MAIN REGULARITIES IN RELATIVISTIC PROJECTILE FRAGMENT TRANSVERSE MOMENTUM DISTRIBUTIONS IN NUCLEAR EMULSION

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The previous work was concerned with the correlations of secondaries and clastering effects in inelastic interactions of relativistic neon-22 nuclei in emulsions [1]. In this paper the main experimental results of investigation of relativistic projectile fragment transverse momenta distributions in nuclear research emulsions of neon-22 nuclei accelerated at 4.1 *GeV/c* per nucleon will be presented.

Being the invariant against Lorenz transformations, the transverse momentum is one of the internal values of neon-22 nucleus in its rest system. It is believed that distribution of the transverse momentum for a fragment with the charge z ($P_\perp = P_\perp(z)$) obeys the Rayleigh distribution. The probability density and the partition function are as follows:

$$f(P_\perp) = \frac{P_\perp}{\sigma^2(z)} \exp\left(\frac{-P_\perp^2}{2\sigma^2(z)}\right), \tag{1}$$

$$F(P_\perp) = 1 - \exp\left(\frac{-P_\perp^2}{2\sigma^2(z)}\right). \tag{2}$$

From the statistical model of fragmentation [2] the dependence $\sigma^2(z)$ upon the mass of the fragment $F = 2z$ and the inotial mass of nucleus A can be written as parabolic dependence:

$$\sigma^2(z) = \sigma_0^2 \frac{F(A-F)}{A-1}. \tag{3}$$

The constant σ_0^2 is simply connected with neon-22 Fermi momentum P_F^2 before the interaction:

$$\sigma_0^2 = \frac{P_F^2}{5}. \tag{4}$$

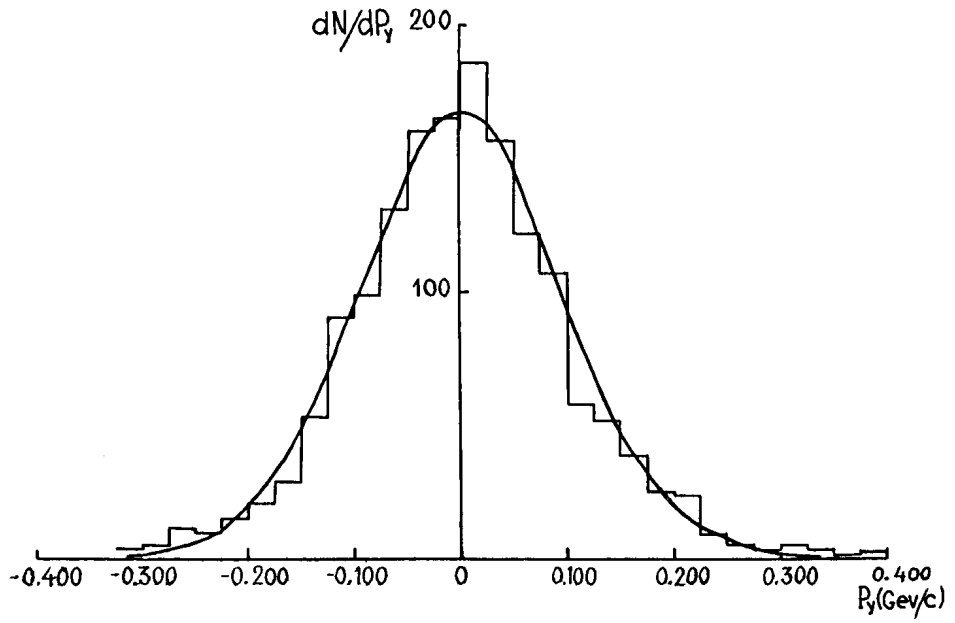

Fig. Distribution of projections of fragment transverse momentum onto plane of emulsion with correction due to parabolic law. Binned distribution is experiment, curve is for normal distribution

The projections of transverse momentum onto the plane of emulsion $P_{|Y} = F \cdot P_0 \cdot \sin\varphi$ were used in this experiment [3] for an experimental estimation of σ_0. Here F is the mass of the projectile fragment, $P_0 = 4.1$ *GeV/c* is the longitudinal momentum of the nucleon, φ is the angle between the projection of the vector integer momentum of the fragment onto the plane of the emulsion and P_0.

Let us suppose that (1) and (3) are valid. The values

$$P_Y = P_{|Y} \left[\frac{A-1}{F(A-F)} \right]^{1/2} \tag{5}$$

must have normal distribution with average equal to zero and the dispersion equal to σ_0^2.

The experimental estimates for the average and the dispersion are equal to $< P_Y > = 0.15 \pm 2.5$ and $S_0 = 102.5 \pm 2.5$ *MeV/c*. The experimental distribution is in agreement with the normal distribution (see fig.).

The quantitative analysis of the data measured according to the criterion of Cramer - Mises (ω^2 — criterion) and the one of Kolmogorov was performed. For all z of the projectile fragments the experimental values for two of these criteria were smaller than 0.743 and 1.63 (there are 1% of the significance level). It means that the hpothesis about the equivalency of the experimental and normal distributions holds true.

The experimental estimation of S_0 is in agreement with the estimation of σ_0 (105.1 *MeV/c*) for Fermi momentum from the electron scattering. So equation (4) is valid.

One can see that the projectile fragment transverse momenta distributions for neon-22 obey the Rayleigh distribution with the constant from the Fermi momentum and the parabolic law. The statistical models of the fragmentation process in the limits of the achieved statictics, are in agreement with the experiment.

One of such models, the cylindrical phase-space one which has only one constant σ_0 permits to describe the main regularities in relativistic projectile fragment transverse momenta of the inclusive disributions, and is in agreement with observation of the multifragmentation process when there are 2 and more fragments in one event [4]. The experimental distributions of the azimuthal assimmetry and collinearity coefficients defined from fragment azimuthal angles, the modulus of vector sum of all and of 2,3 and 4 fragments in one event, the kinetic energy flow angle are in agreement with the ones obtained in the model. Some other more complicated functions of the transverse momenta are also in agreement with the model calculations.

References

1. Lepekhin F.G., Simonov B.B. //LNPI Research report 1988-1989, Leningrad. 1991. P.77-78.
2. Goldhaber A.S. //Phys.Lett., 1974. 53B. 306.
3. Levitskaja O.V., Lepekhin F.G., Siminov B.B. Preprint LNPI-1550. Leningrad. 1989. 20 p.
4. Levitskaja O.V., Lepekhin F.G. Preprint LNPI-1564. Leningrad. 1989. 29 p.