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Probe the nuclear matter with jet productions at NLO

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Jets physics in heavy ion reactions is an important new area of active research at the Relativistic Heavy Ion Collider (RHIC) and at the Large Hadron Collider (LHC) that paves the way for novel tests of QCD multi-parton dynamics in dense nuclear matter. 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 (NLO). While such accuracy is desirable but not necessary for leading particle tomography, it is absolutely essential for the new jet observables.

With this motivation, We investigate the cold nuclear matter(CNM) effects on jet productions in high-energy nuclear collisions at LHC with the NLO perturbative QCD. The nuclear modifications for dijet angular distributions, dijet invariant mass spectra, dijet transverse momentum spectra and dijet momentum imbalance due to CNM effects are calculated by incorporating EPS, EKS, HKN and DS parametrization sets of parton distributions in nucleus . It is found that dijet angular distributions and dijet momentum imbalance are insensitive to the initial-state CNM effects and thus provide optimal tools to study the final-state hot QGP effects such as jet quenching.

Furthermore we present the results and predictions at NLO for productions of the single, the Z0 tagged jet, and double inclusive jet cross sections by including parton energy loss effect in the QGP to be formed in high-energy nucleus-nucleus collisions. We demonstrate how an enhanced di-jet asymmetry in central Pb+Pb reactions at the LHC, recently measured by the ATLAS and CMS experiments, can be derived from these results. We show quantitatively that a significant fraction of this enhancement may be related to the ambiguity in the separation between the jet and soft background medium and point to a suite of measurements that can help build a consistent picture of parton shower modification in heavy ion collisions at the LHC.

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