

Next-to-leading order analysis of inclusive jet, tagged jet and di-jet production in PbPb collisions at the LHC

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Jets physics is an important new area of active research at RHIC and at the LHC that paves the way for novel tests of QCD multi-parton dynamics in heavy-ion reactions. At present, perturbative QCD calculations of hard probes in “elementary” nucleon-nucleon reactions can be consistently combined with the effects of the nuclear medium up to next-to-leading order. While such accuracy is desirable for leading particle tomography, it is absolutely essential for the new jet observables. With this motivation, we present results and predictions at NLO for the recent LHC lead-lead (Pb+Pb) run at a center-of-mass energy of 2.76 TeV per nucleon-nucleon pair. Specifically, we focus on the suppression the single and double inclusive jet cross sections and demonstrate how the di-jet asymmetry, recently measured by ATLAS and CMS, can be related to these general results. The case of jets tagged by an electroweak boson is exemplified by the Z_0 +jet channel. We predict a signature transition from enhancement to suppression of the tagged jet reflective of the medium-induced modification of parton showers. We also present NLO results relevant to the inclusive Z_0 data obtained by the CMS collaboration. Our analysis includes not only final-state inelastic parton interactions in the QGP, but also initial-state cold nuclear matter effects and non-perturbative hadronization corrections. Finally, we clarify the relation between the suppression of inclusive jets, tagged jets and di-jets and the quenching of inclusive particles on the example of the recent ALICE neutral pion attenuation data. We conclude by discussing future directions and effective theories of QCD that can help improve the accuracy of the theoretical tools for jet tomography.

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