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Data-driven extraction of quark and gluon jet substructure

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The different modification of quark- and gluon-initiated jets in the quark-gluon plasma produced in heavy-ion collisions is a long-standing question that has not yet received a definitive answer from experiments. In particular, the relative sizes of the modification of quark and gluon jets differ between theoretical models. Therefore a fully data-driven technique is crucial for an unbiased extraction of the quark and gluon jet spectra and substructure. We perform a proof-of-concept study based on proton-proton and heavy-ion collision events from the PYQUEN generator with statistics accessible in Run 4 of the Large Hadron Collider. We use a statistical technique called topic modeling to separate quark and gluon contributions to jet observables. We demonstrate that jet substructure observables, such as the jet shape and jet fragmentation function, can be extracted using this data-driven method. These results suggest the potential for an experimental determination of quark and gluon jet spectra and their substructure.

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