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## Unveiling the Secrets of Nuclear Structure: Alpha-Clustering and Collective Flow in Collisions of Small systems at LHC Energies

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The search for quark-gluon plasma in small collision systems has led to renewed interest in the internal structure of nuclei. This study explores the impact of alpha-clustering –the formation of  ${}^4\text{He}$  nuclei within larger nuclei –on collective flow in oxygen-oxygen (O-O) collisions at the Large Hadron Collider. Utilizing a sophisticated hybrid hydrodynamic model, we demonstrate that alpha-clustering significantly modifies anisotropic flow coefficients ( $v_2$  and  $v_3$ ), particularly at low multiplicities, leading to enhanced collective behavior. Furthermore, we observe unique fluctuations in  $v_2$  that are sensitive to both final-state multiplicity and the underlying nuclear density profile. These findings provide compelling evidence for the importance of internal nuclear structure in shaping the dynamics of heavy-ion collisions and offer a novel pathway for validating advanced theoretical models. This work opens new avenues for probing the interplay between nuclear structure and the emergence of collective phenomena in extreme environments.

Refs:

- [1] S. Prasad, N. Mallick, R. Sahoo, G.G. Barnaföldi: Phys. Lett. B 860 (2025) 139145
- [2] A.M. Kavumpadikkal Radhakrishnan, S. Prasad, N. Mallick, R. Sahoo, G.G. Barnaföldi: Physics Letters B 870 (2025) 139941

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