Multiparticle production in nucleus-nucleus interactions at 14.6 A GeV

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Introduction

In recent years, much experimental efforts [1] have been devoted towards the investigation of relativistic nucleus-nucleus collisions with the particular interest in the occurrence of new physical phenomenon such as the formation of Quark Gluon Plasma (QGP) [2,3]. In order to disentangle the signature of QGP, one must have a thorough knowledge of the background on which signals from QGP are expected to stand out. A majority of experiments on high energy nucleus-nucleus collisions have been performed to study the characteristics of produced particles in nucleus-nucleus collision.

In this investigation, we present an extensive analysis of multiplicity correlations among different charged particles emitted in interactions of ^{28}Si with nuclear emulsion at 14.6 A GeV. Special attention has been paid to study the dependence of multiplicity of different charged particles as a function of shower particles multiplicity in nuclear emulsion.

Experimental Details:

The present experiment was performed using a stack of the Fuji emulsion pellicles exposed horizontally to a ^{28}Si beam of 14.6 A GeV at BNL AGS, New York. In order to obtain an unbiased sample of events, an along-the-track scanning technique was employed with a 100× oil immersion objective. Each track was picked up at a distance 2 mm from the entrance edge and carefully followed on an OLYMPUS BH2 microscope under a magnification of 2250 until it interacted or escaped from the pellicle. The primary beam tracks were followed to a maximum distance of 4 cm from the entrance edge. Each track was followed in the backward direction up to the leading edge to ensure that the track is a genuine beam track which actually entered the emulsion pellicles. Interactions which were within 20 μm from the top or bottom surface of the emulsion were not taken for analysis. A total of 855 inelastic events were selected for further measurements. The charged secondary particles produced from these interactions were classified into shower, black, grey and projectile fragments in accordance with their ionization, range and velocity. Their multiplicities are denoted by n_s, n_b, n_g and n_F respectively [4].

Results and discussions:

Multiplicity correlation is one of the effective methods to examine the variation among different secondary charged particles emitted in nucleus-nucleus collisions at high energy. Experimentally the impact parameter in an event can not be measured directly but shower particle multiplicity is essentially proportional to the total number of participant nucleons in the two nuclei. Therefore a study of variation of slow particle production as a function of multiplicity of shower particle will reflect the impact parameter dependence. In the Figure shown below, mean multiplicity of grey particles shows a linear dependence on multiplicity of shower particles with positive slope. However in case of $\langle n_b \rangle$ vs n_s, mean multiplicity of black particles linearly increases with multiplicity of shower particles up to $n_s = 80$, then it gets saturated. Recently such saturation effect has been interpreted as an indication of a nuclear phase transition in the target nucleus [5].

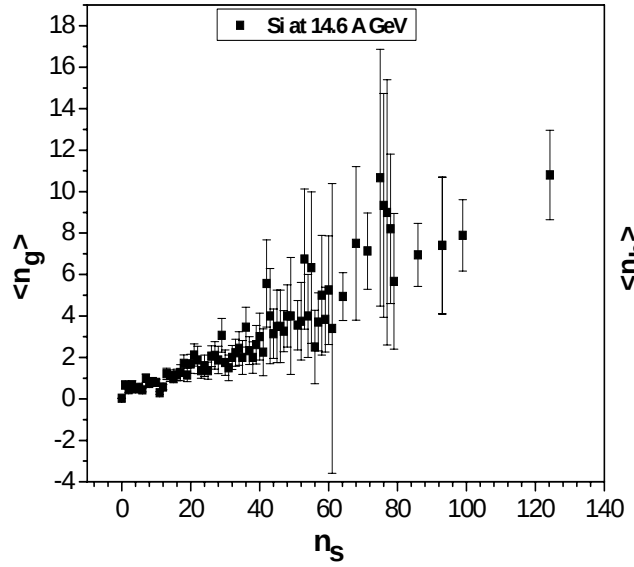

Fig.1. Variation of $<n_g>$ as a function of n_s

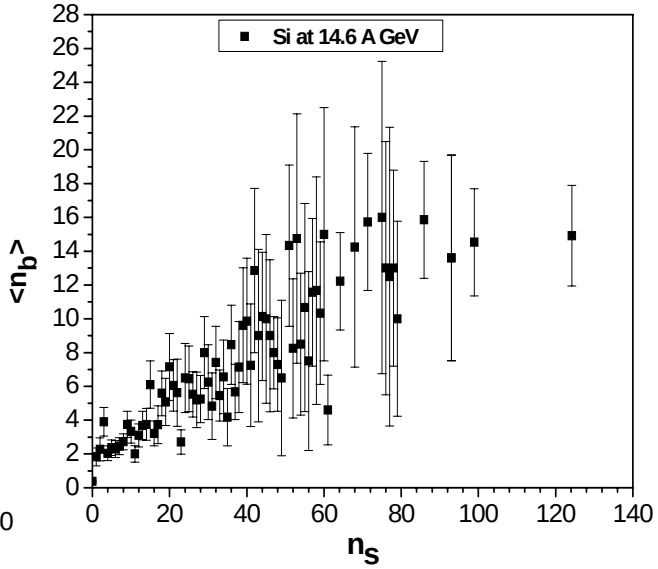

Fig.2. Variation of $<n_b>$ as a function of n_s

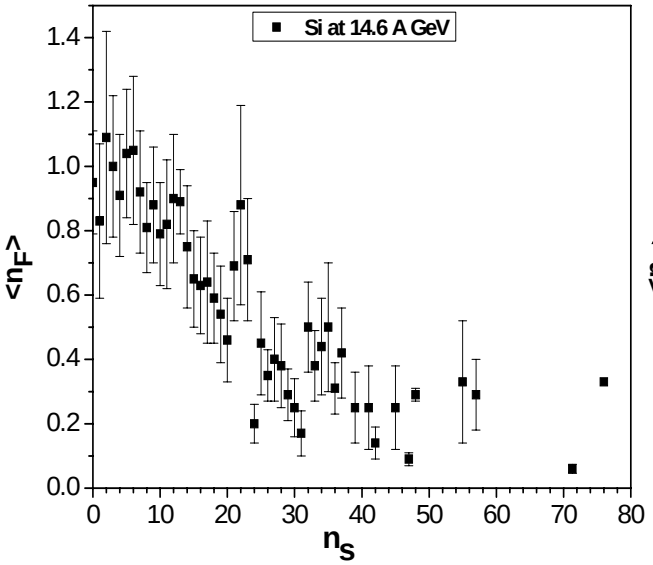

Fig.3. Variation of $<n_F>$ as a function of n_g

Mean multiplicity of non interacting spectator for $z \geq 3$ decreases linearly with increasing shower particle multiplicity up to $n_s = 46$ and then, $<n_F>$ value is very small indicating central collisions with pure Ag, Br events.

In case of $<n_\alpha>$ vs n_s, the production of helium fragments optimizes at n_s value 25 then starts decreasing. Beyond $n_s = 80$, no helium fragments are observed which may be due to central collision in which all of the projectile/target nucleons participate in the reaction.

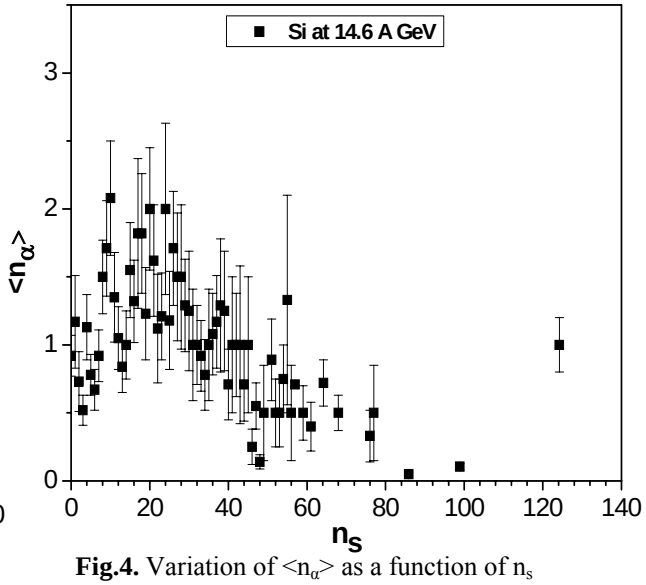

Fig.4. Variation of $<n_\alpha>$ as a function of n_s

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