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The information content of quenched jets

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In high energy heavy-ion collisions the substructure of jets is modified compared to that in proton-proton collisions due to the presence of the quark-gluon plasma (QGP). This modification of jets in the QGP is called “jet quenching”. We employ machine learning techniques to quantify how much information about this process is within the substructure observables. We formulate the question as a binary classification problem where the machine is trained to learn information that distinguishes jets in proton-proton and heavy-ion collisions. We perform the classification task using *i*) deep sets which directly includes Infrared-Collinear (IRC) unsafe information, and *ii*) a complete basis of IRC safe jet substructure observables which is passed to a Dense Neural Network (DNN). From the trained DNN, we identify optimal observables using symbolic regression. We perform our analysis using parton shower event generator models, and outline possible future directions to apply these methods directly to the raw data. We expect that the automated design of observables for heavy-ion collisions can provide new guidance for inferring properties of QGP from jet substructure data. In addition, the proposed framework for jets can be extended to study event-wide properties of any nuclear collisions - in particular, to study electron-ion collisions at the future Electron-Ion Collider.

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