

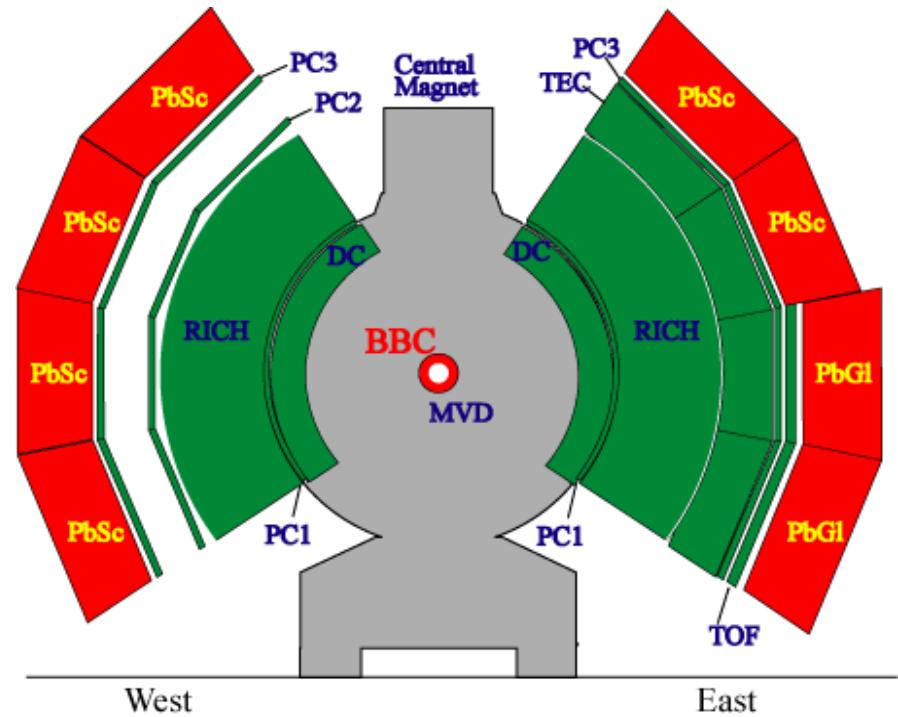
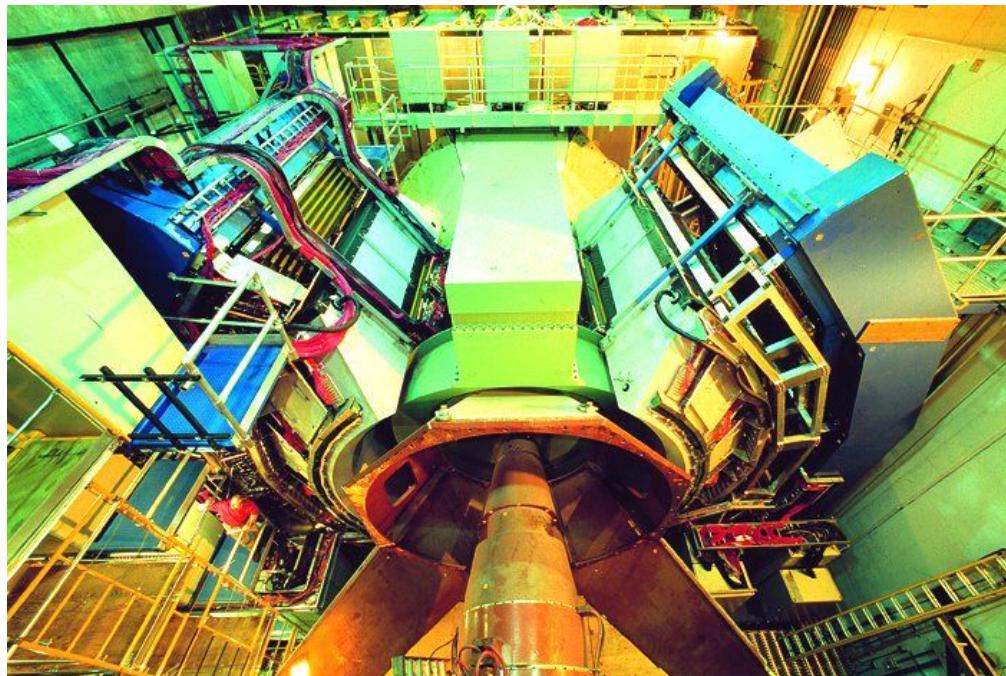
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62.4 GeV Au+Au and 200 GeV Au+Au mean E_T and E_T
fluctuation measurements in event-by-event
distributions (PHENIX Run4 data)

PANIC 2005 conference

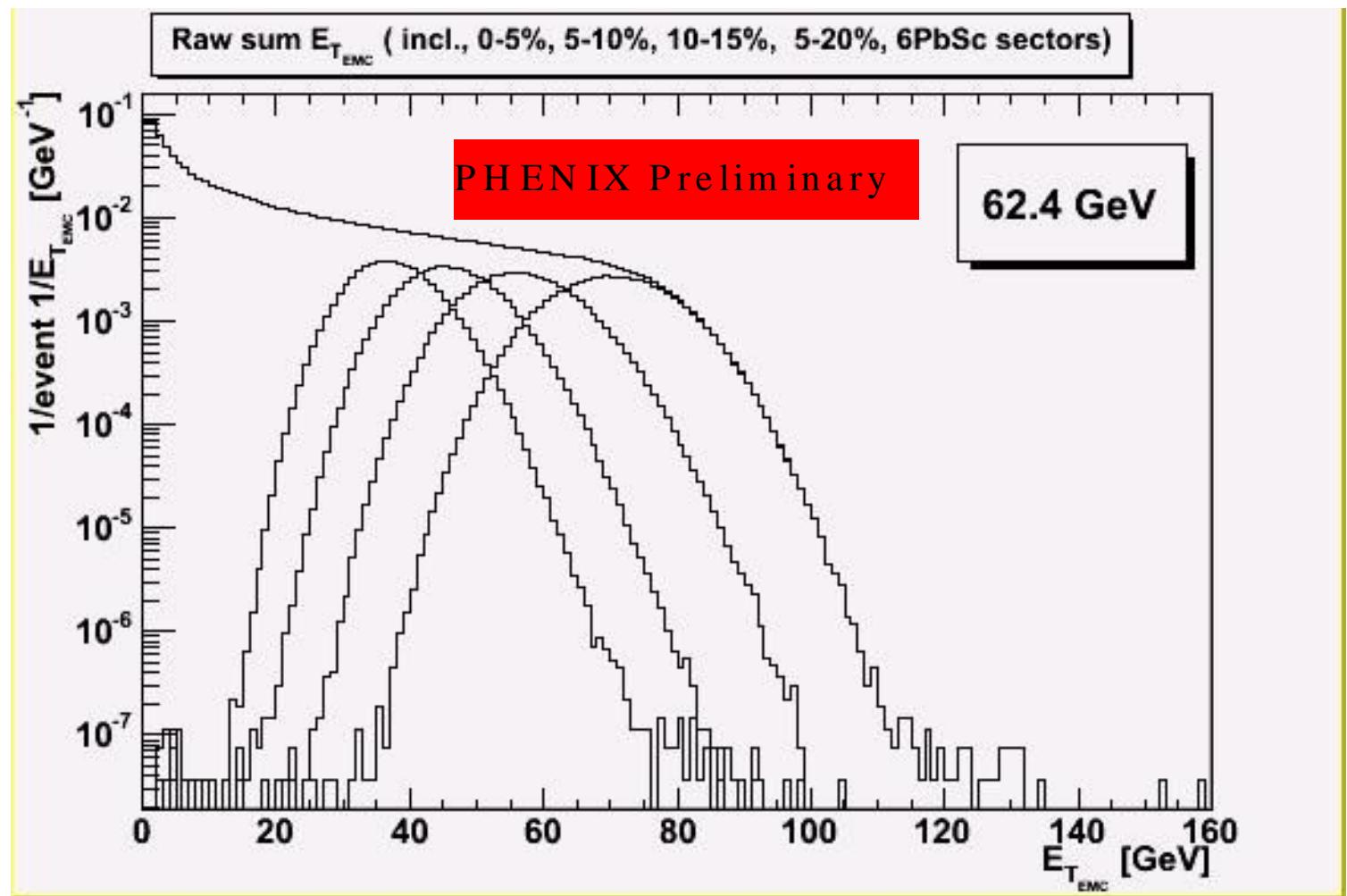
October 27, 2005

The PHENIX electromagnetic calorimeter (EMCal)
6 lead-scintillator sectors were used to measure
transverse energy production

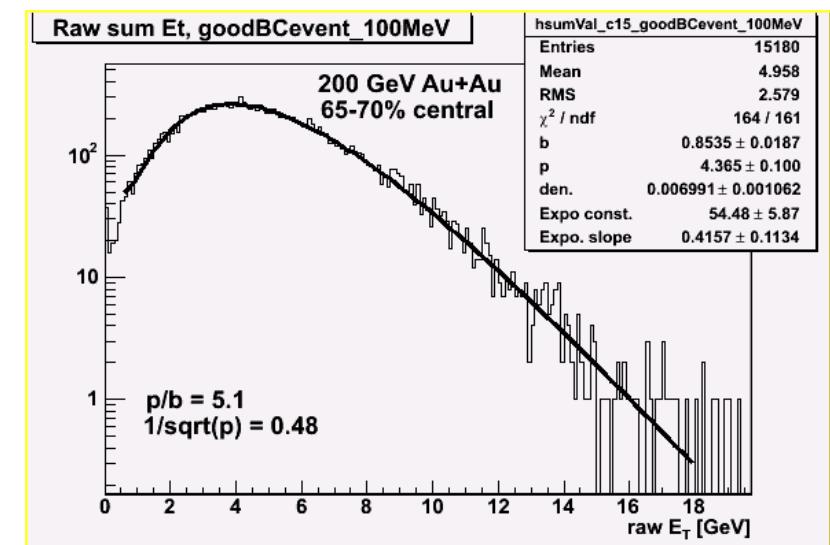
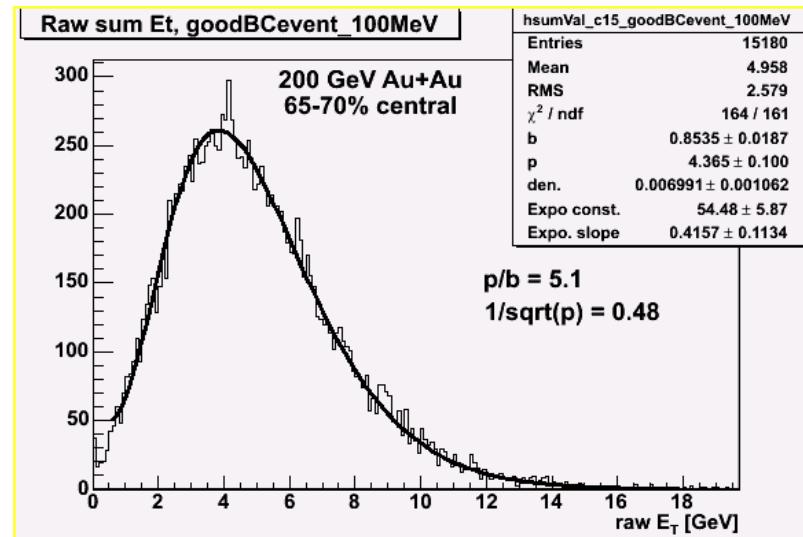


62.4 GeV Au+Au E_T distributions shown for high statistics ($\sim 50E6$ minbias events); the peripheral bins contained an unacceptable level of background (not shown here) which was identified and removed. The central bins appear clean down to 7 orders of magnitude.

For each event of i calorimeter showers, the event $E_T \equiv \sum E_i \sin \theta_i$



E_T distributions are shown to be gamma distributions, and if E_T adds independently for n collisions, participants, etc, the pdf is the n -fold convolution of $f(x)$: $p \rightarrow np$ $b \rightarrow b$
 (200 GeV shown, top: 65-70% central, linear and log scales, bottom: 40-45% central) PHENIX preliminary

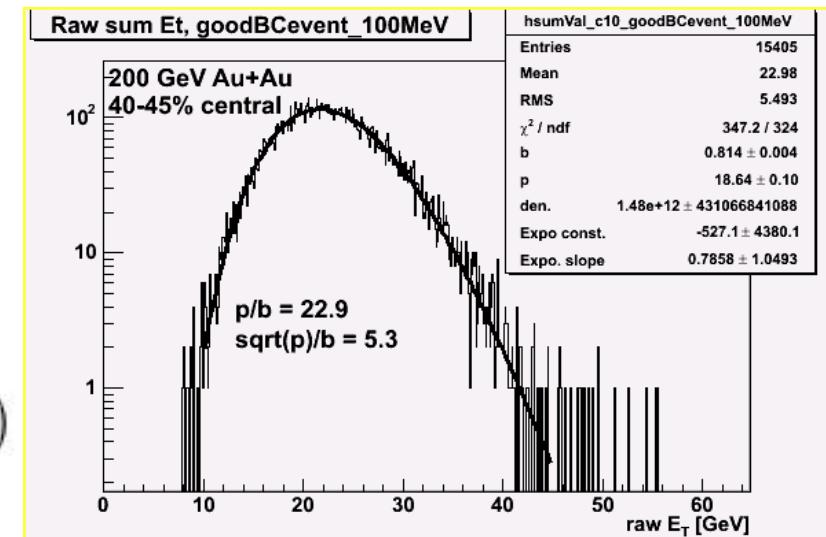


Gamma functional form:

$f(x = E_T)$, for n ($= m$) convolutions

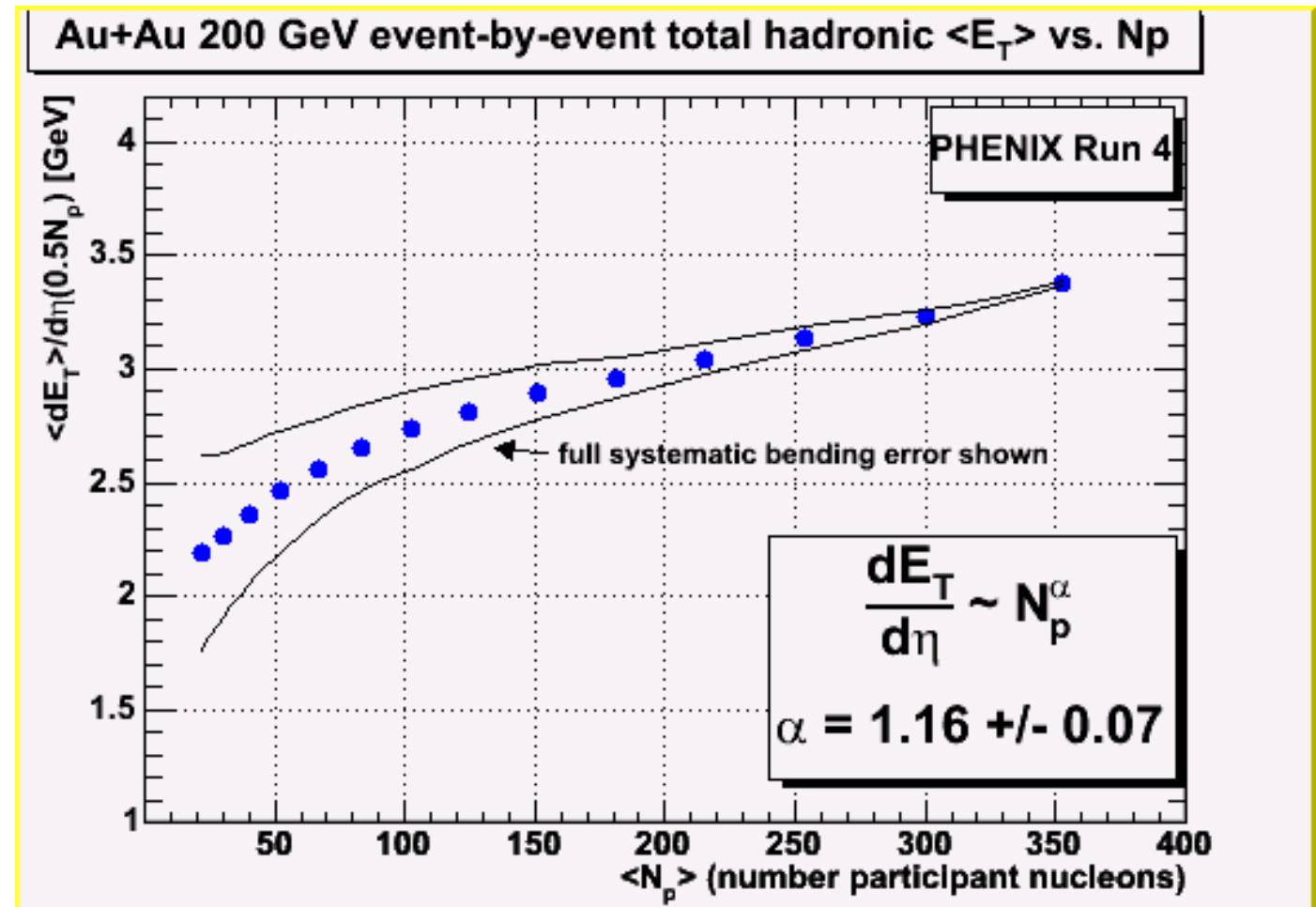
$$f(x) = f_\Gamma(x, p, b) = \frac{b}{\Gamma(p)} (bx)^{p-1} e^{-bx}$$

$$f_n(x) = \frac{b}{\Gamma(np)} (bx)^{np-1} e^{-bx} = f_\Gamma(x, np, b)$$



E_T are gamma distributions which have the property that, if just adding random combinations across centrality, $\langle E_T \rangle$ is expected to go as m , where m is the m^{th} fold convolution of the underlying mechanism of ET production (be it participant nucleons, quarks, ...). The evolution of 200 GeV AuAu mean E_T production across collision centrality rising faster than participant nucleon linear scaling

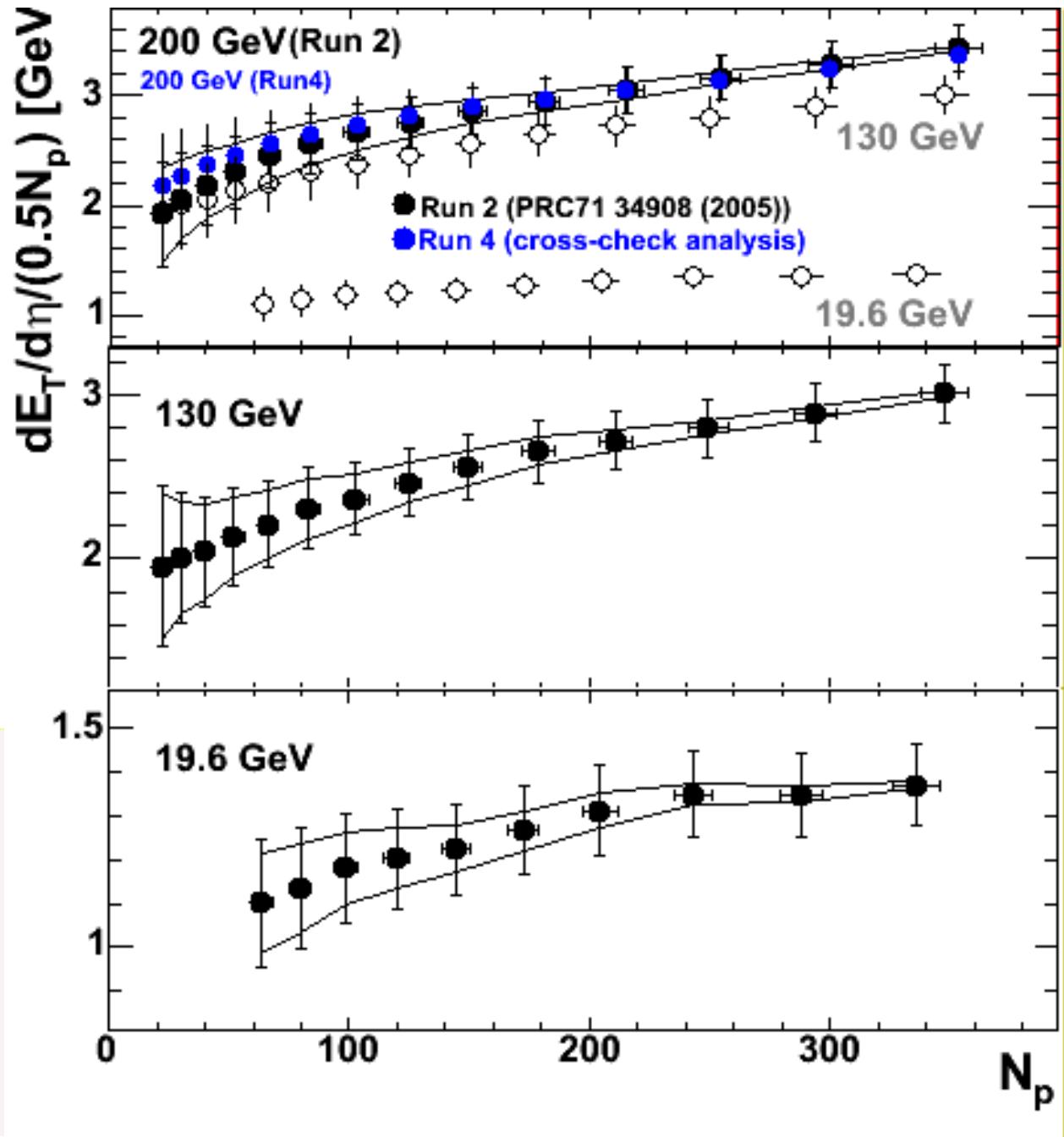
PHENIX preliminary
(Run 4)



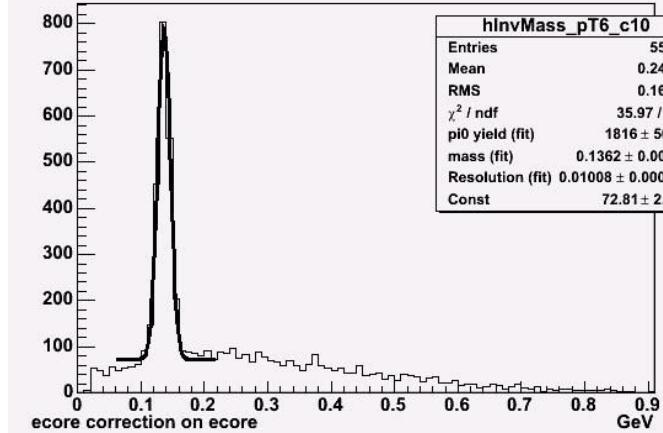
(blue points)

PHENIX preliminary

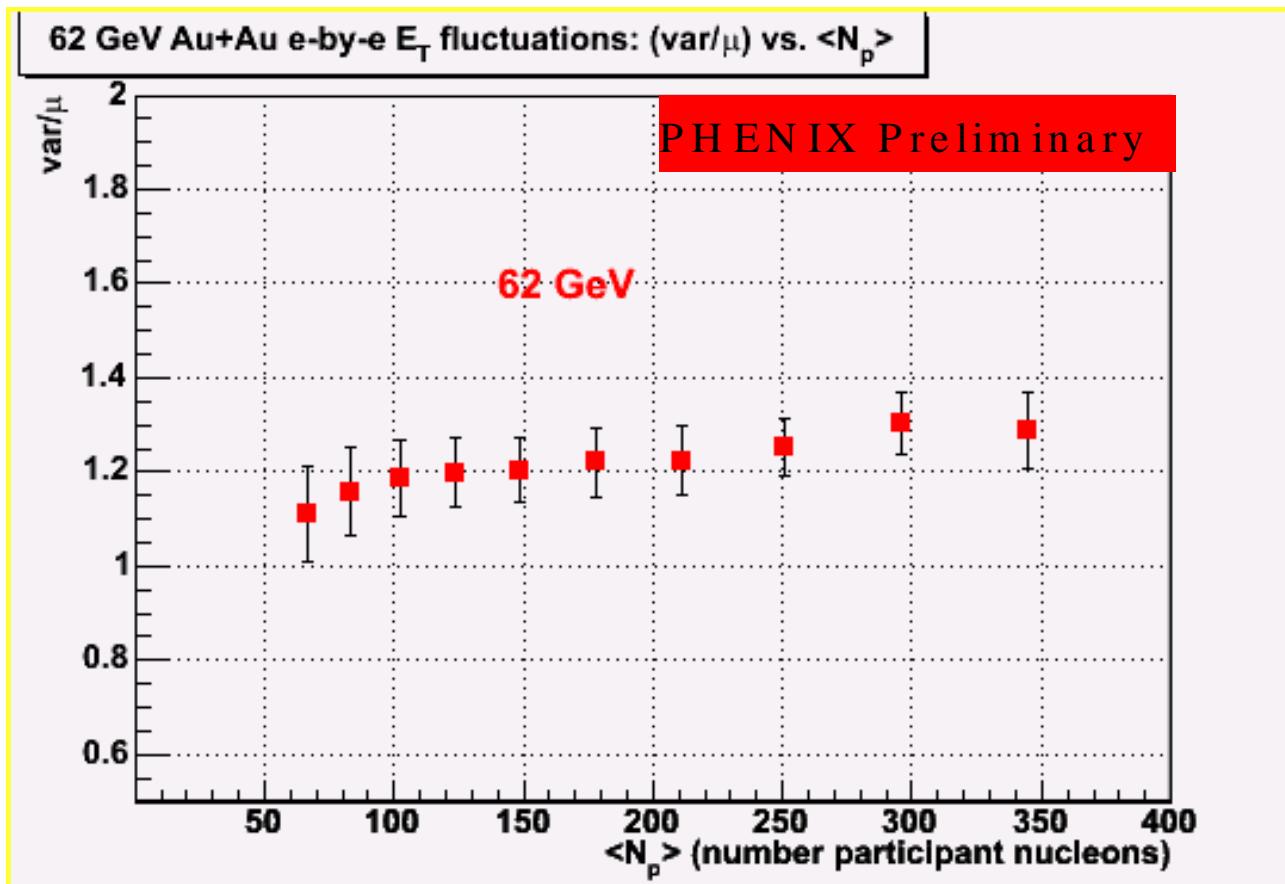
Black points are previously published and official PHENIX results for mean ET at different energies; blue points are Run4 preliminary. Measurement of the pi0 mass in the EMCAL was used as a check to the global energy scale.



Invariant mass, $2.5 < pT < 3.0$, 60-83.7% central

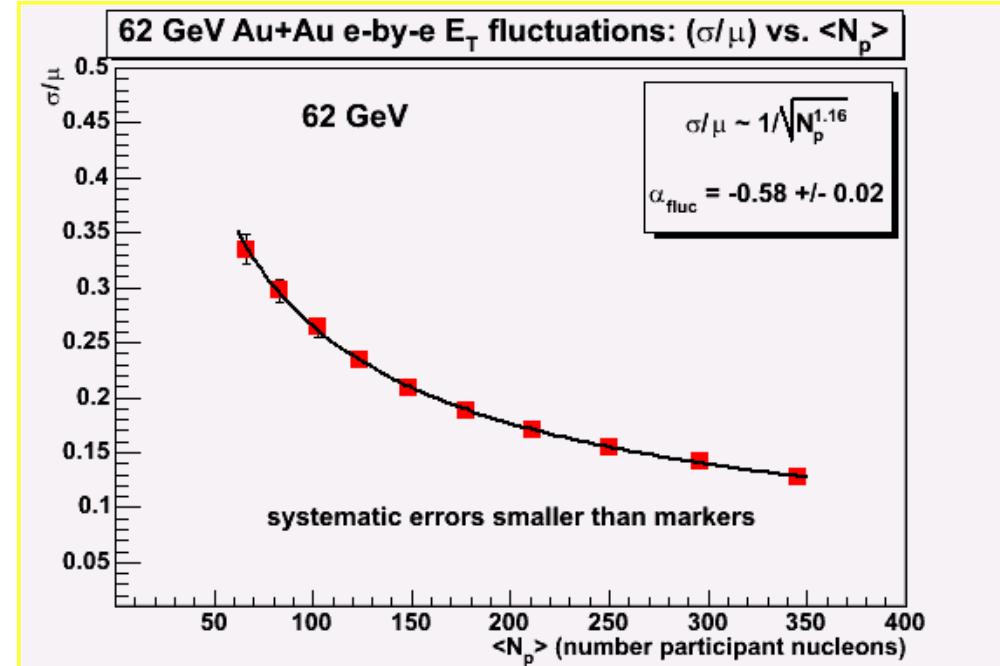
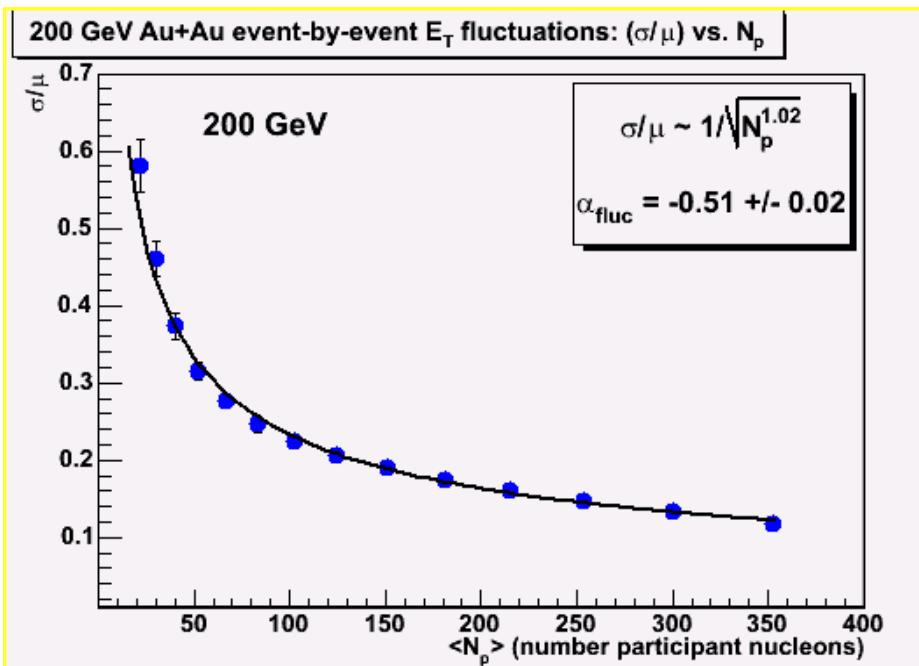


E_T distribution fluctuations of variance/ $\langle E_T \rangle$ vs. N_p . Random combinations of a given distribution preserves the variance/mean – the 62 GeV (shown here) being flat indicates that 62 GeV E_T combines randomly as a function of centrality, and the remaining question is what convolutes: independent collisions, wounded nucleons, participant quarks, .., to be investigated.



E_T are gamma distributions which have the property, that if just adding random combinations across centrality, $\sigma/\langle E_T \rangle$ ($E_T \equiv \mu$) is expected to go as $1/\sqrt{m}$, where m is the m^{th} fold convolution of the underlying mechanism of E_T production (be it participant nucleons, quarks, ..).

PHENIX Preliminary



Conclusion:

Similarly as was illustrated in PHENIX Run 1 & 2 mean E_T measurements (PRL87 52301 2001, PRC71 34908 2005), the distribution relative width fluctuations (involving the second distribution moment), over collision centrality fit an N_p^α power law, suggesting E_T production rises faster than linear participant nucleon scaling.