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Flavor Tagging TeV Jets for BSM and QCD

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We present a new scheme for tagging b-jets with $p_T > 500$ GeV, which we call μ_x tagging. At the LHC, the primary method to tag b-jets (jets which originate from bottom quarks) relies on tracking their charged constituents. However, when jets are highly boosted, their dense, collimated environment makes precise tracking difficult. Thus, as jet p_T approaches 1 TeV, track-based b-tags lose efficiency, and the probability to mis-tag light jets rises dramatically. This is a problem, since many heavy BSM resonances ($W' \to tb$, $Z'/G^* \to t\bar{t}/b\bar{b}$, etc.) require tagging at least one energetic b-jet and rejecting the light-jet background.

Using muons from semi-leptonic b-hadron decay, we define a variable x which encodes angular correlations between the muon and the boosted subjet of the decay. Requiring $x \leq x_{max}$ allows us to tag b-jets and effectively discriminate the light-jets (including those which undergo gluon splitting). This is especially useful at ATLAS, which has excellent capabilities for standalone muons. We find an efficiency to tag b-jets, c-jets and light-jets of $\epsilon_b \approx 14\%$, $\epsilon_c \approx 6.5\%$ and $\epsilon_{light} \approx 0.65\%$ respectively (where primary gluons splitting to heavy flavors are classified as light-jets). For heavy flavor jets (b / c), these efficiencies are essentially flat (over $-2.5 \leq \eta \leq 2.5$ and $0.5\,\text{TeV} \leq p_T \leq 2.1\,\text{TeV}$). For light-jets, the rejection rate improves slightly with p_T.

This scheme could be immediately useful in discovering a heavy, "leptophobic" Z' in the dijet channel. We simulate such a Z' at several TeV-scale masses and, using only the μ_x tag, predict a substantial increase in the sensitivity to discover heavy Z' at the LHC Run II. Additionally, since μ_x and track-based tagging are not mutually exclusive, using both should maximize the total b-tagging efficiency.

Oral or Poster Presentation

Oral

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