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Hanbury-Brown-Twiss signature for clustered substructures probing primordial inhomogeneity in hot and dense QCD matter

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We propose a novel approach to probe primordial inhomogeneity in hot and dense matter which could be realized in noncentral heavy-ion collisions. We discuss the possibility of clustered sub-structures along the axis parallel to the magnetic field. Even if the magnetic field is short-lived, the pseudo-one-dimensional nature in the early dynamics can induce the inhomogeneity which could remain afterward as a metastable state. We propose an approach to probe the inhomogeneous state using the Hanbury Brown and Twiss (HBT) measurement. Although the HBT interferometry is commonly used to infer the system size, the cluster size should be detected if substructures emerge in space. We demonstrate in the Gaussian formalism that a signal peak in the HBT two-particle correlation stands at the relative momentum corresponding to the wave number of spatial pseudo-one-dimensional modulation. To assess the feasibility, we adopt the phase-space distribution with clustering of particles implemented in AMPT model and computed the two-particle correlation with the spatial sub-structures of density distribution. We find that the signal excess in the correlation ratio could be suppressed by the alignment of the magnetic axis but still persist under the appropriate momentum filter. Our results are promising enough and the HBT correlations should deserve further systematic investigations. Ref. K.Fukushima, Y.Hidaka, K.Inoue, K.Shigaki, and Y.Yamaguchi, PRC, 109, L051903, 2024.

Category

Theory

Collaboration

Authors: INOUE, Katsuya (Hiroshima University); Prof. FUKUSHIMA, Kenji (The University of Tokyo); SHIGAKI, Kenta (Hiroshima University (JP)); YAMAUCHI, Wataru (Hiroshima University); YAMAGUCHI, Yorito (Hiroshima University (JP)); HIDAKA, Yoshimasa (YITP, Kyoto University)

Presenter: SHIGAKI, Kenta (Hiroshima University (JP))

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