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Flow and transverse momentum correlation in Pb+Pb and Xe+Xe collisions with ATLAS: assessing the initial condition of the QGP

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One important challenge in our field is to understand the initial condition of the QGP and constrain it using sensitive experimental observables. Recent studies show that the Pearson Correlation Coefficient (PCC) between v_n and event-wise mean transverse momentum $[p_{\mathrm{T}}]$, $\rho_n(v_n, [p_{\mathrm{T}}])$, and its centrality dependence can probe several ingredients of the initial state, such as number and size of sources, nuclear deformation, volume fluctuation, and initial momentum anisotropy. In particular, a recent calculation shows that the ^{129}Xe nucleus is triaxially deformed, which is expected to enhance ρ_2 in ^{129}Xe+^{129}Xe relative to ^{208}Pb+^{208}Pb collisions.

This talk presents new, comprehensive and precision measurements of $v_n - [p_{\mathrm{T}}]$ correlation in ^{129}Xe+^{129}Xe and ^{208}Pb+^{208}Pb collisions for harmonics $n = 2$, 3, and 4. The results are obtained via the standard and subevents cumulant methods to assess the role of non-flow and flow decorrelations in these observables, and they are found to be small in the mid-central and central collisions in these systems. All PCC coefficients, ρ_2, ρ_3 and ρ_4 show rich and non-monotonic dependence on centrality, p_{T} and η, reflecting the fact that different ingredients of the initial state impact different regions of the phase space. For example, it was found the result depends on the centrality estimator used in the analysis, indicating a strong influence of volume fluctuations. On the other hand, the ratio of ρ_2 between the two systems is less sensitive to the centrality estimator, and in the ultra-central region, the value of the ratio suggests that ^{129}Xe has large quadrupole deformation but with a significant triaxial. All current models fail to describe many of the observed trends in the data, pointing to the unprecedented constraining power enabled by this precision measurement.

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