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Study of initial state fluctuations in pp and pPb collisions

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Heavy-ion collisions create an environment characterized by extremely high energy density and temperature, leading to the formation of a deconfined state of matter known as quark-gluon plasma (QGP), where quarks and gluons move freely. Recently, collective effects have also been observed in proton-proton (pp) collisions, specifically in events with a high particle production rate. To gain further insights into the origins of these collective effects, the thermal state generated by such collisions is investigated using soft probes.
This study focuses on analyzing the thermal fluctuations of the initial state in collisions involving proton-proton (pp), proton-lead (pPb), and lead-lead ($PbPb$) systems at the energies of the Large Hadron Collider (LHC). The aim is to examine the state formed during high multiplicity events in these systems and explore whether it corresponds to the quark-gluon plasma. The analysis includes studying fluctuations associated with the initial state, such as variations in the multiplicity spectrum. This investigation enables the examination of temperature, energy density, and species characterization, both locally and globally, for each collision event.
The analysis is conducted using the Color String Percolation Model (SPM), which proposes transverse momentum fluctuations. The results obtained are compared with the Tsallis distribution, known for its successful representation of transverse momentum spectra in both pp collisions and heavy-ion collisions.

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