Contribution ID: **732** Type: **Oral**

Charge-dependent anisotropic flow in relativistic resistive magneto-hydrodynamic expansion

Wednesday, 6 September 2023 17:10 (20 minutes)

We have investigated the charge-dependent anisotropic flow in high-energy heavy-ion collisions, using relativistic resistive magneto-hydrodynamics (RRMHD). For the description of time evolution of the ultraintense electromagnetic fields produced just after the collisions, construction of the relativistic resistive magneto-hydrodynamics (RRMHD) is indispensable
We construct a relativistic resistive magneto-hydrodynamic (RRMHD) numerical simulation code for high-energy heavy-ion collisions as a first designed code in the Milne coordinates. Then we confirm that our code reproduces well the results of standard RRMHD tests in the Cartesian coordinates. Also, we verify the semi-analytic solutions of the accelerating longitudinal expansion of relativistic resistive magneto-hydrodynamics in high-energy heavy-ion collisions in a comparison with our numerical result.
Next, we apply our RRMHD code to analysis of the charge-dependent anisotropic flow in high-energy heavy-ion collisions. We consider the optical Glauber model as an initial model of the quark-gluon plasma (QGP) and the solution of the Maxwell equations with source term of the charged particles in two colliding nuclei as initial electromagnetic fields. The RRMHD simulation is performed with these initial conditions in Au-Au and Cu-Au collisions at $\sqrt{s_{NN}}$= 200 GeV. We have calculated the charge-odd contribution to the directed flow Δv_1 and elliptic flow Δv_2 in both collisions based on electric charge distributions as a consequence of RRMHD. Our results show that the directed and elliptic flows are approximately proportional to the electrical conductivity of the medium in both collisions. In the highly resistive case, our results of the charge-odd contribution to the directed flow are consistent with STAR data in Au-Au collisions. Furthermore, in Cu-Au collisions, the charge-odd contribution to the directed flow has a non-zero value at η = 0 which is also proportional to electrical conductivity of the medium. We conclude that the charge-dependent anisotropic flow is a good probe to extract the electrical conductivity of the QGP medium in high-energy heavy-ion experiments.
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Category

Theory

Collaboration (if applicable)

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Session Classification: New Theory

Track Classification: New theoretical developments