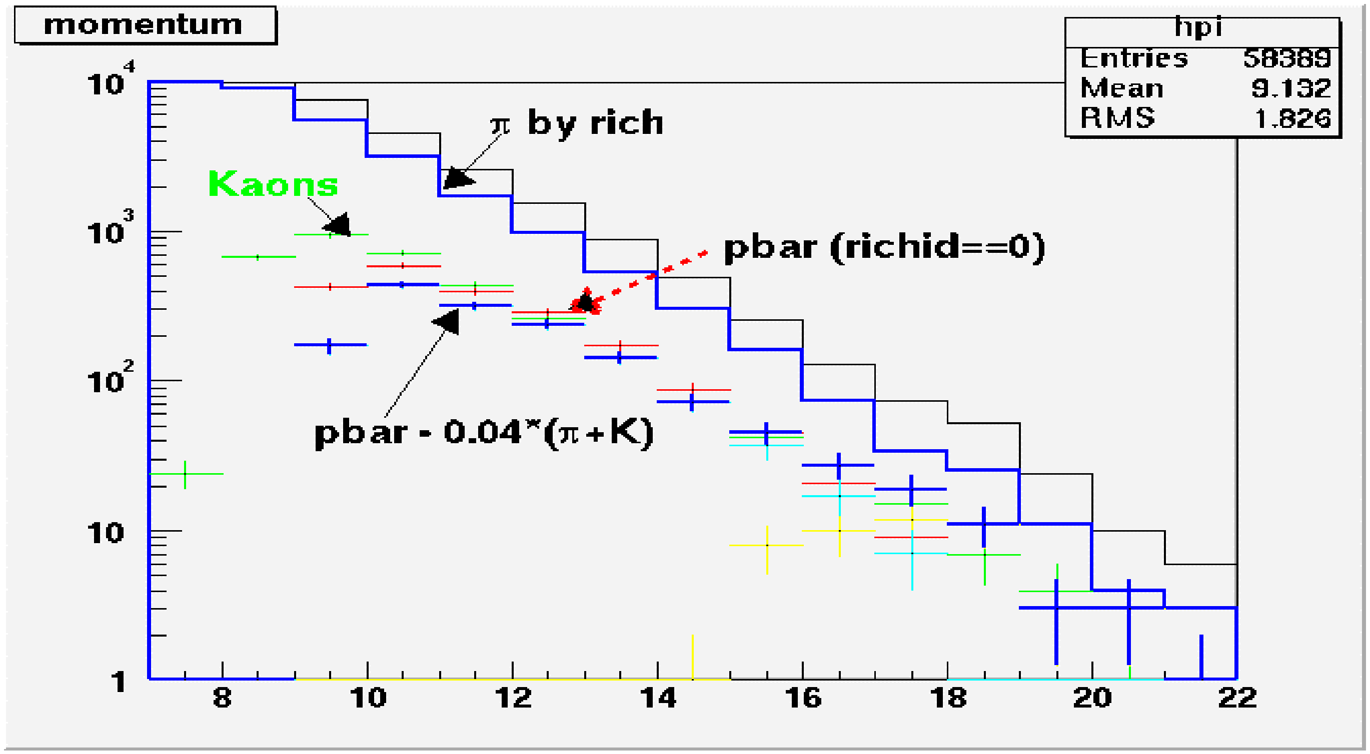
- Iterative analysis. Fix Kaon cont to ~5%.
- Look at negatives I.e pbar; for protons this is quite difficult to determine.
- Calculate position of K,p relative to that of pions which can be easily fitted
- There are some small calibration problem the protons are not centered at 0, but does not change with momentum. This is related to HOW the pid curves are defined (fits) in the bdstDataCut program.





Corrected spectra (for this effect only)

- 4 deg 1124A setting. The p-bar spectrum for richpid=30 is the red ie as is called p-bar so far. The Blue curve is the p-bar corrected for pion + kaon contamination.
- The change is significant ~20-30% at lowest momenta (in otherwise not efficient and acceptance corrected spectra)
- The change in corresponding proton spectra is in order ~4-5% at lowest range, a much lower effect.



Summary

- The in-efficiency in proton Pid with rich is important since pions/kaons identified by RICH do appear to have ‘no rings’ in RICH. This can be due to absorption in H2, decays,..)between H2 and RICH.
- A back counter would have been a wonderful device to confirm tracks after RICH.
- The correction is ~3% , but may be setting dependent (or rather run dependent (background?)).
- The correction is much smaller than the (1-eff) applied to particle ID with PS method (85-90%). (see PID plot some pions probably ends up as grass).
- Others have to figure out how to implement this for final cross sections – this is not a track by track dependent , or centrality dependent correction correction but requires knowledge of **yield** of pions, kaons at given momentum and theta.
- Note: after discussion another issue was brought up; how many particles may end up as ‘electrons’ with a full size ring due to delta-electron knockout in material from H2-RICH