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Gluon transport in a semi-holographic model of QCD

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A semi-holographic approach combining the Boltzmann equation and the gauge/gravity duality is applied to study a gluon plasma which consists of hard and soft degrees of freedom, where the former is at the saturation scale of QCD and the latter is around the temperature of the quark gluon plasma in relativistic heavy ion collisions. The model aims at analyzing gluonic transport in the phase after the thermalization of soft degrees of freedom. The hard sector is presumed to be weakly interacting, where its dynamics is characterized by kinetic theory with the collisional term incorporating the scattering of hard and soft gluons. In contrast, the soft sector is strongly interacting, which could be described by an infrared conformal field theory (IR-CFT) as the gauge theory dual of a supergravity theory in thermal equilibrium. In general, the dynamics of the IR-CFT could be captured by hydrodynamics and the interaction with the hard sector then appears as a driving force thorough the conservation equation, while the input of holography is to obtain the transport coefficients. The corrections on both sectors could be solved order by order in terms of the marginal coupling of two sectors on the boundary. It is found that the correction on the hard gluons is sub-leading compared with that on the soft gluons. In early times, the hard gluons could be characterized by classical Yang-Mills theory with large occupation numbers. In the longitudinal expanding system, the energy density of the IR-CFT receives non-hydrodynamic correction, which depends on the dynamics of the hard gluons captured by the non-thermal attractor solution. In late times, we may expect the thermalization of the hard sector, which then gives rise to hydrodynamic correction on the soft sector.

On behalf of collaboration:

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