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B-hadron identification in b-jets using novel deep learning technique in pp and PbPb collisions in CMS

Advancements in geometric deep learning offer powerful tools to study the internal structure of jets initiated by heavy quarks, particularly in the context of dead-cone effect and jet quenching. The kinematics of b-hadron decays present a challenge for substructure measurements with inclusive b-jets, which are essential for quantum chromodynamics (QCD) studies. We propose an approach using graph-based deep learning that utilises charged decay products of the jets represented as point clouds to simultaneously identify tracks associated with b-hadron decay and perform b-jet tagging. The method is demonstrated in simulated p-p ($\sqrt{s} = 5.02\ TeV$) and Pb-Pb ($\sqrt{s} = 5.36\ TeV$) collisions passed through the CMS detector framework, in both Run 2 and Run 3 conditions. We benchmark our method against traditional boosted decision tree classifiers, showcasing significant performance improvements in b-hadron identification of tracks.

Secondary track

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