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DEPENDENCE OF THE CORRELATION COEFFICIENT ON THE SIZE OF THE PHASE-SPACE INTERVAL IN HIGH-ENERGY INTERACTIONS

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We calculated the cumulant moments in order to find the genuine two-particle short-range correlations among the produced pions and also the correlation coefficients in order to quantify the correlations. We studied the cumulant moments and their variation with the pseudorapidity phase-space interval for nucleus-nucleus interactions (^{24}Mg-AgBr at 4.5A GeV and ^{28}Si-AgBr at 14.5A GeV), hadron nucleus interactions (p-AgBr at 800 GeV) and hadron-hadron collisions (p$\bar{\text{p}}$ at $\sqrt{s} = 200$ GeV and $\sqrt{s} = 900$ GeV). The analysis reveals the presence of genuine two-particle short-range correlations among the produced pions in the multi-particle production processes. It is found that the cumulant moments decrease with the increase of the width of the rapidity phase-space intervals. The decrease of cumulant moments with the increase of phase-space interval signifies that the short-range correlation decreases. We investigated the variation of the correlation coefficients in order to study the correlation effects in some more detail in the above mentioned interactions. The nature of variations of the correlation coefficients with the phase-space interval size is different for different types of interactions.

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1. Introduction

The collision of heavy ions at relativistic energies offers the right kind of environment to explore a variety of aspects related to hot and dense nuclear matter, which

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in turn enhances our existing knowledge about the nuclear equation of state as well as provides us with the possibility of observing the signatures of an unusual form of matter such as a quark-gluon plasma. Thus, during recent years, an intensive effort has been devoted to investigate the formation and decay of highly-excited nuclear matter produced in nucleus-nucleus collisions at various incident energies.

In the field of high-energy interactions, various experiments were performed with lepton-lepton, hadron-hadron, hadron-nucleus and nucleus-nucleus interactions at relativistic and ultra-relativistic energies to reveal the underlying dynamics of multi-particle production process. There are several phenomena regarding interactions between elementary particles, which have possibilities to be understood in terms of correlation effect. Although it can not be said with absolute certainty, whether particular physical processes are responsible for the correlated emission of the produced particles, people have tried to explain their observations regarding this in terms of resonances, clustering or heavier intermediate stages and shock formations [1 − 4], etc.

For a pair of pions having like charges, narrow correlation is observed, which is suggested to be a Bose-Einstein symmetry effect [5] rather than a consequence of charge structure dynamics of particle production. As the heavy-ion interactions came to the picture of high-energy interactions, new theories emerged and the study on correlated particle production becomes one of the important keys to search for new types of parameters. For example, in heavy-ion collision at nearly about $1A$ GeV, the participant system is interpreted as a fireball and some nucleons coalesce to form composite particles. The size of the fireball and the duration is measured in terms of two-particle correlation [6]. Non-statistical multiplicity fluctuations leading to intermittency also speak in favor of the existence of correlation in multi-particle production. Two- and three-particle correlation depend on various parameters, namely momentum vectors, emission angles and the azimuthal angle of the particles produced. Several studies using well known two- and three-particle correlation function have been reported in different types of interactions [7]. When only two and three particles are examined, the information about the rest of the particles remains unknown. Correlation among more than three particles can be studied by using the standard correlation function. But the problem becomes more complex as the number of particles increase. Correlation functions are capable of revealing the significant features of multi-particle production mechanism, and therefore, are a potential source of information. Correlation studies are important for the knowledge about the late stages of interactions. It plays a fundamental role in extracting first information on the underline particle production mechanism.

The study of multiplicity distribution of the produced hadrons along with the analysis of correlation among them stands in the frontier of investigations in the area of multi-particle dynamics. The multiplicity distribution plays a fundamental role in extracting the first information on the underlying particle production mechanism, while the correlations give details of the dynamics. The full multiplicity distribution is a global characteristic and is influenced by the conservation laws. On the contrary the multiplicity distributions in restricted phase-space domains contributing to the correlations are local characteristics and have an advantage of being much less affected by the global conservation laws. In the last decade, the study of multiplicity distribution in the limited region (bins) of phase space has attracted immense interest in view of search for the local dynamical fluctuation of an underlying self-similar fractal structure, the so called intermittency phenomenon. For an extensive review one may consult Ref. [8]. Although this phenomenon has been observed in various interactions, many questions about the intermittency are still to be answered. Studying local fluctuations, one should remember that the fluctuations of a given number of particles say q, is contributed by genuine lower order $p < q$. To extract signals of the correlation of order p, one should be acquainted with the advanced statistical technique of normalized factorial cumulant moment [9 − 11]. In this context, it is to be mentioned that the search for genuine higher-order correlation in multi-particle production process has been studied by OPAL collaboration. They have established the existence of strong genuine multi-hadron correlation up to the 5^{th} order [12]. In proton-proton collisions, correlations among more than three particles have also been observed [13 − 17].

In contrast to this situation, in heavy-ion collisions at low energies and/or in reactions of light nuclei, genuine correlations are found to have non-zero value only up to third order [18]. Furthermore, it has been found that in general these correlations become weaker as the reaction average multiplicity increases. In nucleus-nucleus interactions at higher energies, of about ten to hundreds GeV per nucleon, only the two-particle short range correlations are found to survive [19 − 20]. Thus in relativistic heavy-ion collision, the study of two-particle correlation presents significant features of the nuclear interactions and is a potential source of information.

2. *Method of analysis*

In order to define the two-particle short-range correlation function, let us consider a collision between two particles marked as a and b. It is assumed that the collision between the particles yields exactly n particles in a sub-volume Ω of the total phase space Ω_{tot}. Let z represent the kinematical variable needed to specify the position of each particle in this space. The distribution of points in Ω can be characterized by continuous probability densities $P_n(z_1, z_2, \ldots, z_n)$, $n = 1, 2, \ldots, n$. For simplicity, one may assume all final-state particles to be of same type. In this case, the exclusive distributions $P_n(z_1, z_2, \ldots, z_n)$ can be taken fully symmetric in $(z_1, z_2, \ldots, z_n)$; they describe the distributions in Ω when the multiplicity is exactly n.

The inclusive q particle densities $\rho_q(z_1, z_2, \ldots, z_n)$ in general contain trivial contributions from lower-order densities. Under certain condition it is, therefore, advantageous to consider a new sequence of functions $C_q(z_1, z_2, \ldots, z_n)$ as those statistical quantities that vanish whenever one of their arguments becomes statistically independent of the others. The quantities with such properties are well known correlation functions. In general two-particle correlation function is given by

$$C_2(1,2) = \rho_2(1,2) - \rho_1(1)\rho_1(2)\,. \tag{1}$$

It is convenient to divide the functions ρ_q and C_q by the product of one particle densities. This leads to the definition of the normalized inclusive density correlations.

There is a variety of models which describe particle production as a branching process, see for example Ref. [21]. The main prediction of these models is a suitable parametrization for the multiplicity distribution. Further, more details of the underlying dynamics come from the investigation of the cumulant moment of multiplicity distribution given in Ref. [8]. One of the most popular methods used to describe data in full and limited phase space is the negative binomial distribution or NBD as it is abbreviated. Before a detailed discussion can be made of the multiplicity fluctuations and correlation, it is worthwhile to review some properties of the NB distribution. This distribution has distinct properties which form the basis of counting statistics. The Poisson distribution results from the repeated independent trials, each with the same probability for a given outcome. If the probability of the outcome varies, or if some correlations are introduced so that the trials are not independent, the distribution tends to become negative binomial [22]. One may consult Refs. [23, 24] for a review on this subject and its historical development.

The negative binomial distribution function for n charged particles in the final state is expressed as

$$P_n(\bar{n},k) = \frac{(n+k-1)!}{n!(k-1)!}\left(\frac{\bar{n}}{\bar{n}+k}\right)^n \left(\frac{k}{\bar{n}+k}\right)^k . \tag{2}$$

Here $\bar{n}$ and k are two NBD parameters. $\bar{n}$ is the average multiplicity of the distribution. The parameter k describes the shape of the distribution. k is related to the dispersion of the distribution by the following relation

$$D^2 = \bar{n} + \frac{(\bar{n})^2}{k} . \tag{3}$$

For the NB distribution the normalized factorial cumulant moment is governed by the parameter $1/k$. The normalized factorial cumulants (K_q) of the NBD are related in a simple manner to the NBD parameter k,

$$K_q = \frac{(q-1)!}{k^{q-1}} . \tag{4}$$

The second-order factorial cumulant moment can be obtained putting $q = 2$ in the above relation. We easily get

$$K_2 = \frac{1}{k} . \tag{5}$$

The factorial moment of order q of the multiplicity distribution of the particles in a phase-space domain is equal to the integral of q particle inclusive density ρ_q over the domain [8]. As in the cluster expansion of statistical mechanics, ρ_q can be decomposed into the sum of contributions from the accidental coincidence of the particles in the phase space and the true correlations. The latter are denoted here by unnormalised cumulants K_q. Being the bin averaged factorial cumulant functions K_q is a direct measure of stochastic dependence in multiples of exactly q particles. By the construction K_q vanishes whenever a particle within q-tuple is statistically independent of one of the others. For Poissonian multiplicity fluctuations, the cumulants of all order which are greater than 1 vanish identically. Non-zero values of cumulants therefore indicate the presence of correlation.

The cumulant moments always point out whether the particle production is correlated or not. It does not give any information on the quantification of correlation. To quantify the presence of correlation, another simple method is proposed. In this new method, a parameter called the correlation coefficient is introduced to quantify the degree of correlation between any two quantities. If the multiplicity distribution of the produced particles can be fitted with negative binomial distribution, one can easily calculate the correlation coefficient.

The correlation coefficient b has a simple relationship with the NBD parameter k and the average multiplicity $\bar{n}$ [25]. In terms of $\bar{n}$ and k, the correlation coefficient is expressed as

$$b = \frac{\bar{n}}{\bar{n} + k}\,. \tag{6}$$

If the NBD distribution is studied in a different pseudo-rapidity interval, the correlation coefficient can also be calculated in a different pseudo-rapidity interval and the variation of correlation coefficient in different pseudo-rapidity intervals can be investigated. Higher values of correlation coefficient indicate higher correlation strength.

If we put $k = \infty$ in the above equation, we get $b = 0$, and the distribution (2) will become Poissonian. It is well known that if the charged particles were produced randomly and independently, their multiplicity distributions will be Poissonian. The Poisson distribution results from repeated independent trials, each with the same probability for a given outcome. If the probability of outcome varies or if any correlation is introduced so that the trials are not independent, the distribution tends to become negative binomial giving non-zero values of correlation coefficient b.

In this brief report, we have calculated the second-order cumulant moment and also correlation coefficient of the produced pions and investigated the variation of correlation coefficient with the different pseudo-rapidity interval size ($\Delta\eta$) for the nucleus-nucleus interactions (^{24}Mg-AgBr at 4.5A GeV, ^{28}Si-AgBr at 14.5A GeV), hadron-nucleus interactions (p-AgBr at 800 GeV) and hadron-hadron collisions (p$\bar{\text{p}}$ at $\sqrt{s} = 200$ GeV and $\sqrt{s} = 900$ GeV). In the case of pion multiplicity distribution, the phase-space variable used is pseudo-rapidity η. It is related to the emission angle θ (measured w.r. to the beam direction) by the relation $\eta = -\ln\tan(\theta/2)$. The details of detector used, number of events and other experimental details can be found in Ref. [26] for the ^{24}Mg-AgBr interactions, in Ref. [27] for the ^{28}Si-AgBr interactions at 14.5A GeV and for the p-AgBr interactions at 800 GeV, and in Ref. [28] for the p$\bar{\text{p}}$ collisions at $\sqrt{s} = 200$ GeV and $\sqrt{s} = 900$ GeV.

3. Data analysis and results

The multiplicity distribution of charged particles were studied in the case of ^{24}Mg-AgBr interactions 4.5A GeV [26], ^{28}Si-AgBr interactions at 14.5A GeV and p-AgBr interactions at 800 GeV [27], and the p$\bar{\text{p}}$ collisions at $\sqrt{s} = 200$ GeV and $\sqrt{s} = 900$ GeV [28] with increasing intervals of pseudo-rapidity. In all cases, the multiplicity distribution was fitted with the NBD distribution. The experimental results of the NBD distribution can be found in Refs. [26 − 28]. From these papers, one can see that the k parameters of the NBD fit show a linear increase with the width of the rapidity phase-space interval and also with the average multiplicity. Now we will calculate the cumulant moment in order to search for the genuine two-particle short-range correlation in the multi-particle production in nucleus-nucleus, hadron-nucleus and hadron-hadron interactions. Later we will investigate how the cumulant moment, which plays an important role in our analysis, varies with the phase-space interval. The importance of studying factorial cumulant moment lies in the fact that unlike the factorial moment, cumulant moments are a direct measure of stochastic independence among the group of exactly q particles emitted in the same phase-space cell. In much of the current literature, it is taken for granted that F_2 (the factorial moment) scales rather than K_2. However, it may be the cumulants, which have the feature of scaling rather than the factorial moment.

We have calculated the second-order cumulant moment for different rapidity window sizes in order to search for the genuine two-particle short-range correlation using Eq. (5). The values of the NBD parameters k, which are required for this purpose have been taken from the literature published earlier [26 − 28]. We show the values of the second-order cumulant moment in Tables 1 to 5, respectively, for the ^{24}Mg-AgBr interactions at 4.5A GeV, ^{28}Si-AgBr interactions at 14.5A GeV, p-AgBr interactions at 800 GeV, and p$\bar{\text{p}}$ collisions at $\sqrt{s} = 200$ GeV and at $\sqrt{s} = 900$ GeV. From the tables, it is seen that the second-order cumulant moments have non-

TABLE 1. The values of $\Delta\eta$, $\bar{n}$, k, b and K_2 for ^{24}Mg-AgBr *interactions at 4.5A* GeV.

$\Delta\eta$	$\bar{n}$	k	b	K_2
0.5	1.51	1.14	$0.563 \pm .018$	.877
1.0	3.3	1.32	$0.714 \pm .021$	.757
1.5	5.02	1.55	$0.764 \pm .032$	.645
2.0	6.42	1.78	$0.783 \pm .035$	.562
2.5	8.04	2.00	$0.803 \pm .045$	.5
3.0	9.04	2.34	$0.794 \pm .058$	.427
3.5	10.15	2.79	$0.784 \pm .065$	.358
4.0	10.67	3.22	$0.763 \pm .078$	.310
4.5	11.50	3.53	$0.765 \pm .089$	.283
5.0	11.67	3.81	$0.754 \pm .092$	.262

TABLE 2. The values of $\Delta\eta$, $\bar{n}$, k, b *and* K_2 *for* ^{28}Si-AgBr *interactions at 14.5A* GeV.

$\Delta\eta$	$\bar{n}$	k	b	K_2
0.2	1.84	0.65	$0.734 \pm .011$	1.53
0.5	4.92	0.65	$0.883 \pm .034$	1.53
1.00	9.16	0.64	$0.934 \pm .045$	1.56
2.00	17.97	0.66	$0.964 \pm .049$	1.51
4.00	27.10	0.81	$0.974 \pm .056$	1.23
6.00	33.48	1.16	$0.965 \pm .061$	.862

TABLE 3. The values of $\Delta\eta$, $\bar{n}$, k, b *and* K_2 *for* p-AgBr *interactions at 800* GeV.

$\Delta\eta$	$\bar{n}$	k	b	K_2
0.2	0.77	2.87	$0.211 \pm .008$	.348
0.5	2.12	2.47	$0.462 \pm .009$	.404
1.0	4.08	3.44	$0.542 \pm .012$	.290
2.0	7.85	6.24	$0.557 \pm .017$	.16
4.0	12.7	7.99	$0.613 \pm .022$	.125
6.0	13.68	7.46	$0.647 \pm .026$	.13

TABLE 4. The values of $\Delta\eta$, $\bar{n}$, k, b *and* K_2 *for* p$\bar{\text{p}}$ *collisions at* $\sqrt{s} = 200$ GeV.

$\Delta\eta$	$\bar{n}$	k	b	K_2
0.2	0.96	1.8	$0.347 \pm .009$	.555
0.25	1.21	1.9	$0.383 \pm .019$	.526
0.5	2.48	2.0	$0.553 \pm .034$	.500
1.0	5.32	2.3	$0.693 \pm .037$	.434
1.5	8.1	2.6	$0.757 \pm .044$	.384
2.0	10.7	2.6	$0.804 \pm .05$	.384
2.5	13.2	2.8	$0.825 \pm .053$	.357
3.0	15.4	3.1	$0.832 \pm .065$	.322
3.5	17.4	3.4	$0.835 \pm .068$	.294
4.0	18.8	3.7	$0.835 \pm .069$	.270

zero values for every rapidity window size and for all interactions stated above. The non-zero values of the second-order cumulant moments depict the presence of two-particle short-range correlation among the produced pions. From the tables, it is observed that the values of the cumulant moments decrease as the rapidity window

TABLE 5. The values of $\Delta\eta$, $\bar{n}$, k, b and K_2 for $p\bar{p}$ *collisions at* $\sqrt{s} = 900$ GeV.

$\Delta\eta$	$\bar{n}$	k	b	K_2
0.2	1.42	1.5	$0.485 \pm .012$	.67
0.25	1.79	1.5	$0.544 \pm .022$	.67
0.5	3.55	1.5	$0.703 \pm .035$	.67
1.0	7.4	1.7	$0.813 \pm .033$	.59
1.5	11.1	1.8	$0.863 \pm .045$	.555
2.0	15.0	2.0	$0.882 \pm .054$	.500
2.5	18.8	2.1	$0.893 \pm .056$	.476
3.0	22.1	2.3	$0.905 \pm .058$	.434
3.5	25.3	2.4	$0.913 \pm .058$	.417
4.0	28.0	2.6	$0.915 \pm .061$	.384
4.5	30.3	2.9	$0.912 \pm .062$	.344
5.0	32.2	3.1	$0.912 \pm .065$	.322

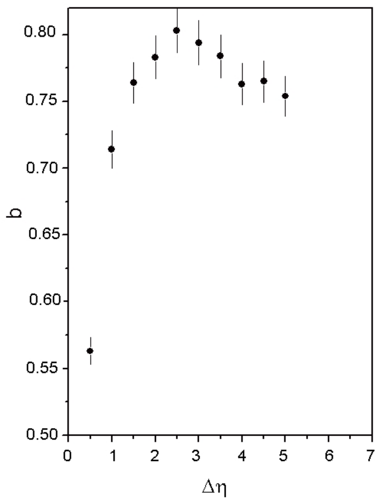
sizes go on increasing. Thus one may point out that the strength of two-particle short-range decreases as the rapidity width is increased. This observation stressed the necessity of quantification of the correlation phenomenon.

In order to calculate the two-particle correlation coefficient, we used Eq. (6). The values of the parameters needed are the average multiplicity ($\bar{n}$) in different rapidity windows and the NBD parameter k, which have been taken from Refs. [26 − 28] for the different interactions.

The calculated values of the correlation coefficient for different rapidity windows are tabulated in Table 1 for ^{24}Mg-AgBr interactions at 4.5A GeV, in Table 2 for ^{28}Si-AgBr interactions at 14.5A GeV, in Table 3 for p-AgBr interactions at 800 GeV, in Table 4 for $p\bar{p}$ collisions at $\sqrt{s} = 200$ GeV and in Table 5 for $p\bar{p}$ collisions at $\sqrt{s} = 900$ GeV. In the tables, we also show the values of $\Delta\eta$, $\bar{n}$, K_2 and k along with the values of b. It is seen from the tables that as the value of $\Delta\eta$ increases, the average multiplicity $\bar{n}$ also increases. Thus for larger values of $\Delta\eta$ the presence of long-range correlation may have been observed.

It is noticed from the tables that for ^{24}Mg-AgBr interactions at 4.5A GeV and ^{28}Si-AgBr interactions at 14.5A GeV, the correlation coefficients increase initially with the increase of the rapidity window size and later show a tendency to decrease as the rapidity window sizes ($\Delta\eta$) are increased more and more beyond a certain value. A clear correlation maximum is observed in case of ^{24}Mg-AgBr interactions. This may be due to the fact that at larger values of $\Delta\eta$, the two-particle short-range correlation becomes much weaker and long-range correlation dominates. This observation is very prominent in the case of nucleus-nucleus interactions. For p-AgBr interactions at 800 GeV, the correlation coefficient increases as the rapidity range increases. In $p\bar{p}$ collisions at both $\sqrt{s} = 200$ GeV and $\sqrt{s} = 900$ GeV, the correlation coefficients increase initially and later become almost constant as the window size $\Delta\eta$ increases.

We ploted the variation of the correlation coefficient with the size of the rapidity window ($\Delta\eta$) in Fig. 1 for ^{24}Mg-AgBr interactions, in Fig. 2 for ^{28}Si-AgBr interactions at 14.5A GeV, in Fig. 3 for p-AgBr interactions at 800 GeV, in Fig. 4 for p$\bar{\text{p}}$ collisions at $\sqrt{s} = 200$ GeV and in Fig. 5 for p$\bar{\text{p}}$ collisions at $\sqrt{s} = 900$ GeV. From the figures, it may be concluded that for smaller values of $\Delta\eta$, the correlation coeffi-



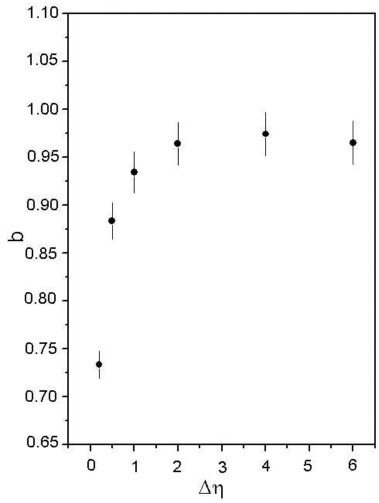


Fig. 1 (left). The plot of b against $\Delta\eta$ for ^{24}Mg-AgBr *interactions at 4.5A* GeV.
Fig. 2. The plot of b against $\Delta\eta$ for ^{28}Si-AgBr *interactions at 14.5A* GeV.

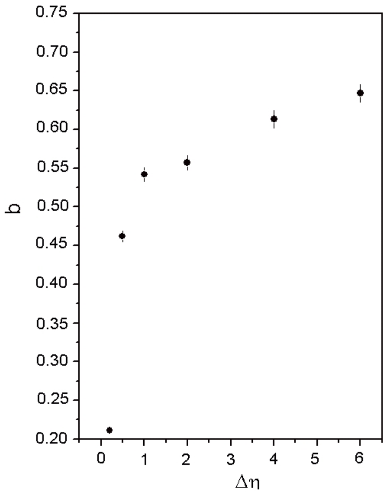
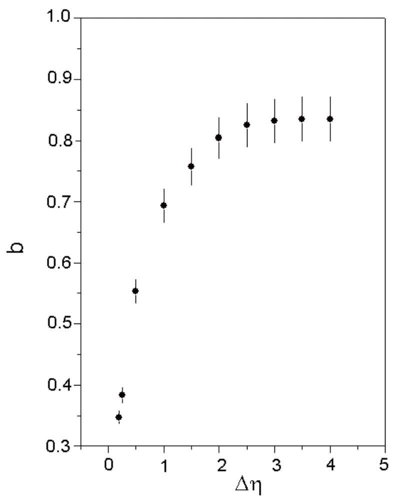


Fig. 3. The plot of b against $\Delta\eta$ for p-AgBr *interactions at 800* GeV.



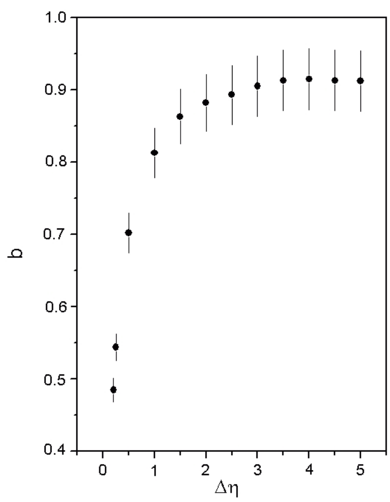


Fig. 4 (left). The plot of b *against* $\Delta\eta$ *for* $\mathrm{p\bar{p}}$ *collisions at* $\sqrt{s} = 200$ GeV.

Fig. 5. The plot of b *against* $\Delta\eta$ *for* $\mathrm{p\bar{p}}$ *collisions at* $\sqrt{s} = 900$ GeV.

cient increases, so there is an increase of the correlation strength in the short-range correlation. But for larger values of $\Delta\eta$, long-range correlation becomes effective. The study reveals that the correlation coefficient, which is used to quantify the correlation effect, behaves differently in the cases of nucleus-nucleus, hadron-nucleus and hadron-hadron interactions. The reason behind this may be that the nuclear geometry for the different interacting system is different. The multiplicity distribution of produced particles is influenced by the nuclear geometry and, consequently, the nature of the correlation is also influenced.

It has also been echoed [29] that in nucleus-nucleus interactions, the overall multiplicity fluctuations are closely related to the nuclear geometry. Fu Hu Liu [30] studied the unified description of multiplicity distribution of final state of particle produced at higher energies. According to him, the nuclear geometry plays a very important role in the multiplicity distribution of the produced particles in the case of nucleus-nucleus interactions. It is obviously needed to investigate whether the presence of short-range correlation in the smaller phase-space interval is influenced by the overall multiplicity distribution. More work in this regard is in progress.

4. *Conclusion*

From our analysis it can be concluded that:

1. For nucleus-nucleus interactions for smaller values of $\Delta\eta$, the correlation coefficient increases. So there is an increase of short-range correlation strength. However, for larger values of $\Delta\eta$ the short-range correlation decreases and long-range correlation becomes effective.

2. For hadron-nucleus interactions, short-range correlation increases with the increase of $\Delta\eta$.

3. For hadron-hadron interactions, short-range correlation increases initially and later saturates at larger window size ($\Delta\eta$).

4. The correlation coefficient, which is used to quantify the correlation effect, behaves differently in the case of nucleus-nucleus, hadron nucleus and hadron-hadron interactions. The reason behind this may be that the nuclear geometry for the different interacting systems is different. The multiplicity distribution of produced particles is influenced by the nuclear geometry and consequently the nature of correlation is also influenced.

References

[1] E. L. Berger, Nucl. Phys. B **85** (1975) 61.

[2] A. W. Chao and C. Quigg, Phys. Rev. D **9** (1974) 2016.

[3] I. M. Dremin and C. Quigg, Usp. Fiz. Nauk **124** (1978) 535.

[4] W. Greiner, Invited talk at the Second High Energy Heavy Ion Summer Study, LBL-3637, 1975 (1974) Page 1.

[5] N. N. Biswas, et al., Phys. Rev. Lett. **35** (1975) 1059.

[6] H. Boggild and I. Otterlund, Proc. of the Bielefeld Workshop (1982), Page 485, ed. M. Jacob and H. Satz, World Scientific, Singapore (1982).

[7] D. Ghosh et al., Can. J. Phys. **84** (2006) 1007, and references therein.

[8] E. A. De Wolf, I. M. Dremin and W. Kittel, Phys. Rep. **270** (1996) 48.

[9] A. H. Mueller, Phys. Rev. D **4** (1971) 150.

[10] P. Carruthers and I. Sarcevic, Phys. Rev. Lett. **63** (1989) 1562.

[11] E. A. De Wolf, Acta Phys. Pol. B **21** (1990) 611.

[12] G. Abbiendi et al., Euro. Phys. J. C **11** (1999) 239.

[13] P. Carruthers, H. C. Eggers and I. Sarcevic, Phys. Rev. C **44** (1991) 1629.

[14] EHS/NA22 collaboration, N. Agababyan et al., Z. Phys. C **59** (1993) 405.

[15] M. Charlet, Ph. D thesis *Multiparticle Correlation in π^+p and k^+p Interactions at 250 GeV/c*, Nijmegen Univ., unpublished, 1994.

[16] EHS/NA22 collaboration, N. Agababyan et al., Phys. Lett. B **332** (1994) 458.

[17] E665 Collaboration, M. Adams et al., Phys. Lett. B **335** (1994) 535.

[18] P. L. Jain and G. Singh, Nucl. Phys. A **596** (1996) 700.

[19] EMU01 Coll., M. I. Adamovich et al., Nucl. Phys. B **388** (1992) 3.

[20] P. L. Jain, A. Mukhopadhyay and G. Singh, Z. Phys. C **58** (1993) 1.

[21] T. Kanki et al., Theor. Phys. Suppl. **97** A (1988) 1; **97** B (1989) 1.

[22] H. Jaffrerys, *Theory of Probability*, Clarendon, Oxford (1981).

[23] C. Fuglesang, Proc. XIX Int. Symp. On Multiparticle Dynamics, Arles 1988, eds. D. Schiff and J. Tran Thanh Van, World Scientific, Singapore, p. 257.

[24] P. Carruthers and C. C. Shih, Int. J. Mod. Phys. A **2** (1987) 1447.

[25] A. Giovannini and L. Van Hove, Z. Phys. C **30** (1986) 391.
[26] D. Ghosh et al., Phys. Lett. B **218** (1989) 431.
[27] P. L. Jain et al., Phys. Lett. B **294** (1992) 27.
[28] R. E. Ansorge et al., Z. Phys. C **43** (1989) 357.
[29] J. Fu, Phys. Rev. C **77** (2008) 027902.
[30] Fu Hu Liu, Nucl. Phys. A **810** (2008) 159.

OVISNOST KORELACIJSKOG KOEFICIJENTA O VELIČINI INTERVALA FAZNOG PROSTORA U VISOKO-ENERGIJSKIM MEĐUDJELOVANJIMA

Izračunali smo kumulacijske momente radi nalaženja pravih dvočestičnih kratkodosežnih korelacija među proizvedenim pionima te korelacijske koeficijente radi utvrđivanja njihovih iznosa. Proučavamo korelacijske momente i njihove promjene sa širinom intervala pseudorapiditeta u faznom prostoru za međudjelovanja jezgra-jezgra (^{24}Mg-AgBr na 4.5A GeV i ^{28}Si-AgBr na 14.5A GeV), hadron-jezgra (p-AgBr na 800 GeV), te u sudarima hadrona (p$\bar{\text{p}}$ na $\sqrt{s}$ = 200 GeV i $\sqrt{s}$ = 900 GeV). Analize pokazuju prisutnost pravih dvočestičnih kratko-dosežnih korelacija među pionima proizvedenim u mnogočestičnoj tvorbi. Nalazimo smanjenje kumulacijskih momenata s povećanjem širine intervala fazno-prostornog rapiditeta. Pad kumulacijskih momenata s povećanjem fazno-prostornog intervala znači da se smanjuju kratkodosežne korelacije. Također smo istraživali promjene korelacijskih koeficijenata radi podrobnijeg poznavanja korelacijskih efekata u navedenim međudjelovanjima. Narav promjena korelacijskih koeficijenata s veličinom fazno-prostornog intervala različita je u tim međudjelovanjima.