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

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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 perform a parton level analysis as well as Monte Carlo simulations
using \textsc{Pythia}˜8 and \textsc{Delphes} to study the flavor changing
top quark decay
$t \to ch^0$, followed by the Higgs decaying into $\tau^+\tau^-$,
with the other top quark decaying to a bottom quark (b) and
two light jets ($t \to bW \to bjj$).
To reduce the physics background to the Higgs signal,
only the leptonic decays of tau leptons are considered,
$\tau^+\tau^- \to e^\pm\mu^\mp +$ MET,
where MET represents the missing transverse energy from
the neutrinos.
In order to reconstruct the Higgs boson and top quark masses as well as
to reduce the physics background, the collinear approximation
for the highly boosted tau decays is employed.
Furthermore, the energy distribution of the charm quark helps set the
acceptance criteria used to reduce the background and improve the statistical
significance of the signal.
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 $\mathcal{L} = 3$ ab^{-1} for a branching fraction
$calB(t \to ch^0) > 1.4 \times 10^{-4}$,
which corresponds to a FCNH coupling $|\lambda_{tch}| > 0.023$.
This FCNH coupling is significantly below the current ATLAS combined
upper limit of $|\lambda_{tch}| = 0.064$.

Are you are a member of the APS Division of Particles and Fields?

Yes

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