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Exploring inelastic and elastic parton interactions and transport properties of the strongly interacting quark-gluon plasma

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We investigate the role of inelastic processes in the strongly interacting quark-gluon plasma (sQGP) within the effective dynamical quasi-particle model (DQPM). In the DQPM the non-perturbative properties of the sQGP at finite temperature T and baryon chemical potential μ_B are described in terms of strongly interacting off-shell partons (quarks and gluons) with dynamically generated spectral functions whose properties are adjusted to reproduce the lQCD EoS for the QGP in thermodynamic equilibrium. For the first time the massive gluon radiation processes from the off-shell quark-quark ($q + q$) and quark-gluon ($q + g$) scatterings are calculated explicitly within leading order Feynman diagrams with effective propagators and vertices from the DQPM without any further approximations. We present the results for the energy, temperature and μ_B dependencies of the total and differential radiative cross sections and compare them to the corresponding elastic cross sections. Moreover, we present estimates for the transition rate and relaxation time of radiative versus elastic scatterings in the sQGP. We also present the results for the jet transport coefficients such as the transverse momentum transfer squared $\hat{q}$ per unit length as well as the energy loss $\Delta E = dE/dx$ per unit length in the sQGP and investigate their dependence on the temperature T and momentum of the jet parton depending on the choice of the strong coupling constant α_s in thermal, jet parton and radiative vertices. For the latter we consider different scenarios used in the literature and find a very strong dependence of $\hat{q}$ and ΔE on the choice of α_s. Finally, we explore the relation of $\hat{q}/T^3$ to the ratio of specific shear viscosity to entropy density η/s and show that the ratio $T^3/\hat{q}$ to η/s has a strong T dependence – especially when approaching to T_c – on the choice of α_s in scattering vertices.

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