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Adding vacuum branching to jet evolution in a dense medium

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It is well known that the multiple interactions of a hard probe with a dense quark-gluon plasma result in the "medium-induced" radiation of soft gluons, responsible e.g. for jet energy loss. Such an emission can be computed using the BDMPS-Z formalism, which has recently been generalised to include multiple medium-induced emissions. To get a complete picture of the evolution of a jet in a dense medium, the main missing ingredient is the inclusion of both medium-induced emissions and "vacuum-like" emissions responsible for the parton shower from large virtualities (of the order of the hard scale) down to the hadronisation scale.

In this talk, we adopt a new approach and show that in a (leading) double-logarithmic approximation, the time scales in the evolution of a jet factorise. The vacuum-like parton cascades develop at early times and exhibit angular ordering due to color coherence, like the standard parton showers in the vacuum. The effect of the medium can be simply formulated as a kinematic constraint which limits the phase-space for vacuum-like radiation and thus reduces the parton multiplicities. The gluons produced by these cascades lose their mutual coherence via multiple scattering and hence act as independent sources of energy loss via medium-induced radiation.

To the best of our knowledge, this is the first complete picture of jet evolution in the medium derived from perturbative QCD. It has the additional advantage of being well-suited for a Monte-Carlo implementation. In the talk, we show how this simple evolution arise and investigate its main properties.

Content type

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