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Initial state effect on the hadron production in small systems at LHC

This work explores the effect of the geometry of the nucleus in the p-^{16}O, ^{16}O-^{16}O and ^{20}Ne-^{20}Ne collisions at LHC energies with the PYTHIA Monte Carlo event generator in Angantyr framework. Angantyr models heavy-ion collisions as a superposition of independent nucleon-nucleon (NN) collisions, without incorporating collective effects. We construct tetrahedral structure of ^{16}O and bi-pyramidal structure of ^{20}Ne composed of four α-clusters and five α-clusters, respectively. We compare their collision dynamics against those generated using Woods-Saxon nuclear density distribution. The results are further compared for different orientations of the ^{20}Ne nuclei, including tip-tip, body-body, body-tip, and random orientations of the bi-pyramidal structure. The results show that the geometric arrangement of α-clusters in the ^{16}O and ^{20}Ne nucleus significantly influence the particle production at the freeze-out boundary there-by affecting the multiplicity and mean transverse momentum, $\langle p_T \rangle$, of the produced hadrons. These results highlight the sensitivity of final state observables to the nuclear structure and orientation of colliding nuclei, providing insights into the dynamics of small collision systems, even in non-hydrodynamic framework.

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