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The problem of overlapping formation times: In-medium virtual corrections in large Nf QED

Summary

High energy particles such as quarks, gluons, electrons etc. traversing through medium primarily lose energy by showering through hard bremsstrahlung and pair production. These splitting processes are coherent over large distances in the very high energy limit, leading to suppression from the Landau-Pomeranchuk-Migdal (LPM) effect. Avoiding soft-emission approximations, we study the cases where the coherence lengths of two consecutive splittings overlap (which is important for calculating corrections to LPM effect in QCD) and focus on calculating virtual corrections to in-medium splitting rates, which will be necessary for infrared safe calculations of the characteristics of high energy in-medium parton showers. We find that these in-medium loop calculations require highly non-trivial UV regularization and renormalization. In the current work, we show how to solve these issues for the slightly simpler case of large-Nf QED, where Nf is the number of electron flavors. Finally, we use these results to calculate corrections to in-medium charge and energy stopping lengths.

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