LETTERS TO THE EDITOR

COMPARISON OF THE BIAŁKOWSKI, CHIU AND TOW MODEL FOR HADRON-NUCLEUS INTERACTIONS TO π^--CARBON DATA AT 40 GeV/c

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Predictions of the modified cascade model for hadron-nucleus collisions proposed by Białkowski, Chiu and Tow are compared to the π^--carbon data at 40 GeV/c.

Białkowski, Chiu and Tow (BCT) have recently proposed a new model of particle production in hadron-nucleus collisions [1]. It is a modified cascade model in which particle production proceeds via an intermediate state of clusters. The intranuclear cascade is modified in the sense that after a collision, the outgoing particles have a decreased probability of interaction due to their "immaturity". The immaturity probability is given by the following time function

$$Q(t) = \exp\left(-\frac{t}{\tau_0\gamma}\right)\exp\left(-\frac{1}{\lambda}\right), \tag{1}$$

where $\tau_0 = 1/m_\pi$ is typical maturity time in the rest frame of a particle, γ — Lorentz factor of the particle and λ is the mean induced maturity path in units of inter-nucleon distance. Thus, in addition to the spontaneous maturity process, there is also an induced maturity process due to the presence of hadronic matter. The parameter λ is the model's only free parameter. Normalizing the model calculation to the 200 GeV proton-nucleus data [2] the authors determined it to be 2.4. The model allows one to obtain single-particle rapidity distributions for hadron-nucleus interaction by $\bar{k}$-fold iteration of single-particle distri-

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butions for hadron-hadron interaction. The $\bar{k}$ is the average number of nucleons that an incident hadron encounters traversing a given nucleus. It is related to the atomic number A by the relation

$$\bar{k} = 0.8A^{1/3}. \tag{2}$$

We have compared the predictions of this model to the π^--carbon data obtained from the Dubna 2-metre propane bubble chamber exposed to the 40 GeV/c π^- beam at Serpukhov. Figure 1a presents longitudinal rapidity distributions for π^-p and π^-C interactions whereas

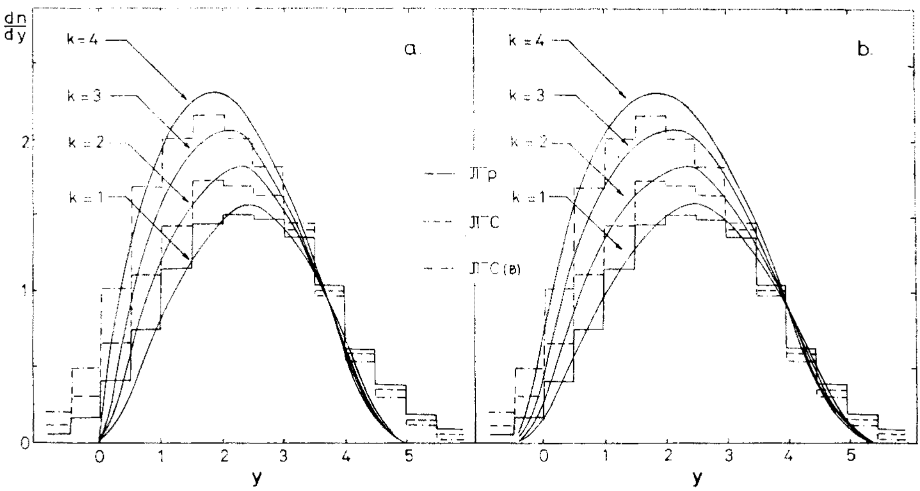

Fig. 1. Longitudinal rapidity distributions for π^-p and π^-C interactions at 40 GeV/c compared to the predictions of the BCT model a. without and b. with cluster decay taken into account

$\pi^-C_{(B)}$ represents pion-carbon interactions after excluding collisions with quasi-free nucleons of the carbon nucleus. This last sample represents about 40% of the entire sample of π^-C interactions. One can see, that in accordance to formula (2), the BCT model predictions for $\bar{k} = 2$ (with the same value of the parameter λ) describe approximately π^-C interactions whereas the sample $\pi^-C_{(B)}$ is reproduced for $\bar{k} \cong 3.5$. The theoretical distributions are, however, too narrow. We think that this might be due to the fact that BCT model does not take into account any widening of the rapidity distributions due to cluster decay. This can be done in the simplest way by increasing the dispersion of the distributions according to the formula

$$\sigma^2 = \sigma_c^2 + (0.9)^2, \tag{3}$$

where σ_c is the dispersion of the distribution of clusters and 0.9 is the dispersion of the Gaussian distribution describing cluster decay (assumed isotropic) [3]. Figure 1b presents the rapidity distributions with the above widening taken into account. One can notice an appreciable improvement in the description of the data, suggesting a line along which the model should be developed. At 40 GeV/c we find the widening to be about 15–20%.

One should, however, also notice that the importance of the discussed effect will decrease with increasing energy of the incident hadron and at 200 GeV it will amount to only a few percent.

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