Contribution ID: **38** Type: **Poster**

Effect of magnetic field on flow fluctuations in ultra-relativistic heavy-ion collisions

Very strong magnetic fields can arise in non-central heavy-ion collisions at ultrarelativistic energies, which may not decay quickly due to induced currents in the conducting plasma. Presence of very strong magnetic fields in the plasma (of order 10^{15} Tesla) during early stages in RHICE has been explored extensively recently primarily in connection with the so called chiral magnetic effect. An important effect of the presence of such strong magnetic fields in the plasma will be to lead to strong variations in velocities of different types of waves in the plasma. In particular the velocity varies with the angle between the wave vector and the direction of the
magnetic field, and also has non-trivial dependence on pressure gradient. This can qualitatively affect the development of anisotropic flow. It was earlier believed that the magnetic field arising from the collision of initial nuclei peaks to strong values for a very short time, essentially the passing time of the Lorentz contracted nuclei (~ 0.2 fm for RHIC energies). Subsequently it rapidly decays. However, it was later realized that due to induced currents in the conducting plasma, the magnetic field may survive for much longer time of order several fm, and can lead to interesting effects. We carry out magnetohydrodynamics simulations to study the effects of this magnetic field
on the evolution of the plasma. We focus on the the elliptic flow as well as the power spectrum of flow fluctuations. Our results show that magnetic field leads to enhancement in elliptic flow. We further find that there are qualitative patterns in the power spectrum of flow fluctuations due to the presence of magnetic field. These features in the power spectrum may provide a clean signal for the presence of strong magnetic field during initial stages. We also show generation of vorticity arising from nontrivial dependence of magnetosonic waves on pressure gradients and magnetic field direction.

Preferred Track

Collective Dynamics

Collaboration

Not applicable

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Session Classification: Poster Session