

Determining charge for heavy flavour tagged jets in CMS with a Graph-Based Particle Transformer

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We present a novel technique to determine the charge of b-tagged small-cone jets in the CMS experiment. While current heavy-flavour tagging algorithms are charge-agnostic, the ability to distinguish between b and anti-b (as well as c and anti-c) jets is essential for several physics analyses, including Higgs and di-Higgs production studies. The proposed method leverages the Particle Transformer architecture, trained on simulated samples using a graph-based representation that connects all Particle Flow candidates and Secondary Vertices within a jet. The resulting charge-sensitive tagger, now fully integrated within the CMSSW framework, outperforms traditional jet-charge proxy variables, providing a robust and scalable tool for exploiting charge information in heavy-flavour jets. Ongoing studies using H and HH samples demonstrate the physics potential of this approach for improving charge-dependent measurements and enhancing signal-background discrimination in future CMS analyses.

Authors: RAMON ALVAREZ, Clara (University of Virginia (US)); MANTILLA SUAREZ, Cristina Ana (University of Virginia (US)); CARRERA JARRIN, Edgar Fernando (Universidad San Francisco de Quito (EC)); OCHOA FLORES, Jose David (Universidad San Francisco de Quito (EC))

Presenter: OCHOA FLORES, Jose David (Universidad San Francisco de Quito (EC))

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