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A multiharmonic/large-order flow cumulant analysis for relativistic heavy-ion collisions

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In the past years, significant progress has happened in high-energy nuclear physics models. A more robust and quantitative picture has replaced the qualitative descriptions of heavy nuclei collisions in the earlier days, enabling us to have a clearer picture of different stages of a heavy-ion collision. These models typically have $O(10)$ free parameters that are tuned by Bayesian analysis in recent years. To better understand the free parameter values, it is essential to experimentally probe their phase space by observables, each containing independent information of the model.
In this presentation, our focus is on anisotropic flow observables. We introduce a method to extract anisotropic flow cumulant systematically. Employing a Monte Carlo simulation tuned by Bayesian analysis results, we predict the value of some abandoned low-order flow harmonic cumulants with significant signals that have not been measured at the LHC. Moreover, we introduce a new method to extract the linear and nonlinear hydrodynamic response coefficients based on our multiharmonic cumulant study. Besides, this systematic study enables us to propose a genuine three-particle correlation function for the first time. This observable is a summation of all third-order flow harmonic cumulants of all harmonics. The large-order flow cumulant ($v_n\{2k\}$ with large k) contains a unique piece of information about the underlying flow distribution. In particular, we discuss the relation between the nonvanishing Lee-Yang zero phase and large-order flow cumulant ratios at ultra-central, ultra-peripheral, large, and small collision systems.

Based on:
1. S. F. Taghavi, (2020), arXiv:2005.04742 [nucl-th] (will be appeared in Eur.Phys.J.C)

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