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Flavor changing top decays to charm and Higgs with $\tau\tau$ at the LHC

We investigate the prospects of discovering the top quark decay into a charm quark and a Higgs boson ($t \to ch^0$) in top quark pair production at the CERN Large Hadron Collider (LHC).
A general two Higgs doublet model is adopted to study flavor changing neutral Higgs (FCNH) interactions.
We apply parton level analysis as well as Monte Carlo simulations with PYTHIA8 and Delphes to study a flavor changing top decay $t \to ch^0$, followed by the Higgs decaying into $\tau\bar{\tau}$, and another top quark decaying hadronically to a bottom quark (b) and two light jets.
To study a Higgs signal with low physics background, we consider only the leptonic decays of tau leptons, $\tau^+\tau^- \to e^\pm\mu^\mp +$ $slashed E_T$, where $slashed E_T$ represents missing transverse energy from neutrinos.
We employ collinear approximation for highly boosted tau decays to reconstruct Higgs mass and top mass with high precision as well as to remove physics background effectively.
In addition, the energy distribution of charm quark helps us to set acceptance cuts to remove more background and improve the statistical significance.
We study the discovery potential for the FCNH top decay at the LHC with collider energy $\sqrt{s} = 13$ and 14 TeV as well as a future hadron collider with $\sqrt{s} = 27$ TeV.
Our analysis suggests that a high energy LHC at $\sqrt{s} = 27$ TeV will be able to discover this FCNH signal with an integrated luminosity $L = 3$ ab^{-1} for a branching fraction $calB(t \to ch^0)$ $agt1.4 \times 10^{-4}$ that corresponds to a FCNH coupling $|\lambda_{tch}|$ $agt0.023$.
This FCNH couplings is significantly below the current ATLAS combined limit $|\lambda_{tch}|$ $agt0.064$.

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