Event-by-Event $\langle P_T \rangle$ Fluctuations in PHENIX

Quark Matter 2002

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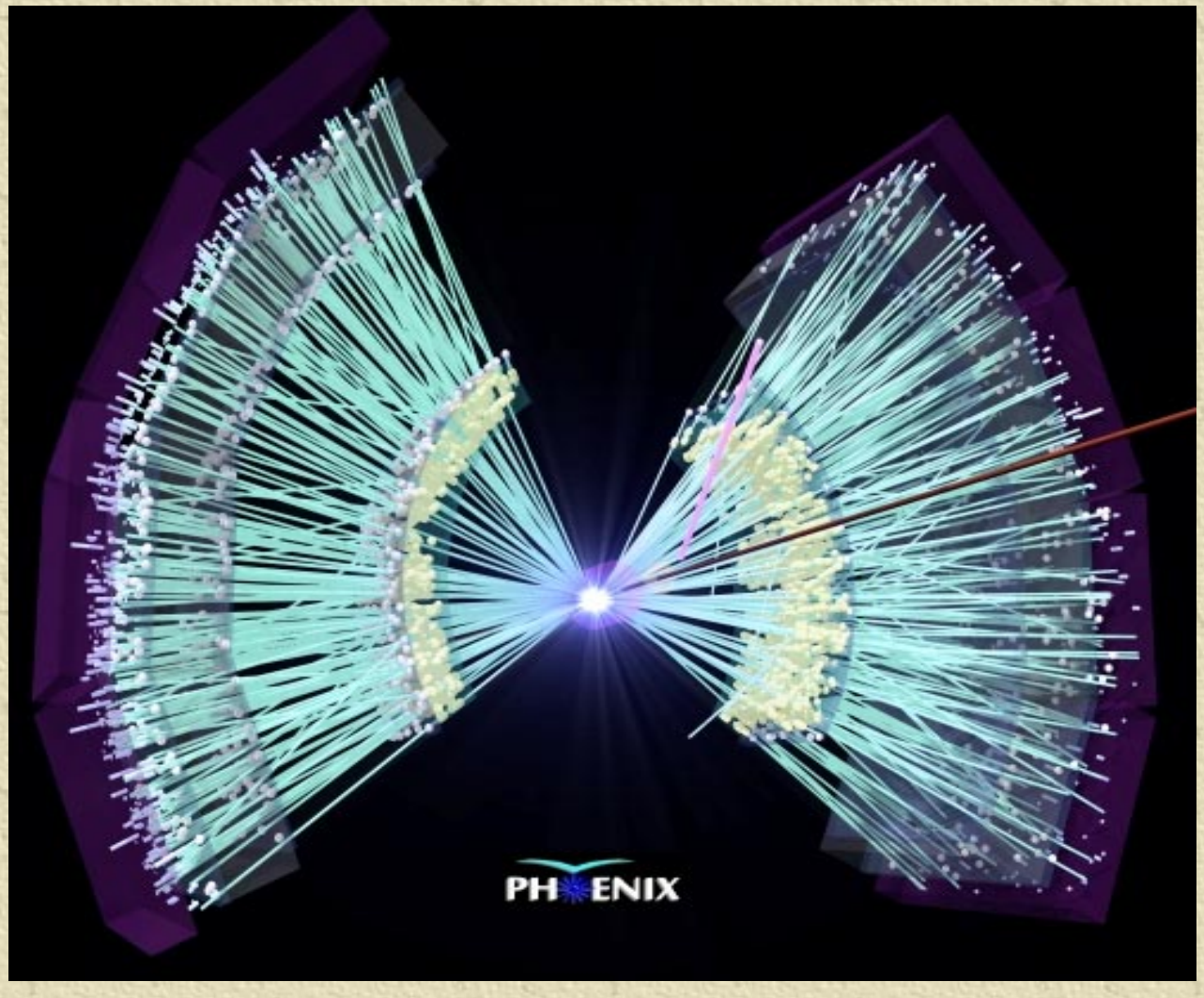


Analysis Details

Data:

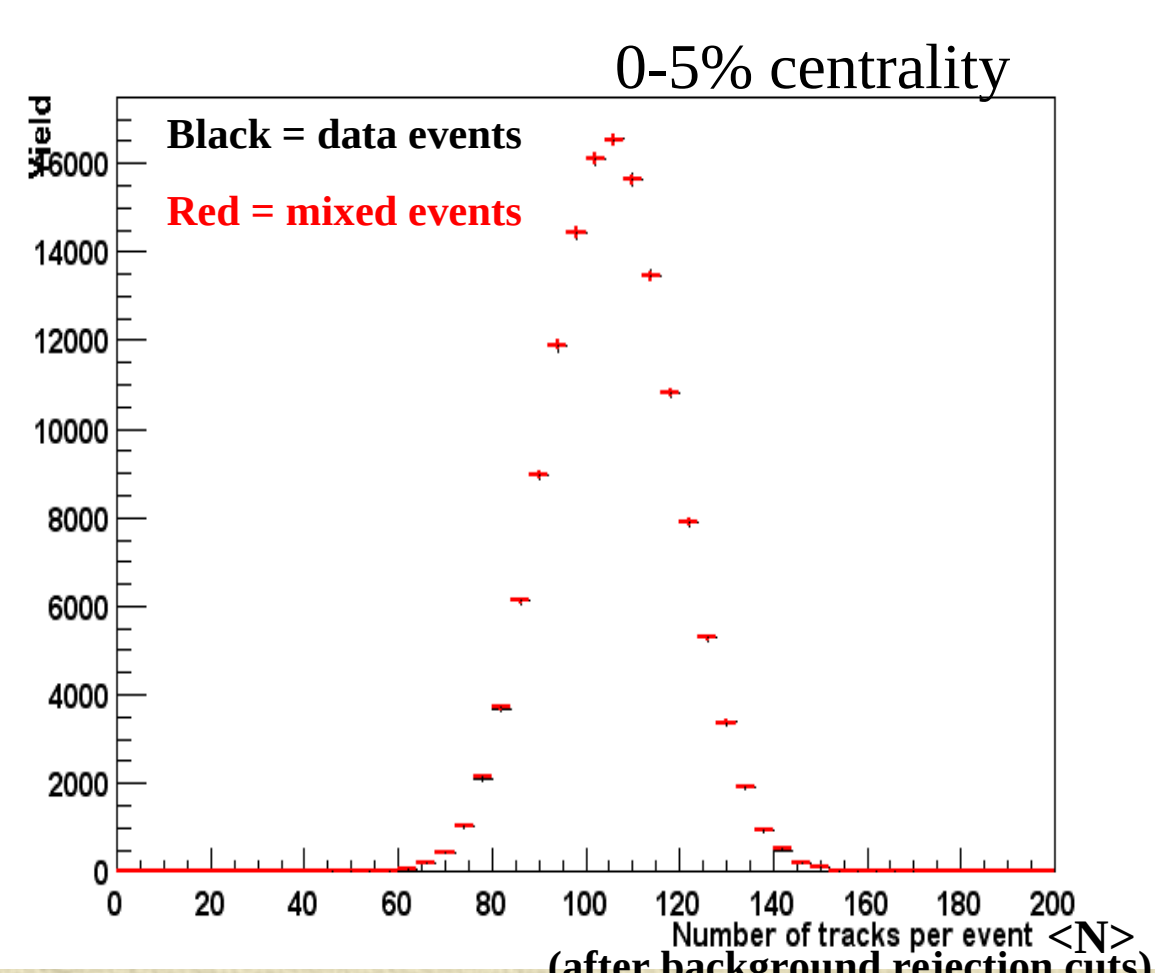
- The average p_T are determined on an event-by-event basis.
- Improvements over the $\sqrt{s_{NN}}$ = 130 GeV analysis include:
  - *3x increase in azimuthal aperture. 2x event statistics.*
  - *Enhanced background rejection from the additional detectors.*

Mixed Events:

- Mixed events serve as the random baseline distributions.
- Mixed event distributions are built from reconstructed tracks in real data events from the same centrality/multiplicity and event vertex class.
- *No two tracks from the same real event are allowed in the same mixed event.*

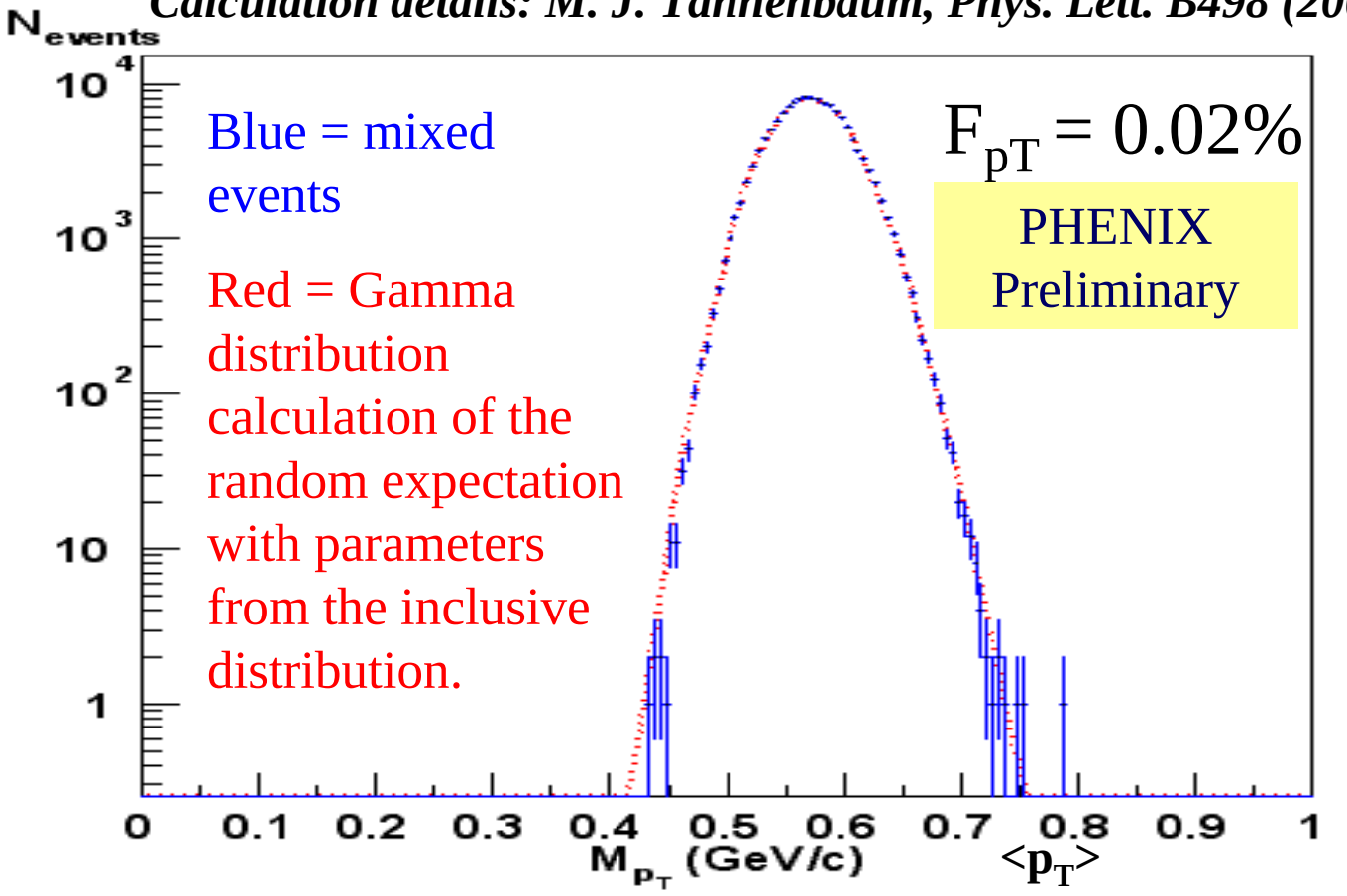
Important Note: Matching mixed events to data events

Since the width of the $\langle p_T \rangle$ distribution depends on <N>, it is important that there is an exact match of the mixed event <N> distribution to the data <N> distribution. The mixed events are constructed by sampling the data <N> distribution.



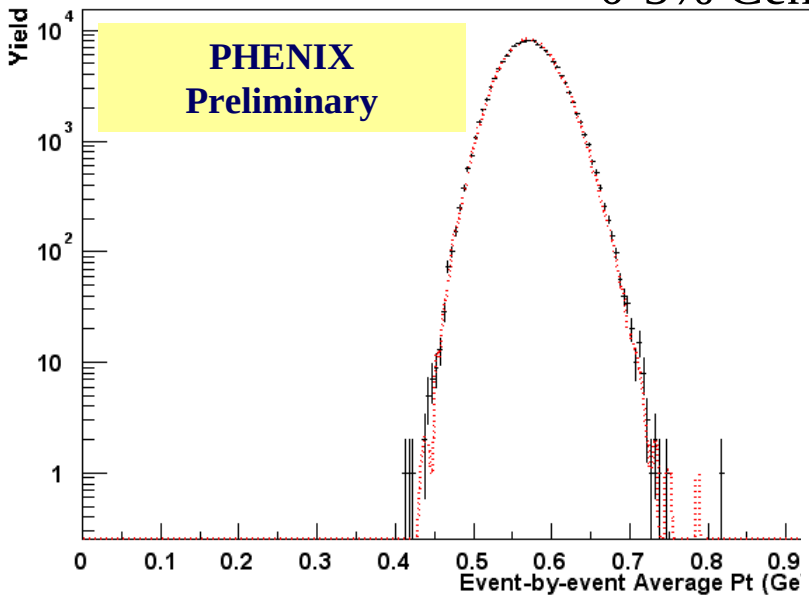
Mixed events as the random baseline distribution

Calculation details: M. J. Tannenbaum, Phys. Lett. B498 (2001) 29.



$\langle P_T \rangle$ distributions

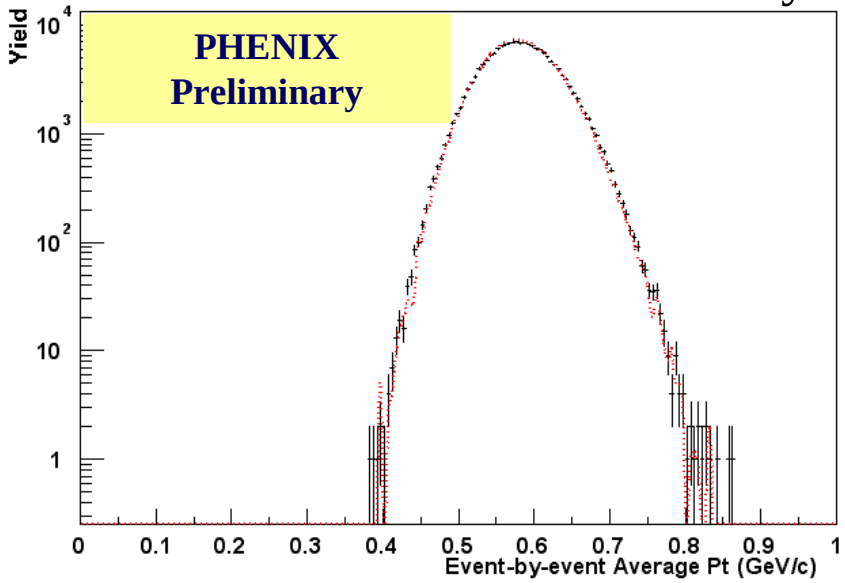
0-5% Centrality



$\sqrt{s_{NN}}$ = **200 GeV**

A small positive fluctuation is apparent.

20-30% Centrality

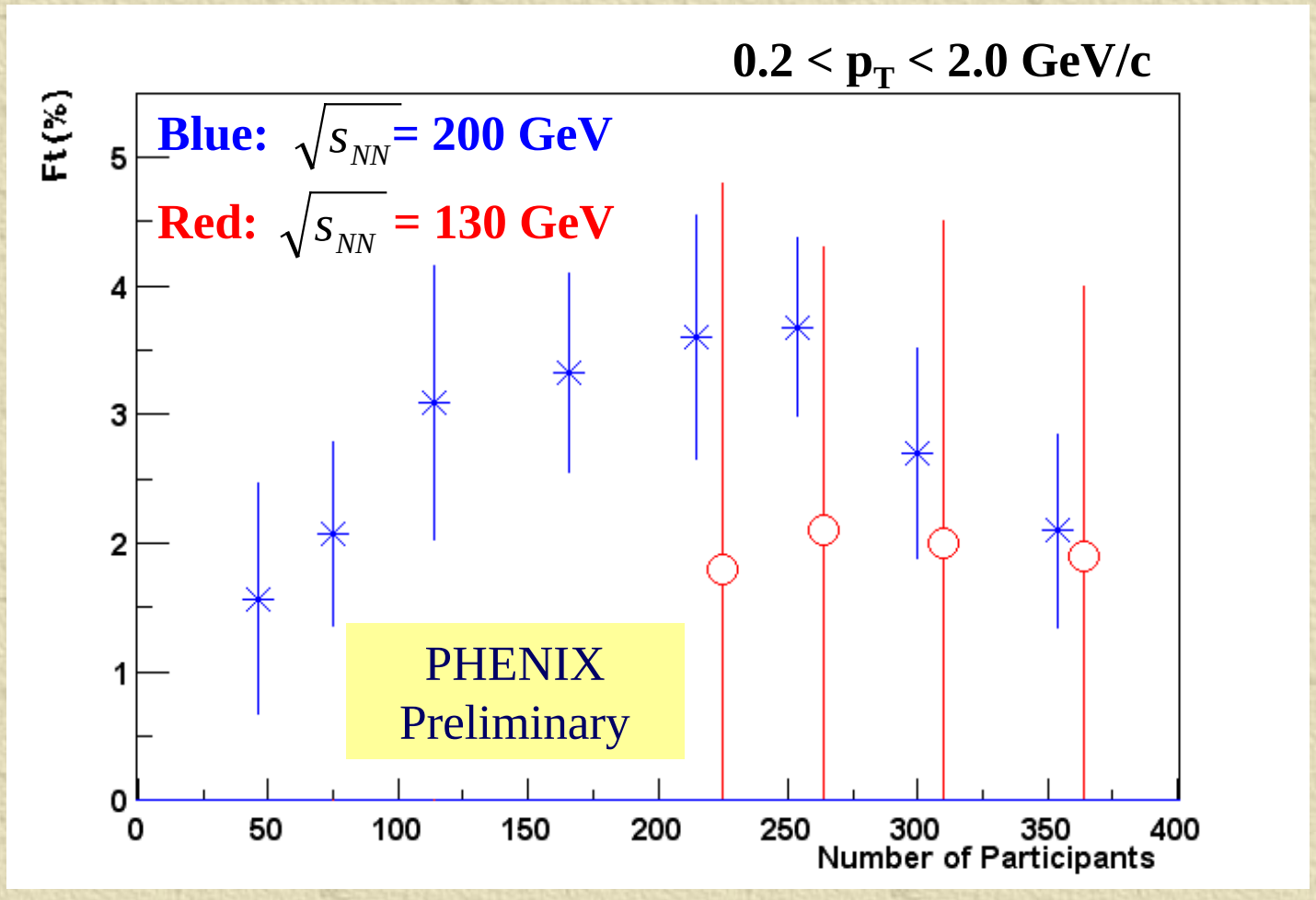


Black = data events

Red = mixed events

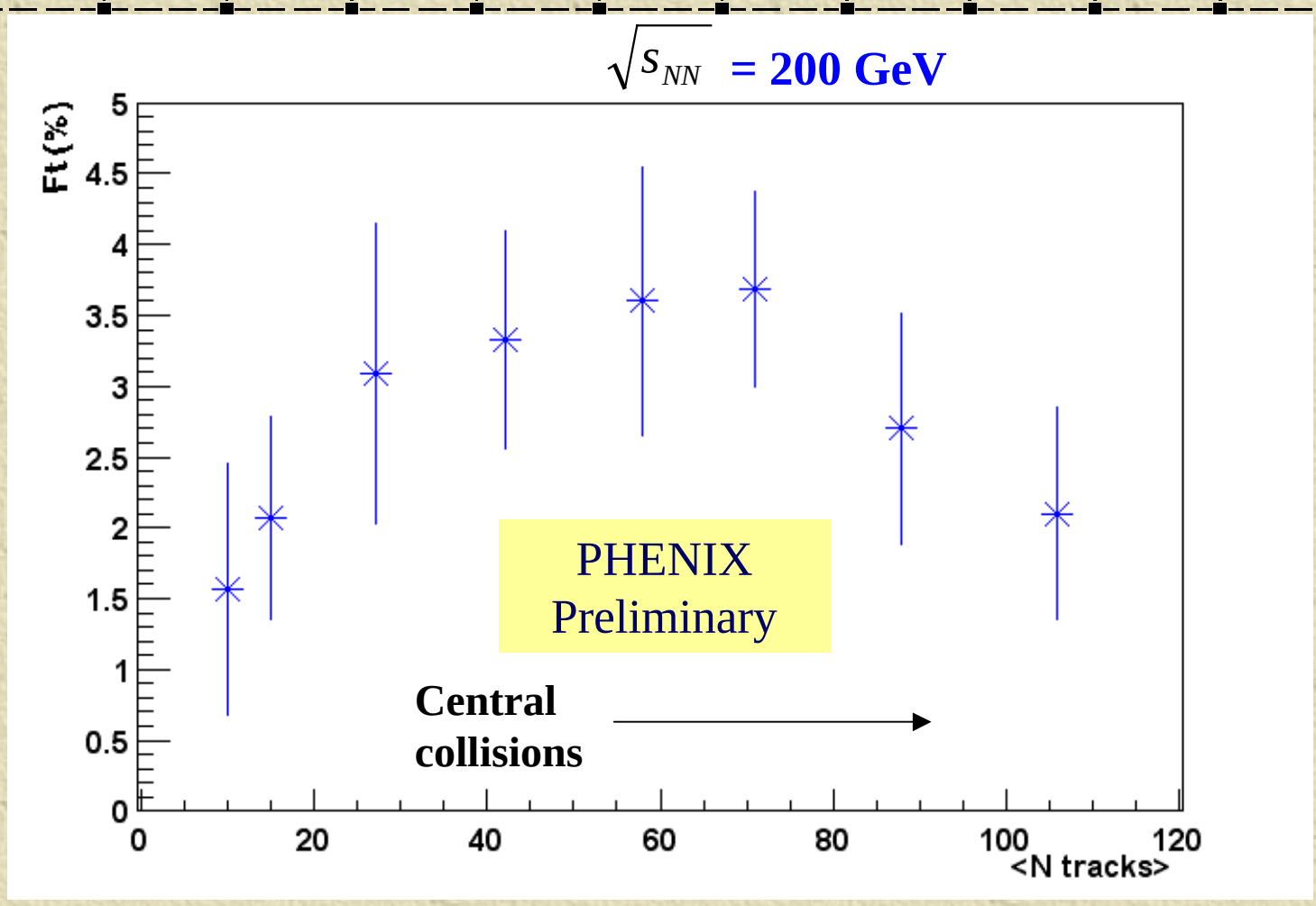
F_{pT} as a function of centrality

The fluctuation magnitude follows a decreasing trend for peripheral collisions.



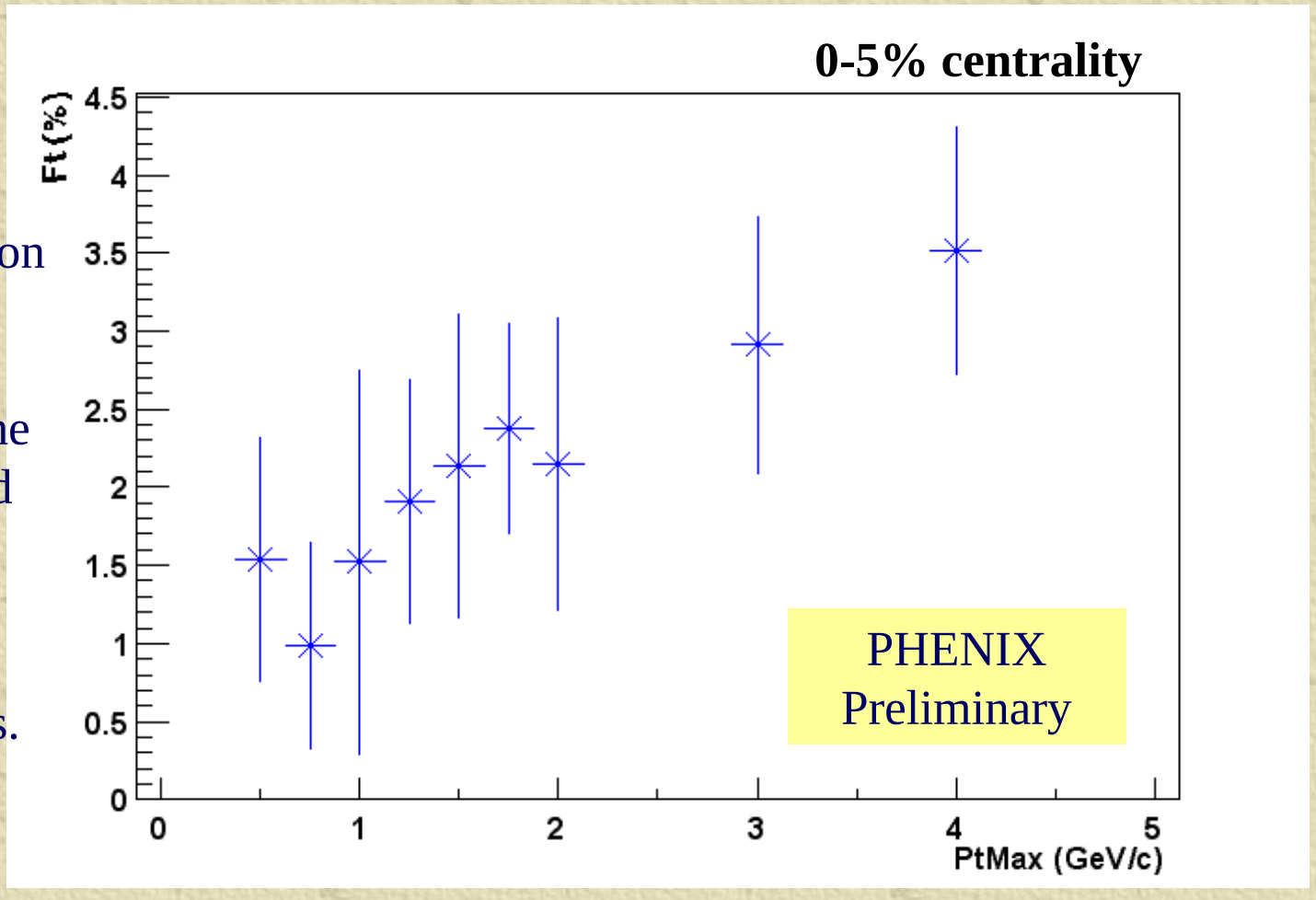
F_{pT} vs. $<N_{tracks}>$

Using the same centrality binning as in the previous figure.

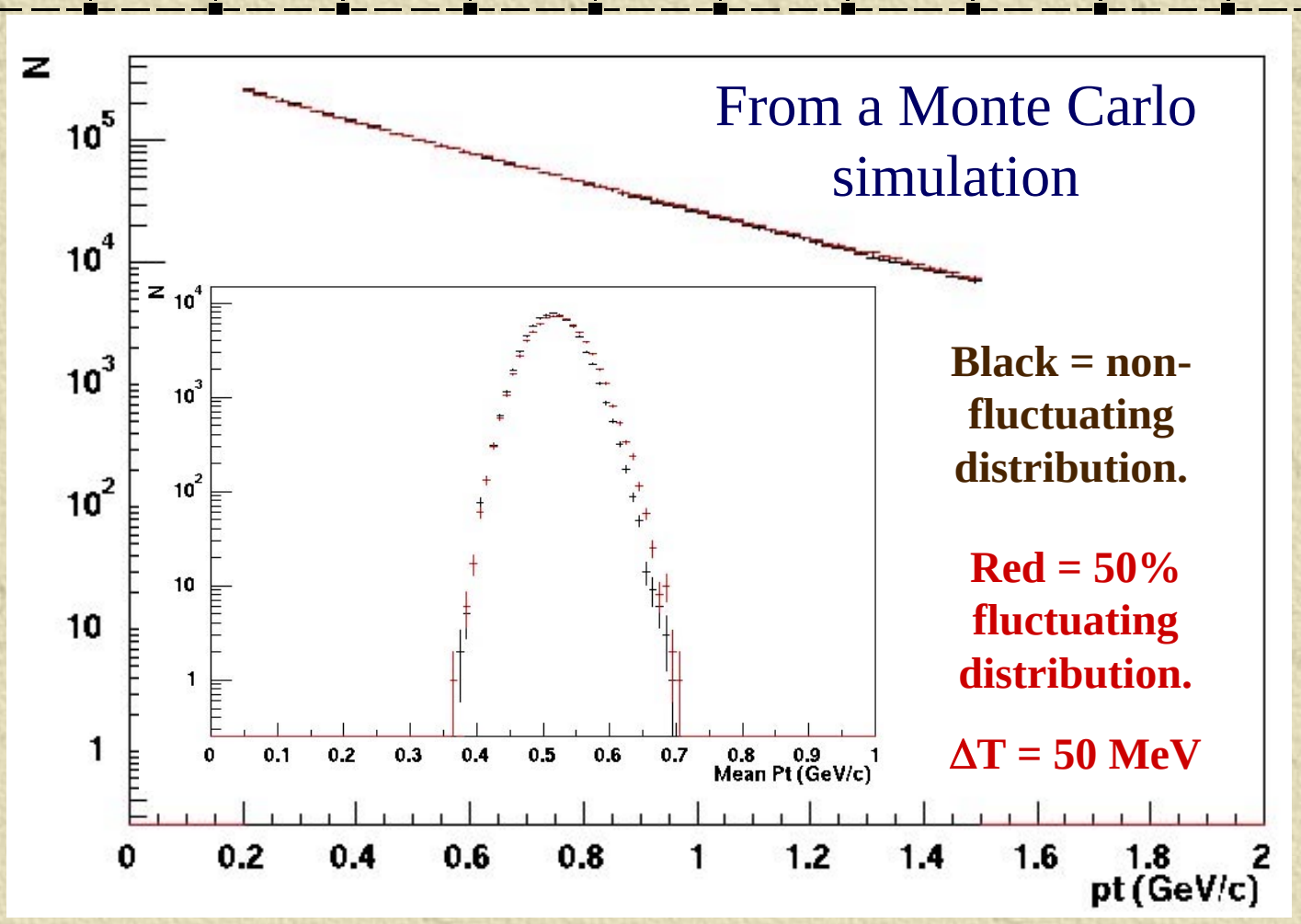


F_T vs. P_T range ($0.2<p_T<p_{T,\,max}$)

The fluctuation magnitude tends to increase as the p_T range used to calculate $\langle p_T \rangle$ is extended to higher values.



“Different Mean, Same Variance” Model Demonstration



Summary and Conclusions

- With the increased PHENIX azimuthal aperture and improved background rejection, a positive non-random fluctuation in event-by-event average p_T is now observed. The fluctuations tend to decrease for peripheral collisions.
- The magnitude of the fluctuation tends to increase slightly with increasing p_T range. Possible causes for this trend await further investigation.
- The contribution of elliptic flow into the PHENIX azimuthal acceptance is estimated (via Monte Carlo simulation using PHENIX preliminary p_T-dependent v_2 measurements wrt to the reaction plane) to be on the order of –0.3% for mid-central collisions, thus not accounting for the observed signal.
- The magnitude of the fluctuations within a pair of dual-event-class models processed through the PHENIX acceptance are estimated to be on the order of ΔT = 10-20 MeV.