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Probing heavy ion collisions using quark and gluon jet substructure with machine learning (15'+5')

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We study the classification of quark-initiated jets and gluon-initiated jets in proton-proton and heavy ion collisions using modern machine learning techniques. We train the deep convolutional neutral network on discretized jet images. The classification performance is compared with the multivariate analysis of several physically-contructed jet observables including the jet mass, the p_T^D, the multiplicity and the radial moments. We also compare with the systematic N-subjet expansion in telescoping deconstruction to exploit the information carried by the subjets. The quark and gluon jet samples generated from JEWEL are used as an example to demonstrate this general method. We find that the classification performance gradually worsens in central or high multiplicity PbPb events at 2.76 TeV in JEWEL w/recoils. The information carried by the subleading subjets can be washed out by the possible subjet thermalization or randomization due to the soft event activities. Our method provides a systematically improvable framework for analyzing and comparing all jet simulations and measurements in heavy ion collisions.

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