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Event-by-event picture for the medium-induced jet evolution

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We discuss the evolution of an energetic jet which propagates through a dense quark-gluon plasma and radiates gluons due to its interactions with the medium. Within perturbative QCD, this evolution can be described as a stochastic branching process, that we have managed to solve *exactly*. We present exact, analytic, results for the gluon spectrum (the average gluon distribution) and for the higher n-point functions, which describe correlations and fluctuations. Using these results, we construct the event-by-event picture of the gluon distribution produced via medium-induced gluon branching.

In contrast to what happens in a usual QCD cascade in vacuum, the medium-induced branchings are *quasi-democratic*, with offspring gluons carrying sizable fractions of the energy of their parent parton. This results in *wave turbulence* - an efficient mechanism for the transport of energy from the jet towards the medium. This mechanism is characterized by a power-law (*Kolmogorov*) spectrum and by *large fluctuations* in the energy loss and the multiplicity of soft gluons. The multiplicity distribution is predicted to exhibit *KNO (Koba-Nielsen-Olesen) scaling*. These predictions can be tested in Pb+Pb collisions at the LHC, via event-by-event measurements of the di-jet asymmetry.

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