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Probing Hadronization Through Jet Substructure Analysis

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Understanding the hadronization mechanism in Quantum Chromodynamics (QCD) remains a significant challenge due to its non-perturbative nature. Hadronization is typically described via phenomenological models in Monte Carlo event generators (such as PYTHIA and HERWIG), whose parameters need to be tuned to data. This work leverages jet substructure to probe underlying features of these frameworks, offering new insights into the hadronization process. While jets were originally proposed to circumvent non-perturbative effects, we show that their substructure can be a powerful tool to investigate these phenomena. Specifically, we demonstrate that the charge correlation ratio, which is sensitive to hadronization effects, can be enhanced by selections on jet substructure, particularly by analyzing the relative placement of splittings that resolve the leading charged particles within the clustering tree. Our findings reveal remarkable differences between widely used hadronization models, contributing to a better understanding of hadronization and opening new avenues for exploring non-perturbative QCD.

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