

Light Charged Higgs Bosons to AW/HW via Top Decay

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While current ATLAS and CMS measurements exclude a light charged Higgs ($m_{H^\pm} < 160$ GeV) for most of the parameter region in the context of the MSSM scenarios, these bounds are significantly weakened in the Type II 2HDM once the exotic decay channel into a lighter neutral Higgs, $H^\pm \rightarrow AW/HW$, is open. In this study, we examine the possibility of a light charged Higgs produced in top decay via single top or top pair production, with the subsequent decay $H^\pm \rightarrow AW/HW$, which can reach a sizable branching fraction at low $\tan\beta$ once it is kinematically permitted. With a detailed collider analysis, we obtain exclusion and discovery bounds for the 14 TeV LHC assuming the existence of a 70 GeV neutral scalar. Assuming $\text{BR}(H^\pm \rightarrow AW/HW) = 100\%$ and $\text{BR}(A/H \rightarrow \tau\tau) = 8.6\%$, the 95% exclusion limits on $\text{BR}(t \rightarrow H^\pm b)$ are about 0.2% and 0.03% for single top and top pair production respectively, with an integrated luminosity of 300 fb^{-1} . The discovery reaches are about 3 times higher. In the context of the Type II 2HDM, discovery is possible at both large $\tan\beta > 17$ for $155 \text{ GeV} < m_{H^\pm} < 165 \text{ GeV}$, and small $\tan\beta < 6$ over the entire mass range. Exclusion is possible in the entire $\tan\beta$ versus m_{H^\pm} plane except for charged Higgs masses close to the top threshold. The exotic decay channel $H^\pm \rightarrow AW/HW$ is therefore complementary to the conventional $H^\pm \rightarrow \tau\nu$ channel.}

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