

Vector-like T Bounds at the LHC: Impact of 2HDM-II

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In our study, we explored the impact of incorporating vector-like T (VLT) quarks into Two-Higgs-Doublet Models (THDMs), which introduces new decay modes beyond the Standard Model (SM) channels ($T \rightarrow Zt$, $T \rightarrow ht$, $T \rightarrow Wb$). These new beyond Standard Model (BSM) decay channels include the CP-even $T \rightarrow Ht$, CP-odd $T \rightarrow At$, and charged $T \rightarrow H^+b$, which have not been experimentally investigated at the LHC, as existing vector-like quark (VLQ) searches focus solely on SM channels. Our analysis focused on how these BSM decay modes affect the stringent mass limits of VLT quarks. For THDM type II (THDM-II) with a singlet T , the mass bound is relaxed from approximately 1.43 TeV to 1.27 TeV. For THDM-II with a doublet (T, B), the mass limit is significantly reduced from about 1.54 TeV to 0.99 TeV, driven primarily by the dominance of the $T \rightarrow H^+b$ decay, which can achieve a branching ratio of nearly 98%.

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