Contribution ID: **616** Type: **Poster**

Effects of hydrodynamic fluctuations in ultra-central Pb-Pb collisions at LHC

Wednesday, 6 April 2022 18:10 (4 minutes)

In ultra-central heavy-ion collisions, the effects of event-by-event fluctuations on anisotropic flow are relatively more pronounced due to less geometrical anisotropy of initial transverse profiles. The magnitudes of elliptic flow v_2 and triangular flow v_3 were reported to be almost the same value in ultra-central collisions [1]. Dynamical models based on relativistic viscous hydrodynamics describe anisotropic flow in non-central collisions well, however, failed to reproduce these v_2 and v_3 data in ultra-central collisions simultaneously [2,3]. Since the hydrodynamic description is supposed to be better in larger systems, the failure of the viscous hydrodynamic models in ultra-central collisions implies the existence of overlooked phenomena. This problem is known as "ultra-central puzzle" and has not been resolved yet.

In this talk, we investigate the effects of hydrodynamic fluctuations on anisotropic flow in ultra-central collisions. We employ an integrated dynamical model [4] with relativistic fluctuating hydrodynamics [5,6] to describe the dynamics of heavy-ion collisions at the LHC energy and compare the results among ideal, viscous, and fluctuating hydrodynamics. In this framework, hydrodynamic fluctuations are introduced through the fluctuation-dissipation relation [5]. Since the anisotropic flow is driven mainly by fluctuations in ultra-central collisions, hydrodynamic fluctuations are expected to play an important role in understanding anisotropic flow.

First, we employ smooth and azimuthally symmetric initial conditions at impact parameter $b = 0$ fm from the optical Glauber model to investigate the effects of genuine hydrodynamic fluctuations on anisotropic flow coefficients. We show that v_2 and v_3 caused by hydrodynamic fluctuations alone are almost the same value which is, however, almost half of the experimental flow coefficients. Second, we introduce a weight function of impact parameters to simulate ultra-central collisions efficiently and compare the results from Monte-Carlo Glauber initial conditions with hydrodynamic fluctuations to experimental data. Even with hydrodynamic fluctuations, we cannot reproduce v_2 and v_3 quantitatively at the same time. Nevertheless, we find the v_2/v_3 ratio becomes closer to the experimental data due to hydrodynamic fluctuations.

[1] S. Chatrchyan *et al.*, (CMS Collaboration), JHEP **02**, 088 (2014).
[2] C. Shen, Z. Qiu, and U. Heinz, Phys. Rev. C **92**, 014901 (2015).
[3] P. Carzon, S. Rao, M. Luzum, M. Sievert, and J. Noronha-Hostler, Phys. Rev. C **102**, 054905 (2020).
[4] T. Hirano, P. Huovinen, K. Murase, and Y. Nara, Prog. Part. Nucl. Phys. **70**, 108 (2013).
[5] K. Murase, Ph. D thesis, The University of Tokyo (2015).
[6] K. Murase and T. Hirano, Nucl. Phys. A **956**, 276 (2016).

Primary author: KUROKI, Kenshi (Sophia University)

Co-authors: SAKAI, Azumi (Sophia University); MURASE, Koichi (Kyoto University); HIRANO, Tetsufumi (Sophia University)

Presenter: KUROKI, Kenshi (Sophia University)

Session Classification: Poster Session 1 T06 / T07

Track Classification: Hadron production and collective dynamics