MULTIPLICITY FLUCTUATIONS IN RELATIVISTIC HEAVY-ION COLLISIONS

(NEGATIVELY CHARGED HADRONS INTERMITTENCY ANALYSIS ON XE+LA COLLISIONS IN NA61/SHINE AT CERN SPS)

Abstract

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The study of the QCD phase diagram is a central topic in both experimental and theoretical research in heavy-ion physics. The comprehensive data collected by the NA61/SHINE experiment during a two-dimensional scan in beam momentum and system size provides a solid foundation for systematically exploring the properties of strongly interacting matter – including the search for non-monotonic dependencies of various correlation and fluctuation observables on collision energy and the size of colliding nuclei. Among the areas of particular interest is the possible existence of the QCD critical point.

Intermittency analysis is a statistical tool applied in heavy-ion collisions that examines scaled factorial moments (SFMs) of multiplicity distributions in two-dimensional transverse momentum space. This method enables the identification of power-law fluctuations, providing insight into various regions of the QCD phase diagram. While proton intermittency has traditionally been used to search for the critical point, the present studies have extended this approach to negatively charged hadrons to gain a broader understanding of QCD interactions.

This thesis presents the results of negatively charged hadrons intermittency for central Xe+La collisions at beam momentum 13A, 19A, 30A, 40A, 75A and 150A GeV/c ($\sqrt{s_{NN}} \approx 5.1$–$16.8$ GeV) recorded by NA61/SHINE at the CERN SPS. The intermittency analysis is performed in transverse and cumulative transverse momentum, and statistically independent data sets are used for each subdivision number. The results provided insight into other possible phenomena that can cause misleading signals of the critical point, which have also been reported by other experiments but not fully explored from a physics perspective. Building on these findings, this thesis investigates the underlying physical mechanisms behind such misleading signals using data from the CERN SPS.

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Signature