

THDM

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$$C_{181}(e_{g1}, \bar{e}_{g2}, h^0) = -\frac{ie\delta_{g1,g2}m_{e_{g1}}Y_1}{2M_W s_W} \begin{bmatrix} 1 \\ - \\ 1 \end{bmatrix}$$

$$C_{184}(e_{g1}, \bar{e}_{g2}, G^0) = \frac{e\delta_{g1,g2}m_{e_{g1}}}{2M_W s_W} \begin{bmatrix} -1 \\ - \\ 1 \end{bmatrix}$$

$$C_{194}(e_{g1}, \bar{e}_{g2}, H^0) = -\frac{ie\delta_{g1,g2}m_{e_{g1}}Y_2}{2M_W s_W} \begin{bmatrix} 1 \\ - \\ 1 \end{bmatrix}$$

$$C_{197}(e_{g1}, \bar{e}_{g2}, A^0) = \frac{e\delta_{g1,g2}m_{e_{g1}}Y_3}{2M_W s_W} \begin{bmatrix} 1 \\ - \\ -1 \end{bmatrix}$$

$$C_{200}(\nu_{g1}, \bar{e}_{g2}, G^-) = -\frac{ie\delta_{g1,g2}m_{e_{g2}}}{\sqrt{2}M_W s_W} \begin{bmatrix} 1 \\ - \\ 0 \end{bmatrix}$$

$$C_{201}(e_{g1}, \bar{\nu}_{g2}, G^+) = -\frac{ie\delta_{g1,g2}m_{e_{g1}}}{\sqrt{2}M_W s_W} \begin{bmatrix} 0 \\ - \\ 1 \end{bmatrix}$$

$$C_{204}(\nu_{g1}, \bar{e}_{g2}, H^-) = \frac{ie\delta_{g1,g2}m_{e_{g2}}Y_3}{\sqrt{2}M_W s_W} \begin{bmatrix} 1 \\ - \\ 0 \end{bmatrix}$$

$$C_{205}(e_{g1}, \bar{\nu}_{g2}, H^+) = \frac{ie\delta_{g1,g2}m_{e_{g1}}Y_3}{\sqrt{2}M_W s_W} \begin{bmatrix} 0 \\ - \\ 1 \end{bmatrix}$$

$$C_{182}(u_{g1}, \bar{u}_{g2}, h^0) = -\frac{ie\delta_{g1,g2}c_\alpha m_{u_{g1}}}{2M_W s_W s_\beta} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$C_{183}(d_{g1}, \bar{d}_{g2}, h^0) = -\frac{ie\delta_{g1,g2}m_{d_{g1}}Y_1}{2M_W s_W} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$C_{185}(u_{g1}, \bar{u}_{g2}, G^0) = \frac{e\delta_{g1,g2}m_{u_{g1}}}{2M_W s_W} \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$

$$C_{186}(d_{g1}, \bar{d}_{g2}, G^0) = \frac{e\delta_{g1,g2}m_{d_{g1}}}{2M_W s_W} \begin{bmatrix} -1 \\ 1 \end{bmatrix}$$

$$C_{195}(u_{g1}, \bar{u}_{g2}, H^0) = -\frac{ie\delta_{g1,g2}m_{u_{g1}}s_\alpha}{2M_W s_W s_\beta} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$C_{196}(d_{g1}, \bar{d}_{g2}, H^0) = -\frac{ie\delta_{g1,g2}m_{d_{g1}}Y_2}{2M_W s_W} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$C_{198}(u_{g1}, \bar{u}_{g2}, A^0) = \frac{e\delta_{g1,g2}m_{u_{g1}}}{2M_W s_W t_\beta} \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$

$$C_{199}(d_{g1}, \bar{d}_{g2}, A^0) = \frac{e\delta_{g1,g2}m_{d_{g1}}Y_3}{2M_W s_W} \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$

$$C_{206} \left(u_{g1}, \bar{d}_{g2}, G^- \right) = \frac{ie\text{CKM}_{g1,g2}^*}{\sqrt{2}M_W s_W} \left[\frac{-m_{d_{g2}}}{m_{u_{g1}}} \right]$$

$$C_{207} \left(d_{g1}, \bar{u}_{g2}, G^+ \right) = \frac{ie\text{CKM}_{g2,g1}}{\sqrt{2}M_W s_W} \left[\frac{m_{u_{g2}}}{-m_{d_{g1}}} \right]$$

$$C_{210} \left(u_{g1}, \bar{d}_{g2}, H^- \right) = \frac{ie\text{CKM}_{g1,g2}^*}{\sqrt{2}M_W s_W} \left[\frac{m_{d_{g2}} Y_3}{\frac{m_{u_{g1}}}{t_\beta}} \right]$$

$$C_{211} \left(d_{g1}, \bar{u}_{g2}, H^+ \right) = \frac{ie\text{CKM}_{g2,g1}}{\sqrt{2}M_W s_W} \left[\frac{\frac{m_{u_{g2}}}{t_\beta}}{m_{d_{g1}} Y_3} \right]$$

[FFV] **2 Leptons – Gauge Boson**

$$C_{187} \left(\bar{e}_{g1}, e_{g2}, \gamma \right) = ie\delta_{g1,g2} \left[\frac{1}{1} \right]$$

$$C_{190} \left(\bar{\nu}_{g1}, \nu_{g2}, Z \right) = -\frac{ie\delta_{g1,g2}}{2c_W s_W} \left[\frac{1}{0} \right]$$

$$C_{191} \left(\bar{e}_{g1}, e_{g2}, Z \right) = -\frac{ie\delta_{g1,g2}}{c_W} \left[\frac{-\frac{1}{s_W} \left(\frac{1}{2} - s_W^2 \right)}{s_W} \right]$$

$$C_{202} \left(\bar{e}_{g1}, \nu_{g2}, W^- \right) = -\frac{ie\delta_{g1,g2}}{\sqrt{2}s_W} \left[\frac{1}{0} \right]$$

$$C_{203}(\bar{\nu}_{g1}, e_{g2}, W^+) = -\frac{ie\delta_{g1,g2}}{\sqrt{2}s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

[FFV] 2 Quarks – Gauge Boson

$$C_{188}(\bar{u}_{g1}, u_{g2}, \gamma) = -\frac{2}{3}ie\delta_{g1,g2} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$C_{189}(\bar{d}_{g1}, d_{g2}, \gamma) = \frac{1}{3}ie\delta_{g1,g2} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$C_{192}(\bar{u}_{g1}, u_{g2}, Z) = \frac{ie\delta_{g1,g2}}{c_W} \begin{bmatrix} -\frac{1}{6s_W} (3 - 4s_W^2) \\ \frac{2s_W}{3} \end{bmatrix}$$

$$C_{193}(\bar{d}_{g1}, d_{g2}, Z) = -\frac{ie\delta_{g1,g2}}{c_W} \begin{bmatrix} -\frac{1}{6s_W} (3 - 2s_W^2) \\ \frac{s_W}{3} \end{bmatrix}$$

$$C_{208}(\bar{d}_{g1}, u_{g2}, W^-) = -\frac{ie\text{CKM}_{g2,g1}^*}{\sqrt{2}s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$C_{209}(\bar{u}_{g1}, d_{g2}, W^+) = -\frac{ie\text{CKM}_{g1,g2}}{\sqrt{2}s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$C_{43}(h^0, h^0, h^0) = \left[-\frac{3ie}{2M_W s_W s_{2\beta}} \left((2c_{\alpha+\beta} + s_{2\alpha} s_{\beta-\alpha}) M_{h^0}^2 - \frac{4\lambda_5 c_{\alpha+\beta} c_{\beta-\alpha}^2 M_W^2 s_W^2}{e^2} \right) \right]$$

$$C_{44}(h^0, h^0, H^0) = \left[-\frac{iec_{\beta-\alpha}}{2M_W s_W s_{2\beta}} \left(s_{2\alpha} (2M_{h^0}^2 + M_{H^0}^2) - \frac{2\lambda_5 (3s_{2\alpha} - s_{2\beta}) M_W^2 s_W^2}{e^2} \right) \right]$$

$$C_{45}(h^0, H^0, H^0) = \left[\frac{ies_{\beta-\alpha}}{2M_W s_W s_{2\beta}} \left(s_{2\alpha} (M_{h^0}^2 + 2M_{H^0}^2) - \frac{2\lambda_5 (3s_{2\alpha} + s_{2\beta}) M_W^2 s_W^2}{e^2} \right) \right]$$

$$C_{46}(H^0, H^0, H^0) = \left[\frac{3ie}{2M_W s_W s_{2\beta}} \left((c_{\beta-\alpha} s_{2\alpha} - 2s_{\alpha+\beta}) M_{H^0}^2 + \frac{4\lambda_5 s_{\alpha+\beta} M_W^2 s_W^2 s_{\beta-\alpha}^2}{e^2} \right) \right]$$

$$C_{47}(h^0, A^0, A^0) = \left[-\frac{ie}{2M_W s_W} \left(s_{\beta-\alpha} (2M_{A^0}^2 - M_{h^0}^2) + \frac{c_{\alpha+\beta}}{s_{2\beta}} \left(2M_{h^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{48}(h^0, A^0, G^0) = \left[\frac{iec_{\beta-\alpha}}{2M_W s_W} (M_{A^0}^2 - M_{h^0}^2) \right]$$

$$C_{49}(h^0, G^0, G^0) = \left[-\frac{ies_{\beta-\alpha} M_{h^0}^2}{2M_W s_W} \right]$$

$$C_{50}(H^0, A^0, A^0) = \left[-\frac{ie}{2M_W s_W} \left(c_{\beta-\alpha} (2M_{A^0}^2 - M_{H^0}^2) + \frac{s_{\alpha+\beta}}{s_{2\beta}} \left(2M_{H^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{51}(H^0, A^0, G^0) = \left[-\frac{ies_{\beta-\alpha}}{2M_W s_W} (M_{A^0}^2 - M_{H^0}^2) \right]$$

$$C_{52}(H^0, G^0, G^0) = \left[-\frac{iec_{\beta-\alpha} M_{H^0}^2}{2M_W s_W} \right]$$

$$C_{53}(h^0, H^-, H^+) = \left[\frac{ie}{2M_W s_W} \left(s_{\beta-\alpha} (M_{h^0}^2 - 2M_{H^-}^2) - \frac{c_{\alpha+\beta}}{s_{2\beta}} \left(2M_{h^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{54}(h^0, H^-, G^+) = \left[-\frac{iec_{\beta-\alpha}}{2M_W s_W} (M_{h^0}^2 - M_{H^-}^2) \right]$$

$$C_{55}(h^0, G^-, H^+) = \left[-\frac{iec_{\beta-\alpha}}{2M_W s_W} (M_{h^0}^2 - M_{H^-}^2) \right]$$

$$C_{56} \left(h^0, G^-, G^+ \right) = \left[-\frac{ies_{\beta-\alpha} M_{h^0}^2}{2M_W s_W} \right]$$

$$C_{57} \left(H^0, H^-, H^+ \right) = \left[-\frac{ie}{2M_W s_W} \left(c_{\beta-\alpha} \left(2M_{H^-}^2 - M_{H^0}^2 \right) + \frac{s_{\alpha+\beta}}{s_{2\beta}} \left(2M_{H^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{58} \left(H^0, H^-, G^+ \right) = \left[-\frac{ies_{\beta-\alpha}}{2M_W s_W} \left(M_{H^-}^2 - M_{H^0}^2 \right) \right]$$

$$C_{59} \left(H^0, G^-, H^+ \right) = \left[-\frac{ies_{\beta-\alpha}}{2M_W s_W} \left(M_{H^-}^2 - M_{H^0}^2 \right) \right]$$

$$C_{60} \left(H^0, G^-, G^+ \right) = \left[-\frac{iec_{\beta-\alpha} M_{H^0}^2}{2M_W s_W} \right]$$

$$C_{61} \left(A^0, H^-, G^+ \right) = \left[\frac{e}{2M_W s_W} \left(M_{A^0}^2 - M_{H^-}^2 \right) \right]$$

$$C_{62} \left(A^0, G^-, H^+ \right) = \left[-\frac{e}{2M_W s_W} \left(M_{A^0}^2 - M_{H^-}^2 \right) \right]$$

[SSV] **2 Higgs – Gauge Boson**

$$C_1 \left(G^-, G^+, \gamma \right) = \left[ie \right]$$

$$C_2 \left(G^-, G^+, Z \right) = \left[\frac{ie}{2c_W s_W} \left(c_W^2 - s_W^2 \right) \right]$$

$$C_3 \left(G^0, G^-, W^+ \right) = \left[\frac{e}{2s_W} \right]$$

$$C_4 \left(G^0, G^+, W^- \right) = \left[\frac{e}{2s_W} \right]$$

$$C_{63} \left(h^0, A^0, Z \right) = \left[\frac{ec_{\beta-\alpha}}{2c_W s_W} \right]$$

$$C_{64} \left(h^0, G^0, Z \right) = \left[\frac{es_{\beta-\alpha}}{2c_W s_W} \right]$$

$$C_{65} \left(H^0, A^0, Z \right) = \left[-\frac{es_{\beta-\alpha}}{2c_W s_W} \right]$$

$$C_{66} \left(H^0, G^0, Z \right) = \left[\frac{ec_{\beta-\alpha}}{2c_W s_W} \right]$$

$$C_{67} \left(H^-, H^+, \gamma \right) = \left[ie \right]$$

$$C_{68} \left(H^-, H^+, Z \right) = \left[\frac{ie}{2c_W s_W} \left(c_W^2 - s_W^2 \right) \right]$$

$$C_{69} \left(h^0, H^-, W^+ \right) = \left[-\frac{iec_{\beta-\alpha}}{2s_W} \right]$$

$$C_{70} \left(h^0, G^-, W^+ \right) = \left[-\frac{ies_{\beta-\alpha}}{2s_W} \right]$$

$$C_{71} \left(H^0, H^-, W^+ \right) = \left[\frac{ies_{\beta-\alpha}}{2s_W} \right]$$

$$C_{72} \left(H^0, G^-, W^+ \right) = \left[-\frac{iec_{\beta-\alpha}}{2s_W} \right]$$

$$C_{73} \left(h^0, H^+, W^- \right) = \left[\frac{iec_{\beta-\alpha}}{2s_W} \right]$$

$$C_{74} \left(h^0, G^+, W^- \right) = \left[\frac{ies_{\beta-\alpha}}{2s_W} \right]$$

$$C_{75} \left(H^0, H^+, W^- \right) = \left[-\frac{ies_{\beta-\alpha}}{2s_W} \right]$$

$$C_{76} \left(H^0, G^+, W^- \right) = \left[\frac{iec_{\beta-\alpha}}{2s_W} \right]$$

$$C_{77} \left(A^0, H^-, W^+ \right) = \left[\frac{e}{2s_W} \right]$$

$$C_{78} \left(A^0, H^+, W^- \right) = \left[\frac{e}{2s_W} \right]$$

[SUU] **Higgs – 2 Ghosts**

$$C_{11} \left(G^0, u_-, \bar{u}_- \right) = \left[-\frac{e\xi_W M_W}{2s_W} \right]$$

$$C_{12} \left(G^0, u_+, \bar{u}_+ \right) = \left[\frac{e\xi_W M_W}{2s_W} \right]$$

$$C_{13} \left(G^-, u_\gamma, \bar{u}_- \right) = \left[-ie\xi_W M_W \right]$$

$$C_{14} \left(G^+, u_\gamma, \bar{u}_+ \right) = \left[-ie\xi_W M_W \right]$$

$$C_{15} \left(G^-, u_Z, \bar{u}_- \right) = \left[-\frac{ie\xi_W M_W}{2c_W s_W} \left(c_W^2 - s_W^2 \right) \right]$$

$$C_{16} \left(G^+, u_Z, \bar{u}_+ \right) = \left[-\frac{ie\xi_W M_W}{2c_W s_W} \left(c_W^2 - s_W^2 \right) \right]$$

$$C_{17} \left(G^-, u_+, \bar{u}_Z \right) = \left[\frac{ie\xi_Z M_W}{2c_W s_W} \right]$$

$$C_{18} \left(G^+, u_-, \bar{u}_Z \right) = \left[\frac{ie\xi_Z M_W}{2c_W s_W} \right]$$

$$C_{83} \left(h^0, u_Z, \bar{u}_Z \right) = \left[-\frac{ie\xi_Z M_W s_{\beta-\alpha}}{2s_W c_W^2} \right]$$

$$C_{84} \left(H^0, u_Z, \bar{u}_Z \right) = \left[-\frac{ie\xi_Z c_{\beta-\alpha} M_W}{2s_W c_W^2} \right]$$

$$C_{85} \left(h^0, u_-, \bar{u}_- \right) = \left[-\frac{ie\xi_W M_W s_{\beta-\alpha}}{2s_W} \right]$$

$$C_{86} \left(H^0, u_-, \bar{u}_- \right) = \left[-\frac{ie\xi_W c_{\beta-\alpha} M_W}{2s_W} \right]$$

$$C_{87} \left(h^0, u_+, \bar{u}_+ \right) = \left[-\frac{ie\xi_W M_W s_{\beta-\alpha}}{2s_W} \right]$$

$$C_{88} \left(H^0, u_+, \bar{u}_+ \right) = \left[-\frac{ie\xi_W c_{\beta-\alpha} M_W}{2s_W} \right]$$

[SVV] **Higgs – 2 Gauge Bosons**

$$C_5(G^-, \gamma, W^+) = \left[ieM_W \right]$$

$$C_6(G^+, \gamma, W^-) = \left[ieM_W \right]$$

$$C_7(G^-, Z, W^+) = \left[-\frac{ieM_W s_W}{c_W} \right]$$

$$C_8(G^+, Z, W^-) = \left[-\frac{ieM_W s_W}{c_W} \right]$$

$$C_{79}(h^0, Z, Z) = \left[\frac{ieM_W s_{\beta-\alpha}}{s_W c_W^2} \right]$$

$$C_{80}(H^0, Z, Z) = \left[\frac{iec_{\beta-\alpha} M_W}{s_W c_W^2} \right]$$

$$C_{81}(h^0, W^-, W^+) = \left[\frac{ieM_W s_{\beta-\alpha}}{s_W} \right]$$

$$C_{82}(H^0, W^-, W^+) = \left[\frac{iec_{\beta-\alpha} M_W}{s_W} \right]$$

[UUUV] **2 Ghosts – Gauge Boson**

$$C_{19}(\bar{u}_-, u_-, \gamma) = -ie \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$C_{20}(\bar{u}_+, u_+, \gamma) = ie \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$C_{21}(\bar{u}_-, u_-, Z) = -\frac{iec_W}{s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{22} C(\bar{u}_+, u_+, Z) = \frac{ie c_W}{s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{23} C(\bar{u}_-, u_\gamma, W^-) = ie \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{24} C(\bar{u}_+, u_\gamma, W^+) = -ie \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{25} C(\bar{u}_\gamma, u_+, W^-) = -ie \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{26} C(\bar{u}_\gamma, u_-, W^+) = ie \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{27} C(\bar{u}_-, u_Z, W^-) = \frac{ie c_W}{s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{28} C(\bar{u}_+, u_Z, W^+) = -\frac{ie c_W}{s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{29} C(\bar{u}_Z, u_+, W^-) = -\frac{ie c_W}{s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$_{30} C(\bar{u}_Z, u_-, W^+) = \frac{ie c_W}{s_W} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

[VVV] 3 Gauge Bosons

$$C_9(\gamma, W^+, W^-) = \left[-ie \right]$$

$$C_{10}(Z, W^+, W^-) = \left[-\frac{iec_W}{s_W} \right]$$

[SSSS] 4 Higgs

$$C_{89}(h^0, h^0, h^0, h^0) = \left[-\frac{3ie^2}{4M_W^2 s_W^2 s_{2\beta}^2} \left((2c_{\alpha+\beta} + s_{2\alpha}s_{\beta-\alpha})^2 M_{h^0}^2 - \frac{2\lambda_5 (c_{2\alpha} + c_{2\beta})^2 M_W^2 s_W^2}{e^2} + c_{\beta-\alpha}^2 M_{H^0}^2 s_{2\alpha}^2 \right) \right]$$

$$C_{90}(h^0, h^0, h^0, H^0) = \left[-\frac{3ie^2 c_{\beta-\alpha} s_{2\alpha}}{4M_W^2 s_W^2 s_{2\beta}^2} \left(s_{2\alpha}s_{\beta-\alpha} (M_{h^0}^2 - M_{H^0}^2) + c_{\alpha+\beta} \left(2M_{h^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{91}(H^0, H^0, h^0, h^0) = \left[\frac{ie^2}{4M_W^2 s_W^2 s_{2\beta}^2} \left(s_{2\beta} \left(s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) - \frac{2\lambda_5 s_{2\beta} M_W^2 s_W^2}{e^2} \right) - 3s_{2\alpha}^2 \left(c_{\beta-\alpha}^2 M_{h^0}^2 - \frac{2\lambda_5 M_W^2 s_W^2}{e^2} + M_{H^0}^2 s_{\beta-\alpha}^2 \right) \right) \right]$$

$$C_{92}(H^0, H^0, H^0, h^0) = \left[\frac{3ie^2 s_{2\alpha} s_{\beta-\alpha}}{4M_W^2 s_W^2 s_{2\beta}^2} \left(c_{\beta-\alpha} s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) + s_{\alpha+\beta} \left(2M_{H^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{93}(H^0, H^0, H^0, H^0) = \left[-\frac{3ie^2}{4M_W^2 s_W^2 s_{2\beta}^2} \left((c_{\beta-\alpha} s_{2\alpha} - 2s_{\alpha+\beta})^2 M_{H^0}^2 - \frac{2\lambda_5 (c_{2\alpha} - c_{2\beta})^2 M_W^2 s_W^2}{e^2} + M_{h^0}^2 s_{2\alpha}^2 s_{\beta-\alpha}^2 \right) \right]$$

$$C_{94}(h^0, h^0, A^0, A^0) = \left[\frac{ie^2}{4M_W^2 s_W^2 s_{2\beta}^2} \left(c_{\beta-\alpha} s_{2\alpha} (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) M_{H^0}^2 + \frac{4\lambda_5 (c_{\alpha+\beta}^2 + c_{2\beta}^2 c_{\beta-\alpha}^2) M_W^2 s_W^2}{e^2} - 2M_{A^0}^2 s_{2\beta}^2 s_{\beta-\alpha}^2 - \frac{(2c_{\alpha+\beta} + s_{2\alpha}s_{\beta-\alpha})(2c_{\alpha+\beta} - s_{2\beta}s_{\beta-\alpha}) M_{h^0}^2}{e^2} \right) \right]$$

$$C_{95}(G^0, A^0, h^0, h^0) = \left[-\frac{ie^2 c_{\beta-\alpha}}{4s_{2\beta} M_W^2 s_W^2} \left(s_{2\alpha}s_{\beta-\alpha} (M_{h^0}^2 - M_{H^0}^2) - s_{2\beta}s_{\beta-\alpha} \left(2M_{A^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) + c_{\alpha+\beta} \left(2M_{h^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{96}(h^0, h^0, G^0, G^0) = \left[-\frac{ie^2}{4s_{2\beta} M_W^2 s_W^2} \left(s_{2\beta} M_{h^0}^2 - s_{2\alpha} c_{\beta-\alpha}^2 (M_{h^0}^2 - M_{H^0}^2) + s_{2\beta} c_{\beta-\alpha}^2 \left(2M_{A^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{97}(H^0, h^0, A^0, A^0) = \left[-\frac{ie^2}{4M_W^2 s_W^2 s_{2\beta}^2} \left(s_{2\alpha} (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) s_{\beta-\alpha} M_{H^0}^2 - \frac{4\lambda_5 c_{2\beta} s_{2\alpha} M_W^2 s_W^2}{e^2} + c_{\beta-\alpha} s_{\beta-\alpha} \left(2M_{A^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) s_{2\beta}^2 + \frac{c_{\beta-\alpha} s_{2\alpha} (2c_{\alpha+\beta} - s_{2\beta}s_{\beta-\alpha}) M_{h^0}^2}{e^2} \right) \right]$$

$$C_{98}(H^0, h^0, A^0, G^0) = \left[-\frac{ie^2}{4s_{2\beta}M_W^2s_W^2} \left(\frac{4\lambda_5c_{2\beta}c_{\beta-\alpha}s_{\beta-\alpha}M_W^2s_W^2}{e^2} - s_{2\beta}M_{A^0}^2 (c_{\beta-\alpha}^2 - s_{\beta-\alpha}^2) + s_{2\alpha} (c_{\beta-\alpha}^2M_{h^0}^2 + M_{H^0}^2s_{\beta-\alpha}^2) \right) \right]$$

$$C_{99}(H^0, h^0, G^0, G^0) = \left[-\frac{ie^2c_{\beta-\alpha}s_{\beta-\alpha}}{4s_{2\beta}M_W^2s_W^2} \left(s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) - s_{2\beta} \left(2M_{A^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) \right) \right]$$

$$C_{100}(H^0, H^0, A^0, A^0) = \left[\frac{ie^2}{4M_W^2s_W^2s_{2\beta}^2} \left(\frac{s_{2\alpha}s_{\beta-\alpha}(2c_{\alpha+\beta} - s_{2\beta}s_{\beta-\alpha})M_{h^0}^2 - (c_{\beta-\alpha}s_{2\alpha} - 2s_{\alpha+\beta})(c_{\beta-\alpha}s_{2\beta} - 2s_{\alpha+\beta})M_{H^0}^2 - 2c_{\beta-\alpha}^2M_{A^0}^2s_{2\beta}^2 + 4\lambda_5M_W^2s_W^2(s_{\alpha+\beta}^2 + c_{2\beta}^2s_{\beta-\alpha}^2)}{e^2} \right) \right]$$

$$C_{101}(G^0, A^0, H^0, H^0) = \left[\frac{ie^2s_{\beta-\alpha}}{4s_{2\beta}M_W^2s_W^2} \left(c_{\beta-\alpha}s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) - c_{\beta-\alpha}s_{2\beta} \left(2M_{A^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) + s_{\alpha+\beta} \left(2M_{H^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) \right) \right]$$

$$C_{102}(H^0, H^0, G^0, G^0) = \left[-\frac{ie^2}{4s_{2\beta}M_W^2s_W^2} \left(s_{2\beta}M_{H^0}^2 - s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) s_{\beta-\alpha}^2 + s_{2\beta} \left(2M_{A^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) s_{\beta-\alpha}^2 \right) \right]$$

$$C_{103}(H^+, H^-, h^0, h^0) = \left[\frac{ie^2}{4M_W^2s_W^2s_{2\beta}^2} \left(\frac{c_{\beta-\alpha}s_{2\alpha}(c_{\beta-\alpha}s_{2\beta} - 2s_{\alpha+\beta})M_{H^0}^2 + \frac{4\lambda_5(c_{\alpha+\beta}^2 + c_{2\beta}^2c_{\beta-\alpha}^2)M_W^2s_W^2}{e^2} - 2M_{H^0}^2s_{2\beta}^2s_{\beta-\alpha}^2 - (2c_{\alpha+\beta} + s_{2\alpha}s_{\beta-\alpha})(2c_{\alpha+\beta} - s_{2\beta}s_{\beta-\alpha})M_{h^0}^2}{(2c_{\alpha+\beta} + s_{2\alpha}s_{\beta-\alpha})(2c_{\alpha+\beta} - s_{2\beta}s_{\beta-\alpha})M_{h^0}^2} \right) \right]$$

$$C_{104}(G^+, H^-, h^0, h^0) = \left[-\frac{ie^2c_{\beta-\alpha}}{4s_{2\beta}M_W^2s_W^2} \left(s_{2\alpha}s_{\beta-\alpha} (M_{h^0}^2 - M_{H^0}^2) + c_{\alpha+\beta} \left(2M_{h^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) - s_{2\beta}s_{\beta-\alpha} \left(2M_{H^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) \right) \right]$$

$$C_{105}(H^+, G^-, h^0, h^0) = \left[-\frac{ie^2c_{\beta-\alpha}}{4s_{2\beta}M_W^2s_W^2} \left(s_{2\alpha}s_{\beta-\alpha} (M_{h^0}^2 - M_{H^0}^2) + c_{\alpha+\beta} \left(2M_{h^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) - s_{2\beta}s_{\beta-\alpha} \left(2M_{H^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) \right) \right]$$

$$C_{106}(G^+, G^-, h^0, h^0) = \left[-\frac{ie^2}{4s_{2\beta}M_W^2s_W^2} \left(s_{2\beta}M_{h^0}^2 - s_{2\alpha}c_{\beta-\alpha}^2 (M_{h^0}^2 - M_{H^0}^2) + s_{2\beta}c_{\beta-\alpha}^2 \left(2M_{H^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) \right) \right]$$

$$C_{107}(H^+, H^-, H^0, h^0) = \left[-\frac{ie^2}{4M_W^2s_W^2s_{2\beta}^2} \left(\frac{s_{2\alpha}(c_{\beta-\alpha}s_{2\beta} - 2s_{\alpha+\beta})s_{\beta-\alpha}M_{H^0}^2 - \frac{4\lambda_5c_{2\beta}s_{2\alpha}M_W^2s_W^2}{e^2} + c_{\beta-\alpha}s_{\beta-\alpha} \left(2M_{H^0}^2 - \frac{4\lambda_5M_W^2s_W^2}{e^2} \right) s_{2\beta}^2 + c_{\beta-\alpha}s_{2\alpha}(2c_{\alpha+\beta} - s_{2\beta}s_{\beta-\alpha})M_{h^0}^2}{c_{\beta-\alpha}s_{2\alpha}(2c_{\alpha+\beta} - s_{2\beta}s_{\beta-\alpha})M_{h^0}^2} \right) \right]$$

$$C_{108}(H^-, G^+, H^0, h^0) = \left[-\frac{ie^2}{4s_{2\beta}M_W^2s_W^2} \left(\frac{4\lambda_5c_{2\beta}c_{\beta-\alpha}s_{\beta-\alpha}M_W^2s_W^2}{e^2} - s_{2\beta}M_{H^0}^2 (c_{\beta-\alpha}^2 - s_{\beta-\alpha}^2) + s_{2\alpha} (c_{\beta-\alpha}^2M_{h^0}^2 + M_{H^0}^2s_{\beta-\alpha}^2) \right) \right]$$

$$C_{109}(G^-, H^+, H^0, h^0) = \left[-\frac{ie^2}{4s_{2\beta}M_W^2s_W^2} \left(\frac{4\lambda_5c_{2\beta}c_{\beta-\alpha}s_{\beta-\alpha}M_W^2s_W^2}{e^2} - s_{2\beta}M_{H^0}^2 (c_{\beta-\alpha}^2 - s_{\beta-\alpha}^2) + s_{2\alpha} (c_{\beta-\alpha}^2M_{h^0}^2 + M_{H^0}^2s_{\beta-\alpha}^2) \right) \right]$$

$$C_{110}(G^+, G^-, H^0, h^0) = \left[-\frac{ie^2 c_{\beta-\alpha} s_{\beta-\alpha}}{4s_{2\beta} M_W^2 s_W^2} \left(s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) - s_{2\beta} \left(2M_{H^-}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{111}(H^+, H^-, H^0, H^0) = \left[\frac{ie^2}{4M_W^2 s_W^2 s_{2\beta}^2} \left(\frac{s_{2\alpha} s_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 - (c_{\beta-\alpha} s_{2\alpha} - 2s_{\alpha+\beta}) (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) M_{H^0}^2 - 2c_{\beta-\alpha}^2 M_{H^-}^2 - s_{2\beta}^2 +}{4\lambda_5 M_W^2 s_W^2 (s_{\alpha+\beta}^2 + c_{2\beta}^2 s_{\beta-\alpha}^2)} \right) \right]$$

$$C_{112}(H^-, G^+, H^0, H^0) = \left[\frac{ie^2 s_{\beta-\alpha}}{4s_{2\beta} M_W^2 s_W^2} \left(c_{\beta-\alpha} s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) - c_{\beta-\alpha} s_{2\beta} \left(2M_{H^-}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) + s_{\alpha+\beta} \left(2M_{H^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{113}(H^+, G^-, H^0, H^0) = \left[\frac{ie^2 s_{\beta-\alpha}}{4s_{2\beta} M_W^2 s_W^2} \left(c_{\beta-\alpha} s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) - c_{\beta-\alpha} s_{2\beta} \left(2M_{H^-}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) + s_{\alpha+\beta} \left(2M_{H^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]$$

$$C_{114}(G^+, G^-, H^0, H^0) = \left[-\frac{ie^2}{4s_{2\beta} M_W^2 s_W^2} \left(s_{2\beta} M_{H^0}^2 - s_{2\alpha} (M_{h^0}^2 - M_{H^0}^2) s_{\beta-\alpha}^2 + s_{2\beta} \left(2M_{H^-}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) s_{\beta-\alpha}^2 \right) \right]$$

$$C_{115}(G^+, H^-, h^0, A^0) = \left[\frac{e^2 s_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{A^0}^2 - M_{H^-}^2) \right]$$

$$C_{116}(H^+, G^-, h^0, A^0) = \left[-\frac{e^2 s_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{A^0}^2 - M_{H^-}^2) \right]$$

$$C_{117}(G^+, H^-, h^0, G^0) = \left[-\frac{e^2 c_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{A^0}^2 - M_{H^-}^2) \right]$$

$$C_{118}(H^+, G^-, h^0, G^0) = \left[\frac{e^2 c_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{A^0}^2 - M_{H^-}^2) \right]$$

$$C_{119}(G^+, H^-, H^0, A^0) = \left[\frac{e^2 c_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{A^0}^2 - M_{H^-}^2) \right]$$

$$C_{120}(H^+, G^-, H^0, A^0) = \left[-\frac{e^2 c_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{A^0}^2 - M_{H^-}^2) \right]$$

$$C_{121}(H^-, G^+, H^0, G^0) = \left[\frac{e^2 s_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{A^0}^2 - M_{H^-}^2) \right]$$

$$C_{122}(H^+, G^-, H^0, G^0) = \left[-\frac{e^2 s_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{A^0}^2 - M_{H^-}^2) \right]$$

$$\begin{aligned}
_{123} C(A^0, A^0, A^0, A^0) &= \left[-\frac{3ie^2}{4M_W^2 s_W^2 s_{2\beta}^2} \left((2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha})^2 M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta})^2 M_{H^0}^2 - \frac{8\lambda_5 c_{2\beta}^2 M_W^2 s_W^2}{e^2} \right) \right] \\
{124} C(A^0, A^0, A^0, G^0) &= \left[-\frac{3ie^2}{4s{2\beta} M_W^2 s_W^2} \left(c_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) s_{\beta-\alpha} M_{H^0}^2 - \frac{4\lambda_5 c_{2\beta} M_W^2 s_W^2}{e^2} \right) \right] \\
{125} C(A^0, A^0, G^0, G^0) &= \left[\frac{ie^2}{4s{2\beta} M_W^2 s_W^2} \left((s_{2\alpha} - 3s_{2\beta} c_{\beta-\alpha}^2) M_{h^0}^2 + \frac{4\lambda_5 s_{2\beta} M_W^2 s_W^2}{e^2} - M_{H^0}^2 (s_{2\alpha} + 3s_{2\beta} s_{\beta-\alpha}^2) \right) \right] \\
{126} C(G^0, G^0, G^0, A^0) &= \left[-\frac{3ie^2 c{\beta-\alpha} s_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{h^0}^2 - M_{H^0}^2) \right] \\
_{127} C(G^0, G^0, G^0, G^0) &= \left[-\frac{3ie^2}{4M_W^2 s_W^2} (c_{\beta-\alpha}^2 M_{H^0}^2 + M_{h^0}^2 s_{\beta-\alpha}^2) \right] \\
_{128} C(H^+, H^-, A^0, A^0) &= \left[-\frac{ie^2}{4M_W^2 s_W^2 s_{2\beta}^2} \left((2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha})^2 M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta})^2 M_{H^0}^2 - \frac{8\lambda_5 c_{2\beta}^2 M_W^2 s_W^2}{e^2} \right) \right] \\
{129} C(G^+, H^-, A^0, A^0) &= \left[-\frac{ie^2}{4s{2\beta} M_W^2 s_W^2} \left(c_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) s_{\beta-\alpha} M_{H^0}^2 - \frac{4\lambda_5 c_{2\beta} M_W^2 s_W^2}{e^2} \right) \right] \\
{130} C(H^+, G^-, A^0, A^0) &= \left[-\frac{ie^2}{4s{2\beta} M_W^2 s_W^2} \left(c_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) s_{\beta-\alpha} M_{H^0}^2 - \frac{4\lambda_5 c_{2\beta} M_W^2 s_W^2}{e^2} \right) \right] \\
{131} C(G^+, G^-, A^0, A^0) &= \left[-\frac{ie^2}{4s{2\beta} M_W^2 s_W^2} \left(s_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 - c_{\beta-\alpha} (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) M_{H^0}^2 + s_{2\beta} \left(2M_{H^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right] \\
{132} C(H^+, H^-, A^0, G^0) &= \left[-\frac{ie^2}{4s{2\beta} M_W^2 s_W^2} \left(c_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) s_{\beta-\alpha} M_{H^0}^2 - \frac{4\lambda_5 c_{2\beta} M_W^2 s_W^2}{e^2} \right) \right] \\
_{133} C(H^-, G^+, A^0, G^0) &= \left[-\frac{ie^2}{4M_W^2 s_W^2} (c_{\beta-\alpha}^2 M_{h^0}^2 - M_{H^0}^2 + M_{H^0}^2 s_{\beta-\alpha}^2) \right] \\
_{134} C(H^+, G^-, A^0, G^0) &= \left[-\frac{ie^2}{4M_W^2 s_W^2} (c_{\beta-\alpha}^2 M_{h^0}^2 - M_{H^0}^2 + M_{H^0}^2 s_{\beta-\alpha}^2) \right] \\
{135} C(G^-, G^+, A^0, G^0) &= \left[-\frac{ie^2 c{\beta-\alpha} s_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{h^0}^2 - M_{H^0}^2) \right] \\
{136} C(H^+, H^-, G^0, G^0) &= \left[-\frac{ie^2}{4s{2\beta} M_W^2 s_W^2} \left(s_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 - c_{\beta-\alpha} (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) M_{H^0}^2 + s_{2\beta} \left(2M_{H^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) \right) \right]
\end{aligned}$$

$$C_{137}(G^+, H^-, G^0, G^0) = \left[-\frac{ie^2 c_{\beta-\alpha} s_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{h^0}^2 - M_{H^0}^2) \right]$$

$$C_{138}(H^+, G^-, G^0, G^0) = \left[-\frac{ie^2 c_{\beta-\alpha} s_{\beta-\alpha}}{4M_W^2 s_W^2} (M_{h^0}^2 - M_{H^0}^2) \right]$$

$$C_{139}(G^+, G^-, G^0, G^0) = \left[-\frac{ie^2}{4M_W^2 s_W^2} (c_{\beta-\alpha}^2 M_{H^0}^2 + M_{h^0}^2 s_{\beta-\alpha}^2) \right]$$

$$C_{140}(H^+, H^-, H^+, H^-) = \left[-\frac{ie^2}{2M_W^2 s_W^2 s_{2\beta}^2} \left((2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha})^2 M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta})^2 M_{H^0}^2 - \frac{8\lambda_5 c_{2\beta}^2 M_W^2 s_W^2}{e^2} \right) \right]$$

$$C_{141}(H^-, H^-, G^+, H^+) = \left[-\frac{ie^2}{2s_{2\beta} M_W^2 s_W^2} \left(c_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) s_{\beta-\alpha} M_{H^0}^2 - \frac{4\lambda_5 c_{2\beta} M_W^2 s_W^2}{e^2} \right) \right]$$

$$C_{142}(H^-, H^-, G^+, G^+) = \left[\frac{ie^2}{2M_W^2 s_W^2} (M_{A^0}^2 - c_{\beta-\alpha}^2 M_{h^0}^2 - M_{H^0}^2 s_{\beta-\alpha}^2) \right]$$

$$C_{143}(H^-, H^+, G^-, H^+) = \left[-\frac{ie^2}{2s_{2\beta} M_W^2 s_W^2} \left(c_{\beta-\alpha} (2c_{\alpha+\beta} - s_{2\beta} s_{\beta-\alpha}) M_{h^0}^2 + (c_{\beta-\alpha} s_{2\beta} - 2s_{\alpha+\beta}) s_{\beta-\alpha} M_{H^0}^2 - \frac{4\lambda_5 c_{2\beta} M_W^2 s_W^2}{e^2} \right) \right]$$

$$C_{144}(H^+, G^+, G^-, H^-) = \left[\frac{ie^2}{4s_{2\beta} M_W^2 s_W^2} \left((s_{2\alpha} - 2s_{2\beta} c_{\beta-\alpha}^2) M_{h^0}^2 - s_{2\beta} \left(M_{A^0}^2 - \frac{4\lambda_5 M_W^2 s_W^2}{e^2} \right) - M_{H^0}^2 (s_{2\alpha} + 2s_{2\beta} s_{\beta-\alpha}^2) \right) \right]$$

$$C_{145}(G^+, G^+, G^-, H^-) = \left[-\frac{ie^2 c_{\beta-\alpha} s_{\beta-\alpha}}{2M_W^2 s_W^2} (M_{h^0}^2 - M_{H^0}^2) \right]$$

$$C_{146}(H^+, H^+, G^-, G^-) = \left[\frac{ie^2}{2M_W^2 s_W^2} (M_{A^0}^2 - c_{\beta-\alpha}^2 M_{h^0}^2 - M_{H^0}^2 s_{\beta-\alpha}^2) \right]$$

$$C_{147}(G^-, G^-, G^+, H^+) = \left[-\frac{ie^2 c_{\beta-\alpha} s_{\beta-\alpha}}{2M_W^2 s_W^2} (M_{h^0}^2 - M_{H^0}^2) \right]$$

$$C_{148}(G^+, G^-, G^+, G^-) = \left[-\frac{ie^2}{2M_W^2 s_W^2} (c_{\beta-\alpha}^2 M_{H^0}^2 + M_{h^0}^2 s_{\beta-\alpha}^2) \right]$$

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$$C_{31}(h^0, h^0, Z, Z) = \left[\frac{ie^2}{2c_W^2 s_W^2} \right]$$

$$C_{32}(h^0, h^0, W^-, W^+) = \left[\frac{ie^2}{2s_W^2} \right]$$

$$C_{33}(G^0, G^0, Z, Z) = \left[\frac{ie^2}{2c_W^2 s_W^2} \right]$$

$$C_{34}(G^0, G^0, W^-, W^+) = \left[\frac{ie^2}{2s_W^2} \right]$$

$$C_{35}(G^-, G^+, \gamma, \gamma) = \left[2ie^2 \right]$$

$$C_{36}(G^-, G^+, \gamma, Z) = \left[\frac{ie^2}{c_W s_W} (c_W^2 - s_W^2) \right]$$

$$C_{37}(G^-, G^+, Z, Z) = \left[\frac{ie^2}{2c_W^2 s_W^2} (c_W^2 - s_W^2)^2 \right]$$

$$C_{38}(G^-, G^+, W^-, W^+) = \left[\frac{ie^2}{2s_W^2} \right]$$

$$C_{149}(h^0, H^-, \gamma, W^+) = \left[\frac{ie^2 c_{\beta-\alpha}}{2s_W} \right]$$

$$C_{150}(h^0, H^-, Z, W^+) = \left[-\frac{ie^2 c_{\beta-\alpha}}{2c_W} \right]$$

$$C_{151}(h^0, G^-, \gamma, W^+) = \left[\frac{ie^2 s_{\beta-\alpha}}{2s_W} \right]$$

$$C_{152}(h^0, G^-, Z, W^+) = \left[-\frac{ie^2 s_{\beta-\alpha}}{2c_W} \right]$$

$$C_{153}(h^0, H^+, \gamma, W^-) = \left[\frac{ie^2 c_{\beta-\alpha}}{2s_W} \right]$$

$$C_{154}(h^0, H^+, Z, W^-) = \left[-\frac{ie^2 c_{\beta-\alpha}}{2c_W} \right]$$

$$_{155} C \left(h^0, G^+, \gamma, W^- \right) = \left[\frac{\mathrm{i} e^2 s_{\beta-\alpha}}{2 s_W} \right]$$

$$_{156} C \left(h^0, G^+, Z, W^- \right) = \left[-\frac{\mathrm{i} e^2 s_{\beta-\alpha}}{2 c_W} \right]$$

$$_{157} C \left(H^0, H^0, Z, Z \right) = \left[\frac{\mathrm{i} e^2}{2 c_W^2 s_W^2} \right]$$

$$_{158} C \left(H^0, H^0, W^-, W^+ \right) = \left[\frac{\mathrm{i} e^2}{2 s_W^2} \right]$$

$$_{159} C \left(H^0, H^-, \gamma, W^+ \right) = \left[-\frac{\mathrm{i} e^2 s_{\beta-\alpha}}{2 s_W} \right]$$

$$_{160} C \left(H^0, H^-, Z, W^+ \right) = \left[\frac{\mathrm{i} e^2 s_{\beta-\alpha}}{2 c_W} \right]$$

$$_{161} C \left(H^0, G^-, \gamma, W^+ \right) = \left[\frac{\mathrm{i} e^2 c_{\beta-\alpha}}{2 s_W} \right]$$

$$_{162} C \left(H^0, G^-, Z, W^+ \right) = \left[-\frac{\mathrm{i} e^2 c_{\beta-\alpha}}{2 c_W} \right]$$

$$_{163} C \left(H^0, H^+, \gamma, W^- \right) = \left[-\frac{\mathrm{i} e^2 s_{\beta-\alpha}}{2 s_W} \right]$$

$$_{164} C \left(H^0, H^+, Z, W^- \right) = \left[\frac{\mathrm{i} e^2 s_{\beta-\alpha}}{2 c_W} \right]$$

$$_{165} C \left(H^0, G^+, \gamma, W^- \right) = \left[\frac{\mathrm{i} e^2 c_{\beta-\alpha}}{2 s_W} \right]$$

$$_{166} C \left(H^0, G^+, Z, W^- \right) = \left[-\frac{\mathrm{i} e^2 c_{\beta-\alpha}}{2 c_W} \right]$$

$$_{167} C \left(A^0, A^0, Z, Z \right) = \left[\frac{\mathrm{i} e^2}{2 c_W^2 s_W^2} \right]$$

$$_{168} C \left(A^0, A^0, W^-, W^+ \right) = \left[\frac{\mathrm{i} e^2}{2 s_W^2} \right]$$

$$_{169} C \left(A^0, H^-, \gamma, W^+ \right) = \left[-\frac{e^2}{2s_W} \right]$$

$$_{170} C \left(A^0, H^-, Z, W^+ \right) = \left[\frac{e^2}{2c_W} \right]$$

$$_{171} C \left(A^0, H^+, \gamma, W^- \right) = \left[\frac{e^2}{2s_W} \right]$$

$$_{172} C \left(A^0, H^+, Z, W^- \right) = \left[-\frac{e^2}{2c_W} \right]$$

$$_{173} C \left(G^0, G^-, \gamma, W^+ \right) = \left[-\frac{e^2}{2s_W} \right]$$

$$_{174} C \left(G^0, G^-, Z, W^+ \right) = \left[\frac{e^2}{2c_W} \right]$$

$$_{175} C \left(G^0, G^+, \gamma, W^- \right) = \left[\frac{e^2}{2s_W} \right]$$

$$_{176} C \left(G^0, G^+, Z, W^- \right) = \left[-\frac{e^2}{2c_W} \right]$$

$$_{177} C \left(H^-, H^+, \gamma, \gamma \right) = \left[2ie^2 \right]$$

$$_{178} C \left(H^-, H^+, \gamma, Z \right) = \left[\frac{ie^2}{c_W s_W} \left(c_W^2 - s_W^2 \right) \right]$$

$$_{179} C \left(H^-, H^+, Z, Z \right) = \left[\frac{ie^2}{2c_W^2 s_W^2} \left(c_W^2 - s_W^2 \right)^2 \right]$$

$$_{180} C \left(H^-, H^+, W^-, W^+ \right) = \left[\frac{ie^2}{2s_W^2} \right]$$

[VVVV] 4 Gauge Bosons

$$C(\gamma, \gamma, W^-, W^+) = ie^2 \begin{bmatrix} -2 \\ 1 \\ 1 \end{bmatrix}$$

$$C(\gamma, Z, W^-, W^+) = \frac{ie^2 c_W}{s_W} \begin{bmatrix} -2 \\ 1 \\ 1 \end{bmatrix}$$

$$C(Z, Z, W^-, W^+) = \frac{ie^2 c_W^2}{s_W^2} \begin{bmatrix} -2 \\ 1 \\ 1 \end{bmatrix}$$

$$C(W^-, W^-, W^+, W^+) = \frac{ie^2}{s_W^2} \begin{bmatrix} 2 \\ -1 \\ -1 \end{bmatrix}$$