

## High Energy Showers: In-medium loop corrections and longitudinally polarized gauge bosons

High energy particles 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 LPM effect. Avoiding soft-gluon 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 two issues: (i) how to include the effects of non-transverse polarized gauge bosons in the intermediate states and (ii) how to calculate 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. 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- $N_f$  QED, where  $N_f$  is the number of electron flavors.

### Summary

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