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Simulation Study of Variation of Elliptic Flow with Centrality for Charged Hadrons

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***Abstract*— Elliptic flow is an observable central to the interpretation of the subsequent expansion of heavy ion collisions. Its large value indicates significant space-momentum correlations, consistent with the rapid expansion of a strongly interacting Quark Gluon Plasma. In this paper we studied the variation of elliptic flow for charged hadrons with centrality using HIJING events generated for Cu+Cu collisions at centre of mass energy 62.4 Gev. We estimated the elliptic flow using event plane angle method.**

***Keywords*— elliptic flow, heavy ion collisions, quark gluon plasma.**

I. INTRODUCTION

A hot, dense non-hadronic matter has been created at Relativistic Heavy Ion Collider (RHIC) in ultra-relativistic heavy ion collision [1-[2]. The creation of this state of matter in the laboratory, and the study of its properties are the main goals of the ultra-relativistic heavy ion collision program. Analysis of the azimuthal anisotropy resulting from non-central nuclear collisions appears to be one of the most informative observables in studying the nature and properties of matter created in ultra-relativistic heavy ion collisions [3]. The azimuthal anisotropy is usually characterized by the Fourier coefficients [4- 5].

II. EVENT GENERATION

We generated events using event generator HIJING for Cu+Cu at 62.4 Gev. This model uses pQCD processes which involves initial and final state radiations in addition to string phenomenology for non-perturbative soft processes. The physics behind the program considers the nuclear effects on the initial parton production, like the multiple parton scattering and nuclear shadowing of parton distribution functions. HIJING is a combination of a QCD-inspired model of jet production and the Lund model for jet fragmentation [6].

III. ANALYSIS

A commonly used method the azimuthal distributions are expanded in Fourier series where the coefficients of expansion are the measures of different orders of anisotropy [3]. This method is also called event plane method. For small values of these coefficients, the first two terms describe an elliptic shape. The first order anisotropy v_1 is called directed flow; it measures the shift of the centroid of the distribution. The second order anisotropy v_2 is called elliptic flow; it measures the difference between the major and minor axes of the elliptic shape of the azimuthal distribution.

We can characterizes this anisotropy in terms of a single-particle probability distribution for each collision event. By writing this distribution as a Fourier series with respect to the azimuthal angle of out-going particles □, one can define flow coefficients v_n and event plane angles Ψ_n:

$$\frac{2\pi}{N}\frac{dN}{d\phi} = 1 + 2\sum_{n=1}^{\infty} v_n \cos n(\phi - \psi_n) \quad (1)$$

$$v_n e^{in\psi_n} \equiv \left\langle e^{in\phi} \right\rangle \quad (2)$$

Where the brackets indicate an average over the single particle probability and the event plane angles Ψ_n are chosen such that v_n are the (positive) magnitudes of the complex Fourier coefficients.

IV. RESULTS

We have presented the results for variation of elliptic flow v_2 with centrality for simulated events generated at 62.4 GeV for Cu+Cu. We calculated the elliptic flow by above mentioned event plane method from HIJING events for 0-10%, 10-20%, 20-30%, 30-40%, 40-50%, 50-60%, 60-70% and 70-80% centrality bins. We calculated the v_2 for all above mentioned centralities for pseudorapities ranging from 0 to 1, 1 to 2, 2 to 3 and 3 to 4. Fig. 1 shows elliptic flow variation with centrality for charged hadrons for different pseudorapidity ranges.

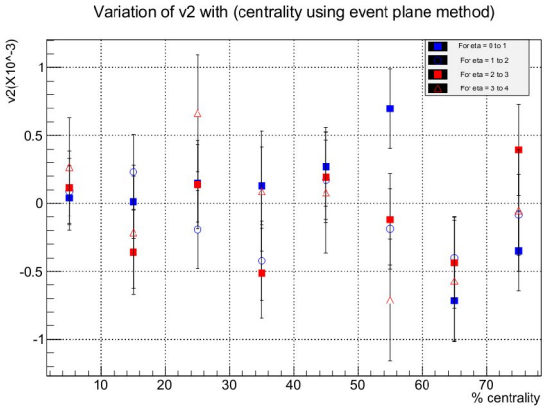

Fig. 1 Variation of Elliptic flow with centrality

V. CONCLUSIONS

We know that theoretically HIJING doesn't have any flow value. But here we are getting the flow values using estimation of event plane angle. It shows that we should take care of the elliptic flow values when we estimate them using event plane angle.

In future further studies can be done at other energies and for other ion species.

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