STUDYING THE KINEMATIC CHARACTERISTICS OF SECONDARY PARTICLES IN HE-COLLISION

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Abstract*: The study of high-energy nucleus-nucleus interactions is the experimental basis of high-energy physics, providing information about nuclear matter, its state and structure, the mechanism of the appearance of new particles, and the properties of elementary particles.*

Keywords*: nucleus, collision, momentum, energy, proton, pi criterion, model, FRITIOF, exit angle, kinematics, fundamental, unified theory*

In this work, the kinematic characteristics of protons and negative pions produced in inelastic collisions of 4He nuclei with a momentum of 4.2 GeV/c with a 12C nucleus were studied. The method of collecting statistical data of the experiment was presented in [1,4] and the experimental data obtained were compared with theoretical calculations of the FRITIOF model [2-5].

There is a kinematic relationship between the momentum and angle of the non-participating fast protons. However, the momentum-angle distribution was not included in the analysis of the physical data obtained in the experiment. Also, the magnitudes P<0.30 GeV/c, P>3.0 GeV/c and <4° were obtained by calculations. The separation of non-participating protons allows us to determine the momentum-angle distribution and to study the composition of the spectator particles in more detail.

The results obtained increase the accuracy of the separation of particles involved in nuclear interactions. The study of the distributions of the momentum of protons formed in the interactions through the degree of collision centrality also allows us to obtain information about the description of the collision mechanism. Analysis of the spectra shows that with an increase in the "net" charge Q, the

distributions appear, that is, there is a shift in the energy of the secondary protons formed in the collision. With an increase in Q, the energy of the secondary protons decreases without any regularity.

It is known that the spectra of protons in nucleus-nucleus interactions are described quite successfully by the Glauber approximation in the limit of the scenario of successive collisions of an incident particle with nuclear nucleons [3-4]. In the central region of the velocity and in the region of target-nucleus fragmentation, that is, at sufficiently high energies, when the contribution of target nuclear nucleons is large, a violation of this scenario can be observed. Therefore, it is interesting to study the characteristics of "leader" and "non-leader" hadrons.

In the Glauber approximation, as in the cascade model, hadron-nucleus and nucleus-nucleus collisions can be imagined as a set of elementary particle interactions. However, this is not the case in the FRITIOF model.

The kinematic characteristics of particles in events at different values of the degree of centrality, presented in this work, allow us to identify those areas of the phase space that are difficult to explain by models. First of all, the analysis of peripheral interactions allows us to check the correctness of the modeling of elementary interactions. In multi-nucleon interactions, it is possible to observe the monotonicity of collective effects. If this is the case, for example, in central collisions, fireballs appear that contain all nucleons, then the kinematic characteristics of particles should be almost independent of the centrality of the collision.

The following conclusions can be drawn from the work done:

- there is no significant deviation in the average values of the kinematic characteristics of cumulative protons formed in inelastic HeC interactions. This can be explained by the close nucleon composition of the target projectile nuclei.

- Deviations from model calculations of around 10-15% can be explained by the fact that mathematical calculations do not take into account factors that occur in experiments.

- The distributions obtained according to the kinematic characteristics of π- - mesons produced in HeC collisions show that the maximum values of the momentum and transverse momentum of π- - mesons, respectively, do not exceed 600 and 370 MeV/c. Their velocities vary in the range (-1□+4), and their average value is found to be 1.4.

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