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Anisotropic flow fluctuation as a possible signature of clustered nuclear geometry in O-O collisions at the LHC

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Nuclei having 4n number of nucleons are theorized to possess clusters of α particles (4He nucleus). The Oxygen nucleus (16O) is a doubly magic nucleus, where the presence of an α-clustered nuclear structure grants additional nuclear stability. In this study, we exploit the anisotropic flow coefficients to discern the effects of an α-clustered nuclear geometry w.r.t. a Woods-Saxon nuclear distribution in O-O collisions at √sNN=7 TeV using a hybrid of IP-Glasma + MUSIC + iSS + UrQMD models. In addition, we use the multi-particle cumulants method to measure anisotropic flow coefficients, such as elliptic flow (v2) and triangular flow (v3), as a function of collision centrality. Anisotropic flow fluctuations, which are expected to be larger in small collision systems, are also studied for the first time in O–O collisions. It is found that an α-clustered nuclear distribution gives rise to an enhanced value of v2 and v3 towards the highest multiplicity classes. Consequently, a rise in v3/v2 is also observed for the (0-10)\% centrality class. Further, for α-clustered O–O collisions, fluctuations of v2 are larger for the most central collisions, which decrease towards the mid-central collisions. In contrast, for a Woods-Saxon 16O nucleus, v2 fluctuations show an opposite behavior with centrality. This study, when confronted with experimental data may reveal the importance of nuclear density profile on the discussed observables.

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