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Jet quenching in strongly magnetized QGP: pQCD vs. AdS/CFT

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We study the jet quenching parameter $\hat{q}$ of QCD plasma in the presence of strong magnetic field in both weakly and strongly
coupled regimes. In weakly coupled regime, we compute $\hat{q}$ in perturbative QCD at complete leading order (that is, leading log as well as the constant under the log) in QCD coupling constant α_s, assuming the hierarchy of scales $\alpha_s eB \ll T^2 \ll eB$.
We consider two cases of jet orientations with respect to the magnetic field: 1) the case of jet moving parallel to the magnetic field, 2) the case jet moving perpendicular to the magnetic field. In the former case, we find $\hat{q} \sim \alpha_s^2(eB)T\log(1/\alpha_s)$, while in the latter we have $\hat{q} \sim \alpha_s^2(eB)T\log(T^2/\alpha_s eB)$. In both cases, this leading order result arises from the scatterings with thermally populated lowest Landau level quarks. In strongly coupled regime described by AdS/CFT correspondence,
we find $\hat{q} \sim \sqrt{\lambda}(eB)T$ or $\hat{q} \sim \sqrt{\lambda}\sqrt{eB}T^2$ in the same hierarchy of $T^2 \ll eB$ depending on whether the jet is moving parallel or perpendicular to the magnetic field, respectively, which indicates a universal dependence of $\hat{q}$ on $(eB)T$ in both regimes for the parallel case, the origin of which should be the transverse density of lowest Landau level states proportional to eB.
Finally, the asymmetric transverse momentum diffusion in the case of jet moving perpendicular to the magnetic field may give an interesting azimuthal asymmetry of the gluon Bremsstrahlung spectrum in the BDMPS-Z formalism.

Summary

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