

Electroweakinos

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1 Background

2 Mixing Matrices

2.1 Neutralino Mixing

Neutralinos are generally comprised of the three Standard Model neutrinos and the neutral component of the fermion partners to the U(1) and SU(2) gauge fields B^0, W^0 and the neutral fermion partners to the Higgs fields H_d, H_u . Neglecting the neutrino mixing into these states, we can summarise the mass terms from the superpotential, putting the fermion fields into a vector $\psi_0^T = (\tilde{B}^0, \tilde{W}^0, \tilde{H}_d^0, \tilde{H}_u^0)$,

$$\mathcal{L}_{\tilde{\chi}^0-\text{mass}} = -\frac{1}{2}\psi_0^T M_{\tilde{\chi}^0} \psi_0 + \text{c. c.}, \quad (1)$$

where

$$M_{\tilde{\chi}^0} = \begin{bmatrix} M_1 & 0 & -\frac{1}{\sqrt{2}}g'v_d & \frac{1}{\sqrt{2}}g'v_u \\ 0 & M_2 & \frac{1}{\sqrt{2}}gv_d & -\frac{1}{\sqrt{2}}gv_u \\ -\frac{1}{\sqrt{2}}g'v_d & \frac{1}{\sqrt{2}}gv_d & 0 & -\mu \\ \frac{1}{\sqrt{2}}g'v_u & -\frac{1}{\sqrt{2}}gv_u & -\mu & 0 \end{bmatrix} \quad (2a)$$

$$= \begin{bmatrix} M_1 & 0 & -c_\beta s_W m_Z & s_\beta s_W m_Z \\ 0 & M_2 & c_\beta c_W m_Z & -s_\beta c_W m_Z \\ -c_\beta s_W m_Z & c_\beta c_W m_Z & 0 & -\mu \\ s_\beta s_W m_Z & -s_\beta c_W m_Z & -\mu & 0 \end{bmatrix}. \quad (2b)$$

$$M_{\tilde{\chi}^\pm} = \begin{bmatrix} 0 & 0 & M_2 & gv_d \\ 0 & 0 & gv_u & \mu \\ M_2 & gv_u & 0 & 0 \\ gv_d & \mu & 0 & 0 \end{bmatrix} \quad (3a)$$

$$= \begin{bmatrix} 0 & 0 & M_2 & \sqrt{2}c_\beta c_W m_Z \\ 0 & 0 & \sqrt{2}s_\beta c_W m_W & \mu \\ M_2 & \sqrt{2}s_\beta c_W m_W & 0 & 0 \\ \sqrt{2}c_\beta c_W m_Z & \mu & 0 & 0 \end{bmatrix} \quad (3b)$$

$$m_{\tilde{\chi}_{1,2}^\pm} = \frac{1}{2} \left(|M_2|^2 + |\mu|^2 + 2m_W^2 \mp \sqrt{(|M_2|^2 + |\mu|^2 + 2m_W^2)^2 - 4|\mu M_2 - m_W^2 s_\beta^2|^2} \right) \quad (4)$$