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Soft-gluon approximation in calculating radiative energy loss of high p_T particles - is it well-founded?

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The soft-gluon approximation, which implies that radiated gluon carries away a small fraction of initial parton's energy, is a commonly used assumption in calculating radiative energy loss of high momentum partons traversing the dense QCD medium, created in ultra-relativistic heavy ion collisions at RHIC and LHC. While soft-gluon approximation is convenient, doubts have been raised over its validity, especially since different theoretical approaches reported significant radiative energy loss of high p_T partons, which implies that this approximation is not applicable in such calculations.

To address this issue, we relaxed the soft-gluon approximation within DGLV formalism [1], and discuss generalizing this relaxation in the dynamical QCD medium. Although the obtained results are quite distinct compared to the soft-gluon case, numerically both cases lead to nearly overlapping predictions for the first order in opacity fractional energy loss. The fractional number of radiated gluons is also barely affected. The effect on these two variables runs in opposite directions, which when combined results in negligible suppression change. Therefore, we unexpectedly conclude that soft-gluon approximation works surprisingly well in energy loss calculations, and that there is no need to go beyond the soft-gluon approximation in energy loss based models of parton suppression.

[1] B. Blagojevic, M. Djordjevic and M. Djordjevic, to be submitted (2017).

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