SUSY PHENOMENOLOGY

Sheet 2

Exercice 1: Radiative symmetry breaking

Given are the following simplified ($A_t = 0, \mu = 0$) renormalization group equations for the up-like Higgs mass and the two stop masses:

$$\frac{\partial}{\partial \log(Q^2/M_{GUT}^2)} \begin{bmatrix} M_{H_u}^2 \\ M_{\tilde{t}_R}^2 \\ M_{\tilde{t}_L}^2 \end{bmatrix} = \frac{\alpha_t}{\pi} \begin{bmatrix} 3 & 3 & 3 \\ 2 & 2 & 2 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} M_{H_u}^2 \\ M_{\tilde{t}_R}^2 \\ M_{\tilde{t}_L}^2 \end{bmatrix} \tag{1}$$

with $\alpha_t = G_F m_t^2/\sqrt{2}\pi$. Solve these equations under the condition $M_{H_u} = M_{\tilde{t}_R} = M_{\tilde{t}_L} = M_0$ at $Q = M_{GUT}$. Show that the Higgs mass squared $M_{H_u}^2$ gets negative at $Q = M_Z$, if the top mass m_t is sufficiently large, whereas the stop masses squared remain positive.