boson allows the decay, $t \to H^+ b$ if the mass of the charged Higgs is less than $M_t - m_b$. This decay looks similar to $t \to Wb$ and can have a significant rate. The coupling of the charged Higgs to the t b system is,

$$g_{tH^+b} \sim m_t \cot\beta P_+ + m_b \tan\beta P_- \tag{144}$$

and so this decay is relevant both for very large and for very small $\tan\beta$. For small $\tan\beta$, $H^+ \to cs$ and $H^+ \to t^* b$, while for large $\tan\beta$, $H^+ \to \tau\nu$. These decays would suppress the rate for top decays to leptons plus jets in the SM top search. In Run I, the Tevatron experiments placed a limit on M_{H^+} of roughly $M_{H^+} > 100\ GeV$ for $\tan\beta < 1$ or $\tan\beta > 50$.[56]

5.5. *The Top squark*

The mass-squared matrix for the scalar partners of the left and right handed top quarks $(\tilde{t}_L, \tilde{t}_R)$ includes mixing between the partners of the left- and right- handed top:

$$\tilde{M}_t^2 = \begin{pmatrix} \tilde{M}_{Q_3}^2 + M_t^2 + M_Z^2 L_t \cos 2\beta & M_t(A_t - \hat{\mu}\cot\beta) \\ M_t(A_t - \hat{\mu}\cot\beta) & \tilde{M}_{t_R}^2 + M_t^2 + M_Z^2 R_t \cos 2\beta \end{pmatrix}$$

The mixing is proportional to the top quark mass and so the large value of M_t can cause one of the top squarks to be relatively light. If the scalar mass scale, $\tilde{M}_{Q_3}$ is much larger than M_Z, M_t, A_t, then the stop masses are roughly degenerate $\sim \tilde{M}_{Q_3}$. On the other hand if $\tilde{M}_{Q_3} \sim M_Z, M_t, A_t$, then the large mixing effects drive the stop mass to a small value and the stop squark becomes the lightest squark.

It is possible to search for a light stop in the decays of the top, $t \to \tilde{t}\tilde{\chi}^0$, where $\tilde{\chi}^0$ is the lightest neutral SUSY particle. The limits then depend on the assumed branching ratio for the top into stop decays. The Run I data was sensitive to stop and chargino masses in the 100 GeV range.[57]

5.6. *The Top Quark and Dynamical Symmetry Breaking*

The top quark has a special role in technicolor models where a $t\bar{t}$ condensate can play the part of the Higgs boson in generating EWSB. This can happen in models where there is a new strong interaction felt by the top quark, but not by the lighter quarks. The proto-type model of this type is called *topcolor*.[?] A review of this class of models can be found in Ref.