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Theoretical perspectives of physics on relativistic heavy ion collisions

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Our knowledge of the hot QCD matter, the quark gluon plasma (QGP), has increased drastically since Relativistic Heavy Ion Collider (RHIC) started to operate at the beginning of this century. There are several major discoveries at RHIC such as large anisotropic flow coefficients and suppression of high p_T hadrons. Among them, the reasonable agreement between elliptic flow coefficients from ideal hydrodynamics of the QGP expansion and experimental data leads to a new paradigm “the strongly interacting QGP” at RHIC. Here relativistic hydrodynamics plays an important role in interpretation of observables related with the QGP expansion. Hot QCD matter created in relativistic heavy ion collisions is highly dynamic and complex by its nature. Thus, the relation between theoretical calculations of equilibrium properties of the QCD matter and experimental observables demands dynamical modeling of various stages in relativistic heavy ion collisions. It is now being in transition from the discovery stage to the stage of precision studies. Moreover, establishment of a realistic, standard, and dynamical model could lead us to new discoveries yet to be known. The society now tries to go beyond the current qualitative understanding and aims at more quantitative studies to constrain properties of the QGP such as the equation of state, the transport coefficients, and the stopping power of the hot QCD matter. In this talk, I first overview the dynamical modeling to describe space-time evolution of the hot matter in relativistic heavy ion collisions. I next introduce several attempts towards more quantitative understanding of the hot QCD matter. Finally, I discuss the role of the dynamical modeling and theoretical issues in the upcoming LHC era.