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Charge-dependent correlations from event-by-event anomalous hydrodynamics

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The chiral magnetic effect (CME) has received considerable attention in recent years, particularly in the context of heavy-ion collisions. The anomaly-induced transport effects like the CME are macroscopic and are incorporated into hydrodynamic equations giving rise to "anomalous hydrodynamics". Theoretically, the CME is expected to occur in heavy-ion collisions. The data reported by STAR[1] and PHENIX[2] collaborations at RHIC and ALICE collaborations [3] at the LHC show a behavior consistent with the CME, but the quantitative understanding is still lacking. In order to reach a definitive conclusion, a reliable theoretical tool that can describe the charge-dependent observables is indispensable.

In this contribution, we report our recent attempt of quantitative modeling of the CME for heavy-ion collisions. We develop an event-by-event hydrodynamic model which includes the anomalous transport effects. We perform 3+1 dimensional anomalous hydrodynamic simulations, with constitutive equations that contain the anomaly-induced effects. We also develop a model of the initial condition for the axial charge that captures the statistical nature of random chirality imbalance created by color flux tubes. Basing on the event-by-event hydrodynamic simulations for hundreds of thousands of collisions, we calculate the correlation functions that are measured in experiments, and discuss how the anomalous transports affect the observables.

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[2] A. Ajitanand, S. Esumi, R. Lacey [PHENIX Collaboration], Proc. of the RBRC Workshops, vol. 96, 2010.

[3] P. Christakoglou [ALICE Collaboration] 2011 J. Phys. G: Nucl. Part. Phys. 38 124165.

[4] Y. Hirono, T. Hirano, and D. E. Kharzeev, [arXiv:1412.0311]

Author: HIRONO, Yuji (Stony Brook University)

Co-authors: KHARZEEV, Dmitri (Stony Brook University); HIRANO, Tetsufumi (Sophia Univ)

Presenter: HIRONO, Yuji (Stony Brook University)

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