FITTING THE SPECTRA OF PIONS, KAONS, PROTONS, AND ANTIPROTONS IN RELATIVISTIC CU + CU COLLISIONS

M.M. Sultanov*, A.N. Jumanov*, A.A. Usarov, Q.Kh. Yakhshiboyev***, A.I. Suvanov******
*Jizakh Polytechnical Institute, Uzbekistan
**Samarkand State Medical Institute, Uzbekistan
***Academic Lyceum under Samarkand State Architectural and Building Institute
**** Samarkand branch of Tashkent Agrarian University
amattou@rambler.ru
Phone: +998 (90) 600-60-22

There are two main problems in quantum chromodynamics (QCD) related to the vacuum structure that can only be solved by relativistic nuclear physics. These problems are: color charge configuration and spontaneous disruption of chiral symmetry. The confinement means that there are no colored objects in the observed spectrum of hadron states. From the point of view of quarks-gluons' assumptions about the structure of hadrons, the confinement means that quarks and gluons cannot propagate at distances greater than 1fm (hadron size) [1]. However, this assertion is valid only at normal nuclear densities. The high-density nuclear material formed in the collisions of relativistic nuclei occurs in the deconfusion phase, that is, the generalization of quarks and gluons belonging to a single nucleon. can be spread over distances up to the size. Spontaneous disruption of chiral symmetry means the following. At the limit of the mass of the quarks close to zero, in the QCD this limit is fully valid for the quarks u and d. Because mu, d << mp << mN, the right and left components of their QCD lagrangian are different from each other, and the vector gluons do not mix with each other. The QCD vacuum is chiral asymmetric due to the presence of a π-meson with almost no mass relative to other hadrons and a negative internal pair. Thus, at zero temperature and normal core densities, the QCD vacuum is configurable and is in a state of disturbed chiral symmetry.

Today, the most pressing problems of microcosm physics are being solved in giant colliders with energies of accelerating nuclei up to a few TeV. Depending on their structure, colliders come in a variety of design solutions. Colliders are giant blocking complexes in which particles or ionized heavy nuclei (e.g., Au, Pb, U) reach speeds of up to several tens of kilometers in length. Typically, colliders consist of two synchrotrons with a single ring, in which the same charged ions are accelerated in opposite directions, and the meeting points of these bundles in orbit are formed in the area where the experimental devices - detectors are installed. A nuclear reaction occurs as a result of the collision of heavy ions forming opposite bundles. One such collider is the RHIC (Relativistic Heavy Ion Collider) at the Brookhaven National Laboratory in the United States, which accelerates the Cu, Au, and Pb nuclei. The RHIC orbit is 3834 m long and has a one-way acceleration energy of 100 GeV / nucleon, launched in 2000.

In RHIC, nuclei such as gold (Au) and uranium (U) collide with 200 GeV energy per nucleon. [2]. Such collisions result in an opaque environment composed of partons, strongly bonded, elongated, and reflecting a hydrodynamic flow. This medium is called strongly bound quark-gluon plasma (QGP).

Matter formed by the collision of heavy ions has a very short lifespan. After the collision, it expands and then cools with the conversion of all the particles into hadrons (adronization), and some of them can be recorded experimentally by wires through detectors as wires or leading hadrons (e.g., high-energy π-mesons). The QGP matter can be studied by comparing the spectra of sample particles formed in the collision of heavy ions with the spectra of particles formed in the p + p collisions of the same energy. In the measurement of narrow and leading hadrons, it is assumed that the sample formed in the initial state of the particle-dense medium. The observer's task is to provide information about the initial state of the low-energy hadron system and its evolution. Conducting such observations systematically as a function of the Hadrons involved in the collision (N_{part}) is very important in understanding the properties and state of matter formed in the collision Au + Au with energy $\sqrt{S_{NN}}$=200 GeV. However, in Au + Au peripheral collisions with $N_{part} <60$, the error in detecting N_{part} is around 20% [3,4]. In this case, the particles leave the collision field in different scenarios, depending on their origin.

The elongation of the size of relatively small systems such as Cu + Cu, where physically observed d + Au and p + p, $A_{Cu} = 63$, is separated by the amount of particles involved in well-shielded peripheral Au + Au collisions. The uncertainty in the Cu + Cu collision sections is rarely compared to the Au + Au collisions in the same number of participants. Assuming that the mass distribution is isotropic, the area of the shield will be spherical at Cu + Cu central collisions. The shape of the system in the Au + Au collision, in which a similar participant exists, is in the form of an alloy (cocoon), which allows to study the geometric effects in experimental observations.

Most of the data on the recorded hadrons are based on average speeds. BRAHMS data offer a great way to increase our knowledge of matter formation and various chemical conditions by studying the hadrons formed at both average velocities and anterior velocities, comparing their properties. $\sqrt{S_{NN}}$=200 GeV The transverse pulse pt spectra of charged hadrons ($\pi^{\pm}$, $K^{\pm}$, p, ṕ) in collisions with energy $\sqrt{S_{NN}}$=200 GeV Cu + Cu were measured as a function of the collision center at velocity y = 0 and y = 3. The results were compared with those obtained at p + p and Au + Au collisions with the same energy, velocity, and centrality (number of participating particles).

In the case of elementary p + p and p + ṕ collisions, the spectra of hadrons are expressed by the peturbatic QCD for $p_t \sim 2$ GeV [5-6]. The data on Cu + Cu collisions in this paper cover the lower physics field as well as the high pt-transition phenomenon. In this study, we study the origin of such a transition, first by studying the global hydrodynamic properties of the system using blast wave fits, secondly by generating a complete output for each particle type and $<p_t>$ average transverse impulse, and thirdly by different is expressed by showing the particle ratio as a function of p_t and, finally, by summing the nuclear variability (RAA) factor as a function of p_t and velocity.

The process of determining the collision center in the Cu + Cu system is described in detail in the study of Au + Au collisions using the amount of particle $<N_{part}>$ and sequential colliding nucleons $<N_{coll}>$. The values obtained during the process are given in Table 1. For this analysis, events were divided into 4 central areas: 0-10%, 10-30%, 30-50%, and 50-70%. Events within ± 25 cm of the nominal collision point were selected.

Table 1. Values of $<N_{part}>$ and $<N_{coll}>$ quantities for Cu + Cu collision centrality area

centrality	$<N_{part}>$	$<N_{coll}>$
0-10%	97±0,8	166±2
10-30%	61±02,6	85±5
30-50%	29±4,3	30±6
50-70%	12±3,2	9. 6±3,2

Measuring the transverse momentum p_t spectrum of secondary particles formed by the collision of heavy ions is the first and most important step in the study of a number of quantities that reflect the properties of the particle medium.

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