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PAIReD jet: A calibratable, Lorentz-boost independent, multi-pronged resonance tagger

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Several jet flavor identification strategies have been employed to identify jets originating from heavy-flavor quarks and from the decay of heavy Lorentz-boosted objects. Often, separate tagging strategies are utilized for different Lorentz-boost regimes of the target physics object. For instance, in searches for the Higgs boson decaying into a pair of heavy-flavor quarks, a division is made between the low-boost (resolved) regime, where two separate thin jets are flavor-tagged, and the high-boost (merged) regime, where a single large-radius jet is flavor-tagged. Although the latter approach effectively exploits correlations between the two decay products thereby rejecting background more strongly, it fails to effectively perform in low-boost regimes, which encompass the majority of signal events. In this talk, we propose a novel tagging strategy that optimally exploits available information across all Lorentz-boost regimes. The new approach employs clustered thin jets as seeds to define unconventional jets, referred to as PAIReD jets, which are subsequently input into existing machine learning-based algorithms to discriminate between signal and background events. As a result, we achieve a 2-3x stronger background rejection compared to conventional strategies in low Lorentz-boost regimes, without the need for additional clustering algorithms. The momenta, masses, and tagger scores of these PAIReD jets can be calibrated using standard calibration methods employed in hadron collider experiments.

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