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Characterising the initial conditions and probing the nuclear structure with multiparticle correlations techniques at ALICE

Tuesday 5 September 2023 17:30 (2h 10m)

High-energy heavy-ion collisions offer a unique and precise way to probe nuclear structures by providing a snapshot of the nuclear distribution at the time of the collision, which is complementary to low-energy nuclear physics experiments.

In this talk, we present a comprehensive scan of flow observables, including anisotropic flow coefficients, nonlinear flow modes, and normalized symmetric cumulants, in Pb–Pb and Xe–Xe collisions measured with ALICE at $\sqrt{s_{\rm NN}} = 5.02$ and 5.44 TeV, respectively. These measurements can probe distinctive nuclear structures (i.e., quadrupole deformation) in central collisions and the size of the ^{208}Pb neutron skin in midcentral to peripheral collisions. The measurements of multiparticle cumulants of mean transverse momentum, $[p_{\rm T}]$, allow us to probe the size and its fluctuations in the initial state. Furthermore, we present the first measurements of newly proposed multiparticle cumulants between anisotropic flow $v_{\rm n}^{\rm m}$ (m = 2,4) and mean transverse momentum correlations $[p_{\rm T}^{(k)}]$ (k $\leq$ 4), in both Pb–Pb and Xe–Xe collisions. The presented measurements and comparisons to the state-of-the-art theoretical model calculations show unambiguous evidence of a deformed and triaxial structure for ^{129}Xe, and in Pb–Pb collisions further provide tight constraints to the nucleon width w, which was poorly controlled before. These studies enormously improve our understanding of the initial conditions of heavy-ion collisions and allow us to explore LHC's full potential as a robust nuclear physics machine.

Category

Experiment

Collaboration (if applicable)

ALICE

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