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Implications of Yukawa texture in the charged Higgs boson phenomenology within 2HDM-III

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Outline

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- **Implications of four-zero Yukawa texture for the 2HDM-III**
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Motivations

Standard Model: 1 doublet of scalar fields (spontaneous ew symmetry breaking)

→ 1 neutral scalar particle is predicted: the Higgs boson H^0

Simple extension of the Higgs sector: 2 doublets of scalar fields (SUSY)

→ 5 Higgs bosons are predicted

- 3 neutral (h^0, H^0, A^0)
- 1 pair of charged bosons $H^{\pm}$

at tree-level, Higgs sector defined by $(M_{A^0}, tan\beta)$

observation of $H^{\pm}$
important role in the proof of
an extended SM Higgs sector

MSSM Charged Higgs
LEP limit: $M_{H^{\pm}} > 78.6$ GeV
(model independent)

Versions of the 2HDM

Type I: one Higgs doublet provides masses to all quarks (up- and down-type quarks) (~SM).

Type II: one Higgs doublet provides masses for up-type quarks and the other for down-type quarks (~MSSM).

Type III: the two doublets provide masses for up and down type quarks, as well as charged leptons.

We could consider this model as a generic description of physics at a higher scale (i. e. Radiative corrections of the MSSM Higgs sector* or from extradimension**).

*J. L. Díaz-Cruz, R. Noriega-Papaqui and A. Rosado, Phys. Rev. D 71, 015014 (2005).

**A. Aranda, J.L. Díaz-Cruz, J. Hernández-Sánchez, R. Noriega-Papaqui, Phys. Lett. B 658, 57 (2007).

How to distinguish 2HDM type II and type III from MSSM using charged Higgs sector ?

1. Mass relations enforced by SUSY and experimental limits on the MSSM (Mh<<MH~MA~MH+) need not be true in the 2HDM

2a. Couplings H+/- H0/h0 W+/- enabling H+ -> W+H0/h0:

$$g_{H^+W^-h^0} = \frac{g}{2}\cos(\beta - \alpha),\; g_{H^+W^-H^0} = \frac{g}{2}\sin(\beta - \alpha)$$

where α is the neutral Higgs mixing angle:

$$h^0 = \sqrt{2}\left[-\left(\mathrm{Re}\,\phi_1^0 - v_1\right)\sin\alpha + \left(\mathrm{Re}\,\phi_2^0 - v_2\right)\cos\alpha\right]$$

α is derived in MSSM, while is free parameter in the 2HDM !

2b. Couplings H+/- A0 W+/- enabling H+ -> W+A0 is pure gauge

2c. Other charged Higgs decay modes are MSSM-like:

$$H^\pm \to cs, \tau\nu\,,$$

$$H^\pm \to tb, \text{ if kinematically possible}$$

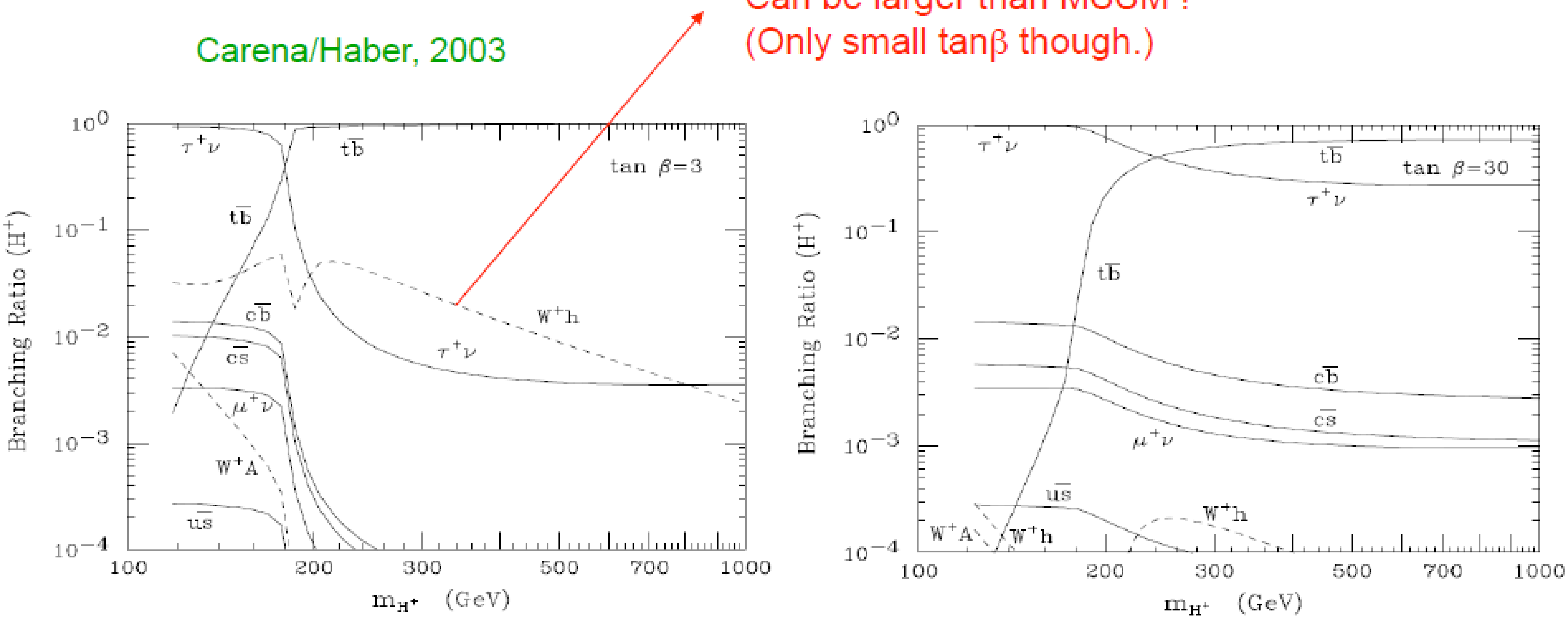
3. Only for type III:

H+ $\rightarrow$ cb, ts could be important, in some cases dominant !!

Branching ratios of charged Higgses in 2HDM model II

Can be larger than MSSM !
(Only small tanβ though.)

Carena/Haber, 2003



Note that there is no $H^+W^-\gamma$ or H^+W^-Z coupling in 2HDMs at tree-level

➡ No tree-level gauge boson fusion in production at hadron colliders

Yukawa texture chosen

After spontaneous symmetry breaking the quark mass matrix is given by

$$M_q = \frac{1}{\sqrt{2}}(v_1 Y_1^q + v_2 Y_2^q). \qquad (3)$$

We will assume that both Yukawa matrices Y_1^q and Y_2^q have the four-texture form and are Hermitic; following the conventions of [18], the quark mass matrix is then written as

$$M_q = \begin{pmatrix} 0 & C_q & 0 \\ C_q^* & \tilde{B}_q & B_q \\ 0 & B_q^* & A_q \end{pmatrix};$$

For diagonalize them we using the matrices O_q and P_q in the following way

$$\bar{M}^q = O_q^T P_q M^q P_q^\dagger O_q$$

J. L. Díaz-Cruz, R. Noriega-Papaqui and A. Rosado, Phys. Rev. D71, 015014, (2005) After spontaneous symmetry breaking (SSB) and including the diagonalizing matrices for quarks and Higgs bosons [1], the interactions of the charge Higgs boson H^+ with quark pairs acquire the following form:

$$
\begin{aligned}
\mathcal{L}^q = & \frac{g}{2\sqrt{2}M_W}\bar{u}_i \left\{ (V_{CKM})_{il} \left[\tan\beta\, m_{d_l}\, \delta_{lj} - \sec\beta \left(\frac{\sqrt{2}M_W}{g} \right) \left(\tilde{Y}_2^d \right)_{lj} \right] \right. \\
& + \left[\cot\beta\, m_{u_i}\, \delta_{il} - \csc\beta \left(\frac{\sqrt{2}M_W}{g} \right) \left(\tilde{Y}_1^u \right)^\dagger_{il} \right] (V_{CKM})_{lj} \\
& + (V_{CKM})_{il} \left[\tan\beta\, m_{d_l}\, \delta_{lj} - \sec\beta \left(\frac{\sqrt{2}M_W}{g} \right) \left(\tilde{Y}_2^d \right)_{lj} \right] \gamma^5 \\
& \left. - \left[\cot\beta\, m_{u_i}\, \delta_{il} - \csc\beta \left(\frac{\sqrt{2}M_W}{g} \right) \left(\tilde{Y}_1^u \right)^\dagger_{il} \right] (V_{CKM})_{lj}\, \gamma^5 \right\} d_j\, H^+
\end{aligned}
\qquad (2)
$$

and similarly for the leptons.

The term proportional to δ_{ij} corresponds to the contribution of the 2HDM-II, while the terms proportional to $\tilde{Y}_2^d$ and $\tilde{Y}_1^u$ denote the new contributions from 2HDM-III.

J. L. Díaz-Cruz, J. Hernández-Sánchez, S. Moretti, R. Noriega and A. Rosado, Phys. Rev D. 79:095025 (2009)

To derive a better suited approximation for the product $O_q^T\, P_q\, Y_n^q\, P_q^\dagger\, O_q$ we express the rotated matrix $\tilde{Y}_n^q$ in the form,

$$\left[\tilde{Y}_n^q\right]_{ij} = \frac{\sqrt{m_i^q m_j^q}}{v}\,[\tilde{\chi}_n^q]_{ij} = \frac{\sqrt{m_i^q m_j^q}}{v}\,[\chi_n^q]_{ij}\; e^{i\vartheta_{ij}^q}$$

In order to perform our phenomenological study we find convenient to rewrite the lagrangian given in Eq.2 in terms of the coefficients $[\tilde{\chi}_n^q]_{ij}$ as follows:

$$\begin{aligned}
\mathcal{L}^q = & \frac{g}{2\sqrt{2}M_W}\bar{u}_i \Bigg\{ (V_{CKM})_{il} \left[\tan\beta\, m_{d_l}\, \delta_{lj} - \frac{\sec\beta}{\sqrt{2}}\sqrt{m_{d_l} m_{d_j}}\,\tilde{\chi}_{lj}^d \right] \\
& + \left[\cot\beta\, m_{u_i}\, \delta_{il} - \frac{\csc\beta}{\sqrt{2}}\sqrt{m_{u_i} m_{u_l}}\,\tilde{\chi}_{il}^u \right] (V_{CKM})_{lj} \\
& + (V_{CKM})_{il} \left[\tan\beta\, m_{d_l}\, \delta_{lj} - \frac{\sec\beta}{\sqrt{2}}\sqrt{m_{d_l} m_{d_j}}\,\tilde{\chi}_{lj}^d \right] \gamma^5 \\
& - \left[\cot\beta\, m_{u_i}\, \delta_{il} - \frac{\csc\beta}{\sqrt{2}}\sqrt{m_{u_i} m_{u_l}}\,\tilde{\chi}_{il}^u \right] (V_{CKM})_{lj}\, \gamma^5 \Bigg\}\, d_j\, H^+
\end{aligned}$$

Coupling H+ fu fd

$$g_{H^+\bar{u}_i d_j} = -\frac{ig}{2\sqrt{2}M_W}(S_{ij} + P_{ij}\gamma_5), \quad g_{H^- u_i \bar{d}_j} = -\frac{ig}{2\sqrt{2}M_W}(S_{ij} - P_{ij}\gamma_5).$$

S_{ij} and P_{ij} are defined as:

$$S_{ij} = \sum_{l=1}^{3} (V_{\rm CKM})_{il}\, m_{d_l}\, X_{lj} + m_{u_i}\, Y_{il} (V_{\rm CKM})_{lj},$$

$$P_{ij} = \sum_{l=1}^{3} (V_{\rm CKM})_{il}\, m_{d_l}\, X_{lj} - m_{u_i}\, Y_{il} (V_{\rm CKM})_{lj}.$$

with

$$X_{lj} = \left[\tan\beta\, \delta_{lj} - \frac{\sec\beta}{\sqrt{2}} \sqrt{\frac{m_{d_j}}{m_{d_l}}}\, \tilde{\chi}^d_{lj}\right],$$

$$Y_{il} = \left[\cot\beta\, \delta_{il} - \frac{\csc\beta}{\sqrt{2}} \sqrt{\frac{m_{u_l}}{m_{u_i}}}\, \tilde{\chi}^u_{il}\right].$$

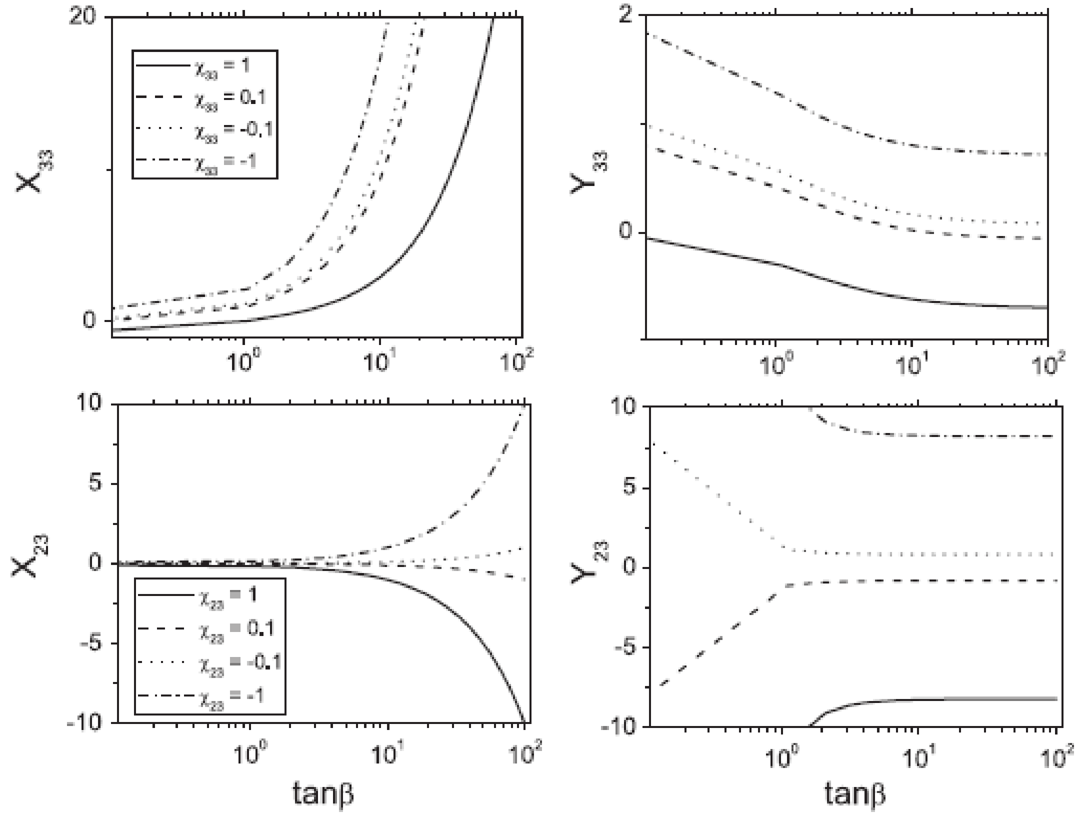


FIG. 1. The figure shows X_{33}, Y_{33}, X_{23}, and Y_{23} vs $\tan\beta$, taking $\tilde{\chi}^{u,d}_{3,3} = 1$ (solid line), $\tilde{\chi}^{u,d}_{3,3} = 0.1$ (dashed line), $\tilde{\chi}^{u,d}_{3,3} = -0.1$ (dotted line), and $\tilde{\chi}^{u,d}_{3,3} = -1$ (dashed-dotted line).

Based on the analysis of $B \to X_s\gamma$ [36, 37], it is claimed that $X \le 20$ and $Y \le 1.7$ for $m_{H^+} > 250$ GeV, while for a lighter charged Higgs boson mass, $m_{H^+} \sim 180$ GeV, one gets $(X, Y) \le (18, 0.5)$. In recently work we get the values of (X, Y) as a function of $\tan\beta$ within our model. Thus, we find the bounds: $|\chi^{u,d}_{33}| \lesssim 1$ for $0.1 < \tan\beta \le 70$

Other constraints

we consider in the numerical analysis of this paper the constraints imposed by the perturbativity bound, $Z \to b\bar{b}$, ρ_0 parameter and $B^0 - \bar{B}^0$ mixing.

Combining the criteria of the analysis radiative corrections of $Zb\bar{b}$ vertex and $B_0 - \bar{B}_0$ mixing, $\tan\beta > 0.3$ is allowed for $m_{H^+} > 170$ GeV and $\chi_{33}^{u,d} = 1$. However, when $\chi_{33}^{u,d} = -1$ and $m_{H^+} < 600$ GeV, $\tan\beta < 2$ is disfavored.

Arxiv: 1002.2626 (hep-ph), J.E. Barradas-Guevara et. al, to appear in J. Phys. G.

Experimental bound on the BR(t--> bH+)

If the decay mode (H+ --> τ+ ν) dominates the charged Higgs boson decay width, then BR(t --> H+ b) is constrained to be less than 0.4 at 95 % C.L.

However, if the decay mode (H+ --> τ+ ν) is not dominant, then BR(t --> H+ b) is constrained to be less than 0.91 at 95 % C.L.

The combined LEP data excluded a charged Higgs boson with mass less than 79.3 GeV at 95 % C. L.

Thus, we need to discuss all the charged Higgs decays.

A. Abulencia et al. (CDF Collaboration), Phys. Rev. Lett. 96, 042003 (2006)

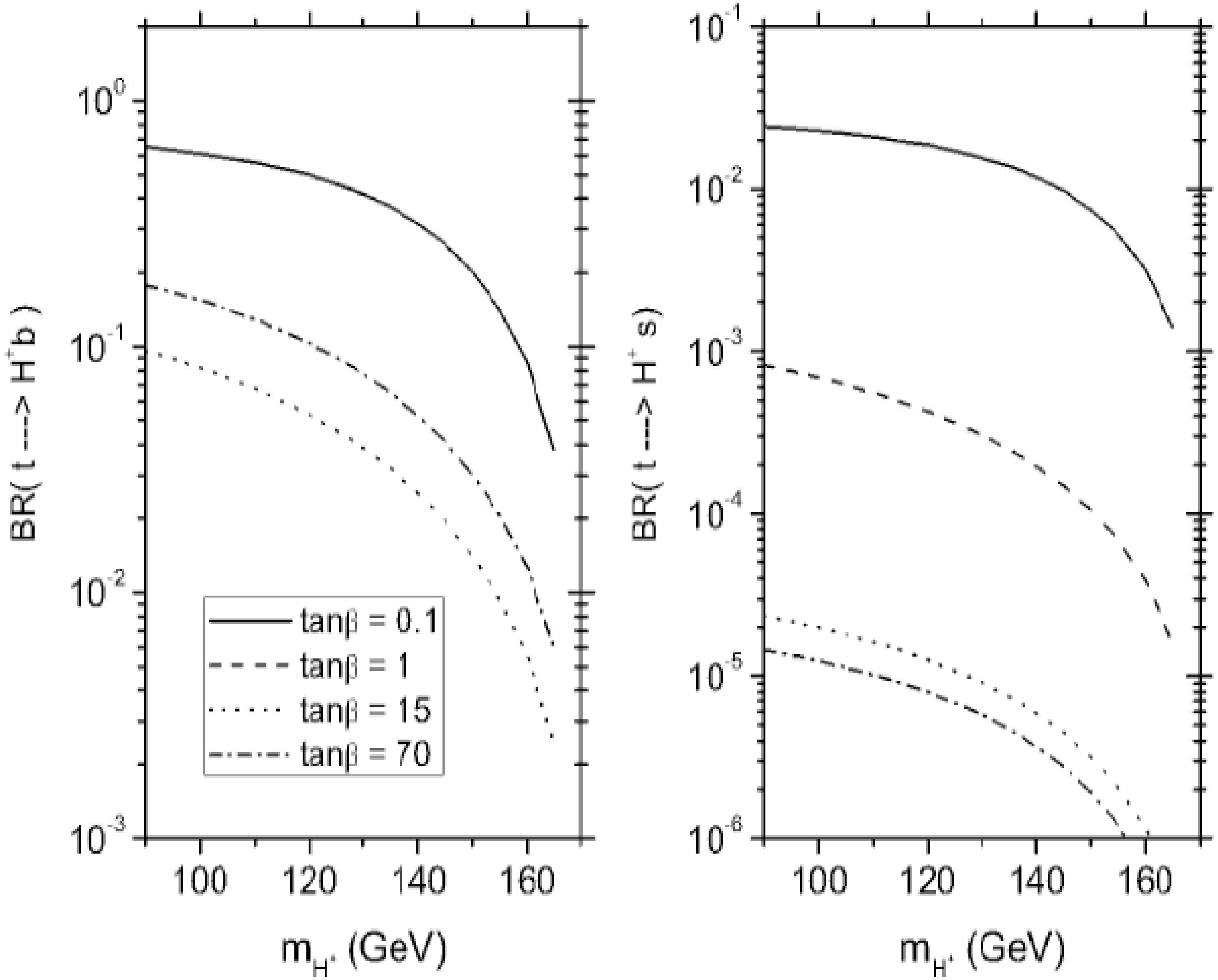


FIG. 5: It is plotted: a) the BR$(t \to b\, H^+)$ vs. m_{H^+} (left), b) the BR$(t \to b\, H_2^+)$ vs. m_{H^+} (right), in Scenario A by taking $\tilde{\chi}^u_{ij} = 1$ and $\tilde{\chi}^d_{ij} = 1$, for: $\tan\beta = 0.1$ (solid), $\tan\beta = 1$ (dashes), $\tan\beta = 15$ (dots), $\tan\beta = 70$ (dashes-dots).

The expressions for the charged Higgs boson decay widths $H^+ \to u_i \bar{d}_j$ are of the form:

$$\Gamma(H^+ \to u_i \bar{d}_j) = \frac{3g^2}{32\pi M_W^2 m_{H^+}^3} \lambda^{1/2}(m_{H^+}^2, m_{u_i}^2, m_{d_j}^2) \times \left(\frac{1}{2} \left[m_{H^+}^2 - m_{u_i}^2 - m_{d_j}^2 \right] (S_{ij}^2 + P_{ij}^2) - m_{u_i} m_{d_j} (S_{ij}^2 - P_{ij}^2) \right),$$

where λ is the usual kinematic factor $\lambda(a, b, c) = (a - b - c)^2 - 4bc$. When we replace $\tilde{\chi}_{ud} \to 0$, the formulae of the decays width become those of the 2HDM-II

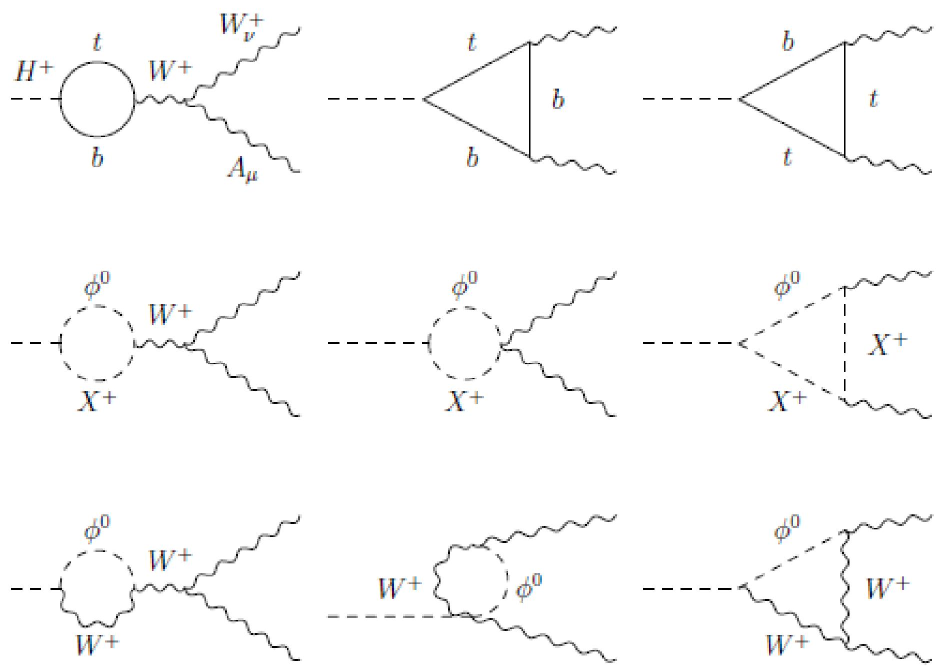
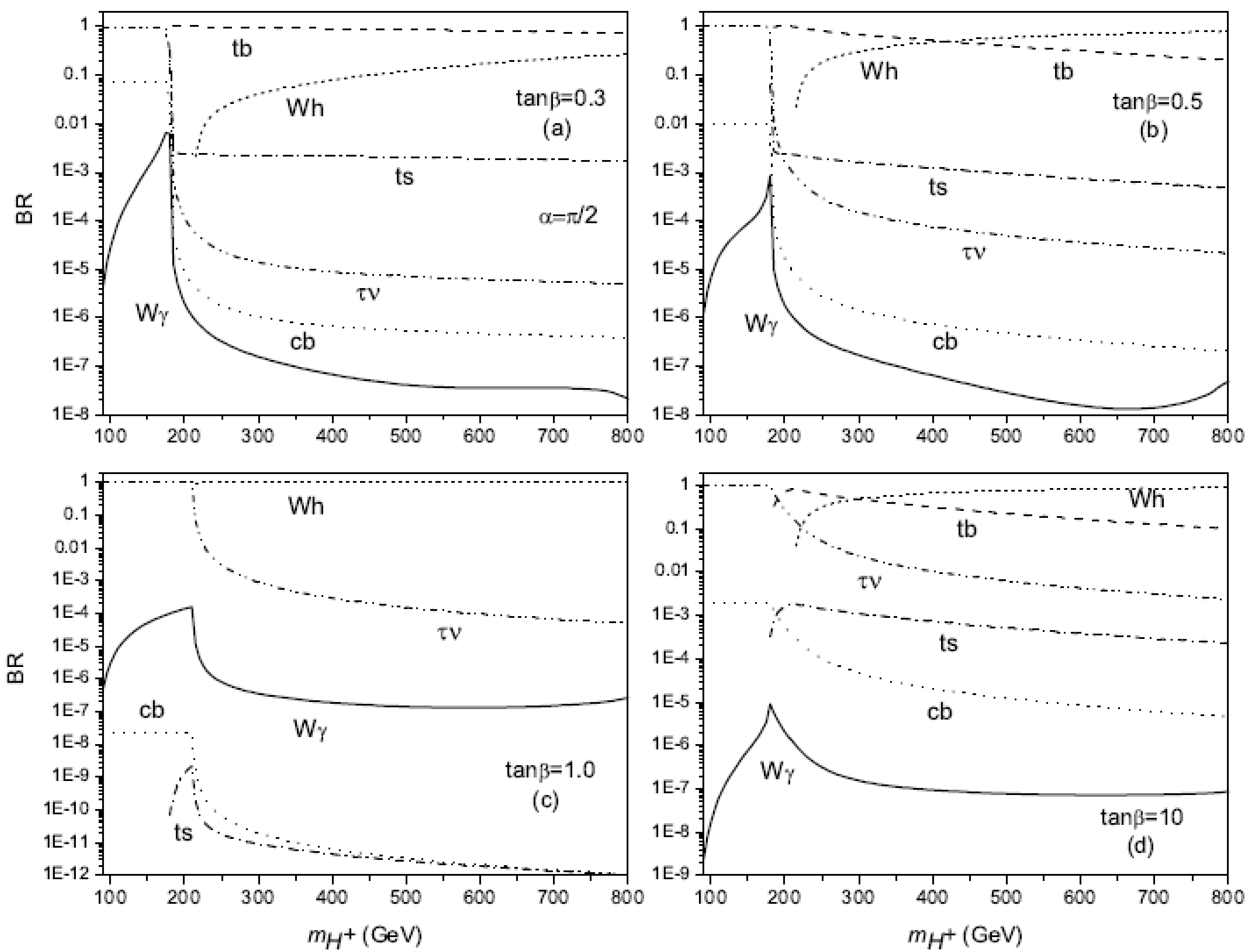
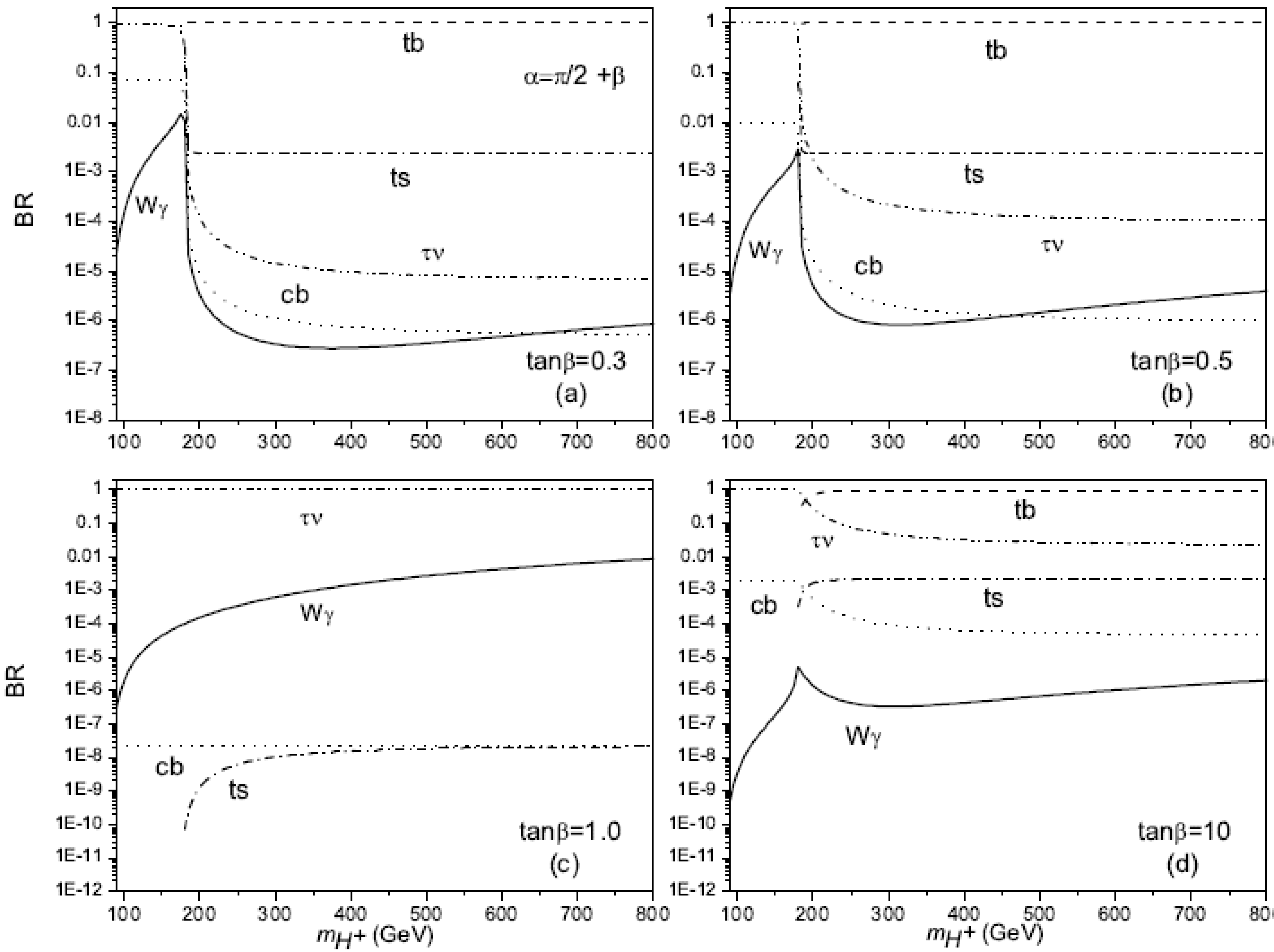


Figure 1. Feynman diagrams contributing to the $H^+ \to W^+\gamma$ decay in the nonlinear R_ξ-gauge. ϕ^0 stands for h^0 and H^0, and X^+ for H^+ and G_W^+.

Scenario with χ=1, but α=π/2



Scenario with χ=1, but α=π/2+β



C. s-channel production of charged Higgs boson

Large flavor mixing coupling $H^{\pm}\bar{q}q'$ enables the possibility of studying the production of charged Higgs boson via the partonic s-channel production mechanism, $c\bar{b}, \bar{c}b \to H^{\pm}$. This mechanism was discussed first by He and Yuan

$$\sigma(h_1 h_2 (c\bar{b}) \to H^+ X) \frac{\pi}{12s}(|C_L|^2 + |C_R|^2) I_{c,\bar{b}}^{h_1,h_2}$$

where

$$I_{c,\bar{b}}^{h_1,h_2} = \int_{\tau}^{1} dx \, [f_c^{h_1}(x,\tilde{Q}^2) f_{\bar{b}}^{h_2}(\tau/x,\tilde{Q}^2) + f_{\bar{b}}^{h_1}(x,\tilde{Q}^2) f_c^{h_2}(\tau/x,\tilde{Q}^2)]/x$$

and $\tau = m_{H^{\pm}}^2/s$. The parton distribution functions (PDFs) $f_q^{h_i}(x,\tilde{Q}^2)$ describe the quark q content of the hadron i at a scale interaction of $\tilde{Q}^2$. In other words, the PDFs $f_q^h(x,\tilde{Q}^2)$ give the probabilities to find a quark q inside a hadron with the fraction x of the hadron momentum, in a scattering process with momentum transfer square $\tilde{Q}^2$, in this case we will take $\tilde{Q}^2 = m_{H^+}^2$.

H. J. He and C.P. Yuan , Phys. Rev. Lett. 83, 28 (1999) we see that for the case of the 2HDM-III, S and A for the subprocess $(c\bar{b}) \rightarrow H^+$ are giving as follows

$$C_L^{III} = -\frac{ig}{\sqrt{2}M_W}\left[\cot\beta\, m_c\, \delta_{2l} - \frac{\csc\beta}{\sqrt{2}}\sqrt{m_c m_{u_l}}\,\tilde{\chi}^u_{2l}\right](V_{CKM})_{l3}$$

and

$$C_R^{III} = -\frac{ig}{\sqrt{2}M_W}(V_{CKM})_{2l}\left[\tan\beta\, m_{d_l}\, \delta_{l3} - \frac{\sec\beta}{\sqrt{2}}\sqrt{m_{d_l} m_{d_3}}\,\tilde{\chi}^d_{l3}\right]$$

where $l = 1, 2, 3$.

integrated luminosity at LHC is of the order 10^5 pb.

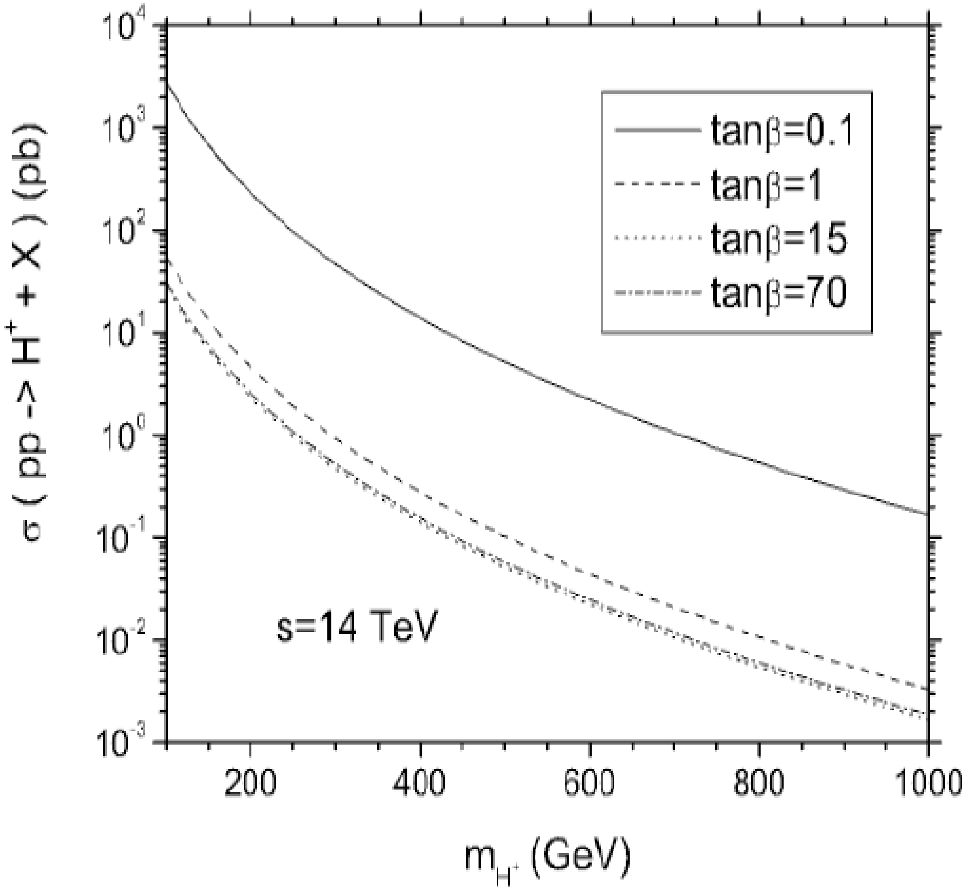


FIG. 9: The figure shows the total cross section rates of process $h_1h_2(c\bar{b}) \to H^+X$ as a function of m_{H^+} in the 2HDM-III at LHC energies ($s = 14$ TeV), by taking $\tilde{\chi}^d_{l3} = 1$ and $\tilde{\chi}^u_{2l} = 1$ ($l = 1, 2, 3$). The lines correspond to: $\tan\beta = 0.1$, $\tan\beta = 1$, $\tan\beta = 15$, and $\tan\beta = 70$.

TABLE II: Summary of LHC event rates for some parameter combinations within Scenarios A, B, C, D with for an integrated luminosity of 10^5 pb^{-1}, for several different signatures, through the channel $c\bar{b} \to H^+ +$ c.c.

$(\tilde{\chi}^u_{ij}, \tilde{\chi}^d_{ij})$	$\tan\beta$	m_{H^+} in GeV	$\sigma(pp \to H^+ + X)$ in pb	Relevant BRs	Nr. Events
(1,1)	15	400	1.14×10^{-1}	$\mathrm{BR}(H^+ \to t\bar{b}) \approx 3.2 \times 10^{-1}$	3648
				$\mathrm{BR}(H^+ \to \tau^+\nu^0_\tau) \approx 2.1 \times 10^{-3}$	24
				$\mathrm{BR}(H^+ \to W^+h^0) \approx 6.3 \times 10^{-1}$	7182
				$\mathrm{BR}\left(H_2^+ \to W^+A^0\right) \approx 1.7 \times 10^{-2}$	194
(1,1)	70	400	1.25×10^{-1}	$\mathrm{BR}(H^+ \to t\bar{b}) \approx 3.5 \times 10^{-1}$	4375
				$\mathrm{BR}(H^+ \to c\bar{b}) \approx 1.4 \times 10^{-2}$	175
				$\mathrm{BR}(H^+ \to \tau^+\nu_\tau) \approx 2.5 \times 10^{-1}$	3125
				$\mathrm{BR}(H^+ \to W^+h^0) \approx 3.6 \times 10^{-1}$	4500
(0.1,1)	1	600	3.41×10^{-4}	$\mathrm{BR}(H^+ \to t\bar{b}) \approx 3 \times 10^{-1}$	10
				$\mathrm{BR}(H^+ \to t\bar{s}) \approx 9.1 \times 10^{-4}$	0
				$\mathrm{BR}(H^+ \to W^+h^0) \approx 3.6 \times 10^{-1}$	12
				$\mathrm{BR}(H^+ \to W^+A^0) \approx 3.2 \times 10^{-1}$	11

In order to provide an estimate of the irreducible backgrounds to the signal studied, we estimate the number of events of the background signal $pp \to W^+\gamma$ from the analysis of the Ref. [52], where we use the differential cross section for the invariant mass distribution $d\sigma/dM_{W\gamma}$ (pb/GeV) and an integrated luminosity $L_I = 10^5$ pb^{-1}. Then we obtain the background signal through the formulae $N_B = L_I(d\sigma/dM_{W\gamma})\Delta M$, taking $\Delta M = 10$ GeV and $M_{W\gamma} = m_{H^+}$, e.g. when $m_{H^+} = 500$ GeV the number of events of the background signal $pp \to W^+\gamma$ is of order 160. We show in the Table 1 the statistical factor $N_S/\sqrt{N_B}$ for all the cases, where N_S is the number of events of signal $H^+ \to W^+\gamma$ in the final state of the reaction $pp \to H^+ + X$ and N_B is the number of events of the background signal $pp \to W^+\gamma$.

Table 1. Summary of LHC event rates for some parameter combinations within Scenario B ($\tilde{\chi}_{ij}^{u,d} = 1$) with an integrated luminosity of 10^5 pb^{-1}, for the signal $H^+ \to W^+\gamma$, through the channel $c\bar{b} \to H^+$ + c.c.

α	$\tan\beta$	m_{H^+} in GeV	$\sigma(pp \to H^+ + X)$ in pb	$BR(H^+ \to W^+\gamma)$	N_S	$\frac{N_S}{\sqrt{N_B}}$
$\pi/2$	0.3	200	2.1×10^2	2×10^{-6}	42	2.02
$\pi/2 + \beta$	0.5	300	4.5×10	9×10^{-7}	4	0.223
$\pi/2$	1	200	4.5	1.4×10^{-4}	63	3.03
$\pi/2 + \beta$	1	300	0.89	7×10^{-4}	62	3.46
$\pi/2$	10	200	2.5	2×10^{-6}	0	0
$\pi/2$	10	300	5.2×10^{-1}	1.5×10^{-7}	0	0

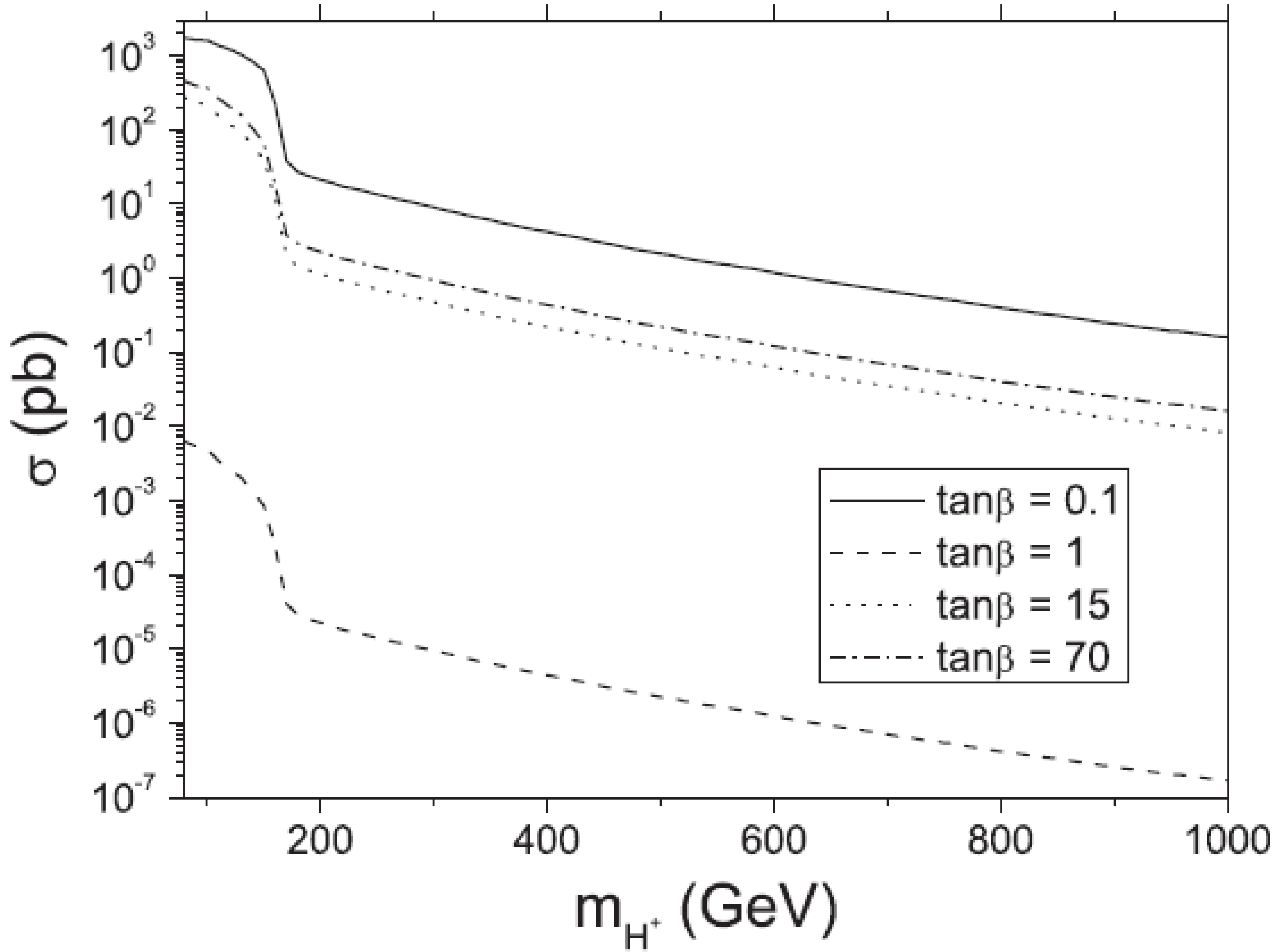


FIG. 15. The figure shows the cross sections of H^+ production at the LHC through the channel $q\bar{q}, gg \to t\bar{b}H^- +$ c.c. in scenario A ($\tilde{\chi}^u_{ij} = 1$ and $\tilde{\chi}^d_{ij} = 1$) and for $\tan\beta = 0.1$, 1, 15, and 70.

TABLE I: Summary of LHC event rates for some parameter combinations within Scenarios A, B, C, D with for an integrated luminosity of 10^5 pb^{-1}, for several different signatures, through the channel $q\bar{q}, gg \to \bar{t}bH^+$ + c.c.

$(\tilde{\chi}^u_{ij}, \tilde{\chi}^d_{ij})$	$\tan\beta$	m_{H^+} in GeV	$\sigma(pp \to H^+\bar{t}b)$ in pb	Relevant BRs	Nr. Events
(1,1)	15	400	2.23×10^{-1}	$\mathrm{BR}(H^+ \to t\bar{b}) \approx 3.2 \times 10^{-1}$	7040
				$\mathrm{BR}(H^+ \to \tau^+\nu^0_\tau) \approx 2.1 \times 10^{-3}$	46
				$\mathrm{BR}(H^+ \to W^+h^0) \approx 6.3 \times 10^{-1}$	13860
				$\mathrm{BR}\left(H_2^+ \to W^+A^0\right) \approx 1.7 \times 10^{-2}$	374
(1,1)	70	400	4.3×10^{-1}	$\mathrm{BR}(H^+ \to t\bar{b}) \approx 3.5 \times 10^{-1}$	15050
				$\mathrm{BR}(H^+ \to c\bar{b}) \approx 1.4 \times 10^{-2}$	602
				$\mathrm{BR}(H^+ \to \tau^+\nu_\tau) \approx 2.5 \times 10^{-1}$	10750
				$\mathrm{BR}(H^+ \to W^+h^0) \approx 3.6 \times 10^{-1}$	15480
(0.1,1)	1	600	1.1×10^{-1}	$\mathrm{BR}(H^+ \to t\bar{b}) \approx 3 \times 10^{-1}$	3300
				$\mathrm{BR}(H^+ \to t\bar{s}) \approx 9.1 \times 10^{-4}$	10
				$\mathrm{BR}(H^+ \to W^+h^0) \approx 3.6 \times 10^{-1}$	3960
				$\mathrm{BR}(H^+ \to W^+A^0) \approx 3.2 \times 10^{-1}$	3520

Similarly as in the direct production of the charged Higgs, we estimate the irreducible backgrounds to the signal studied. We can get the number of events of the background signal $pp \to W^+\gamma t\bar{b}$ from the study of the References [53, 54]. They show that the subprocesses $gg \to W^+\gamma q\bar{q}$ and $q\bar{q} \to W^+\gamma q\bar{q}$ are of order 15% compared with the dominant reaction $pp \to W^+\gamma$. Also, we show in the Table 2 the statistical factor $N_S/\sqrt{N_B}$ for all the cases, once again N_S is the number of events of signal $H^+ \to W^+\gamma$ in the final state of the reaction $pp \to H^+t\bar{b}$ and N_B is the number of events of the background signal $pp \to W^+\gamma t\bar{b}$.

Table 2. Summary of LHC event rates for some parameter combinations within Scenarios B ($\tilde{\chi}_{ij}^{u,d} = 1$) with an integrated luminosity of 10^5 pb^{-1}, for $H^+ \to W^+\gamma$ signature, through the channel $q\bar{q}, gg \to \bar{t}bH^+$ + c.c.

α	$\tan\beta$	m_{H^+} in GeV	$\sigma(pp \to H^+\bar{t}b)$ in pb	BR($H^+ \to W^+\gamma$)	N_S	$\frac{N_S}{\sqrt{N_B}}$
$\pi/2$	0.3	200	25.8	2×10^{-6}	5	0.62
$\pi/2+\beta$	0.5	300	5	9×10^{-7}	0	0
$\pi/2$	1	200	2.3	1.4×10^{-4}	32	3.98
$\pi/2+\beta$	1	300	1.79	7×10^{-4}	125	18.04
$\pi/2$	10	200	2.4	2×10^{-6}	0	0
$\pi/2$	10	300	0.68	1.5×10^{-7}	0	0

Some conclusions

We have discussed the implications of assuming a four-zero Yukawa texture for the properties of the H+.

We have studied the fermion-charged Higgs vertices in the 2HDM-III

We have analyzed the decay t --> b H+ and the charged Higgs decays

H+ --> cb could be dominant for $\tan \beta = 0.1$ and mH+ < 175 GeV

We have evaluated the s-channel production of H+ through (cb) fusion, which could reach detectable rates.

We study pp-->tb H+ and cb---> H+ X

- Implications of the Yukawa texture on the rare decays H + --->W+ γ are studied, which appear at one loop level.
- This mode could have a BR´s ~ 10^-2, 10^-3 for the mode W+ γ in the following range of parameters:

  150 GeV < mH+ < 200 Gev and 0.1<tan β< 10

- Even rates: in qq, gg ---> H+ tb is posible we have nr. events 30 in the LHC.

- In cb --> H+ X is posible that we have nr. Events 60 in the LHC.