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Triangularity and Dipole Assymetry in Ideal Hydrodynamics

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We introduce a cumulant expansion to parameterize possible initial conditions in heavy ion collisions. We show that the cumulant expansion converges and can systematically reproduce the results of the Glauber type initial conditions.

At third order in the gradient expansion, the cumulants are described with the triangularity

$$\langle \cos 3(\phi - \psi_{1,3}) \rangle$$

and a dipole

assymetry,

$$\langle \cos(\phi - \psi_{1,3}) \rangle$$

We show that the

orientation angle of the dipole assymetry $\psi_{1,3}$

has a 20% assymetry out of plane for mid-central collisions.

This leads to a small net v_1 out of plane.

In peripheral and mid-central collisions the

orientation angles $\psi_{1,3}$ and $\psi_{3,3}$ are strongly correlated, but this correlation disappears towards central collisions.

We study the ideal

hydrodynamic response to these cumulants and determine the associated v_1/ϵ_1

and v_3/ϵ_3 for a massless ideal gas. The space time development of v_1 and

v_3 is clarified with figures. These figures show that v_1 and v_3

develop towards the edge of the nucleus, and consequently the final spectra are more sensitive to the viscous dynamics of freezeout.

The hydrodynamic calculations for v_3 is provisionally compared to Alver and Roland fit of STAR inclusive two particle correlation functions. Finally, we propose to

measure the v_1 associated with the dipole assymetry by measuring

$$\langle \cos(\phi - 3\Psi_{R3} + 2\Psi_{R2}) \rangle$$

where Ψ_{R3}

is an experimental estimate for the triangular event plane while Ψ_{R2}

is the usual quadrupole event plane estimate.

This experimental measurement would provide convincing evidence for the

strong correlation between $\psi_{1,3}$ and $\psi_{3,3}$, and by association

the hydrodynamic interpretation of two particle correlations at RHIC.

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