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Search for charged Higgs bosons decaying via $H^{\pm} \to \tau^{\pm}\nu_{\tau}$ in the τ+jets and τ+lepton final states in pp collisions at $\sqrt{s} = 13\tilde{}$ TeV with the ATLAS experiment

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Charged Higgs bosons produced either in top-quark decays or in association with a top-quark, subsequently decaying via $H^{\pm} \to \tau^{\pm}\nu_{\tau}$, are searched for in 36.1fb^{-1} of proton-proton collision data at $\sqrt{s} = 13$ TeV recorded with the ATLAS detector. Depending on whether the associated top-quark decays hadronically or leptonically, the search targets τ+jets and τ+lepton final states. In both cases, the τ-lepton decays hadronically. No evidence of a charged Higgs boson is found. For the mass range of $m_{H^{\pm}} =$ 90-2000 GeV, upper limits at the 95% confidence level are set on the production cross-section of the charged Higgs boson times the branching fraction $\text{calB}(H^{\pm} \to \tau^{\pm}\nu_{\tau})$ in the range 4.2-0.0025 pb. In the mass range 90-160 GeV, assuming the Standard Model cross-section for $t\bar{t}$ production, this corresponds to upper limits between 0.25% and 0.031% for the branching fraction $\text{calB}(t \to bH^{\pm}) \times \text{calB}(H^{\pm} \to \tau^{\pm}\nu_{\tau})$. In the newest iteration of the search, the mass range has been extended to $m_{H^{\pm}}$ = 80-3000 GeV and novel machine learning techniques have been developed to sift through $139\,\text{fb}^{-1}$ of data. A parameterized neural network (PNN) is trained across the entire mass spectrum to provide signal-background discrimination in τ+jets or τ+lepton final states.

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Yes

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