First Draft of What I Need
for conversion e^+e^- analysis
M. J. Tannenbaum Electron WG 10/97

For Each Event

- List of electron candidates with Very Loose Cuts
- Event Vertex

Global Information to Characterize Reaction

- $E_T(\eta)$ in e.g. 7 bins of $\delta\eta = 0.1$ $(-0.35 \leq \eta \leq -0.35)$ from **EMCal**
- $dn(\eta)/d\eta$ from **MVD**

  a. in central acceptance

  b. in full MVD acceptance
- Zero Degree Cal Energy from **ZDC**
- Number, $<p_T>$ or $<m_T - m>$ for **Charged Tracks**

  a. All detected non-identified charged particles

  b. All identified π^+, π^-, K^+, K^-, p
- $<E_T>$ and number of clusters for several classes **EMCal**

  a. All calorimter clusters

  b. All calorimeter clusters caused by charged track

  c. All non-charged track calorimeter clusters

  d. All calorimeter clusters $E_T \geq 500$ MeV

  e. ...

the situation for multiplicity distributions, where the shape as characterized by the NBD parameter $k(\delta\eta)$ can be related to the 2-particle short-range correlation length [12,23,24], there is at present no theoretical framework to relate the systematic variation in the Gamma distribution parameter $p(\delta\eta)$ to other physical quantities. On the other hand, Gamma distribution fits to ^{16}O+Cu multiplicity distributions [21] (open diamonds on Fig. 10) give $p(\delta\eta)$ in excellent agreement with the E_T results.

B. More complicated fits

As the multiplicity distribution for O+Cu central collisions is well represented [21] by a NBD, $f_{\rm NBD}(n, 1/k, \mu)$, and the E_T distribution per particle is reasonably represented [71] by a Gamma distribution, $f_\Gamma(E_T, p, b)$, a fit of the form

$$\frac{d\sigma}{dE_T} = \sigma \sum_{n=1}^{n_{\rm max}} f_{\rm NBD}(n, 1/k, \mu)\, f_\Gamma(E_T, np, b) \tag{5}$$

was tried, where it is assumed that the E_T spectra for individual particles are independent of each other and independent of the multiplicity, n, so that the E_T spectrum for n particles is the n-th convolution of the spectrum for a single particle [25]. Satisfactory convergence of Eq. 5 could not be obtained, so the NBD was restricted to be Poisson, by fixing $1/k = 0$, which led to convergence. These fits are shown as dots on Fig. 8. A simpler fit based on Eq. 2 was also tried which assumed a constant energy per particle, denoted $\langle p_T \rangle$, so that the number of particles, n, for a given E_T was taken as $n = E_T/\langle p_T \rangle$ (nearest integer) and fit to a NBD:

$$\frac{d\sigma}{dE_T} = \sigma\, f_{\rm NBD}(E_T/\langle p_T \rangle, 1/k, \mu) \quad . \tag{6}$$

These fits are shown as dashed lines on Fig. 8. Neither of the more complicated forms fit the central collision data as well as a single Gamma distribution. The tendency is for the NBD based fits to be lower than the single Gamma distribution fits at the higher values of E_T and higher than the Gamma fits at the lower values of E_T. Surprisingly, the more complicated fit

(Eq. 5) with more parameters fits the data much worse than the simpler form (Eq. 6) which again fits the data much more poorly than a single Gamma distribution. It is tempting to speculate on the implications of these results for the detailed relationship between E_T and multiplicity distributions and the effect of hadronization; however, the present experiment has huge instrumental effects in both the E_T and multiplicity measurements so that a more controlled experiment to better examine these issues certainly seems desirable.

C. Wounded Projected Nucleon Model

A simple and elegant method for separating instrumental effects from nuclear geometrical and possible dynamical effects is to use extreme-independent-collision models such as the Wounded Nucleon Model (WNM) [36,32,37] or the Wounded Projectile Nucleon Model (WPNM) [61,55,40,41] to relate measurements of different nuclei in the same detector. In these models, the nuclear geometry is represented as the relative probability per interaction for a given number of total participants (WNM) or projectile participants (WPNM) integrated over the impact parameter of the p+A or B+A reaction.[4] Typically, Woods-Saxon densities are used for both the projectile and target nuclei, and a nucleon-nucleon inelastic cross section of 30mb is taken, corresponding to a nucleon-nucleon mean free path of ~2.2 fm at nuclear density [61,40,41]. Once the nuclear geometry is specified in this manner, experimental measurements can be used to derive the distribution (in the actual detector) of E_T or multiplicity (or other additive quantity) for the elementary collision process, i.e. a wounded nucleon or a wounded projectile nucleon, which is then used as the basis of the analysis of a nuclear scattering as the result of multiple independent elementary collision processes. The key issue then becomes the linearity of the detector response to multiple collisions ($\sim 1\%$ in the present case), instead of detailed instrumental corrections to obtain e.g. the 'true E_T' impinging on the detector from the measured E_T response (Eq. 4).

[4] It can also be done as a function of impact parameter.

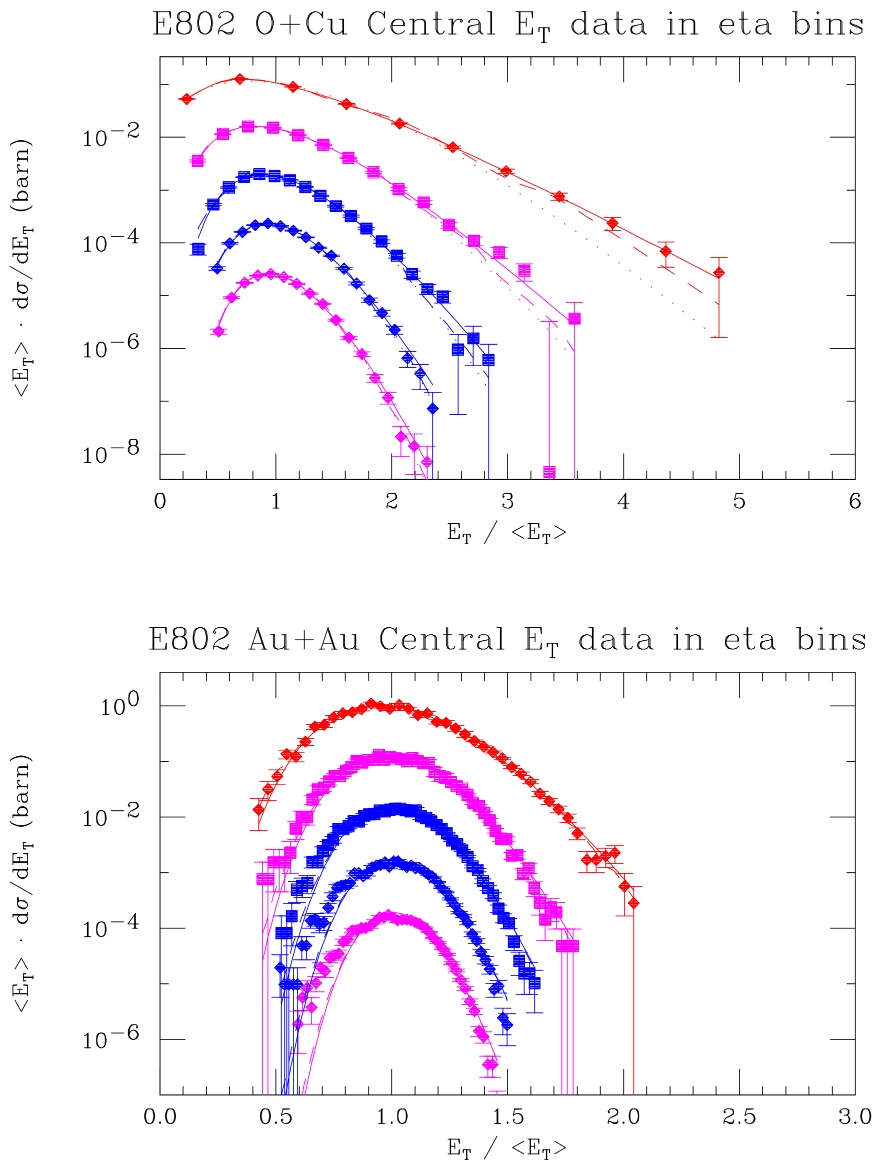

FIG. 8. (Top) E_T distributions measured in ^{16}O+Cu central collisions at 14.6A GeV/c; (Bottom) E_T distributions measured in Au+Au central collisions at 11.6A GeV/c. Measurements are shown for 5 $\delta\eta$ intervals, $0.17, 0.378, \ldots, 1.30$, scaled by $\langle E_T \rangle$ on the interval. The scale in $\langle E_T \rangle \cdot d\sigma/dE_T$ corresponds to the uppermost plot. Succesive distributions have been normalized by factors of $10^{-1} \ldots 10^{-4}$ for clarity of presentation. The curves correspond to fits which are discussed in the text.

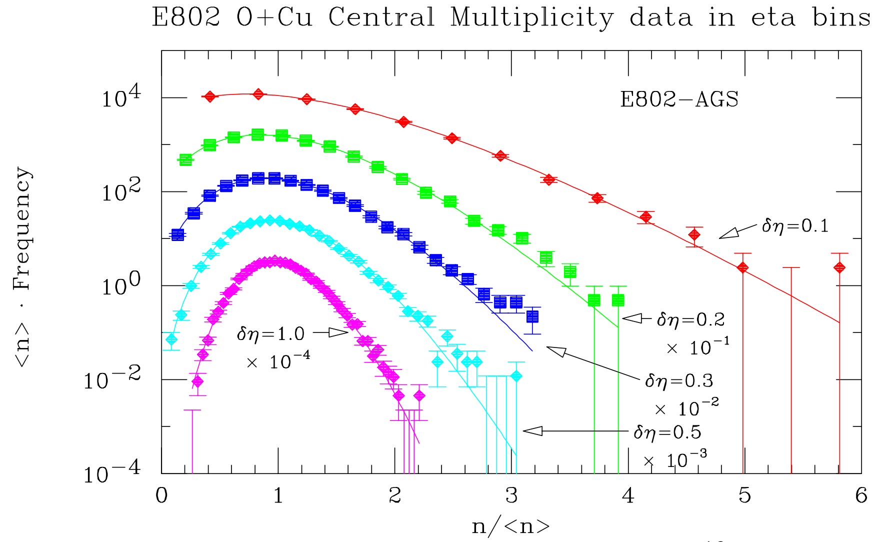

FIG. 9. Multiplicity distributions from reference [21] measured in ^{16}O+Cu central collisions at 14.6A GeV/c for 5 $\delta\eta$ intervals (indicated) around mid-rapidity, scaled by the $\langle n\rangle$ on the interval. Each successive distribution has been normalized downwards by the factor indicated for clarity of presentation.