Event-by-Event Fluctuations of Particle ratios

- Status Report -

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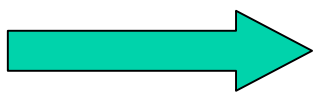
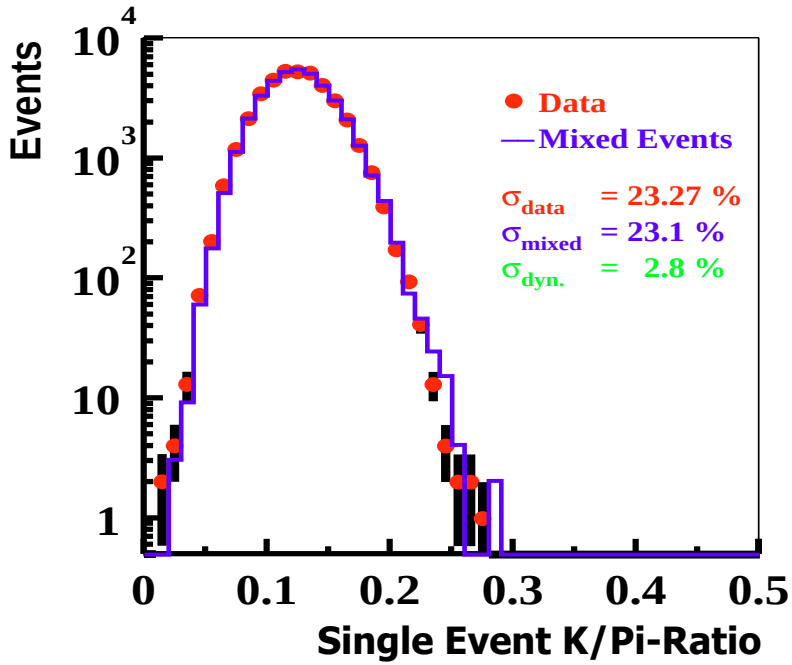
What we want to do…

- Mareks horn suggests a phase transition observed in the K/pi energy scan
- Do energy scan of the event-by-event K/pi fluctuation analysis

Done and published so far only for 160GeV Pb+Pb



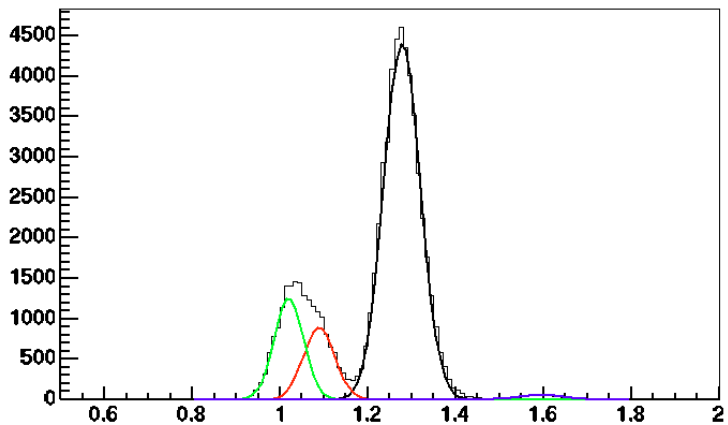


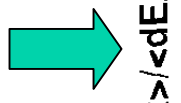
How its done

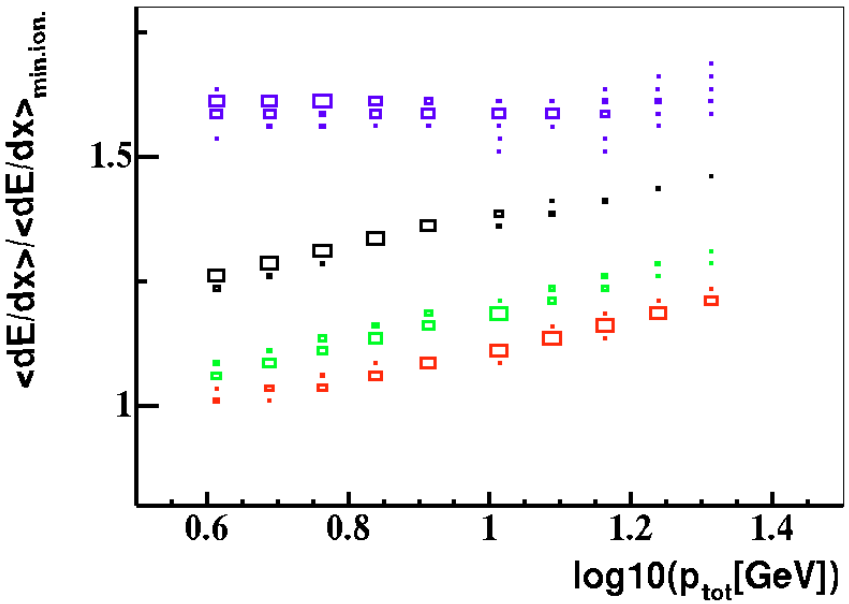
- Need an estimator of the e-by-e K/pi ratio
  - **Derive a Probability Density Function (PDF) from the total data ensemble**
  - **Use this in a maximum likelihood fit to estimate the e-b-e K/pi ratio**
- Remove effects of finite number fluctuations and experimental resolution to obtain the dynamical fluctuations
  - **Compare the e-b-e K/pi distributions to mixed events**
  - **The difference in width of data and mixed events tells us about dynamical fluctuations**

The PDF

- We fit the dE/dx distributions of the whole data sample in bins of charge, p_{tot} , p_T, phi

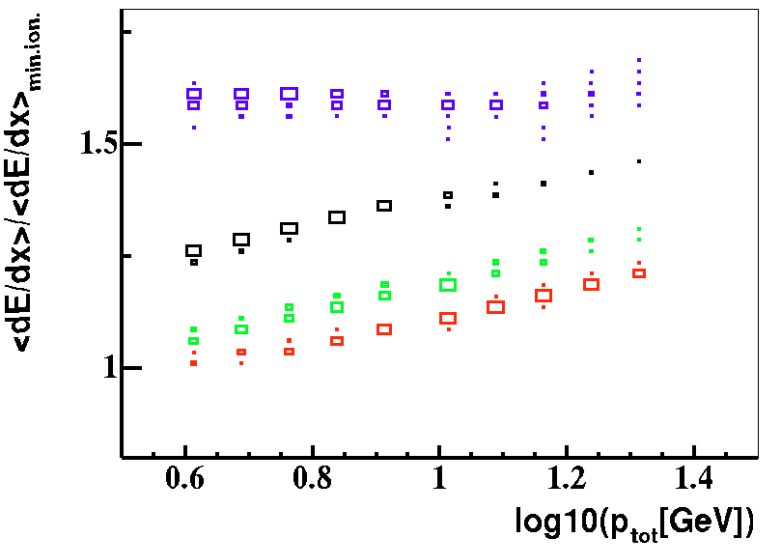


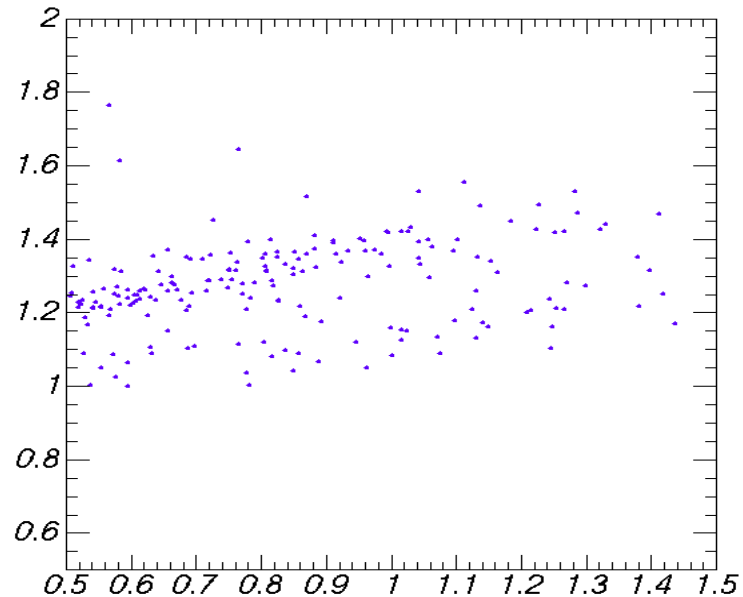




- Store fit results (positions, amplitudes, resolution) for each bin in a lookup table.

The Max Likelihood Fit





- Assume a K/pi ratio
- Set the relative normalization in the PDF
- Calculate the likelihood of measuring the given event
- Iterate and maximize the likelihood

Whats New?

- Use global dE/dx
- Now we also fit the Proton/Pion ratio.
  - **Was fixed to ensemble average @ 160GeV**
  - **High p/pi ratio gives nice convergence**
- Knowing the number of particles and K/pi and p/pi ratios we can estimate the absolute yield of each particle species event-by-event…

Statistics

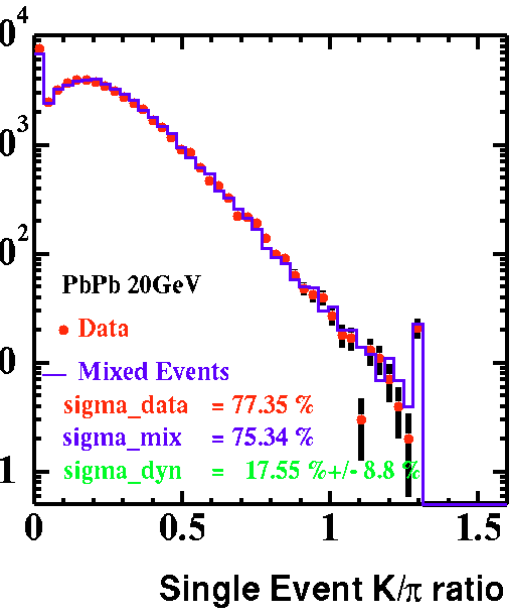
Track cuts:

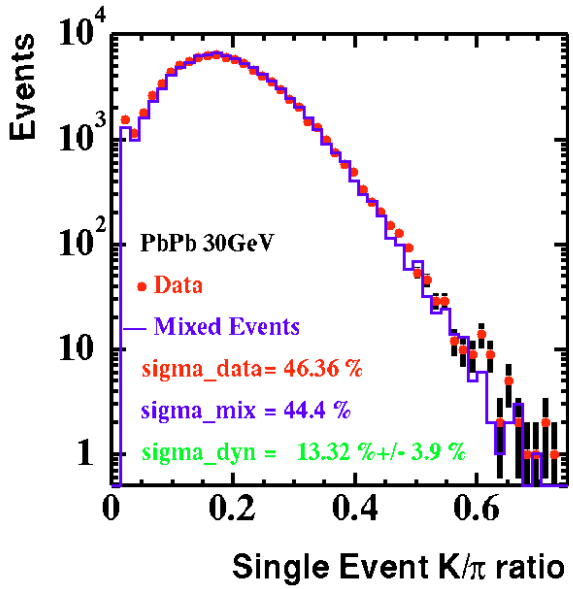
- **>30 points in MTPC**
- **Found point/ potential points >0.5**
- **Track within fitted bin in the PDF**

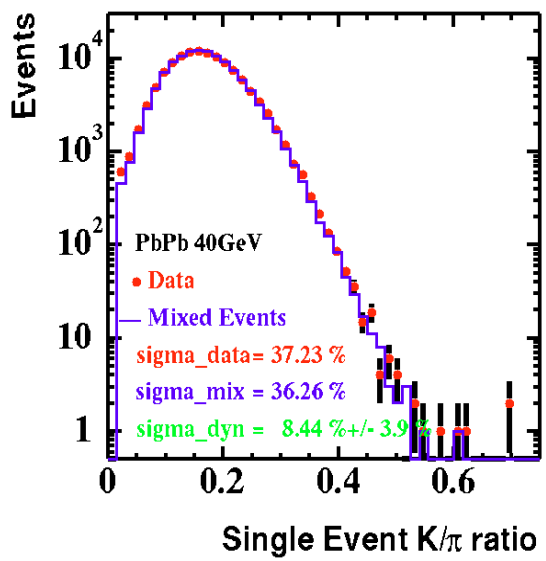
Statistics

- **20 GeV ~ 50k Ev. ~ 50 Tracks/Event**
- **30 GeV ~ 90k Ev. ~100 Tracks/Event**
- **40 GeV ~120k Ev. ~150 Tracks/Event**

The very first results on K/pi

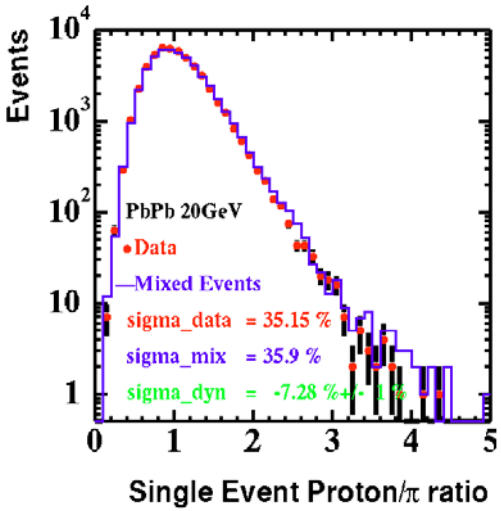


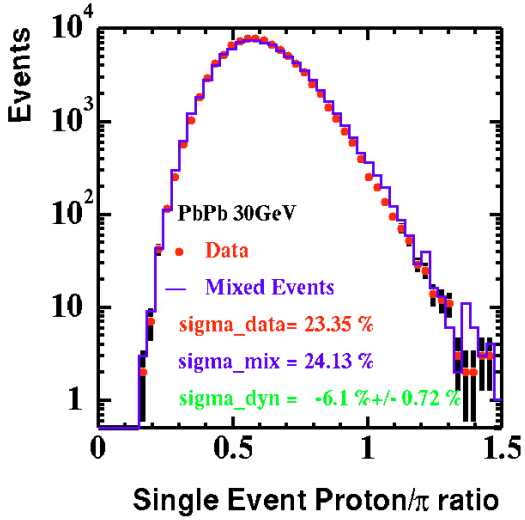


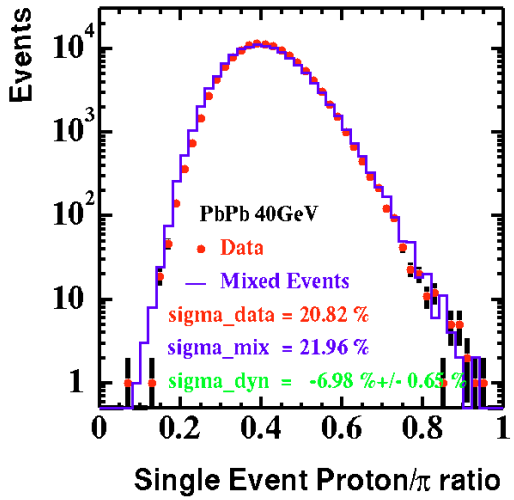


- The distributions are much wider than @ 160 GeV due to the low event statistics.
- But we see significant signal of dynamical fluctuations!
- Signal is increasing to lower energies.

Results on proton/pion

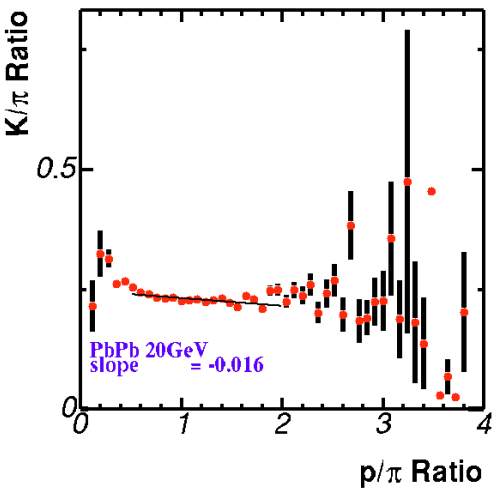


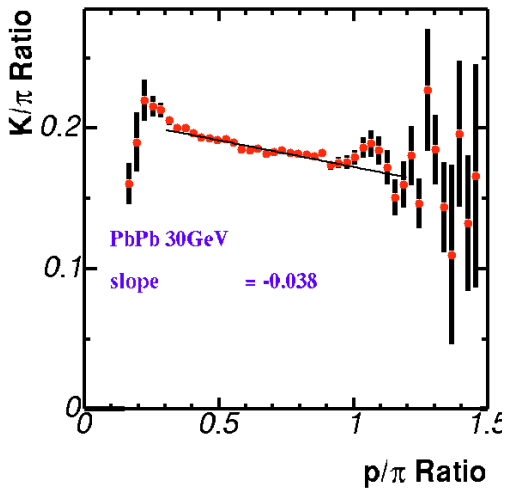


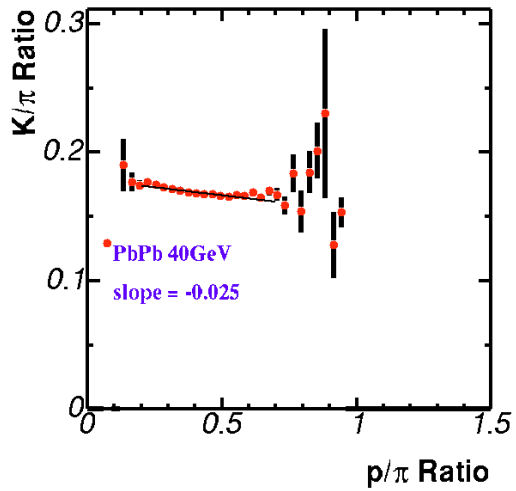


- The e-by-e proton/pion ratio for data is narrower than the mixed event distribution

Are K/pi and p/pi correlated?

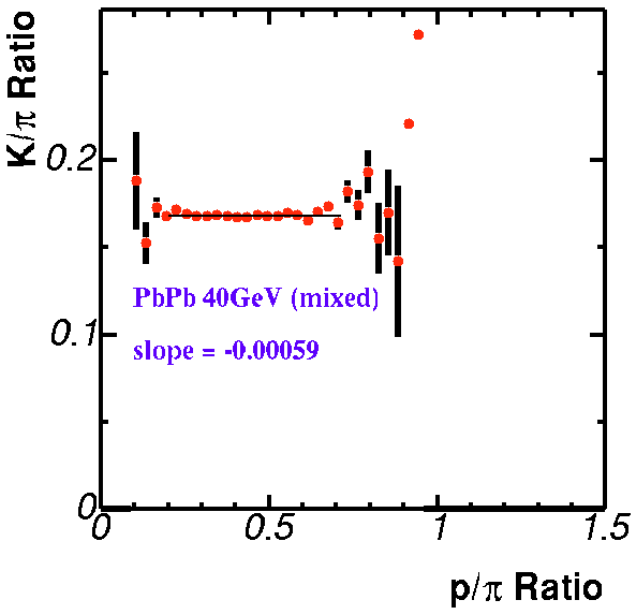


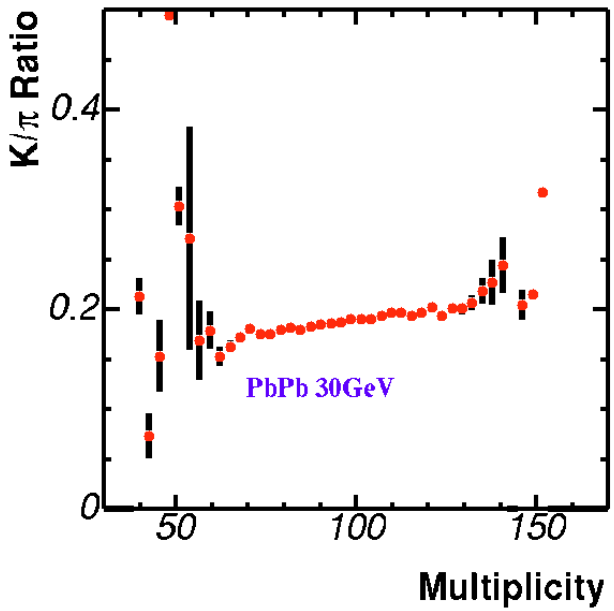




- K/pi and p/pi are correlated

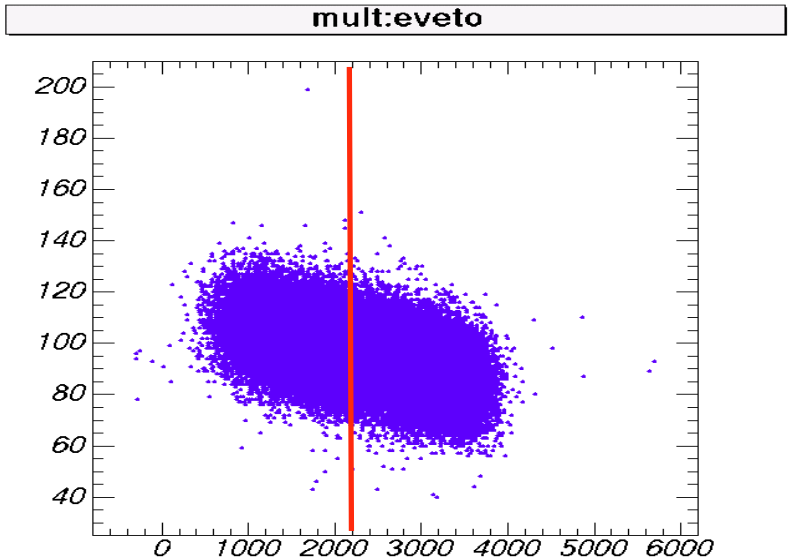
Some systematic checks…





- The K/pi vs p/pi correlation is not present in mixed events.
  - Not an artefact of the method!
- Within the 7% central trigger sample we still see a dependence of the K/pi ratio on event multiplicity.

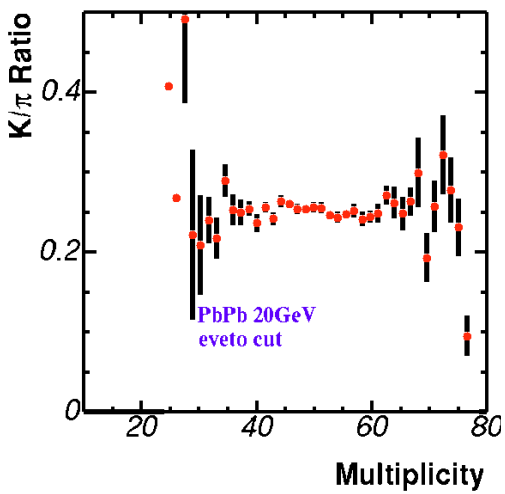
Tighten Centrality Selection…

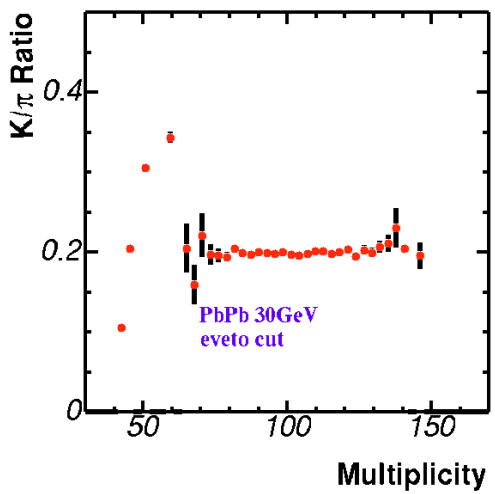


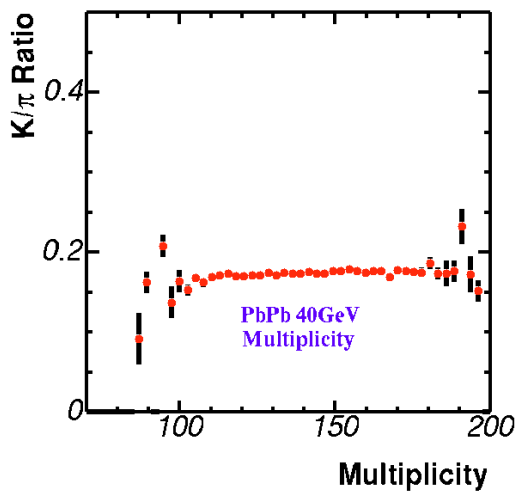
Tighten the veto energy cut:

- Reject about half of the events

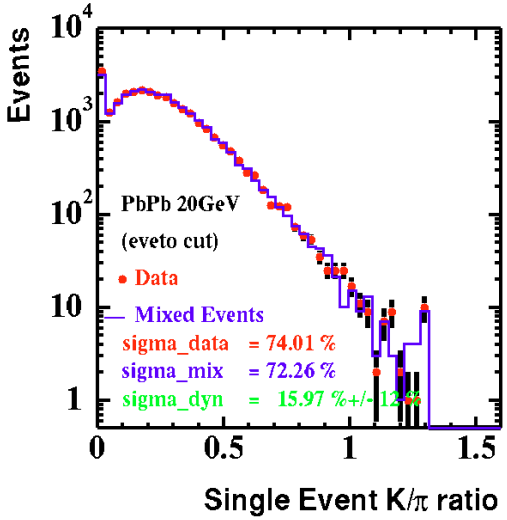
This removes most of the correlation with event multiplicity

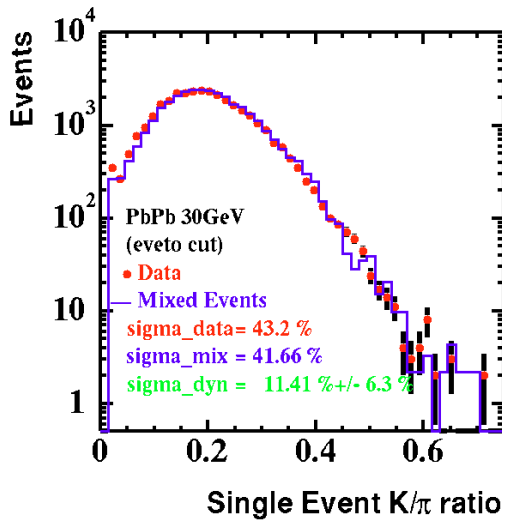


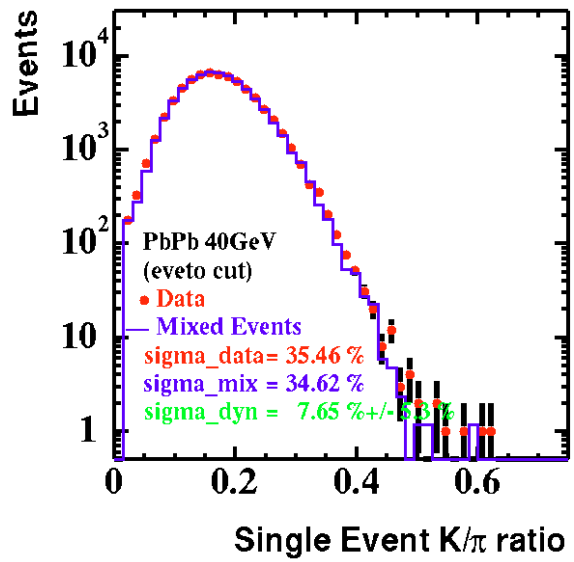




Whats left of the fluctuation signal ?

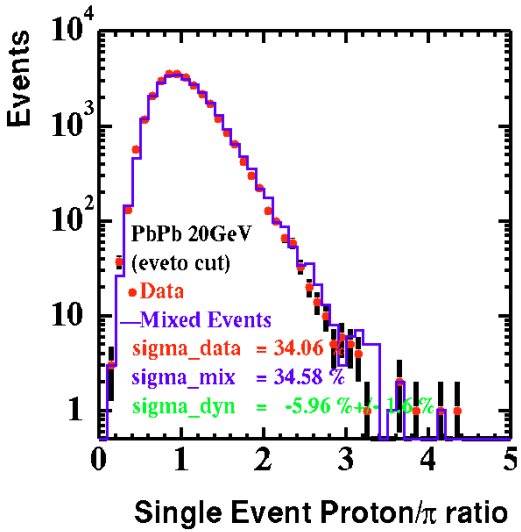


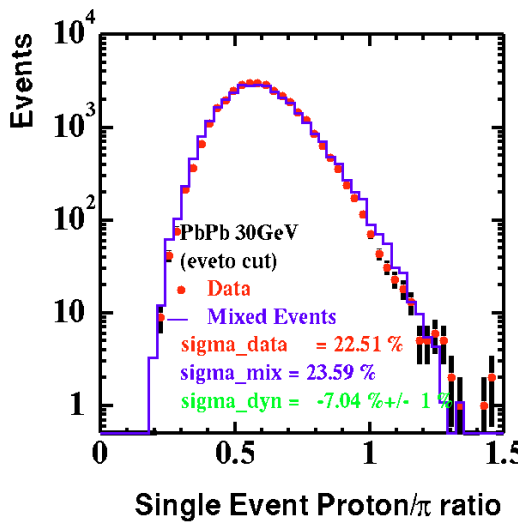


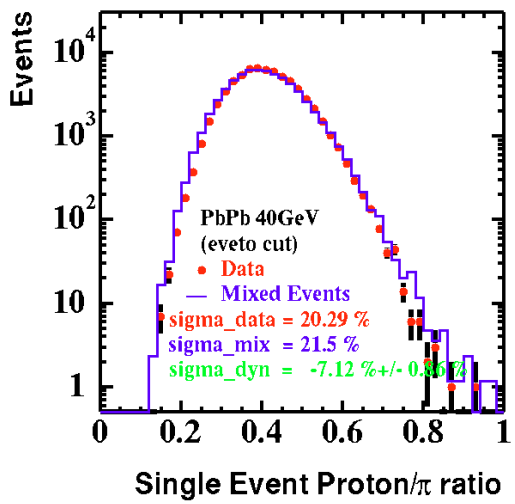


- **Fluctuation signal still present with tight centrality selection.**

P/pi + thight centrality

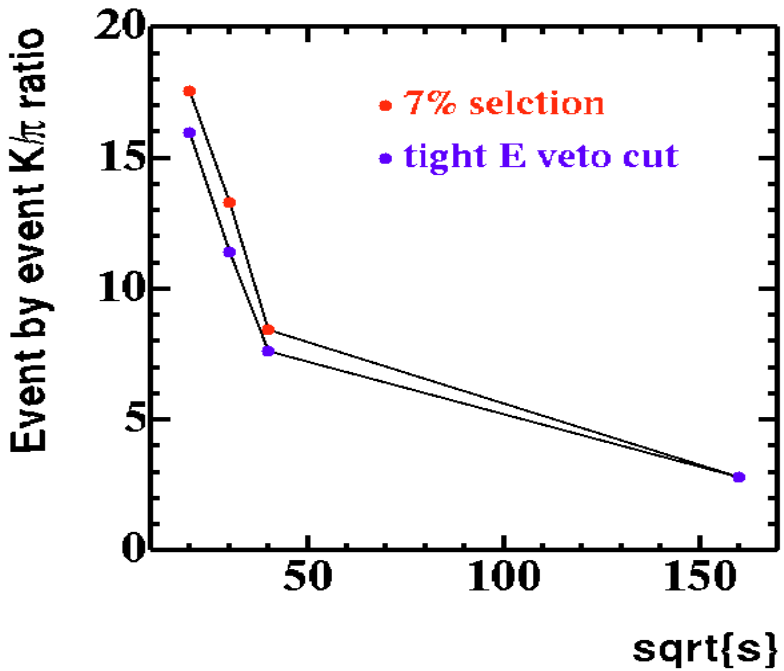






- **E-by-E p/pi distribution is also still narrower than mixed events with tight centrality selection**

Excitation function…

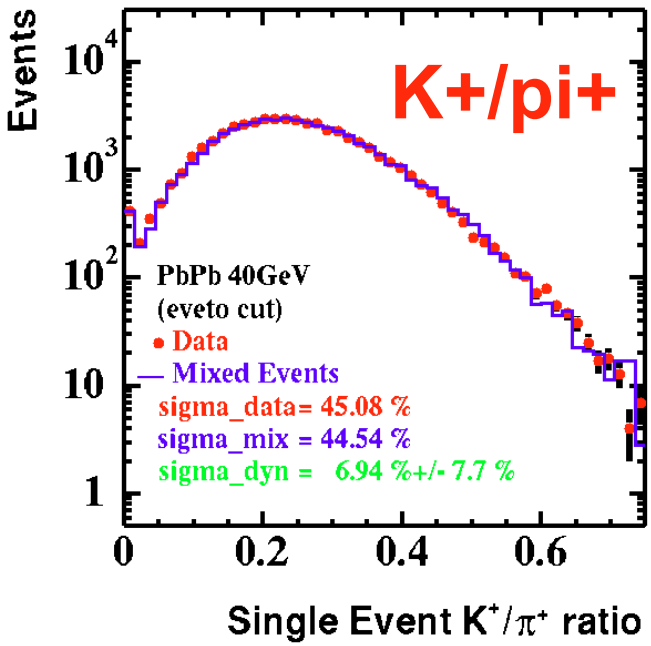


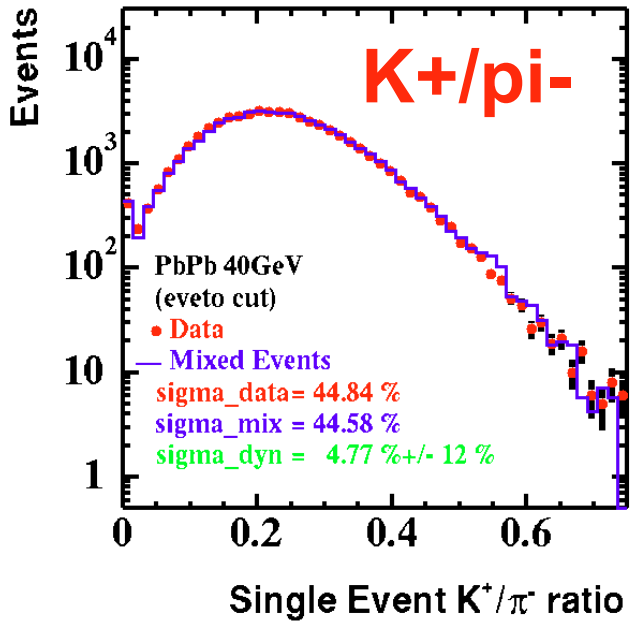
- Fluctuation signal shows similar trend like “Mareks horn”
- What is the significance of the signal??

To Do

- Run 80GeV + reprocess 160GeV
- Process higher statistics.
- Estimate proper statistical errors.
- Look at MC events/generators
  - **What are the effect expected from**
    - **resonance production**
    - **local strangeness conservation**
    - **Correlations**
- Systematic effects?

Hot of the press…





- Can fit charge signs separately as of tonight!
- Should make interpretation easier…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