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Indirect search for light charged Higgs bosons through the dominant semileptonic decays of top quark $t \to b(\to B/D + X) + H^+(\to \tau^+\nu_\tau)$

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In this work we introduce a new channel to indirect search for the light charged Higgs bosons, which are predicted in several extensions of the standard model (SM) such as the two-Higgs-doublet models (2HDMs). We calculate the $calO(\alpha_s)$ QCD radiative corrections to the energy distribution of bottom- and charmed-flavored hadrons (B/D) produced in the dominant decays of the polarized top quark in the 2HDM, i.e. $t(\uparrow) \longrightarrow b(\to B/D + \text{jet}) + H^+(\to \tau^+\nu_\tau)$. %This analysis is studied in a specific helicity coordinate system where the polarization vector of the top quark is evaluated with respect to the momentum direction of the bottom quark.
Generally, the energy distribution of hadrons is governed by the unpolarized rate and the polar and the azimuthal correlation functions which are related to the
density matrix elements of the decay $t(\uparrow) \to bH^+$.
In our proposed channel, any deviation of the B/D-meson energy spectrum from its corresponding SM predictions can be considered as a signal for the existence of charged Higgs at the LHC. We also calculate, for the first time, the azimuthal correlation rate Γ_ϕ at next-to-leading order which vanishes at the Born level.

Primary author: Dr S. MOHAMMAD, Moosavi Nejad (Yazd University, Yazd, Iran)

Presenter: Dr S. MOHAMMAD, Moosavi Nejad (Yazd University, Yazd, Iran)

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