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Multiparticle Cumulants to Constrain the Initial State in Xe-Xe and Pb-Pb Collisions in the CMS Experiment

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Xenon (Xe) nuclei are deformed and have a non-zero quadrupole moment, whereas lead (Pb) nuclei are considered spherical in shape. The study of Xe-Xe collisions at a center-of-mass energy per nucleon pair of $\sqrt{s_{\rm NN}} = 5.44$ TeV opens up a window to study nuclear deformation at LHC. When compared to Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV, one can explore the dependence of the Fourier flow harmonics (v_n) on the size and initial-state geometry of the colliding systems. For the first time, correlations between higher-order moments ($\langle v_n^k v_m^l \rangle$, where $n, m = 2, 3, 4$ and $k, l = 2, 4, 6$) between two (v_2 and v_3 or v_2 and v_4) or even three flow harmonics (v_2, v_3 and v_4) are measured and compared between Xe-Xe and Pb-Pb collisions as a function of collision centrality. These new measurements have been calculated with multiparticle mixed harmonic cumulants (upto 8th order) using charged particles in the wide pseudorapidity region of the CMS detector ($|\eta| < 2.4$) and in the transverse momentum range of $0.5 < p_{\rm T} < 3.0$ GeV/c. The results have also been compared to several theoretical model predictions. The observables measured in this analysis have been used to closely probe the non-linearities between v_2, v_3 and v_4 and their corresponding eccentricities ϵ_2, ϵ_3 and ϵ_4. This not only helps us to constrain the deformation parameters of Xe nuclei, but can also significantly constrain initial-state model parameters and give us a better understanding of the evolution of the quark-gluon plasma created in heavy-ion collisions at LHC.

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