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Kelvin-Helmholtz instability in relativistic heavy ion collisions

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Relativistic hydrodynamic simulations play a key role in understanding the property of the QGP and the QCD phase transition from analyses of high-energy heavy ion collisions. Recently, significant developments are achieved in construction of realistic hydrodynamic models with viscosity effects and event-by-event fluctuations. As a result, we can discuss the bulk feature of the QGP such as transport coefficients and the equations of state in detail from comparison between hydrodynamic calculations and experimental results at RHIC and LHC. One of the current hottest topics is higher flow harmonics which has the information of initial conditions through event-by-event fluctuations and the space-time evolution of the QGP matter. In particular, it is pointed out that the higher flow harmonics is related to the ridge structure which is remnant of long correlations in the longitudinal direction [1]. The dynamics in the longitudinal direction may affect that on the transvers plane. Here, we investigate the effect of longitudinal fluctuations to the higher flow harmonics, using a hydrodynamic simulation [2]. Especially, we discuss possible existence and time evolution of the Kelvin-Helmholtz instability in high-energy heavy ion collisions. If the Kelvin-Helmholtz instability occurs through longitudinal fluctuations, the vortexes form, which may affect the expansion in the transvers direction. We also argue the influence of the Kelvin-Helmholtz instability to physical observables such as particle distributions and higher flow harmonics.

[1] G. Aad *et al.* (ATLAS Collaboration), Phys. Rev. C 86, 014907 (2012).

[2] Y. Akamatsu, S. Inutsuka, C. Nonaka, M. Takamoto, J. Comput. Phys. 256, 34 (2014), K. Okamoto, Y. Akamatsu, C. Nonaka, in preparation.

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