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Advances in machine learning tools, software, and calibration for jet-flavor identification in CMS

Tuesday 8 July 2025 08:30 (20 minutes)

Identification of hadronic jets originating from heavy-flavor quarks is essential to several physics analyses in High Energy Physics, such as studies of the properties of the top quark and the Higgs boson and searches for new physics. Recent algorithms used in the CMS experiment are developed using state-of-the-art machine-learning techniques to distinguish jets emerging from the decay of heavy flavor (charm and bottom) quarks from those arising from light-flavor (udsg) ones. Increasingly complex deep neural network architectures, such as graphs and transformers, have helped achieve unprecedented accuracies in jet tagging. Furthermore, the models are extended also to identify jets originating from hadronic tau leptons and conduct a flavor-aware jet momentum regression. Along with these advances, we present new calibration methods using flavor-enriched selections of proton-proton collision events, which allow us to measure flavor tagging performances in Run 3 of the LHC. We also present modern software and data analysis tools, which allow for a fast and comprehensive development of machine-learning models and the analysis of ever-increasing volumes of data.

Secondary track

T12 - Data Handling and Computing

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