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

Nuclei having 4n number of nucleons are theorized to possess clusters of α particles (4He nucleus). The Oxygen nucleus (^{16}O) 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 $\sqrt{s_{NN}} = 7$ 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 (v_2) and triangular flow (v_3), 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 v_2 and v_3 towards the highest multiplicity classes. Consequently, a rise in v_3/v_2 is also observed for the (0-10)% centrality class. Further, for α-clustered O-O collisions, fluctuations of v_2 are larger for the most central collisions, which decrease towards the mid-central collisions. In contrast, for a Woods-Saxon ^{16}O nucleus, v_2 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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