Argonne National Laboratory

Theory Institute 2004: Supersymmetry, Extra Dimensions, and Higgs Bosons

TeV-scale gauge symmetry and anomaly mediation

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O.C. Anoka, K.S. Babu and I.G,

Nucl. Phys. B686, 135 (2004)

Nucl. Phys. B687, 3 (2004)

The mass of the scalar components of the chiral supermultiplet

$$(\mathbf{m^2})^{\phi_\mathbf{j}}_{\phi_\mathbf{i}} = \frac{\mathbf{1}}{\mathbf{2}}\mathbf{M^2_{aux}}\left[\beta(\mathbf{Y})\frac{\partial}{\partial \mathbf{Y}}\gamma^{\phi_\mathbf{j}}_{\phi_\mathbf{i}} + \beta(\mathbf{g})\frac{\partial}{\partial \mathbf{g}}\gamma^{\phi_\mathbf{j}}_{\phi_\mathbf{i}}\right]$$

$\gamma^{\phi_\mathbf{j}}_{\phi_\mathbf{i}}$ are the one–loop anomalous dimensions, $\beta(\mathbf{Y})$ is the beta function for the Yukawa coupling, and $\beta(g)$ is the beta function for the gauge coupling. $\mathbf{M_{aux}}$ is the vacuum expectation value of a "compensator superfield" which sets the scale of SUSY breaking

The gaugino mass M_g associated with the gauge group with coupling g is given by

$$\mathbf{M_g} = \frac{\beta(\mathbf{g})}{\mathbf{g}}\mathbf{M_{aux}}$$

The trilinear soft supersymmetry breaking term is given by

$$\mathbf{A_Y} = -\frac{\beta(\mathbf{Y})}{\mathbf{Y}}\mathbf{M_{aux}}$$

In the specific scenario for generating the μ term, the B-term is given by

$$\mathbf{B} = -\left(\gamma_{\mathbf{H_u}} + \gamma_{\mathbf{H_d}}\right)\mathbf{M_{aux}}$$

Introducing new particles at the TeV scale with large Yukawa couplings to the lepton fields.

Z. Chacko, M.A. Luty, I. Maksymyk and E. Ponton, JHEP 04, (2000) 001

The Yukawa contributions can also be enhanced by invoking R–parity violating couplings in the MSSM

B.C. Allanach and A. Dedes, JHEP 06, (2000) 017

Positive D–term contributions from a $U(1)$ gauge symmetry broken at the weak scale. This was achieved by adding TeV scale Fayet–Iliopoulos terms explicitly to the theory

I. Jack and D.R.T. Jones, Phys. Lett. B 473, (2000) 102; Phys. Lett. B 482, (2000) 167

New D–term contributions generated in a controlled fashion by the breaking of $U(1)_{B-L}$ at an arbitrary high scale

N. Arkani-Hamed, H. Murayama, Y. Nomura and D.E. Kaplan, JHEP 0102, (2001) 041; R. Harnik, H. Murayama and A. Pierce, JHEP 0208, (2002).

A low scale ancillary $U(1)$ as a solution to the problem has been studied

B. Murakami and J.D. Wells, Phys. Rev. D 68, (2003) 035006

A non–decoupling universal bulk contribution to all the scalar masses is a widely studied option

Particle Content and Charge Assignment of the Model

	$SU(3)_C$	$SU(2)_L$	$U(1)_Y$	$SU(3)_H$	$SU(3)_G$
Q_i	3	2	1/6	1	1
u_i^c	$\bar{3}$	1	-2/3	1	1
d_i^c	$\bar{3}$	1	1/3	1	1
L_α	1	2	-1/2	3	1
e_α^c	1	1	1	3	1
H_u	1	2	1/2	1	1
H_d	1	2	-1/2	1	1
Φ_i^α	1	1	0	$\bar{3}$	3
η_i	1	1	0	$\bar{3}$	3
$\bar{\eta}_i$	1	1	0	3	$\bar{3}$

Model with $SU(3)_H$ Leptonic Horizontal Symmetry

$$\mathbf{W} = (\mathbf{Y_u})_{\mathbf{ij}}\, \mathbf{Q_i H_u u_j^c} + (\mathbf{Y_d})_{\mathbf{ij}}\, \mathbf{Q_i H_d d_j^c} + \mu \mathbf{H_u H_d}$$
$$+\kappa \mathbf{\Phi_1^\alpha \Phi_2^\beta \Phi_3^\gamma} \epsilon_{\alpha\beta\gamma} + \lambda \eta_{\mathbf{a}}^\alpha \eta_{\mathbf{b}}^\beta \mathbf{\Phi_c^\gamma} \epsilon_{\alpha\beta\gamma} \epsilon^{\mathbf{abc}}$$
$$+\mathbf{M}_\eta \eta_{\mathbf{a}} \bar{\eta}_{\mathbf{a}}$$

In the $\mathbf{SU(3)_H}$ symmetric limit the leptons are all massless.

$$\mathbf{L_{eff}^l} = \frac{\mathbf{L}_\alpha \mathbf{e}_\alpha^{\mathbf{c}} \mathbf{\Phi_i^\alpha \Phi_i^\alpha H_d}}{\mathbf{M_i^2}}.$$

the mass scale $\mathbf{M_i}$ order of 5TeV, 20TeV and 300TeV will generate realistic τ, μ and electron mass.

Small neutrino masses are induced through the seesaw mechanism.

$$L^{\nu}_{eff} = \frac{\lambda^{\alpha\beta}_{OJ} L_\alpha L_\beta H_u h_u \Phi^\alpha_i \Phi^\beta_j}{M_N^3}.$$

For $M_N \sim 10^7$ **GeV and** $\langle \Phi_i \rangle \sim$ **TeV, neutrino masses are in the right range.**

$SU(3)_H$ symmetry breaking

The $SU(3)_H$ symmetry breaking sector of the potential is given by:

$$\begin{aligned} V(\Phi_i) &= m_\phi^2(\Phi_1^\dagger\Phi_1 + \Phi_2^\dagger\Phi_2 + \Phi_3^\dagger\Phi_3) + \kappa A_\kappa \left(\Phi_1^\alpha\Phi_2^\beta\Phi_3^\gamma\epsilon_{\alpha\beta\gamma} + c.c\right) \\ &+ \kappa^2\left[(\Phi_1\Phi_2)^\dagger(\Phi_1\Phi_2) + (\Phi_1\Phi_3)^\dagger(\Phi_1\Phi_3) + (\Phi_2\Phi_3)^\dagger(\Phi_2\Phi_3)\right] \\ &+ \frac{g_4^2}{8}\sum_{a=1}^{8}|\Phi_1^\dagger\lambda^a\Phi_1 + \Phi_2^\dagger\lambda^a\Phi_2 + \Phi_3^\dagger\lambda^a\Phi_3|^2. \end{aligned}$$

Here g_4 is the gauge coupling of the $SU(3)_H$, A_κ is the trilinear A–term corresponding to the coupling κ, m_ϕ^2 is the soft mass squared for the Φ_i fields.

$$\langle\Phi_1\rangle = \begin{pmatrix} u \\ 0 \\ 0 \end{pmatrix}, \qquad \langle\Phi_2\rangle = \begin{pmatrix} 0 \\ u \\ 0 \end{pmatrix} \qquad \langle\Phi_3\rangle = \begin{pmatrix} 0 \\ 0 \\ u \end{pmatrix}$$

Using these VEVs the potential becomes

$$\langle V(\Phi)\rangle = 3m_\phi^2u^2 + 3\kappa^2u^4 + 2\kappa A_\kappa u^3$$

Minimization leads to the condition

$$u = \frac{-\mathbf{A}_\kappa \pm \sqrt{-8\mathbf{m}_\phi^2 + \mathbf{A}_\kappa^2}}{4\kappa}$$

Since the symmetry breaking chain is $\mathbf{SU(3)_H \times SU(3)_G \rightarrow SU(3)_{H+G}}$, we can classify the masses of all scalars and fermions as multiplets of $\mathbf{SU(3)_{H+G}}$

A physical octet remains in the spectrum with a mass given by

$$\mathcal{M}^2_{\mathbf{octet}} = -2\kappa^2\mathbf{u}^2 - 2\kappa\mathbf{u}\mathbf{A}_\kappa + \mathbf{g}_4^2\mathbf{u}^2$$

There are two singlets, one scalar (ϕ_s) and one pseudoscalar (ϕ_p) with masses

given by

$$m^2_{\phi_s} = 4\kappa^2 u^2 + \kappa u A_\kappa,$$
$$m^2_{\phi_p} = -3\kappa u A_\kappa$$

the octet Higgsino mixes with the octet gaugino

$$\mathcal{M}'_{\mathbf{octet}} = \begin{pmatrix} m_4 & g_4 u \\ g_4 u & \kappa u \end{pmatrix}$$

there is a Majorana fermion, a singlet of $\mathbf{SU(3)_{H+G}}$, with a mass of

$$\mathbf{m}_{\tilde{\phi}} = \mathbf{2}\kappa\mathbf{u}$$

the gauge bosons form an octet with a mass

$$\mathbf{M_V} = \mathbf{g_4 u}$$

Since the Higgs potential respects $\mathbf{SU(3)_H \otimes SU(3)_G}$ symmetry, after spontaneous symmetry breaking, the diagonal subgroup $\mathbf{SU(3)_{G+H}}$ remains as an unbroken global symmetry. This subgroup contains e, μ and τ lepton numbers.

Slepton masses

The slepton mass–squareds are given by the eigenvalues

$$\begin{pmatrix} m^2_{\tilde{L}_\alpha} & m_{E_\alpha}\left(A_{Y_{E_\alpha}} - \mu \tan\beta\right) \\ m_{E_\alpha}\left(A_{Y_{E_\alpha}} - \mu \tan\beta\right) & m^2_{\tilde{e}^c_\alpha} \end{pmatrix}$$

$$\mathbf{m^2_{\tilde{L}_\alpha}} = \frac{\mathbf{M^2_{aux}}}{(\mathbf{16\pi^2})}(\mathbf{Y_{E_\alpha}}\beta(\mathbf{Y_{E_\alpha}}) - \frac{\mathbf{3}}{\mathbf{2}}\mathbf{g_2}\beta(\mathbf{g_2}) - \frac{\mathbf{3}}{\mathbf{10}}\mathbf{g_1}\beta(\mathbf{g_1}) - \frac{\mathbf{8}}{\mathbf{3}}\mathbf{g_4}\beta(\mathbf{g_4})) + \mathbf{m^2_{E_\alpha}} + \left(-\frac{\mathbf{1}}{\mathbf{2}} + \sin^{\mathbf{2}}\theta_{\mathbf{W}}\right)\cos\mathbf{2}\beta\mathbf{M^2_Z}$$

$$\mathbf{m^2_{\tilde{e}^c_\alpha}} = \frac{M^2_{aux}}{(16\pi^2)}\left(2Y_{E_\alpha}\beta(Y_{E_\alpha}) - \frac{6}{5}g_1\beta(g_1) - \frac{8}{3}g_4\beta(g_4)\right) + \mathbf{m^2_{E_\alpha}} - \sin^{\mathbf{2}}\theta_{\mathbf{W}}\cos\mathbf{2}\beta\mathbf{M^2_Z}$$

$$\beta(\mathbf{g_4}) = -\frac{\mathbf{3}}{\mathbf{16\pi^2}}\mathbf{g_4^3} \quad \textbf{and} \quad \mathbf{g_4} > \mathbf{0.5.}$$

MSSM Particles	Mass (TeV)
$\{m_{\tilde{\chi}_1^0},\ m_{\tilde{\chi}_2^0},\ m_{\tilde{\chi}_3^0},\ m_{\tilde{\chi}_4^0}\}$	$\{0.19625,\ 0.585,\ 1.179,\ 1.184\}$
$\{m_{\tilde{\chi}_1^\pm},\ m_{\tilde{\chi}_2^\pm}\}$	$\{0.196291,\ 1.183\}$
M_3	1.411
$\{m_h,\ m_H,\ m_A,\ m_{H^\pm}\}$	$\{0.115,\ 1.177,\ 1.176,\ 1.179\}$
$\{m_{\tilde{e}_R},\ m_{\tilde{\mu}_R},\ m_{\tilde{\tau}_1}\}$	$\{0.245,\ 0.245,\ 0.232\}$
$\{m_{\tilde{e}_L},\ m_{\tilde{\mu}_L},\ m_{\tilde{\tau}_2}\}$	$\{0.254,\ 0.254,\ 0.263\}$
$\{m_{\tilde{\nu}_e},\ m_{\tilde{\nu}_\mu},\ m_{\tilde{\nu}_\tau}\}$	$\{0.242,\ 0.242,\ 0.242\}$
$\{m_{\tilde{d}_R},\ m_{\tilde{s}_R},\ m_{\tilde{b}_1}\}$	$\{1.373,\ 1.373,\ 1.369\}$
$\{m_{\tilde{d}_L},\ m_{\tilde{s}_L},\ m_{\tilde{b}_2}\}$	$\{1.361,\ 1.361\ 1.195\}$
$\{m_{\tilde{u}_R},\ m_{\tilde{c}_R},\ m_{\tilde{t}_1}\}$	$\{1.365,\ 1.365,\ 0.983\}$
$\{m_{\tilde{u}_L},\ m_{\tilde{c}_L},\ m_{\tilde{t}_2}\}$	$\{1.359\ 1.359,\ 1.244\}$

Sparticle masses for the choice $M_{aux} = 63$ TeV, $\tan\beta = 4$, $\mu = 1.177$ TeV, $y_b = 0.0716$, $\lambda = 0.1$, $\kappa = 0.08$, $g_4 = 0.55$, $u = -3.4$ TeV, $M_\eta = 1.0$ TeV

New Particles	Mass (TeV)
$\mathbf{M_V}$	**1.871**
$\mathbf{m_{\tilde{\phi}}}$	**0.544**
$\mathbf{m_{\tilde{\phi}_{1,2}}}$	$\{\mathbf{1.553,\ 2.191}\}$
$\{\mathbf{m_{\phi_s}, m_{\phi_p}, m_{\phi-octet}}\}$	$\{\mathbf{0.247,\ 0.840,\ 1.955}\}$
$\mathbf{m^{octet}_{\eta_{1,2}}}$	$\{\mathbf{0.716,\ 1.397}\}$
$\mathbf{m^{singlet}_{\eta_{1,2}}}$	$\{\mathbf{0.529,\ 1.890}\}$
$\mathbf{m^{s-octet}_{\tilde{\eta}_{1,2}}}$	$\{\mathbf{0.421,\ 1.699}\}$
$\mathbf{m^{p-octet}_{\tilde{\eta}_{1,2}}}$	$\{\mathbf{1.031,\ 1.098}\}$
$\mathbf{m^{s-singlet}_{\tilde{\eta}_{1,2}}}$	$\{\mathbf{0.850,\ 1.593}\}$
$\mathbf{m^{p-singlet}_{\tilde{\eta}_{1,2}}}$	$\{\mathbf{0.247,\ 2.189}\}$

Sparticle masses for the choice $\mathbf{M_{aux} = 63}$ TeV, $\tan\beta = 4$, $\mu = 1.177$ TeV, $\mathbf{y_b = 0.0716}$, $\lambda = 0.1$, $\kappa = 0.08$, $\mathbf{g_4 = 0.55}$, $\mathbf{u = -3.4}$ TeV, $\mathbf{M_\eta = 1.0}$ TeV

MSSM Particles	Mass (TeV)
$\{m_{\tilde{\chi}_1^0},\ m_{\tilde{\chi}_2^0},\ m_{\tilde{\chi}_3^0},\ m_{\tilde{\chi}_4^0}\}$	$\{0.143,\ 0.434,\ 0.872,\ 0.879\}$
$\{m_{\tilde{\chi}_1^\pm},\ m_{\tilde{\chi}_2^\pm}\}$	$\{0.143219,\ 0.878\}$
M_3	1.065
$\{m_h,\ m_H,\ m_A,\ m_{H^\pm}\}$	$\{0.113,\ 0.897,\ 0.896,\ 0.900\}$
$\{m_{\tilde{e}_R},\ m_{\tilde{\mu}_R},\ m_{\tilde{\tau}_1}\}$	$\{0.825,\ 825,\ 0.823\}$
$\{m_{\tilde{e}_L},\ m_{\tilde{\mu}_L},\ m_{\tilde{\tau}_2}\}$	$\{0.827,\ 0.827,\ 0.828\}$
$\{m_{\tilde{\nu}_e},\ m_{\tilde{\nu}_\mu},\ m_{\tilde{\nu}_\tau}\}$	$\{0.823,\ 0.823,\ 0.823\}$
$\{m_{\tilde{d}_R},\ m_{\tilde{s}_R},\ m_{\tilde{b}_1}\}$	$\{1.017,\ 1.017,\ 1.014\}$
$\{m_{\tilde{d}_L},\ m_{\tilde{s}_L},\ m_{\tilde{b}_2}\}$	$\{1.008,\ 1.008,\ 0.886\}$
$\{m_{\tilde{u}_R},\ m_{\tilde{c}_R},\ m_{\tilde{t}_1}\}$	$\{1.011,\ 1.011,\ 0.718\}$
$\{m_{\tilde{u}_L},\ m_{\tilde{c}_L},\ m_{\tilde{t}_2}\}$	$\{1.005,\ 1.005,\ 0.944\}$

Sparticle masses for the choice $M_{aux} = 47$ TeV, $\tan\beta = 3.9$, $\mu = 0.870$ TeV, $y_b = 0.0713$, $\lambda = 0.3$, $\kappa = 0.14$, $g_4 = 1.0$, $u = -3.779$ TeV, $M_\eta = 0.8$ TeV

New Particles	Mass (TeV)
$\mathbf{M_V}$	3.779
$\mathbf{m_{\tilde{\phi}}}$	**1.058**
$\mathbf{m_{\tilde{\phi}_{1,2}}}$	$\{\mathbf{3.071},\ \mathbf{4.495}\}$
$\phi\ \{\mathbf{m_{\phi_s}}, \mathbf{m_{\phi_p}}, \mathbf{m_{\phi-octet}}\}$	$\{\mathbf{0.465},\ \mathbf{1.646},\ \mathbf{3.940}\}$
$\mathbf{m^{octet}_{\eta_{1,2}}}$	$\{\mathbf{0.254},\ \mathbf{2.521}\}$
$\mathbf{m^{singlet}_{\eta_{1,2}}}$	$\{\mathbf{0.137},\ \mathbf{4.672}\}$
$\mathbf{m^{s-octet}_{\tilde{\eta}_{1,2}}}$	$\{\mathbf{0.588},\ \mathbf{3.090}\}$
$\mathbf{m^{p-0ctet}_{\tilde{\eta}_{1,2}}}$	$\{\mathbf{1.058},\ \mathbf{1.952}\}$
$\mathbf{m^{s-singlet}_{\tilde{\eta}_{1,2}}}$	$\{\mathbf{0.964},\ \mathbf{4.116}\}$
$\mathbf{m^{p-singlet}_{\tilde{\eta}_{1,2}}}$	$\{\mathbf{0.711},\ \mathbf{5.224}\}$

Sparticle masses for the choice $\mathbf{M_{aux}} = \mathbf{47\ TeV}$, $\tan\beta = \mathbf{3.9}$, $\mu = \mathbf{0.870\ TeV}$, $\mathbf{y_b} = \mathbf{0.0713}$, $\lambda = \mathbf{0.3}$, $\kappa = \mathbf{0.14}$, $\mathbf{g_4} = \mathbf{1.0}$, $\mathbf{u} = \mathbf{-3.779\ TeV}$, $\mathbf{M_\eta} = \mathbf{0.8\ TeV}$

$U(1)_x$ Model

$$U(1)_x = xY - (B - L)$$

	Q_i	u_i^c	d_i^c	L_i	e_i^c
$U(1)_x$	$x/6 - 1/3$	-2x/3+1/3	x/3+1/3	-x/2+1	x-1

	H_u	H_d	ν_i^c	ν^c	$\bar{\nu}^c$	S_+	S_-
$U(1)_x$	x/2	-x/2	-1	-1	1	2	-2

to have positive mass–squared from the $U(1)_x$ D-term, x must be $1 < x < 2$

$$W = (Y_u)_{ij}\, Q_i H_u u_j^c + (Y_d)_{ij}\, Q_i H_d d_j^c + (Y_l)_{ij}\, L_i H_d e_j^c + \mu H_u H_d$$
$$+\mu' S_+ S_- + \sum_{i=1}^{3} f_{\nu_i^c} \nu_i^c \nu_i^c S_+ + f_{\nu^c} \nu^c \nu^c S_+ + h \bar{\nu}^c \bar{\nu}^c S_- + M_{\nu^c} \nu^c \bar{\nu}^c$$

$$L_{eff}^{\nu} = \frac{Y_{\nu_{ij}}^2}{M_N^2} L_i L_j H_u H_u S_-$$

Slepton Masses

$$
\begin{aligned}
\mathbf{m}^2_{\tilde{\mathbf{l}}_\mathbf{i}} &= \frac{\mathbf{M}^2_{\mathbf{aux}}}{(\mathbf{16}\pi^\mathbf{2})}(\mathbf{Y}_{\mathbf{l}_\mathbf{i}}\beta(\mathbf{Y}_{\mathbf{l}_\mathbf{i}}) - (\frac{\mathbf{3}}{\mathbf{2}}\mathbf{g}_\mathbf{2}\beta(\mathbf{g}_\mathbf{2}) + \frac{\mathbf{3}}{\mathbf{10}}\mathbf{g}_\mathbf{1}\beta(\mathbf{g}_\mathbf{1}) \\
&+ \mathbf{2}\left(\mathbf{1} - \frac{\mathbf{x}}{\mathbf{2}}\right)^\mathbf{2}\mathbf{g}_\mathbf{x}\beta(\mathbf{g}_\mathbf{x})) + \left(-\frac{\mathbf{1}}{\mathbf{2}} + \sin^\mathbf{2}\theta_\mathbf{W}\right)\cos\mathbf{2}\beta\mathbf{M}^\mathbf{2}_\mathbf{Z} \\
&+ \mathbf{m}^\mathbf{2}_{\mathbf{e}_\mathbf{i}} + \mathbf{2}\mathbf{g}^\mathbf{2}_\mathbf{x}\left(\mathbf{1} - \frac{\mathbf{x}}{\mathbf{2}}\right)(\mathbf{z}^\mathbf{2} - \mathbf{y}^\mathbf{2})
\end{aligned}
$$

$$
\begin{aligned}
\mathbf{m}^\mathbf{2}_{\tilde{\mathbf{e}}^\mathbf{c}_\mathbf{i}} &= \frac{\mathbf{M}^\mathbf{2}_{\mathbf{aux}}}{(\mathbf{16}\pi^\mathbf{2})}\left[\mathbf{2}\mathbf{Y}_{\mathbf{l}_\mathbf{i}}\beta(\mathbf{Y}_{\mathbf{l}_\mathbf{i}}) - (\frac{\mathbf{6}}{\mathbf{5}}\mathbf{g}_\mathbf{1}\beta(\mathbf{g}_\mathbf{1}) + \mathbf{2}(\mathbf{x}-\mathbf{1})^\mathbf{2}\mathbf{g}_\mathbf{x}\beta(\mathbf{g}_\mathbf{x}))\right] \\
&+ \mathbf{m}^\mathbf{2}_{\mathbf{e}_\mathbf{i}} - \sin^\mathbf{2}\theta_\mathbf{W}\cos\mathbf{2}\beta\mathbf{M}^\mathbf{2}_\mathbf{Z} + \mathbf{2}\mathbf{g}^\mathbf{2}_\mathbf{x}(\mathbf{x}-\mathbf{1})(\mathbf{z}^\mathbf{2} - \mathbf{y}^\mathbf{2})
\end{aligned}
$$

We seek solutions where $z = \langle S_+ \rangle$ and $y = \langle S_- \rangle$ are much larger than v_u, v_d, of order TeV, with $z \gtrsim y$.

MSSM Particle	Mass (TeV)
$\{m_{\tilde{\chi}_1^0},\ m_{\tilde{\chi}_2^0},\ m_{\tilde{\chi}_3^0},\ m_{\tilde{\chi}_4^0}\}$	$\{0.185.851,\ 0.550,\ 1.049,\ 1.050\}$
$\{m_{\tilde{\chi}_5^0},\ m_{\tilde{\chi}_6^0},\ m_{\tilde{\chi}_7^0}\}$	$\{0.498,\ 2.840,\ 4.539\}$
$\{m_{\tilde{\chi}_1^\pm},\ m_{\tilde{\chi}_2^\pm}\}$	$\{0.185855,\ 1.051\}$
M_3	1.298
$\{m_h,\ m_H,\ m_A\}$	$\{0.126,\ 0.625,\ 0.625\}$
$\{m_{h'},\ m_{H'},\ m_{A'}\}$	$\{0.023,\ 3.436,\ 0.125\}$
$m_{H^\pm}$	0.630
$\{m_{\tilde{e}_R},\ m_{\tilde{\mu}_R},\ m_{\tilde{\tau}_1}\}$	$\{0.383,\ 0.383,\ 0.385\}$
$\{m_{\tilde{e}_L},\ m_{\tilde{\mu}_L},\ m_{\tilde{\tau}_2}\}$	$\{0.213,\ 0.213,\ 0.210\}$
$\{m_{\tilde{\nu}_e},\ m_{\tilde{\nu}_\mu},\ m_{\tilde{\nu}_\tau}\}$	$\{0.174,\ 0.174,\ 0.174\}$
$\{m_{\tilde{d}_R},\ m_{\tilde{s}_R},\ m_{\tilde{b}_1}\}$	$\{1.370,\ 1.370,\ 1.369\}$
$\{m_{\tilde{d}_L},\ m_{\tilde{s}_L},\ m_{\tilde{b}_2}\}$	$\{1.267,\ 1.267,\ 1.087\}$
$\{m_{\tilde{u}_R},\ m_{\tilde{c}_R},\ m_{\tilde{t}_1}\}$	$\{1.031,\ 1.031,\ 0.406\}$
$\{m_{\tilde{u}_L},\ m_{\tilde{c}_L},\ m_{\tilde{t}_2}\}$	$\{1.264,\ 1.264,\ 1.1141\}$

$x = 1.6$, $M_{aux} = 60$ TeV, $u = 2.7$ TeV, $g_x = 0.45$, $M_1' = 2.2$ TeV, $M_{\nu^c} = 1$ TeV. $\tan\beta = 5.8$, $\mu = -1$ TeV, $\mu' = -0.5$ TeV

Conclusion

We have suggested two new scenario for solving the tachyonic slepton mass problem of AMSB

1) An Asymptotically free $SU(3)_H$ symmetry acting on the lepton superfields provides positive masses th the sleptons. The $SU(3)_H$ must be broken at the TeV scale. FCNC processes mediated by the $SU(3)_H$ gauge bosons are suppressed adequately via approximate global symmetry. this scenario predicts:

$m_h \lesssim$ **120 GeV** **and** $\tan\beta \simeq$ **4**

2) A new class of supersymmetric $\mathbf{Z'}$ models motivated by the AMSB was presented, where $\mathbf{U(1)_x = xY - (B - L)}$. For $\mathbf{1 < x < 2}$, the charges of the lepton doublets and the lepton singlets have the same sign. This implies that the $U(1)_x$ D–term can induce positive masses for sleptons. We have found that $\mathbf{M_{Z'} = 2 - 4}$ TeV and the $Z - Z'$ mixing angle $\xi \simeq \mathbf{0.001}$. The Z' is leptophobic $\mathbf{Br(Z' \to \ell^+\ell^-) \simeq (1 - 1.6)\%}$. The correlations between the Z' decays and the supersymmetric spectrum should make this class of models distinguishable from other Z' models.