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Theoretical summary on QGP at RHIC and LHC and future¹

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Relativistic heavy ion collision experiments at RHIC and LHC have produced a wealth of data that have allowed quantifying properties of hot QCD matter and understanding its fundamental structure in the temperature regime at the order of Λ_{QCD} . In this talk I discuss recent theoretical/phenomenological progress, with an emphasis on insights from contrasting empirical observations at varied collision energies. While a low-viscosity and color-opaque matter has been observed at both RHIC and LHC, evidences are gathering to indicate at a considerable change of the QGP transport properties in a relatively narrow temperature span. I will discuss these evidences and how such observation may connect with our understanding of one fundamental aspect of QCD, the confinement transition. Another fundamental aspect of QCD, chiral symmetry breaking and restoration, suggests specific chiral effects that may become observable at RHIC and LHC, such as a number of anomalous effects and the chiral critical point. I will discuss the search of these effects by tuning beam energy across a wide window. The importance and challenge of understanding and constraining the very early stages of heavy ion collisions, such as initial fluctuations and pre-equilibrium evolutions, have become widely appreciated in the past few years. I will discuss the status of ongoing efforts in bridging the gap between the collision moment and the emergence of hydrodynamic expansion. Finally, I will discuss critical theoretical issues to be addressed as well as key experimental measurements to be made in the future.

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