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Nonlinear hydrodynamic response confronts LHC data

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Higher-order harmonics of anisotropic flow (v_n with $n \geq 4$) can be measured with the direction of lower-order harmonics, e.g., v_4 with respect to the v_2 plane.
We show that one can scale these measurements by quantities involving lower-order harmonics in such a way that the ratio is independent of initial conditions, and solely involves the medium nonlinear response.
The resulting ratios allow to directly confront hydrodynamics with experimental data [1].

We construct four independent such ratios involving v_4, v_5 and v_6 and extract their values from LHC data on Pb+Pb collisions, as a function of centrality.
We then calculate these ratios using single-shot hydrodynamics and using the transport model AMPT [2].
Model calculations are in very good agreement with data.
We point out that hydrodynamics predicts simple scaling relations between these response coefficients, which can be read off directly from data.

A substantial response ratio in the seventh harmonic is found in theoretical calculations (both in AMPT and in hydrodynamics), from which we argue that a nonzero v_7 signal should be seen when measured with respect to elliptic and triangular flow. We present predictions for v_7 versus centrality in Pb+Pb collisions at the LHC.

Finally, we point out that combined measurements of higher-order harmonics with their own plane and with respect to lower-order planes can be quantitatively related to event-plane correlations. As an illustration, we show that CMS data on v_4 and v_6 are compatible with ATLAS data on event-plane correlations.

[1] L. Yan and J. Y. Ollitrault, Phys.Lett. B **744**, 82 (2015) [arXiv:1502.02502 [nucl-th]].

[2] L. Yan, S. Pal and J. Y. Ollitrault, in preparation

On behalf of collaboration:

NONE

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