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Accessing the nuclear structure at the LHC

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One of the main challenges in nuclear physics is studying the structure of the atomic nucleus. Recently, it has been shown that high-energy heavy-ion collisions at RHIC and the LHC can complement low-energy experiments. Heavy-ion collisions provide a snapshot of the nuclear distribution at the time of collisions, offering a unique and precise probe of the nuclear structure.

This talk presents our latest developments in nuclear structure studies using the novel multi-particle correlations technique at relativistic energies. Specifically, we demonstrate how to precisely constrain the quadrupole deformation β_2 and triaxial structure of ^{129}Xe and showcase new opportunities to observe the ⍰-clustering structure of ^{16}O using A Multi-Phase Transport model (AMPT). We propose a new multi-particle correlation algorithm that allows us to study genuine multi-particle correlations of the anisotropic flow, v_n, and the mean transverse momentum, $[p_{\mathrm{T}}]$. These new cumulants not only show better sensitivities to probe the nuclear structure than existing standard observables like anisotropic flow and/or event-by-event fluctuations of $[p_{\mathrm{T}}]$, but they also help to pin down the uncertainty in the width of the nucleon and the neutron skin of ^{208}Pb at the LHC. This approach can help resolve the current discrepancy of state-of-the-art nuclear theory predictions from Ab initio and recent determination from parity-violating asymmetries in polarised electron scattering from PREX. These latest developments have vast potential in heavy-ion data taking at the LHC. They will be a crucial component in spanning the bridge between the fields of low-energy nuclear physics at the MeV energy scale and high-energy heavy-ion physics at the TeV energy scale.

Collaboration / Activity

Relate to the LHC experiments

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