UCLA NUCLEAR PHYSICS SEMINAR

Data-driven quark and gluon jet modification in heavy-ion collisions

Presented by: Jasmine Brewer
CERN

Whether quark- and gluon-initiated jets are modified differently by the quark-gluon plasma produced in heavy-ion collisions is a long-standing question that has thus far eluded a definitive experimental answer. A crucial complication for quark-gluon discrimination in both proton-proton and heavy-ion collisions is that all measurements necessarily average over the (unknown) quark-gluon composition of a jet sample. In the heavy-ion context, the simultaneous modification of both the fractions and substructure of quark and gluon jets by the quark-gluon plasma further obscures the interpretation. Here, we discuss a fully data-driven method for separating quark and gluon contributions to jet observables using a statistical technique called topic modeling. Assuming that jet distributions are a mixture of underlying "quark-like" and "gluon-like" distributions, we show how to extract quark and gluon jet fractions and constituent multiplicity distributions as a function of the jet transverse momentum. This proof-of-concept study is based on proton-proton and heavy-ion collision events from the Monte Carlo event generator Jewel with statistics accessible in Run 4 of the Large Hadron Collider. These results suggest the potential for an experimental determination of quark and gluon jet modifications.

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