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Jet evolution in a dense medium: event-by-event fluctuations and multi-particle correlations

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We study the gluon distribution produced via successive medium-induced branchings by an energetic jet propagating through a weakly-coupled quark-gluon plasma. We show that under suitable approximations, the jet evolution is a Markovian stochastic process, which is exactly solvable. For this process, we construct exact analytic solutions for all the n -point correlation functions describing the gluon distribution in the space of energy [1,2]. Using these results, we study the event-by-event distribution of the energy lost by the jet at large angles and of the multiplicities of the soft particles which carry this energy. We find that the event-by-event fluctuations are huge: the standard deviation in the energy loss is parametrically as large as its mean value [1]. This has important consequences for the phenomenology of di-jet asymmetry in Pb+Pb collisions at the LHC: it implies that the fluctuations in the branching process can contribute to the measured asymmetry on an equal footing with the geometry of the di-jet event (i.e. as the difference between the in-medium path lengths of the two jets). We compute the higher moments of the multiplicity distribution and identify a remarkable regularity known as Koba-Nielsen-Olesen (KNO) scaling [2].

These predictions could be tested via event-by-event measurements of the di-jet asymmetry.

References

- [1] Event-by-event fluctuations in the medium-induced jet evolution
M. Escobedo, E. Iancu, e-Print: arXiv:1601.03629 [hep-ph], JHEP 1605 (2016) 008.
- [2] Multi-particle correlations and KNO scaling in the medium-induced jet evolution
M. Escobedo, E. Iancu, e-Print: arXiv:1609.06104 [hep-ph], JHEP 1612 (2016) 104.

Experimental Collaboration

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