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Partonic Critical Opalescence and Its Impact on the Jet Quenching Parameter $\hat{q}$

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Jet quenching parameter $\hat{q}$ is essential for characterizing the interaction strength between jet partons and nuclear matter. Based on the quark-meson (QM) model, we develop a new framework for calculating $\hat{q}$ at finite chemical potentials, in which $\hat{q}$ is related to the spectral function of the chiral order parameter. A mean field perturbative calculation up to the one-loop order indicates that the momentum broadening of jets is enhanced at both high temperature and high chemical potential, and approximately proportional to the parton number density in the partonic phase. We further investigate the behavior of $\hat{q}$ in the vicinity of the critical endpoint (CEP) by coupling our calculation with a recently developed equation of state that includes a CEP in the universality class of the Ising model, from which we discover the partonic critical opalescence (PCO) – the divergence of scattering rate of jets and their momentum broadening at the CEP, contributed by scatterings via the σ exchange process. Hence, for the first time, jet quenching is connected with the search of CEP.

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