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Higher harmonics from causal hydrodynamic fluctuation

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The hydrodynamic fluctuations are thermal fluctuations arising in the event-by-event hydrodynamic evolution of the system, and its power spectrum is determined through the fluctuation-dissipation relation. While, the higher harmonics v_n are systematically observed in RHIC and LHC and attract a lot of theoretical and experimental interests. Initial state fluctuations turned out to be important to explain these higher harmonics through event-by-event hydrodynamic simulations. The event-by-event hydrodynamic fluctuation, although its average is locally zero, also has effects on the higher harmonics and other observables in the same manner as the initial fluctuations which vanish in the averaged picture of the initial condition. We implement causal hydrodynamic fluctuation [1] in our (3+1)-dimensional dissipative hydrodynamics code, and investigate the effect of the hydrodynamic fluctuation, in addition to the initial state fluctuations, on higher harmonics.

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