



Prospects of measuring the CKM matrix element V_{ts} at the LHC

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We study the prospects of measuring the CKM matrix element $|V_{ts}|$ at the LHC with the top quarks produced in the processes $pp \rightarrow t\bar{t}X$ and $pp \rightarrow t/\bar{t}X$, and the subsequent decays $t \rightarrow W^+s$ and $\bar{t} \rightarrow W^-\bar{s}$. To reduce the jet activity in top quark decays, we insist on tagging the W^\pm leptonically, $W^\pm \rightarrow \ell^\pm\nu_\ell$ ($\ell = e, \mu, \tau$), and analyse the anticipated jet profiles in the signal process $t \rightarrow Ws$ and the dominant background from the decay $t \rightarrow Wb$. To that end, we analyse the V_0 (K^0 and Λ) distributions in the s - and b -quark jets concentrating on the energy and transverse momentum distributions of these particles. The V_0 s emanating from the $t \rightarrow Wb$ branch have displaced decay vertexes from the interaction point due to the weak decays $b \rightarrow c \rightarrow s$ and the b -quark jets are rich in charged leptons. Hence, the absence of secondary vertexes and of the energetic charged leptons in the jet provide additional (b -jet vs. s -jet) discrimination in top quark decays. These distributions are used to train a boosted decision tree (BDT), a technique used successfully in measuring the CKM matrix element $|V_{tb}|$ in single top production at the Tevatron.

Using the BDT classifier, and a variant of it called BDTD, which makes use of decorrelated variables, we calculate the BDT(D)-response functions corresponding to the signal ($t \rightarrow Ws$) and background ($t \rightarrow Wb$). Detailed simulations undertaken by us with the Monte Carlo generator PYTHIA are used to estimate the background rejection versus signal efficiency for three representative LHC energies $\sqrt{s} = 7$ TeV, 10 TeV and 14 TeV, of which only the analysis for the $\sqrt{s} = 14$ TeV case is shown in detail. We argue that a benchmark with 10% accuracy for the signal $t \rightarrow Ws$ at a background ($t \rightarrow Wb$) rejection by a factor 10^3 (required due to the anticipated value of the ratio $|V_{ts}|^2/|V_{tb}|^2 \simeq 1.6 \times 10^{-3}$) can be achieved at the LHC@14 TeV with an integrated luminosity of 10 fb^{-1} .

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