Contribution ID: **388** Type: **not specified**

Boosted semi leptonic top tagging with tau

Friday, 27 August 2021 14:50 (20 minutes)

Boosted top quark tagging is one of the challenging tasks in high energy physics experiments, in particular in exploring new physics signals at the LHC. Several techniques are already developed to tag boosted top quark in its hadronic decay channel, and recently tagging in the semi leptonic channel also has been receiving a lot of attention. In this current study we try to develop boosted($p_T > 300$ GeV) semi leptonic top quark tagging methodology in tau channel considering its hadronic mode. In this method two sub jets inside the top like fat jets are constructed employing standard jet substructure techniques, and then cleaning those using soft drop methods. Eventually, two sub jets are identified as b and τ like jets, naively applying techniques used in the LHC experiments. Investigating several kinematic variables of these sub jets, such as sub jets energy fractions, invariant mass etc, we show that the main QCD background can be rejected achieving higher signal tagging efficiency. It is observed that the signal efficiency ˜ 82% against background rejection efficiency of ˜ 98% can be achievable. We try to improve further by employing multivariate analysis techniques applying boosted decision tree inputting several kinematic variables constructed out of these two subjects. Tagging boosted top quark in its tau decay channel is very useful in improving signal efficiencies, for instance, in searching very energetic Leptoquark, top squarks in R-parity breaking SUSY model etc.

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Session Classification: Electroweak, Top quark, and Higgs Physics

Track Classification: Electroweak, Top quark, and Higgs Physics