Pi/K Ratio Analysis Plan

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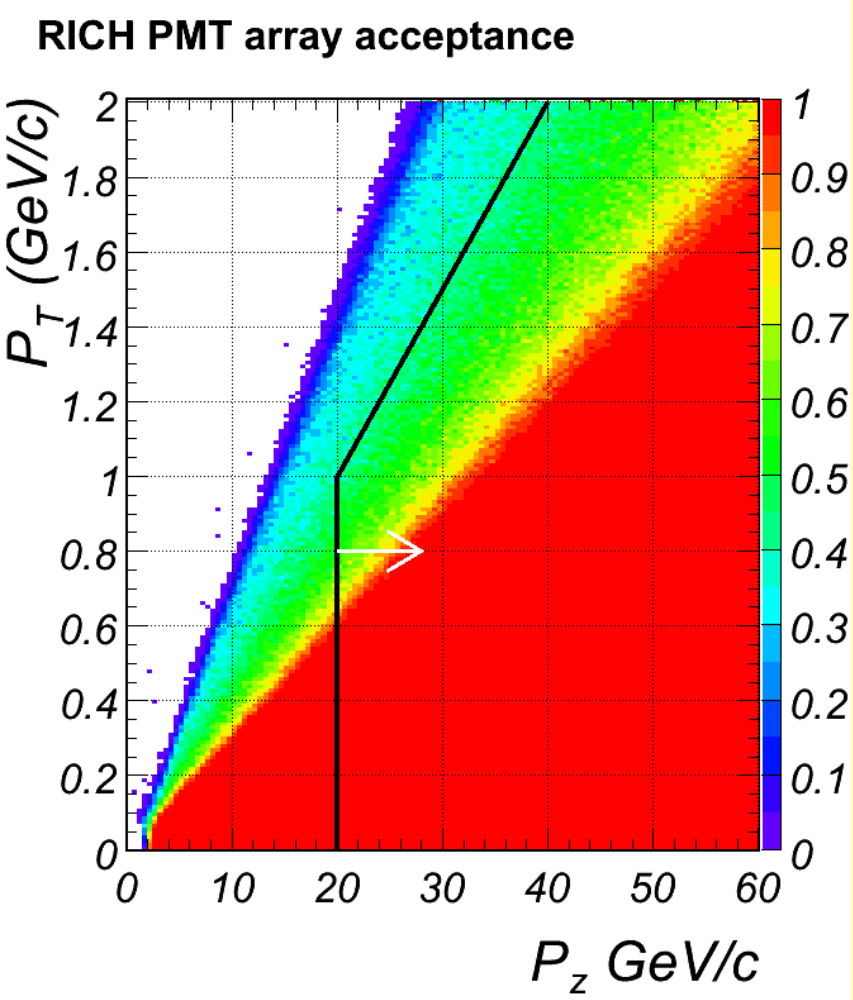
The Big Picture

- The measurement is K/π production ratio above 20 GeV/c using RICH for particle ID
  - Determine four ratios: K^+/π^+, K^-/π^-, K^-/K^+, π^-/π^+
    - Divide by variable with more statistics
- Data is to be binned in p_z and p_T
- $p_z > 20$ GeV/c is chosen so as to stay away from K threshold
- Previous relevant measurements:
  - Carbon: Barton et al measurement at 100 GeV/c (12 points)
  - Beryllium: SPY at 450 GeV/c and Atherton et al at 400 GeV/c (9 points)

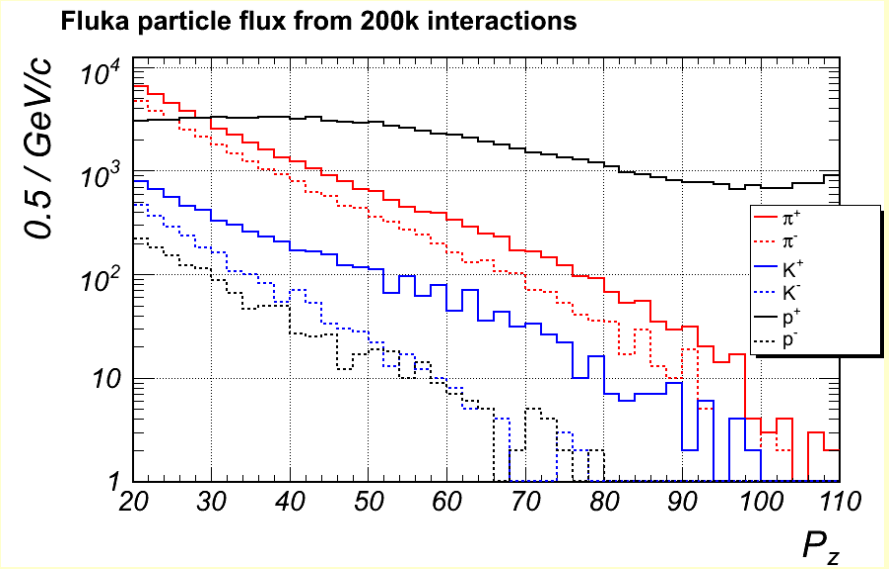
Geometric Acceptance

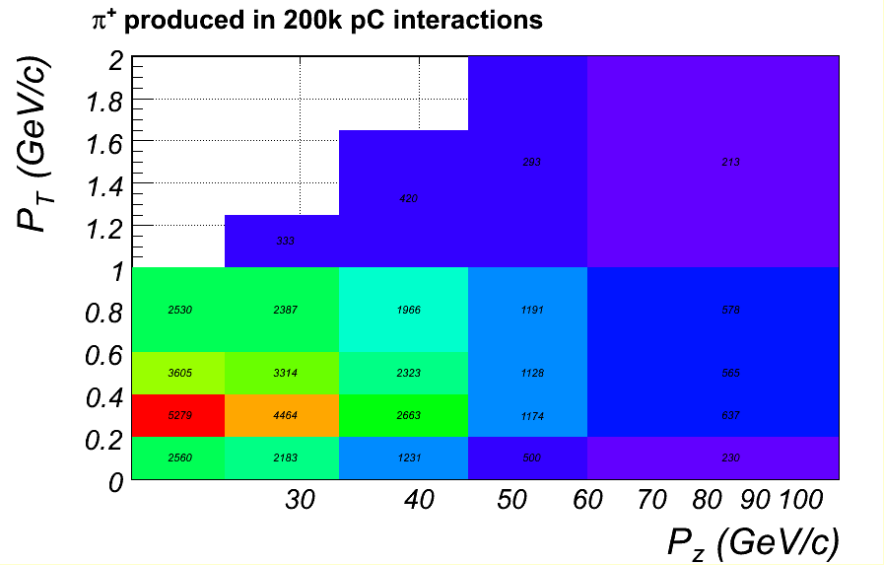
- Largest constraint on acceptance is whether ring center lands on PMT array
- I expect K ring radius of ~15 cm at 20 GeV/c, so I want the ring center within 5 cm of PMT array
- Take data where geometric acceptance is above 50%
- PWC6 acceptance is larger



Data Binning

- The goal is to have a 3-10% statistical error in each bin if possible
- I use Fluka to simulate 200k interactions in 2% carbon target
- Cutting out bins with <50% acceptance, I propose the 24 rectangular bins based on π^+ distribution





Corrections

- The following correction need to be applied (in order of decreasing significance)
  - Interactions in the spectrometer: ~13.5% of protons interact before the RICH
    - In addition ~10 % of particles that go through the RICH flange (rather than window) will interact
  - Decay in flight: ~10% of 20 GeV/c kaons will decay before the RICH
    - Not relevant for K^-/K^+ and π^-/π^+ ratios
  - Multiple scattering: should not matter much given bin size
    - Except hard-scattered protons which create background for K+

Corrections (cont.)

- Interaction trigger efficiency
  - Multiplicities of events with kaons and pions may be different
- Reconstruction efficiency
  - Track-finding efficiency should cancel
  - Incorrectly pulled in particles from decay of neutrals
- Interactions in the scint counter: may do target out subtraction
- Re-interaction in the target: ~1% softening of the particle spectrum
- Electrons from primary target: <1%
- Pileup: cleaned up, reduces statistics

Corrections (cont.)

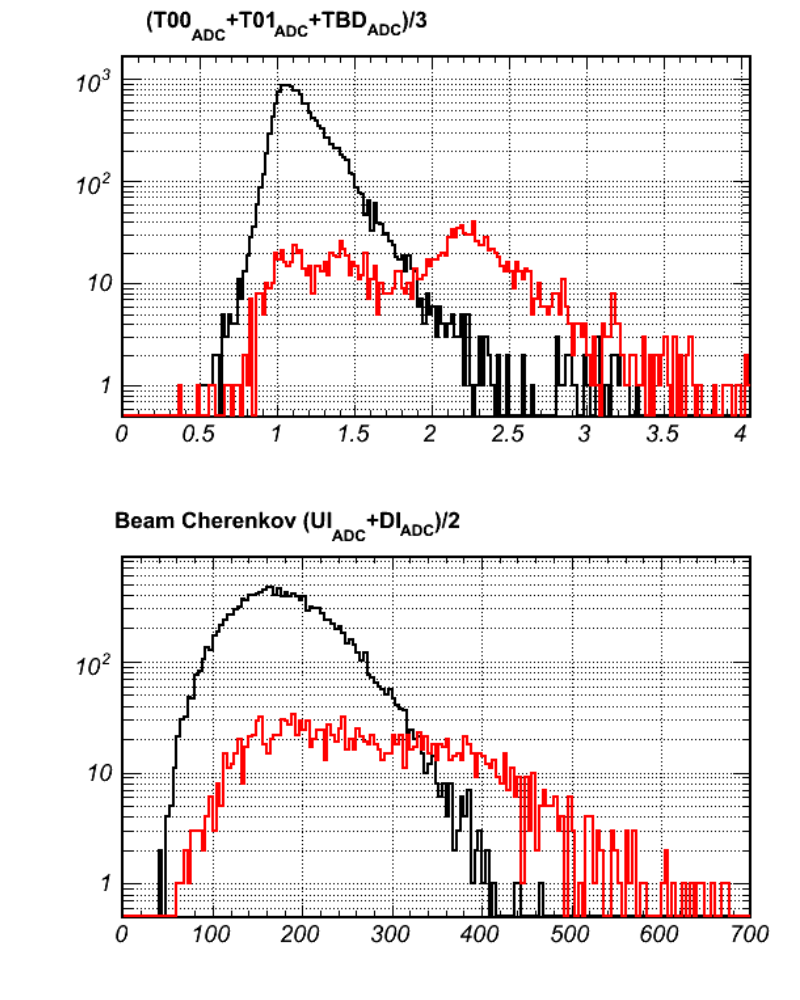
- Most corrections will be extracted from e907mc
  - $p \rightarrow K^+$ scattering
  - $K \rightarrow \pi$ migration in decays
  - Confusion from interactions in the spectrometer
  - RICH reconstruction efficiency
- From Fluka we get
  - Target re-interaction
  - Electron contamination

Analysis Path

- Measure interaction trigger efficiency using min-bias data of Be/Bi/C combined
  - Expect ~1500 interactions in the sample
- Calibrate RICH for each subrun using proton rings
- Fill mass squared histograms for each bin
  - Weigh particle based on trigger efficiency for event multiplicity
- Count the particles (may fit for the 3 peaks and background)
- Apply corrections derived from Monte Carlo

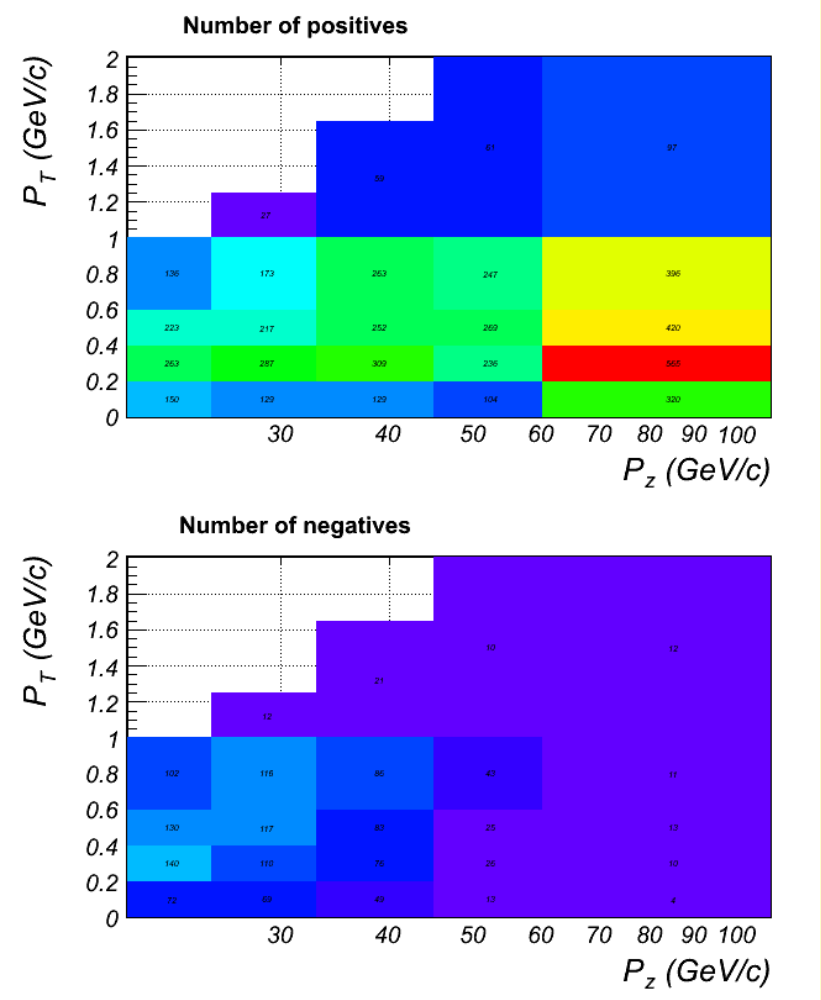
Progress so far
(plots from latest 15860 DST)

- Pile up code is pretty much ready, based on TPC dE/dx of beam tracks (doc149). Strongest variables:
  1. Out of time tracks
  2. Average charge of T00/TBD/T01
  3. Average charge of BCkov ADC's
- RICH R0 calibration is ready to go



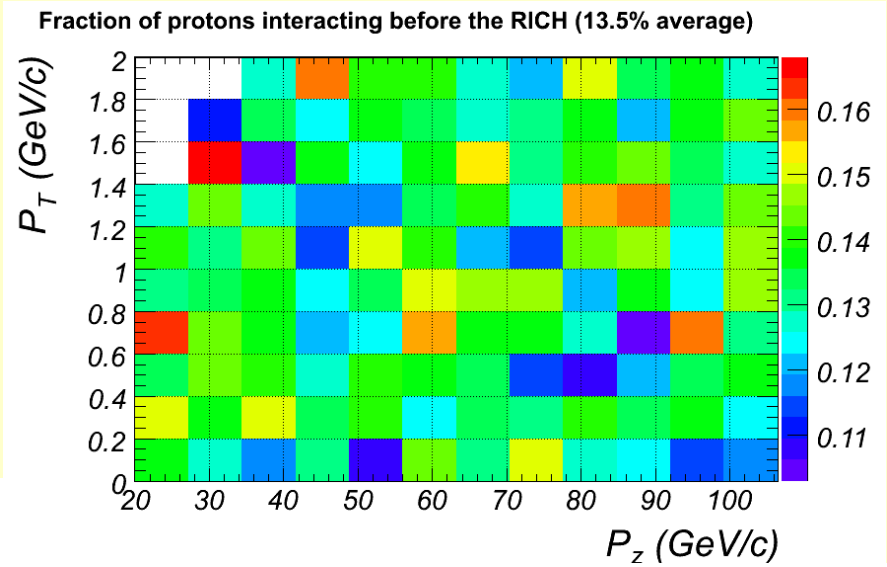
Progress (cont.)

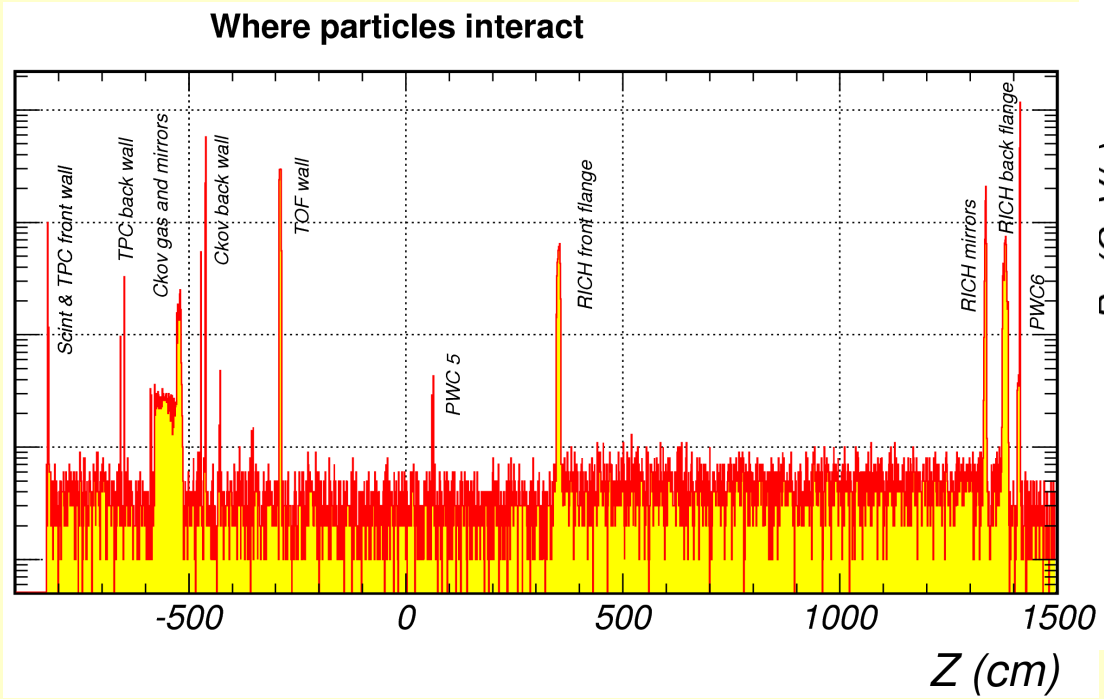
- Data binning exists, run 15860 is ~10% of carbon statistics
  - I'm surprised by a factor of 2 less statistics than I was hoping for
- Digitization and reconstruction of Monte Carlo works
- Waiting for tagged release for pass 4 and MC

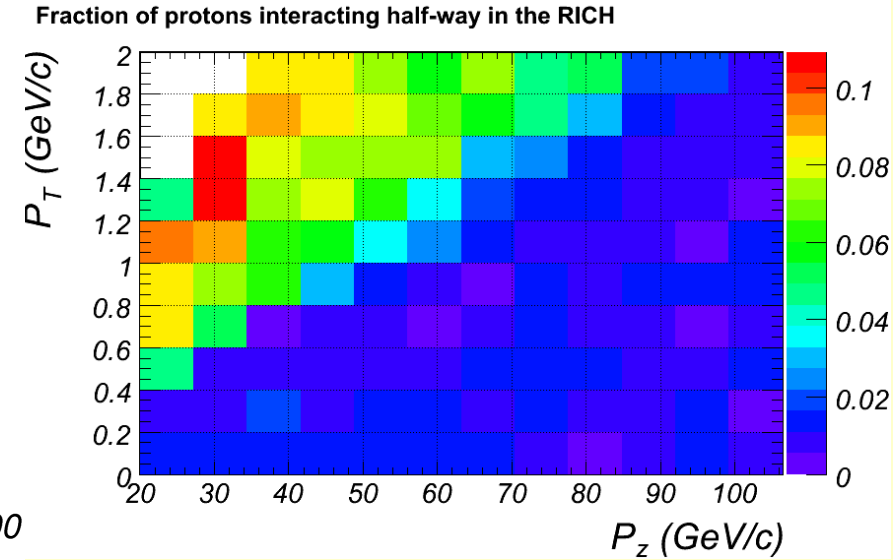


Interactions per GEANT 3.21

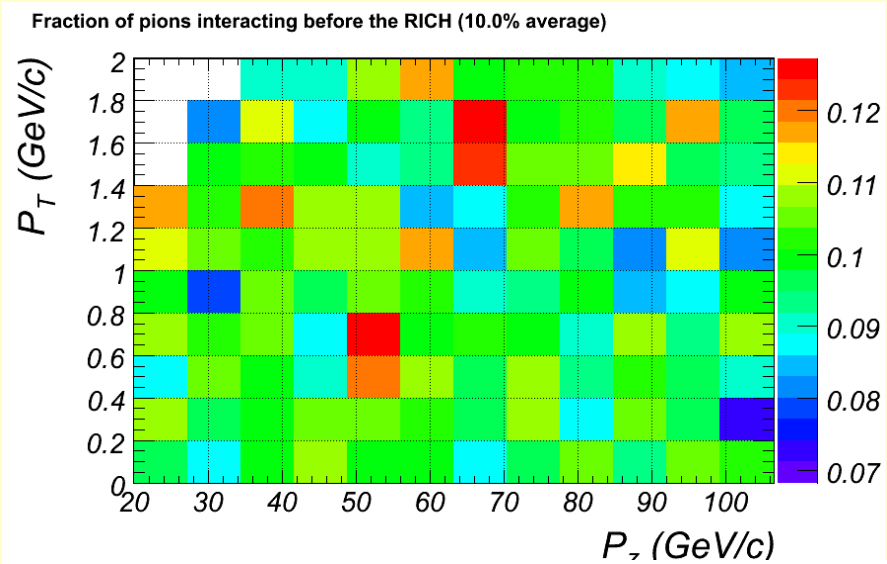
- The problem is that π and K have different interaction lengths and create different particles when they do interact

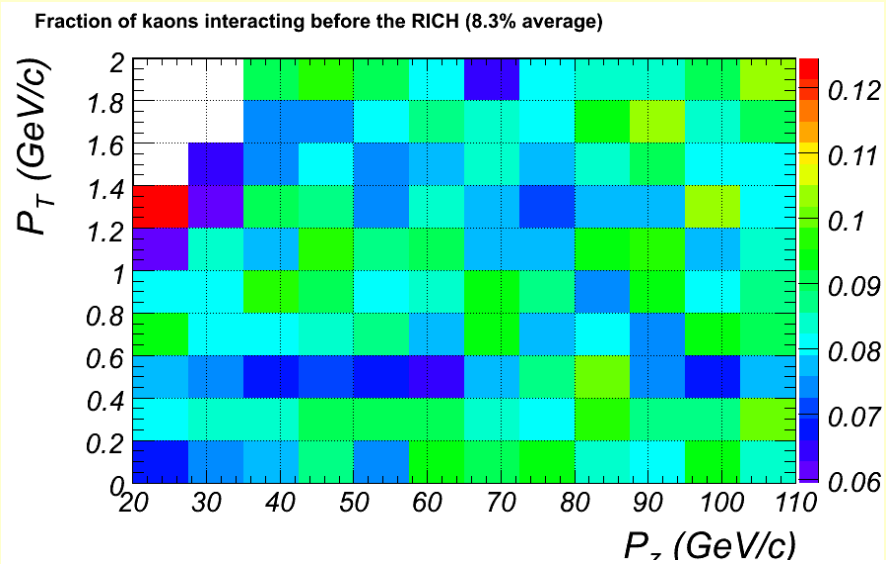


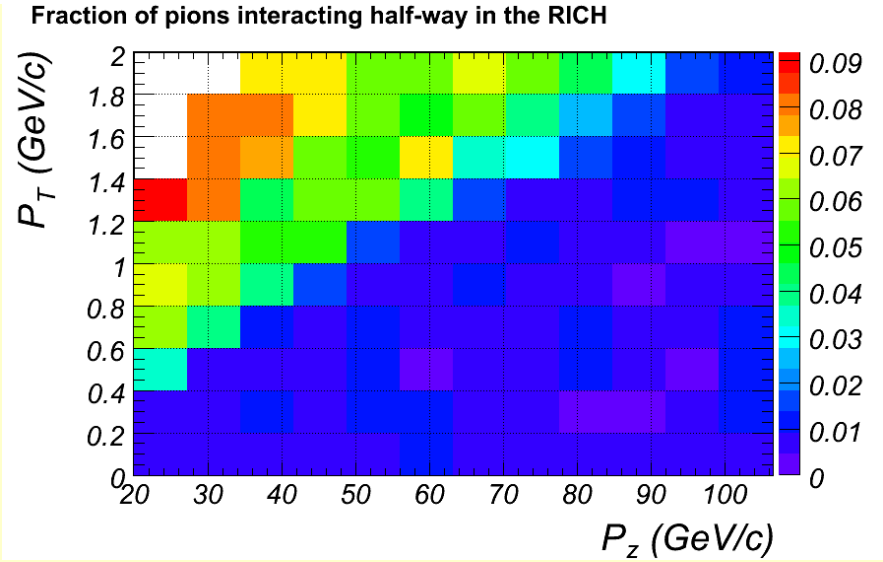


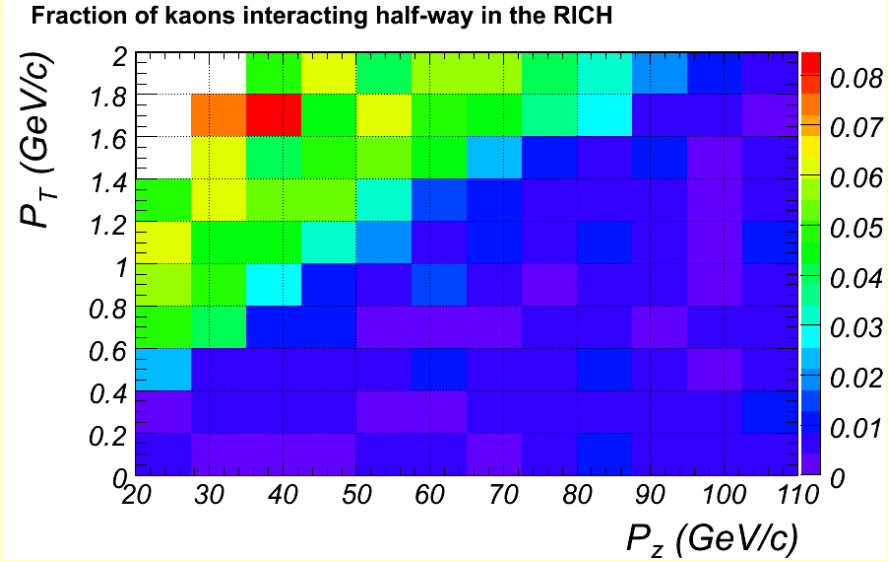


Interactions (cont.)



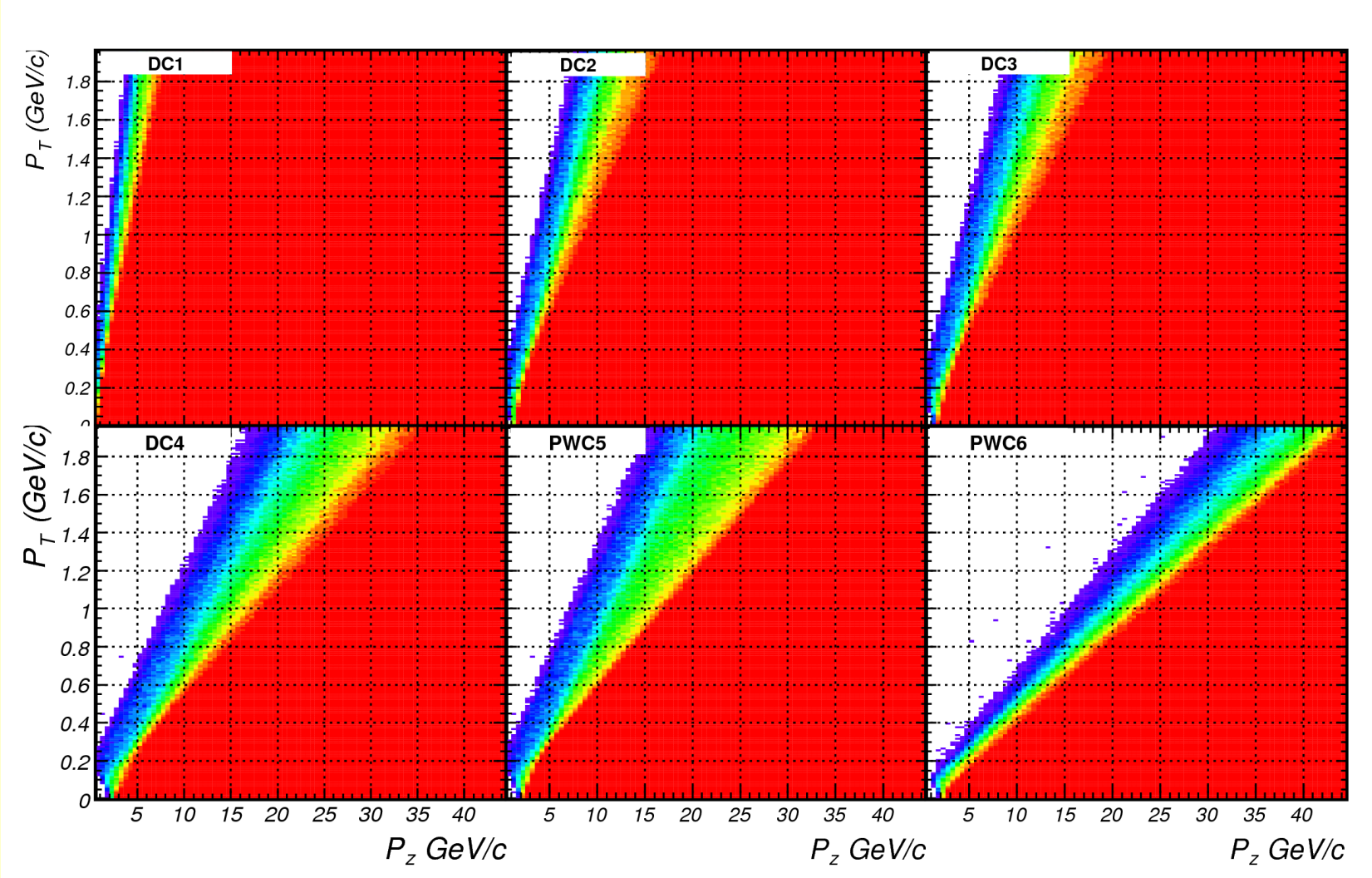




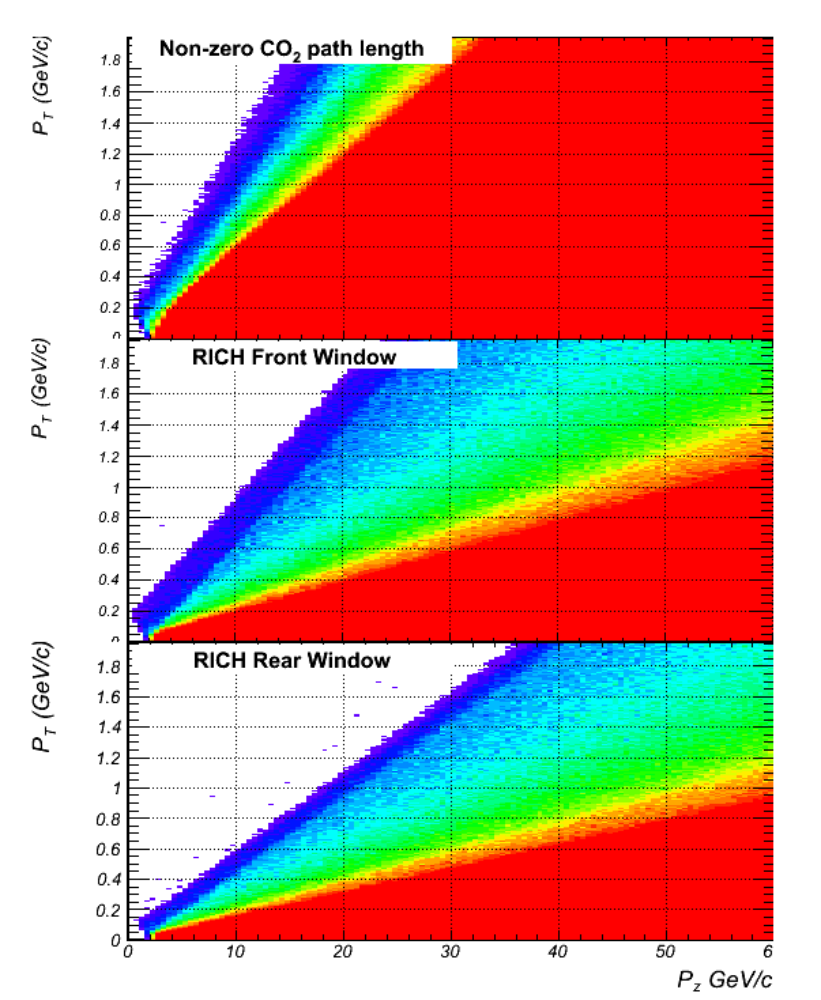


Chamber Acceptance

(Require > 1 wire hit, multiple scattering included)



Acceptance of RICH windows



- These plots show that
  - Not all particles that enter the RICH can be detected by PMT's
  - Acceptance of the windows is far from ideal