

The 223th HENPIC seminar by Prof. Li Yan (严力), Fudan University, Feb. 20-2025, Thursday, 10:30am (Beijing time)

Title:

QCD Speed of Sound and QCD Thermalization

Abstract:

The thermalization of quark-gluon plasma (QGP) created in heavy-ion collisions is crucial for understanding its behavior as a relativistic fluid and the thermodynamic properties of the Quantum Chromodynamics (QCD). For instance, QGP thermalization plays a significant role in the search of QCD critical point in the beam energy scan program of heavy-ion collisions. This talk presents the investigation of the role of fluctuations in the relationship between transverse momentum and particle multiplicity, with a particular focus on their impact on extracting the QCD speed of sound. In a thermalized quark-gluon plasma, fluctuations are dominantly quantum in origin and follow a Gaussian distribution due to their independence from the thermodynamic response. In contrast, non-thermalized systems display non-Gaussian fluctuations, reflecting the breakdown of thermalization. By leveraging the Gaussianity condition of quantum fluctuations, the physical value of the speed of sound can be extracted statistically, even in the presence of significant event-by-event fluctuations. This framework provides a robust diagnostic tool for probing thermalization and extracting thermodynamic properties of QCD in both large and small collision systems.

Brief introduction about the speaker:

Li Yan is currently an Assistant Professor at the Institute of Modern Physics, Fudan University. He obtained his PhD in 2013 from Stony Brook University. Afterward, he joined the Institut de Physique Théorique (IPhT) at Saclay, France, in 2013, and later the Department of Physics at McGill University in 2016 as a postdoctoral researcher. His research focuses on relativistic hydrodynamics and its application to quark-gluon plasma in high-energy heavy-ion collisions, the electromagnetic properties of quark-gluon plasma, and non-equilibrium systems.

Summary

Presenter: Prof. YAN, Li