Event-by-Event fluctuations in high multiplicity events produced in 158A GeV/c Pb-AgBr collisions

Shaista Khan* and Shakeel Ahmad
Department of Physics, Aligarh Muslim University, Aligarh-202002, INDIA

One of the main goals of studies involving collisions of heavy nuclei at relativistic energies is to investigate the characteristics of strongly interacting matter under extreme conditions of initial energy density and/or temperature; where the formation of Quark-gluon plasma (QGP) is envisaged to take place. However, even if suitable conditions for QGP formation is reached, not all the event would produce QGP and hence a search for such a rare event from the large sample of events is to be carried out which is not an easy task. For this purpose one has to find possible ways to characterize each event which in turn may lead to triggering of different classes of events. A search is, therefore carried out for the events with high density phase regions where a lot of entropy is confined within a small domain. Such a high density regions in one-dimensional distributions are called "hot regions" or spikes. For searching spikes, a parameter, d_{ik} was introduced[1] which measures the local deviations from mean particle density in units of statistical errors. For a given distribution, d_{ik} for the ith bin of kth event is expressed as $d_{ik} = \left(n_{ik} - \frac{N_k}{<N>} < n_{ik} >\right)/\sigma_{ik}$, where n_{ik} is the charged particle multiplicity in i^{th}-bin of k^{th}-event, N_k denotes the multiplicity of k^{th}-event, σ_{ik} represents the statistical error while $< N >$ is the average multiplicity of the sample.

An attempt is, therefore, made to search for the events with "hot" region and to check whether they exhibit same distinct feature, as compare to other events with nearly the same multiplicity by analysing the experimental data on 158A GeV Pb-AgBr collisions.

*Electronic address: khanshaista123@gmail.com

The event samples are taken from the collection of EMU01 experiment. All the relevant details about the collection of events and methods of measurements may be found elsewhere[2]. By plotting the d_{ik} distribution and comparing with the reference distribution, a sample 52 events having "hot" regions in pseudorapidity (η) and ϕ spaces is selected for the analysis. The reference distribution is obtained by carrying out the parallel analysis of mixed events.

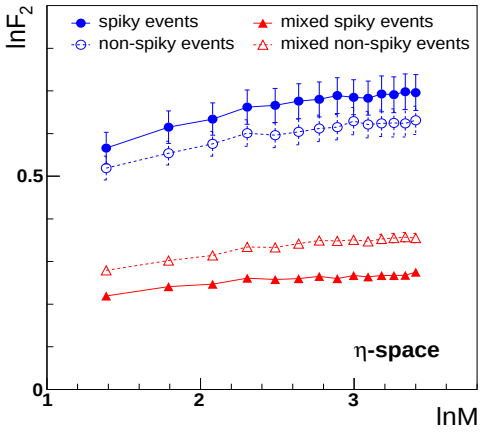

FIG. 1: lnF_2 vs lnM plots for real and mixed events.

In order to test whether the spiky events exhibit some distinct features, values of normalized factorial moments for the spiky and non-spiky events are calculated using the relation[3], $F_q^{(e)} = \frac{<n(n-1)....(n-q+1)>_e}{<n>_e^q}$. Dependence of ln$F_2$ on lnM for the spiky and non-spiky events are plotted in Fig.1. Similar plots for the mixed events generated from the two sets of the real data are also shown in the same figure. It is noted from the figure that values of F_2 moments for the spiky events are sig-

nificantly larger than those obtained from the non-spiky events. The mixed event samples give much smaller values of F_2 as compared to that estimated from the two real sets.

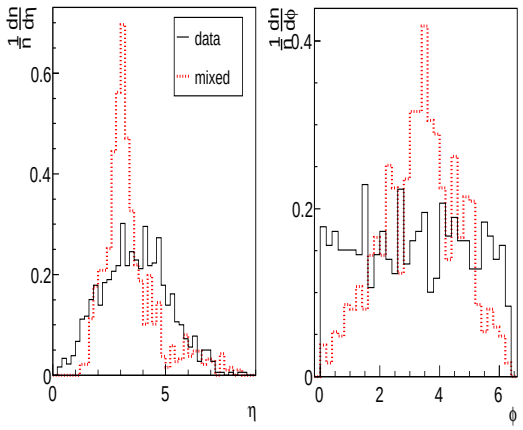

FIG. 2: η- and ϕ- distributions for the two events.

From the sample of spiky events four events with multiplicities, 896, 1047, 1211 and 934 are selected for further analysis. η- and ϕ- distributions of two of these events are displayed in Fig.2. It is evident from the figure that one of these events exhibit distinct peaks in the distribution while the other one has the distributions similar to that exhibited by the total event sample. Deviation in ϕ- distribution for one of the events from the other is particularly noticeable. It would therefore be interesting to look whether the spiky event show same distinct features as compared to the other three events. Fig.3 shows lnF_2 vs lnM plots for the four events in η-space. It may be observed from the figure that F_2 values for one of the events are much larger as compared to the other. These values are also noticed to be larger than the average F_2 values obtained for the entire spiky events sample (Fig.1). These observations, therefore, tend to indicate that by examining the factorial moments events of special interest may be identified from a given data sample. Since in the spiky events there would be relatively larger number of particles confined in small η- and ϕ- bins, it would be interesting to examine the cluster characteristics of such events, like number of cluster produced, mean multiplicities of clusters and fraction of particle coming out via clusters. These features will be presented.

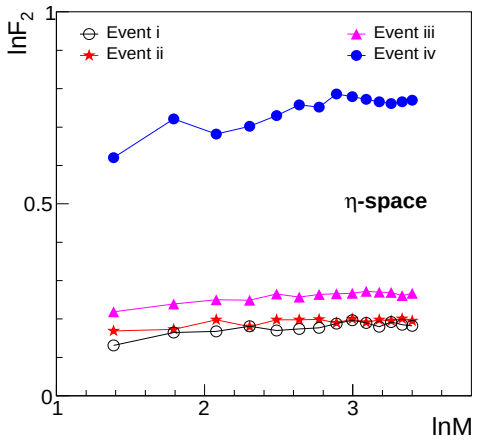

FIG. 3: Variations of lnF_2 with lnM plots for the selected four spiky events.

References

[1] M. L. Cherry et al., *Acta Phys. Pol.* B**29** (1998) 2129.
[2] Shakeel Ahmad *et al*, *Int. J. Mod. Phys.* E **23** (2014) 1450065.
[3] R. C. Hwa, *Acta Phys. Pol.* **27** (1996) 1789.