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Bayesian extraction of $\hat{q}$ with a multi-stage jet evolution approach

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The jet energy loss coefficient $\hat{q}$ serves as one of the most important transport coefficients that characterize the modification of hard jets in a QGP. A quantitative extraction of $\hat{q}$ requires sophisticated jet quenching theory, precise and extensive experimental data, as well as an advanced statistical framework that compares theory to data. Within the JETSCAPE collaboration, we have developed a multi-stage approach of jet evolution, where the medium-modified parton showers at high virtuality scale are described using the DGLAP evolution and simulated with the MATTER event generator, while the in-medium elastic and inelastic scatterings of partons at low virtuality scale are described using a transport theory implemented with the LBT event generator.

The transition from the DGLAP phase to the transport phase of jet modification, and its dependence on properties of the jet and the local medium, has so far only been approximately estimated. The goal of this work is to use the advanced statistical framework to determine this transition. To this end, a simplified version of the state-of-the-art JETSCAPE generator is embedded into a Bayesian analysis framework for a simultaneous calibration on jet quenching data at various centrality bins in 200˜GeV Au-Au, 2.76˜TeV Pb-Pb and 5.02˜TeV Pb-Pb collisions, from which $\hat{q}$ is systematically extracted as functions of both jet energy and medium temperature. The dependence of $\hat{q}$ on the medium induced virtuality scale is quantitatively explored for the first time. This virtuality, in combination with the local temperature and parton energy, serves as a crucial separation scale between the DGLAP dominating region and the transport dominating region for jet quenching and is found to vary from 1.25˜GeV at RHIC to 2.5˜GeV at the LHC.

Summary

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