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Deep learning on jet modification in the presence of the QGP background

Jet interactions with the color-deconfined QCD medium in relativistic heavy-ion collisions are conventionally assessed by measuring the modification of the distributions of jet observables with respect to their proton-proton baselines. Deep learning methods allow us to evaluate the modification of jets on a jet-by-jet basis, and therefore significantly improve the capability of using jets to probe the QGP properties. In this work, we first explore the fractional energy loss of each jet through the QGP using the Convolutional Neural Network (CNN) method. The initial jets are generated by Pythia, and their subsequent evolution through the QGP is simulated using a linear Boltzmann transport (LBT) model that incorporates both elastic and inelastic scatterings between jet partons and the QGP. By mixing jet partons with the QGP background generated by a thermal model, and then training the neutral network with jets obtained using the constituent subtraction method, we show the neural network can provide a good prediction on the fractional energy loss of jets in the presence of the QGP background. We further apply the Dense Neural Network (DNN) method and the aforementioned CNN method to the background subtraction in constructing jets. Although the recoil partons from the LBT simulation, scattered out of the QGP background but belonging to jets, can inevitably lead to over-subtraction of the background, we obtain better accuracy of background subtraction by using the deep learning methods than by using the traditional constituent subtraction method and area-based method adopted in many experimental measurements.

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