**How to Measure Specific Heat Using Event-by-Event Average \( p_T \) Fluctuations.**

MICHAEL TANNENBAUM, Brookhaven National Laboratory, PHENIX COLLABORATION — A simple way to visualize event-by-event average \( p_T \) fluctuations is by assuming that each collision has a different temperature parameter (inverse \( p_T \) slope) and that the ensemble of events has a temperature distribution about the mean, \( \langle T \rangle \), with standard deviation \( \sigma_T \) [R. Korus, *et al.* PRC 64, 054908 (2001)]. PHENIX characterizes the non-random fluctuation of \( M_{p_T} \), the event-by-event average \( p_T \), by \( F_{p_T} \), the fractional difference of the standard deviation of the data from that of a random sample obtained with mixed events. This can be related to the temperature fluctuation:

\[
F_{p_T} = \frac{\sigma_{M_{p_T}}^{\text{data}}}{\sigma_{M_{p_T}}^{\text{random}}} - 1 \simeq \frac{(\langle n \rangle - 1)\sigma_T^2}{\langle T \rangle^2} .
\]

Combining this with the Gavai, *et al.*, [hep-lat/0412036] definition of the specific heat per particle, a simple relationship is obtained:

\[
c_v/T^3 = \frac{\langle n \rangle}{\langle N_{\text{tot}} \rangle} \frac{1}{F_{p_T}} .
\]

\( F_{p_T} \) is measured with a fraction \( \langle n \rangle / \langle N_{\text{tot}} \rangle \) of the total particles produced, a purely geometrical factor representing the fractional acceptance, \( \sim 1/20 \) in PHENIX. The Gavai, *et al.* prediction that \( c_v/T^3 = 15 \) corresponds to \( F_{p_T} \sim 0.33\% \), which may be accessible in PHENIX by measurements of \( M_{p_T} \) in the range \( 0.2 \leq p_T \leq 0.6 \) GeV/c.

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