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SCALING NATURE OF TARGET FRAGMENTS IN THE ^{28}Si-EMULSION INTERACTION AT AN ENERGY OF 14.6*A* GeV

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An attempt has been made to study the fractal behavior of the experimental data on nuclear fragments obtained from ^{28}Si-Emulsion collisions at 14.6A GeV. The whole analysis is performed by using two different methods, namely the methods of scaled factorial moments (SFMs), F_q, and multifractal moments, G_q. We have found that the present data reflect a multifractal geometry for nuclear fragments along with the Monte Carlo events (simulated events). Finally, some evidences of non-thermal phase transitions and the scaling law nature of SFMs have been studied.

Keywords: scaled factorial moments, multifractal moments, quark-gluon plasma, hadrons.

1. Introduction

The unusually large non-statistical particle density fluctuations in small phase space regions have attracted a lot of attention in the field of relativistic nuclear collisions to understand the mechanism of particle production. Several theoretical and experimental groups have suggested different methods to identify the existence of non-statistical fluctuations. Bialas and Peschanski [1] were the first to introduce the most suitable method known as the method of scaled factorial moments (SFMs) to study the non-statistical fluctuations in the distributions of relativistic shower particles produced in high-energy collisions. The proposal of these factorial moments was made in analogy with the phenomenon known as the intermittency in the hydrodynamics of turbulent fluid flows. On the other hand, R.C. Hwa and J.C. Pan [2] also first suggested a modified multifractal moments to extract the dynamical fluctuations in such heavy ion collisions. In high-energy physics, the power law behavior of the scaled factorial moment is known as the intermittency, where the power law behavior of a modified multifractal moment is known as the multifractality. One of the possible characteristics of the analysis of scaled factorial moments and modified multifractal moments is that it can detect and characterize the dynamical fluctuations, and it is also capable of filtering out the statistical noise. In these methods, the scaled factorial moments, F_q, and the modified multifractal moments, G_q, are computed as a function of the decreasing phase space size. The values of F_q and G_q for purely statistical fluctuations saturate with decreasing the phase space size, whereas F_q and G_q moments in dynamical fluctuations are supposed to increase with decreasing the phase-space size and exhibit a power law behavior of normalized factorial moments, F_q and G_q. However, the method of ordinary multiplicity moments ($\langle n^q\rangle/\langle n\rangle^q$) is used to demonstrate different features of multiplicity distributions and is unable to reveal the existence of dynamical fluctuations due to a significant contribution of purely statistical fluctuations.