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Exploring the origin of $[p_{\mathrm{T}}]$ fluctuations in ultra-central heavy ion collisions: Higher order $[p_{\mathrm{T}}]$ correlations in ATLAS

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The thermal fluctuations in the QGP medium formed in heavy ion collisions present themselves as event-wise $[p_{\mathrm{T}}]$ fluctuations in the final state. Recent studies have shown that the average and higher-order fluctuations of $[p_{\mathrm{T}}]$ in ultra-central collisions are sensitive to radial flow, random thermal motion, and nuclear deformation, and can provide constraints on the extent of thermalization of the QGP droplet. This talk presents new precise measurements of $[p_{\mathrm{T}}]$ cumulants up to 3rd order in ^{129}Xe+^{129}Xe and ^{208}Pb+^{208}Pb collisions. The multiplicity dependence of $[p_{\mathrm{T}}]$ cumulants show deviations from expected power-law behavior. The average $\langle[p_{\mathrm{T}}]\rangle$ shows a non-trivial rise in the ultra-central collisions, whereas the variance shows a clear and sharp drop in ultra-central collisions. The skewness, expected to be more sensitive towards higher p_{T} particles, also shows a non-trivial increase in ultra-central collisions. All observables also show a clear dependence on the p_{T} ranges in consideration and the centrality estimator used in the analysis. These results have strong implications for understanding the impacts of the initial condition, medium thermalization, and medium properties on final state $[p_{\mathrm{T}}]$ fluctuations.

Category

Experiment

Collaboration (if applicable)

ATLAS

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