bound was obtained for $m_{H_1^0}$ (assuming $m_{A^0} > m_Z$) in the limit of $m_Z \ll m_t \ll M_{\widetilde{t}}$ [where top-squark ($\widetilde{t}_L$–$\widetilde{t}_R$) mixing is neglected]

$$m^2_{H_1^0} \lesssim m_Z^2 + \frac{3g^2 m_Z^4}{16\pi^2 m_W^2} \times \left\{ \ln\left(\frac{M^2_{\widetilde{t}}}{m_t^2}\right)\left[\frac{2m_t^4 - m_t^2 m_Z^2}{m_Z^4}\right] + \frac{m_t^2}{3m_Z^2}\right\}. \quad (2)$$

For a top-squark mass of $M_{\widetilde{t}} = 1$ TeV, Eq. (2) yields a positive mass shift for $m_{H_1^0}$ of about 20 GeV for $m_t = 150$ GeV, and 40 GeV for $m_t = 180$ GeV. Even if $\tan\beta = 1$ (so that $m_{H_1^0} = 0$ at tree-level), there is a large shift in $m^2_{H_1^0}$ due to radiative corrections of similar size. Clearly, the radiative corrections to the Higgs masses can have a significant impact on the search for the Higgs bosons of the MSSM at LEP and LEP-II [23].

Consider next the supersymmetric particle sector of the MSSM. The supersymmetric partners of the gauge and Higgs bosons are fermions, whose names are obtained by appending "ino" at the end of the corresponding Standard Model particle name. The *gluino* is the color octet Majorana fermion partner of the gluon with mass $M_{\widetilde{g}} = |M_3|$. The supersymmetric partners of the electroweak gauge and Higgs bosons (the *gauginos* and *Higgsinos*) can mix. As a result, the physical mass eigenstates are model-dependent linear combinations of these states, called *charginos* and *neutralinos*, which are obtained by diagonalizing the corresponding mass matrices. The chargino mass matrix depends on M_2, μ, $\tan\beta$ and m_W [24]. The corresponding chargino mass eigenstates denoted by $\widetilde{\chi}_1^+$ and $\widetilde{\chi}_2^+$, with masses

$$M^2_{\widetilde{\chi}_1^+,\widetilde{\chi}_2^+} = \tfrac{1}{2}\left[|\mu|^2 + |M_2|^2 + 2m_W^2\right] \mp \left\{\left(|\mu|^2 + |M_2|^2 + 2m_W^2\right)^2 - 4|\mu|^2|M_2|^2 - 4m_W^4\sin^2 2\beta + 8m_W^2\sin 2\beta\,\mathrm{Re}(\mu M_2)\right\}^{1/2}, \quad (3)$$

where the states are ordered such that $M_{\widetilde{\chi}_1^+} \le M_{\widetilde{\chi}_2^+}$. If CP-violating effects are ignored (in which case, M_2 and μ are real parameters), then one can choose a convention where $\tan\beta$ and M_2 are positive. (Note that the relative sign of M_2 and μ is meaningful. The sign of μ is convention-dependent; the reader is warned that both sign conventions appear in the literature.) The sign convention for μ implicit in Eq. (3) is used by the LEP collaborations [25] in their plots of exclusion contours in the M_2 *vs.* μ plane derived from the non-observation of $Z \to \widetilde{\chi}_1^+\widetilde{\chi}_1^-$. The neutralino mass matrix depends on M_1, M_2, μ, $\tan\beta$, m_Z, and the weak mixing angle θ_W [24]. The corresponding neutralino eigenstates are usually denoted by $\widetilde{\chi}_i^0$ ($i = 1,\ldots 4$), according to the convention that $M_{\widetilde{\chi}_1^0} \le M_{\widetilde{\chi}_2^0} \le M_{\widetilde{\chi}_3^0} \le M_{\widetilde{\chi}_4^0}$. If a chargino or neutralino eigenstate approximates a particular gaugino or Higgsino state, it may be convenient to use the corresponding nomenclature. For example, if M_1 and M_2 are small compared to m_Z (and μ), then the lightest neutralino $\widetilde{\chi}_1^0$ will be nearly a pure photino, $\widetilde{\gamma}$ (the supersymmetric partner of the photon). It is common practice in the literature to reduce the supersymmetric parameter freedom by requiring that all three gaugino mass parameters are equal at some grand unification scale. Then, at the electroweak scale, the gaugino mass parameters can be expressed in terms of one of them (say, M_2). The other two gaugino mass parameters are given by

$$M_3 = (g_s^2/g^2)M_2 \qquad M_1 = (5g'^2/3g^2)M_2\ . \quad (4)$$

Having made this assumption, the chargino and neutralino masses and mixing angles depend only on three unknown parameters: the gluino mass, μ, and $\tan\beta$.

The supersymmetric partners of the quarks and leptons are spin-zero bosons: the *squarks*, charged *sleptons*, and *sneutrinos*. For a given fermion f, there are two supersymmetric partners $\widetilde{f}_L$ and $\widetilde{f}_R$ which are scalar partners of the corresponding left and right-handed fermion. (There is no $\widetilde{\nu}_R$.) However, in general, $\widetilde{f}_L$ and $\widetilde{f}_R$ are not mass-eigenstates since there is $\widetilde{f}_L$-$\widetilde{f}_R$ mixing which is proportional in strength to the corresponding element of the scalar mass-squared-matrix [26]:

$$M^2_{LR} = \begin{cases} m_d(A_d - \mu\tan\beta), & \text{for "down"-type } f \\ m_u(A_u - \mu\cot\beta), & \text{for "up"-type } f, \end{cases} \quad (5)$$

where m_d (m_u) is the mass of the appropriate "down" ("up") type quark or lepton. Here, A_d and A_u are (unknown) soft-supersymmetry-breaking A–parameters and μ and $\tan\beta$ have been defined earlier. The signs of the A parameters are also convention-dependent; see Ref. 18. Due to the appearance of the *fermion* mass in Eq. (5), one expects M_{LR} to be small compared to the diagonal squark and slepton masses, with the possible exception of the top-squark, since m_t is large, and the bottom squark and τ slepton if $\tan\beta \gg 1$. The (diagonal) L and R-type squark and slepton masses are given by [2]

$$M^2_{\widetilde{u}_L} = M^2_{\widetilde{Q}} + m_u^2 + m_Z^2\cos 2\beta(\tfrac{1}{2} - \tfrac{2}{3}\sin^2\theta_W) \quad (6)$$

$$M^2_{\widetilde{u}_R} = M^2_{\widetilde{U}} + m_u^2 + \tfrac{2}{3}m_Z^2\cos 2\beta\sin^2\theta_W \quad (7)$$

$$M^2_{\widetilde{d}_L} = M^2_{\widetilde{Q}} + m_d^2 - m_Z^2\cos 2\beta(\tfrac{1}{2} - \tfrac{1}{3}\sin^2\theta_W) \quad (8)$$

$$M^2_{\widetilde{d}_R} = M^2_{\widetilde{D}} + m_d^2 - \tfrac{1}{3}m_Z^2\cos 2\beta\sin^2\theta_W \quad (9)$$

$$M^2_{\widetilde{\nu}} = M^2_{\widetilde{L}} + \tfrac{1}{2}m_Z^2\cos 2\beta \quad (10)$$

$$M^2_{\widetilde{e}_L} = M^2_{\widetilde{L}} + m_e^2 - m_Z^2\cos 2\beta(\tfrac{1}{2} - \sin^2\theta_W) \quad (11)$$

$$M^2_{\widetilde{e}_R} = M^2_{\widetilde{E}} + m_e^2 - m_Z^2\cos 2\beta\sin^2\theta_W\ . \quad (12)$$

The soft-supersymmetry-breaking parameters: $M_{\widetilde{Q}}$, $M_{\widetilde{U}}$, $M_{\widetilde{D}}$, $M_{\widetilde{L}}$, and $M_{\widetilde{E}}$ are unknown parameters. In the equations above, the notation of first generation fermions has been used and generational indices have been suppressed. Further complications such as intergenerational mixing are possible, although there are some constraints from the nonobservation of flavor-changing neutral currents (FCNC) [27].