14.3 Fermion-Goldstone boson vertices in R_ξ gauge.

We introduced Yukawa interactions between Φ and fermions as

$$\mathscr{L}_Y = -y_f \left(\bar{L}\Phi e_R + \bar{e}_R \Phi^\dagger L \right) \tag{270}$$

(plus terms with $\mathrm{i}\tau_2\phi^*$). Looking first at the physical higgs h, we have

$$\begin{aligned}\mathscr{L} &= -\frac{y_f h}{\sqrt{2}} \left[\begin{pmatrix} \bar{\nu}_e & \bar{e} \end{pmatrix}_L \begin{pmatrix} 0 \\ 1 \end{pmatrix} e_R + \bar{e}_R \begin{pmatrix} 0 & 1 \end{pmatrix} \begin{pmatrix} \nu_e \\ e \end{pmatrix}_L \right] \\ &= -g\frac{m_f}{2m_W} h \left(\bar{e}_L e_R + \bar{e}_R e_L \right) = -g\frac{m_f}{2m_W} h\bar{e}e \,,\end{aligned}$$

where we used $y_f/\sqrt{2} = m_f/v = gm_f/(2m_W)$. Thus the the vertex is $-\mathrm{i}g\frac{m_f}{2m_W}$. (The same vertex follows for the down-like quarks using the charge conjugated $\mathrm{i}\tau_2\phi^*$.) Analogously, we find for the G^0,

$$\begin{aligned}\mathscr{L} &= -\frac{\mathrm{i}y_f G^0}{\sqrt{2}} \left[\begin{pmatrix} \bar{\nu}_e & \bar{e} \end{pmatrix}_L \begin{pmatrix} 0 \\ 1 \end{pmatrix} e_R - \bar{e}_R \begin{pmatrix} 0 & 1 \end{pmatrix} \begin{pmatrix} \nu_e \\ e \end{pmatrix}_L \right] \\ &= -g\frac{m_f}{2m_W} G^0 \left(\bar{e}_L e_R - \bar{e}_R e_L \right) .\end{aligned}$$

With $\bar{e}_L e_R - \bar{e}_R e_L = \bar{e}P_R e - \bar{e}P_L e = \bar{e}[\frac{1}{2}(1+\gamma^5)]e - \bar{e}[\frac{1}{2}(1-\gamma^5)]e = \bar{e}\gamma^5 e$, the vertex follows as $+g\frac{m_f}{2m_W}\gamma^5$.