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Identification of charm quark jets at the CMS experiment

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The hadronic products that result from proton-proton collisions at the Large Hadron Collider (LHC) can give rise to jet formation that can be detected be the Compact Muon Solenoid (CMS) detector. Several interesting physics, both Standard Model (SM) and Beyond Standard Model (BSM), processes can result the final states with charm quark jets. Analyzes rely on the algorithms that try to identify the flavour of these jets, called heavy-flavour taggers. In addition to the widely used b-tagger to identify the bottom quark jets, the new algorithm is developed to identify charm quark jets while rejecting bottom and light flavour jets. Such the algorithm is consequently called c-tagger. C-tagger relies on the characterestic of charm quarks hadronizing to long lifetime D mesons. Consequently, they travel a significative distance before decaying into showers of detectable particles, called jets. These new tracks arised from this decay do not point back to the primary interaction vertex. Thus, charm jets can be distinguished by particular properties such as secondary vertices from displaced tracks with respect to the primary interaction. The algorithm to identify charm jets, c-tagging algorithm, is invented based on Combined Secondary Vertex algorithm for b-tagger. C-tagger uses a Boosted Decision Tree (BDT) as multivariate analysis (MVA) technique to study a set of jet properties in order to identify jets originated from charm quarks. It is the first of its kind at the CMS collaboration. The c-tagger is integrated into the CMS software (CMSSW). It can be used in supersymmetry (SUSY) searches for new particles such as stop, the SUSY partner of standard model (SM) top, that may subsequently decay to a charm quark and the lightest supersymmetric particle (LSP), and for SM precision measurements in the data taking at the Large Hadron Collider (LHC) in 2016 and 2017.

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