

ON TRANSVERSE ENERGY DISTRIBUTIONS IN HIGH-ENERGY  
NUCLEUS-NUCLEUS COLLISIONS

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Nuclear enhancements of the large transverse energy ( $E_t > 50$  GeV) far beyond the allowed ( $E_t < 30$ ) kinematics of pp interactions have been observed in  $pA^1$  and  $A^1A^2$  collisions. Events with large total transverse energy are believed to be a good place for looking for the signature of quark-gluon plasma formation as expected from QCD lattice calculations<sup>3</sup>. The large total transverse energy could be caused by the transverse flow of the expanding plasma and can be seen as an excess of events above the model predictions in large  $E_t$  tail of the  $E_t$  distribution.

To explain the transverse energy distribution for protons on A targets, it is found that the proton has to interact with an object in the target having at least 6 or 8 nucleons in the cluster. Using targets of different thickness<sup>4</sup>, it can be shown that high  $E_t$  is not produced by multiple interaction in the target.

In the present note we compare simple models of large  $E_t$  events in  $A^1-A$  collisions. These are: a) multiple independent nucleon-nucleon collision mechanism when the observed pp spectrum  $f_{pp}(E_t) = 1/\sigma_{pp} \int_{in}^{pp} (d\sigma/dE_t)_{pp}$  in the form of gamma distribution is used:

$$f_{pp}(E_t) = \frac{\alpha^a}{\Gamma(a)} E_t^{a-1} e^{-\alpha E_t} \quad (1)$$

which fit the pp data very well with parameters<sup>5</sup>

$$\begin{aligned} \alpha &= 1.41 \pm 0.01 \text{ GeV}^{-1} , \\ a &= 2.50 \pm 0.06 , \\ \langle E_t \rangle &= a/\alpha = 1.77 \pm 0.03 \text{ GeV} . \end{aligned} \quad (2)$$

The probability distribution of observing  $E_t$  in  $n$  such overlapped collisions is given by the  $n$ -fold convolution of  $f_{pp}(E_t)$ . This is obtained from

$$f_n(E_t) = \int_0^{E_t} dE'_t f_{pp}(E'_t) f_{n-1}(E_t - E'_t) \quad (3)$$

and gives

$$f_n(E_t) = \frac{\alpha^{na}}{\Gamma(na)} E_t^{na-1} e^{-\alpha E_t} . \quad (4)$$

All  $f_n(E_t)$  remain normalized to unity.

b) Wounded nucleon model<sup>6</sup> which counts the number of struck nucleons geometrically. A nucleon contributes only once to the production of particles, no matter how many times ( $\geq 1$ ) it is successively scattered. Data can be partly explained within this model if  $n$  in the distribution (4) is allowed to take non-integer ( $n \sim (A^2 A)^{1/3}$ ) as well as integer values. The fit

to the data is best if the largest number of allowed wounded nucleons is used.

c) Convolution model in which the normalized transverse energy distribution  $f_{pA}(E_t)$  in pA collisions is used as an input instead of  $f_{pp}(E_t)$ .

Then for central collisions of  $A'-A$  ( $A' < A$ ) we make  $A'$ -time convolution of the  $f_{pA}(E_t)$  to obtain for the gamma distribution of the type (1)

$$f_{A'A}(E_t) = \frac{a^{A'a}}{\Gamma(A'a)} E_t^{A'a-1} e^{-aE_t} .$$

The parameters  $a$  and  $\alpha$  are obtained from the fit to the pA distribution function.

A similar fit has been attempted for  $^{16}\text{O}-^{209}\text{Pb}$  collisions at 200 GeV/A<sup>2</sup> with the parameters  $a$  and  $\alpha$  obtained from the p-Au collision,

$$a = 3.36,$$

$$\alpha = 0.727 \cdot \text{GeV}^{-1},$$

$$A' = 16 .$$

This convolution model with pA as an input with certain refinement is able to reproduce both the "central collision" peak position and the slope at high  $E_t$ .

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