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Probing sound propagation in the QGP via relativistic ultra-central collisions with ALICE

Relativistic heavy-ion collisions create a hot, dense state of QCD matter called Quark–Gluon Plasma (QGP). In ultra-central collisions, the QGP volume saturates and remains constant; instead, entropy fluctuations cause temperature variations in the system. This property can be probed by measuring the correlation between the average transverse momentum ($\langle p_{\mathrm{T}} \rangle$) and the multiplicity of charged hadrons. This contribution shows the latest ALICE measurements of charged-hadron $\langle p_{\mathrm{T}} \rangle$ and its higher-order cumulants in ultra-central Pb–Pb collisions. Results are in close agreement with state-of-the-art hydrodynamic models. Furthermore, by fitting the relative increase of $\langle p_{\mathrm{T}} \rangle$ to the relative change in the average charged-particle density at midrapidity, it is possible to extract the speed of sound (c_s) in the QGP, which indicates how fast compression waves propagate through the QGP medium. The extracted c_s shows a strong dependence on the choice of the centrality estimators used to select ultra-central collisions, highlighting the sensitivity of this measurement to experimental biases. This observation suggests a need for careful reassessment of methods for determining cs from heavy-ion data. The measurements are compared with predictions from state-of-the-art models in ultra-central events.

Secondary track

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