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A Systematic Study of In-Medium Hadronization of Jet Showers with JETSCAPE and Hybrid Hadronization

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"Hybrid Hadronization"is a Monte Carlo package that hadronizes systems of partons. It smoothly combines quark recombination, applicable when distances between partons in phase space are small, and string fragmentation appropriate for dilute parton systems, following the picture outlined by Han et al. [PRC 93, 045207 (2016)]. Hybrid Hadronization can be applied to a variety of systems from $e^+ + e^-$ to A+A collisions. It takes systems of partons and their color flow information, for example from a Monte Carlo parton shower generator, as input. In addition, if for A+A collisions a thermal background medium is provided, the package allows to sample thermal partons that contribute to hadronization. Hybrid Hadronization is available for use as a standalone code and is part of JETSCAPE since the 2.0 release. In this presentation we review the physics concepts underlying Hybrid Hadronization. We then quantify the effects that an ambient medium has on the hadronization process of jet showers. We focus in particular on the dependence of medium effects on the flow and size of the medium. Jet showers are simulated in JETSCAPE either in vacuum or in an ambient medium. We systematically vary parameters like jet energy, jet flavor, medium size, medium flow velocity, medium flow direction, and orientation of the hadronization hypersurface. Among other observables we compute hadron fragmentation functions, ratios of identified hadrons, properties of clustered jets, and jet shapes. We see clear signatures of the medium interacting with jets during hadronization. Our results clarify the effect we expect from in-medium hadronization of jets on observables like fragmentation functions, hadron chemistry, jet shape, or acoplanarity. They could be useful to further constrain our understanding of the interaction of jet showers in the parton phase extracted from experimental data.

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