THE PARTON PICTURE OF RELATIVISTIC NUCLEI FRAGMENTATION

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There were published the earlier results of relativistic ^{22}Ne [1] and ^{6}Li [2] nuclei fragmentation at 4.5 A GeV/c. The data about light fragments production in deep inelastic lead nuclei interactions with nuclei in photoemulsion [3,4] were found to be especially useful for understanding of the basic mechanism of this phenomenon . In these interactions from a heavy projectile nucleus remains only its small part as a narrow jet of light fragments. After interaction all other nucleons of lead under the kinematics characteristics do not differ from large number of particles produced in this interaction.

Let's remind, that in such large project as ALICE the main goal is the investigation of central nucleus-nucleus interactions ($Pb + Pb$). In these experiments one hopes to receive the stricter proofs of existence of the longlived Quark - Gluon Plasma and to observe qualitatively new phenomena. These hopes are connected to representation about of the basic mechanism of nucleus - nucleus interactions. It is supposed, that as a result of shock compression of nuclear matter there can be achieved an internal energy density far superior theoretical durability of nuclear matter ($\simeq 1$ GeV/fm^3 [5]).

In each new area of energies the photoemulsion experiments always gave qualitatively correct picture of the phenomena in this area. The fragmentation of relativistic nuclei at 160-200 A GeV confirms this. We summarize in brief, what is established as in ours, and in other experiments with study of relativistic nuclei fragmentation.

- Projection of a transverse momenta of a i-th fragment with mass number A_i on an any direction in a transverse planes has Gauss distribution with a dispersion σ_i^2 which is proportional to the dispersion $\sigma_0^2 = P_F^2/5$ of nucleons in a nucleus with mass number A. P_F is the Fermi momentum of this nucleus. According to A. S. Goldhaber [6]

$$\sigma_i^2 = \sigma_0^2 \cdot \frac{A_i \cdot (A - A_i)}{A - 1}.$$

- The value σ_i does not depend on an energy of primary nuclei in energy region from 1 A to 200 A GeV.

- For k of identical fragments in event a dispersion of distributions of the absolute value of the vector sum of their transverse momenta

$$Q = \sum_{i=1}^{k} \vec{P_{\perp i}}$$

  is k times more, than dispersion of transverse momentum distribution of one fragment σ_i^2. So it is $\sigma_Q^2 = k \cdot \sigma_i^2$. It means, that directions of k vectors of transverse momenta in one events actually do not depend from each other.

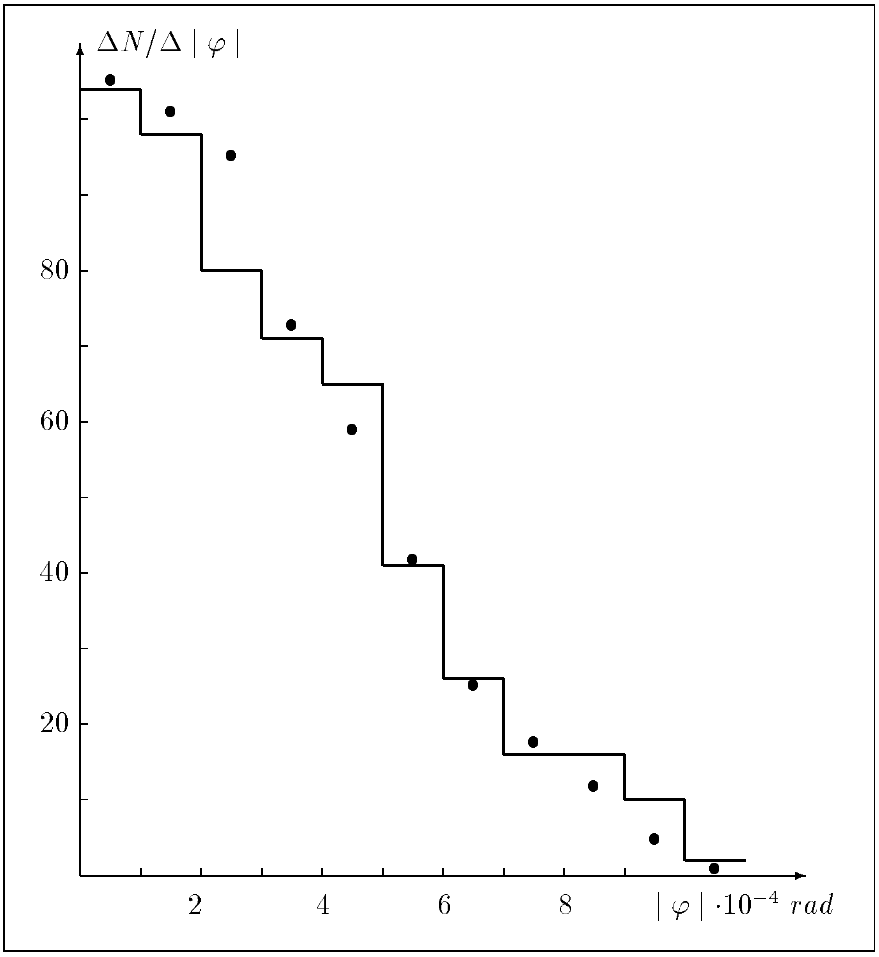

Fig. 1. The experimental distribution of absolute value of φ - angles of lead fragments with $Z = 2, 3, 4$ (histogram). $\bullet$ - the expected distribution.

- There where calcucated the angular distribution of light fragments of lead nuclei at 160 A GeV from deep inelastic interactions with nuclei in emulsion. Any free parameters in this calculation were absent. The experimental and calculated distributions of absolute values of angles φ of fragments in emulsion plane are given in a fig. 1. They are practically identical to each other and are in agreement with a hypothesis of their Gauss distributions. The constants of these experimental and calculated distributions are equal accordingly $\sigma_{exp} = 0.43 \pm 0.02$ mrd and $\sigma_{calc} = 0.39 \pm 0.02$ mrd.

All these features are in agreement with a parton picture of relativistic nuclei fragmentation presented in [4]. In its basis the partons are represented as virtual point-particles, quantums of a field of strong interactions [7]. These representations were already used for the description of particles production in nucleus - nucleus interactions [8]. According to this picture, the relativistic nucleus even before interaction represents a system of uncertain number of virtual particles or partons. Each of them lets out and absorbs of others partons. The conditions of existence of such parton cascade are considered in work [8].

Interaction of two partons, (see fig. 2), belonging to different colliding nuclei, breaks

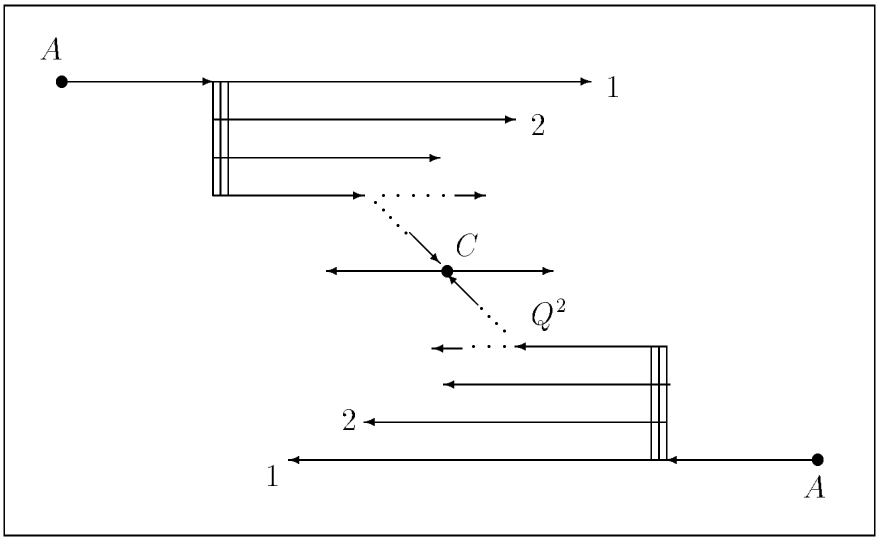

Fig. 2. The parton picture of nucleus - nucleus interaction. A-A is an initial condition of colliding nuclei. In point C the interaction of two partons takes place. 1, 2, 3 - are the fragments observable after interaction.

the coherence of the cascade. Partons cannot again be going together and to pass in an initial condition. Begins the process of thier hadronisation, i.e. partons thus acqure the rest masses and transit in usual, observable particles. Momenta of partons formed particles, on value and on a direction coincide with momenta of partons. There is a process of particles liberation or a limiting fragmentation one.

If these representations about the parton mechanism of relativistic nuclei fragmentation correspond to the validity, there are some simple predictions.

- With increase of a degree of inelasticy of event a dispersion of angular distribution of relativistic nuclei fragments should grow.

- The cascade of partons can be considered as a dynamic system, developing in space and in time. It is a stochastic process of Markov's type. Therefore correlations in the parton cascade fade exponentialy with increase of distance between its branches .

- Conditional probabilities of set of condition of parton cascade are determined by Hibb's distribution. It is equivalent to the statement that the relativistic nucleus is in statistical balance with vacuum and passes in a condition, noticed in experiment, without formation of an intermediate equilibrum state. There is a base for account of relative yildes of fragments.

- As for the cascade partons does not exist any of observed effects, which depend on centre of mass of a cloud partons, concept of parameter of impact loses physical sense [7]. For pair of colliding point-particles (see fig. 2), the place of their interaction can to be located anywhere. A multiplicity of particles production does not depend on it. It is determined only by degree of development of the cascade at the moment of partons interaction.

Experimental research of properties of a parton cascade as dynamic system represents an interest and not only for understanding of the basic laws of relativistic nuclei fragmentation. Obviously, for example, that the longitudinal sizes of area of particles production in nuclear - nuclear interactions should be increased with growth of an energy of colliding nuclei faster, than the sizes of this area in a transverse direction. Main role in increase of the longitudinal sizes of the areas of particles production play fragments of relativistic nuclei.

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