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# A Principal Component Analysis of event-by-event fluctuations in hydrodynamic simulations at the LHC

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The expansion of the matter formed in nucleus-nucleus collisions at relativistic energies produces a collective transverse flow. This flow is the response to the density gradients in the initial fireball. It is azimuthally asymmetric because the initial fire-ball is anisotropic and contains hot spots. These inhomogeneities are of particular interest for two reasons. They reflect the poorly known mechanism of energy deposition (and the strong interaction) when two nuclei collide. In addition, the details of how they influence the final flow depends on also poorly known fluid properties, in particular, its shear and bulk viscosities. Therefore a lot of work has been done to relate initial inhomogeneities and final flow of produced particles.
In the beginning, the mapping between initial conditions and anisotropic flow has
been studied globally and event-by-event. The next step was to look at a more detailed level: the correlations of flow harmonics at different transverse momenta or pseudorapidities, encoded in the factorization breaking ratio rn, can bring new information on fluctuations in the initial state. More recently a new tool was proposed: the Principal Component Analysis (PCA) for event-by-event fluctuations is a more precise way to study the connection between initial and final stages. Last year experimental results for such an analysis have been presented by the CMS collaboration. The aim of this work is to present a first hydrodynamical study of these data and point out an interesting difference between data and some hydrodynamic simulations for the n=0 leading component. This leading component is the simplest possible observable for fluctuations: it shows the relative change of multiplicity in relation to the mean in a given transverse momentum bin. It is sensitive to physics not explored by standard anisotropic flow and can put new constraints on models.

## Collaboration name

## Track

Hydrodynamics, chirality and vorticity

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