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$H^\pm \to W^\pm Z$, $H^\pm \to W^\pm\gamma$ IN THE MSSM*

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We study the complete one loop contribution to $H^\pm \to W^\pm Z$ and $H^\pm \to W^\pm\gamma$ in the Minimal Supersymmetric Standard Model (MSSM).

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At the LHC, the detection of light charged Higgs boson with $m_{H^\pm} \lesssim m_t$ is straightforward from top production followed by the decay $t \to bH^+$. Such light charged Higgs ($m_{H^\pm} \lesssim m_t$) can be detected also for any $\tan\beta$ in the $\tau\nu$ decay which is indeed the dominant decay mode. However, for heavy charged Higgs ($m_{H^\pm} \gtrsim m_t$) which decay predominantly to $t\bar{b}$, the search is rather difficult due to large irreducible and reducible backgrounds associated with $H^+ \to t\bar{b}$ decay. However, it has been demonstrated that the $H^+ \to t\bar{b}$ signature can lead to a visible signal at LHC provided that the charged Higgs mass is below 600 GeV and $\tan\beta$ is either below $\lesssim 1.5$ or above $\gtrsim 40$. An other alternative discovery channel for heavy charged Higgs is $H^\pm \to W^\pm h^0$, followed by the dominant decay of h^0 to $b\bar{b}$. This channel could lead to charged Higgs discovery only for low $\tan\beta$ where the branching ratio of $H^\pm \to W^\pm h^0$ is sizeable.

In MSSM, at tree level, the couplings $H^\pm \to W^\pm\gamma$, $H^\pm \to W^\pm Z$ are absent. Therefore, decay modes like $H^\pm \to W^\pm\gamma$, $H^\pm \to W^\pm Z$ are mediated at one loop level and then are expected to be loop suppressed. Moreover, those channels have a very clear signature and might emerge easily at future colliders. For instance, if $H^\pm \to W^\pm Z$ is enhanced enough, this decay may lead to three leptons final state if both W and Z decay leptonically and that would be the corresponding golden mode for charged Higgs boson.

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We have evaluated the one-loop induced process $H^{\pm} \to W^{\pm}V$ in the 't Hooft–Feynman gauge using dimensional regularization. We have also use the on-shell renormalization scheme for Higgs sector (see [1] for more details). Form factors of $H^{\pm} \to W^{\pm}\gamma$ are constrained by electromagnetic gauge invariance while those of $H^{\pm} \to W^{\pm}Z$ are not. In this respect, $H^{\pm} \to W^{\pm}Z$ will be more enhanced by SUSY contributions than $H^{\pm} \to W^{\pm}\gamma$.

Our main result is shown in Fig. 1 where we have illustrated Br($H^{\pm} \to W^{\pm}Z$) as a function of charged Higgs mass. Numerically, the Br($H^{\pm} \to W^{\pm}\gamma$) never exceeds 10^{-5} and will not be show here (see [1] for more details). In Fig. 1, we have shown both the pure 2HDM and the full MSSM contribution. It is clear that the 2HDM contribution is rather small. Once we include the SUSY particles, we can see that the Branching fraction get enhanced and can reach 10^{-3}. The source of this enhancement is mainly due to the presence of scalar fermion contribution in the loop which are amplified by threshold effects from the opening of the decay $H^{\pm} \to \widetilde{t}_i\widetilde{b}_j^*$. It turns out that the contribution of charginos neutralinos loops does not enhance the Branching fraction significantly as compared to scalar fermions loops. The plot also show that, the branching fraction is more important for intermediate $\tan\beta = 16$ and is slightly reduced for larger $\tan\beta = 25$.

To conclude, those Branching ratios of the order 10^{-3} might provide an opportunity to search for a charged Higgs boson at the LHC through $H^{\pm} \to W^{\pm}Z$. The smallness of those branching ratios may require high luminosity option as is already planned with SuperLHC.

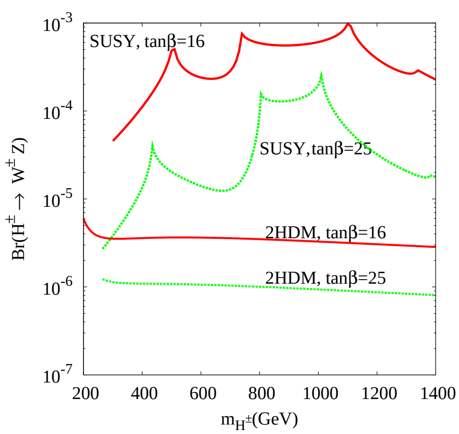

Fig. 1. Br($H^{\pm} \to W^{\pm}Z$) as a function of $m_{H^{\pm}}$ in the MSSM and 2HDM for $M_{\rm SUSY}, M_2, \mu = 500,\ 175,\ -1400$ GeV and $A_{t,b,\tau} = -\mu$ for various values of $\tan\beta$.

REFERENCES

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