

$$\begin{aligned}
& e^{i1-i2} \rightarrow c_\gamma y_e^{i1i2} + \hbar \left(\frac{1}{16} c_\gamma \frac{1}{m_\Phi^2} (m_\Phi^2 y_e^{i1i2} (3 g_2^2 (1 + 2 c_\gamma^2 + 2 s_\gamma^2) + g_1^2 (5 + 2 c_\gamma^2 + 2 s_\gamma^2)) + \right. \\
& \quad \overline{y_e}^{pr} (6 m_\Phi^2 y_e^{pi2} y_e^{i1r} (1 + s_\gamma^2) - 8 C_{H^2} s_\gamma^2 y_e^{pr} y_e^{i1i2})) + \\
& \quad \frac{1}{2} \sum_p s_{2\gamma} s_\gamma g_1^2 \frac{1}{m_\Phi^4} y_e^{i1i2} (C_{H^2} - m_\Phi^2) LF_{1,0}[m_d^{pr}] + \frac{3}{2} s_{2\gamma} s_\gamma \frac{1}{m_\Phi^4} \overline{y_d}^{pr} y_d^{pr} y_e^{i1i2} \\
& \quad (-C_{H^2} + m_\Phi^2) LF_{1,0}[m_d^{pr}] + \frac{1}{2} \sum_p s_{2\gamma} s_\gamma g_1^2 \frac{1}{m_\Phi^4} y_e^{i1i2} (C_{H^2} - m_\Phi^2) LF_{1,0}[m_e^{pr}] + \\
& \quad \frac{1}{2} s_{2\gamma} s_\gamma \frac{1}{m_\Phi^4} \overline{y_e}^{pr} y_e^{pr} y_e^{i1i2} (-C_{H^2} + m_\Phi^2) LF_{1,0}[m_e^{pr}] + \\
& \quad \frac{1}{2} s_{2\gamma} s_\gamma \frac{1}{m_\Phi^4} y_e^{i1i2} (-C_{H^2} + m_\Phi^2) (\overline{y_e}^{pr} y_e^{pr} + \sum_p g_1^2) LF_{1,0}[m_l^{pr}] - \\
& \quad \frac{1}{2} s_{2\gamma} s_\gamma \frac{1}{m_\Phi^4} y_e^{i1i2} (-C_{H^2} + m_\Phi^2) (-3 \overline{y_d}^{pr} y_d^{pr} + 3 \overline{y_u}^{pr} y_u^{pr} + \sum_p g_1^2) LF_{1,0}[m_q^{pr}] + \\
& \quad \sum_p s_{2\gamma} s_\gamma g_1^2 \frac{1}{m_\Phi^4} y_e^{i1i2} (-C_{H^2} + m_\Phi^2) LF_{1,0}[m_u^{pr}] + \\
& \quad \frac{3}{2} s_{2\gamma} s_\gamma \frac{1}{m_\Phi^4} y_e^{i1i2} \overline{y_u}^{pr} y_u^{pr} (C_{H^2} - m_\Phi^2) LF_{1,0}[m_u^{pr}] + \\
& \quad \frac{3}{8} s_{4\gamma} s_\gamma \frac{1}{m_\Phi^4} y_e^{i1i2} (g_1^2 + g_2^2) (C_{H^2} - m_\Phi^2) LF_{1,0}[m_\Phi] - \frac{3}{4} c_\gamma s_\gamma^2 \overline{y_e}^{pr} y_e^{pi2} y_e^{i1r} LF_{1,1}[m_\Phi] - \\
& \quad c_\gamma g_1^2 y_e^{i1i2} LF_{1,1,0}[m_1, m_e^{i2}] + \frac{1}{2} c_\gamma g_1^2 y_e^{i1i2} LF_{2,1,-1}[m_1, m_e^{i2}] - \\
& \quad \frac{1}{4} c_\gamma g_1^2 y_e^{i1i2} LF_{1,1,0}[m_1, m_l^{i1}] + \frac{1}{8} c_\gamma g_1^2 y_e^{i1i2} LF_{2,1,-1}[m_1, m_l^{i1}] + \\
& \quad m_1 s_\gamma \tilde{\mu} g_1^2 \frac{1}{m_\Phi^4} y_e^{i1i2} (C_{H^2} - m_\Phi^2) (-c_\gamma^2 + s_\gamma^2) LF_{1,1,0}[m_1, \tilde{\mu}] - \\
& \quad \frac{3}{4} c_\gamma g_2^2 y_e^{i1i2} LF_{1,1,0}[m_2, m_l^{i1}] + \frac{3}{8} c_\gamma g_2^2 y_e^{i1i2} LF_{2,1,-1}[m_2, m_l^{i1}] + \\
& \quad 3 m_2 s_\gamma \tilde{\mu} g_2^2 \frac{1}{m_\Phi^4} y_e^{i1i2} (C_{H^2} - m_\Phi^2) (-c_\gamma^2 + s_\gamma^2) LF_{1,1,0}[m_2, \tilde{\mu}] + \\
& \quad 3 s_\gamma \frac{1}{m_\Phi^4} y_e^{i1i2} (C_{H^2} - m_\Phi^2) (s_\gamma \overline{a_d}^{pr} + \tilde{\mu} c_\gamma \overline{y_d}^{pr}) (-c_\gamma a_d^{pr} + s_\gamma \tilde{\mu} y_d^{pr}) LF_{1,1,0}[m_d^{pr}, m_q^{pr}] + \\
& \quad s_\gamma \frac{1}{m_\Phi^4} y_e^{i1i2} (C_{H^2} - m_\Phi^2) (s_\gamma \overline{a_e}^{pr} + \tilde{\mu} c_\gamma \overline{y_e}^{pr}) (-c_\gamma a_e^{pr} + s_\gamma \tilde{\mu} y_e^{pr}) LF_{1,1,0}[m_e^{pr}, m_l^{pr}] - \\
& \quad \frac{1}{2} c_\gamma \overline{y_e}^{pr} y_e^{pi2} y_e^{i1r} LF_{1,1,0}[m_e^{pr}, \tilde{\mu}] + \frac{1}{2} \frac{1}{m_\Phi^2} y_e^{i1i2} \\
& \quad (\overline{a_e}^{pr} (m_\Phi^2 c_\gamma^2 + 2 C_{H^2} s_\gamma^2) + s_\gamma \tilde{\mu} c_\gamma \overline{y_e}^{pr} (2 C_{H^2} - m_\Phi^2)) (c_\gamma a_e^{pr} - s_\gamma \tilde{\mu} y_e^{pr}) LF_{2,1,0}[m_l^{pr}, m_e^{pr}] - \\
& \quad \frac{1}{2} \frac{1}{m_\Phi^2} y_e^{i1i2} (\overline{a_e}^{pr} (m_\Phi^2 c_\gamma^2 + 2 C_{H^2} s_\gamma^2) + s_\gamma \tilde{\mu} c_\gamma \overline{y_e}^{pr} (2 C_{H^2} - m_\Phi^2)) (c_\gamma a_e^{pr} - s_\gamma \tilde{\mu} y_e^{pr}) \\
& \quad LF_{3,1,-1}[m_l^{pr}, m_e^{pr}] + C_{H^2} c_\gamma y_e^{i1i2} (c_\gamma \overline{a_e}^{pr} - s_\gamma \tilde{\mu} \overline{y_e}^{pr}) (c_\gamma a_e^{pr} - s_\gamma \tilde{\mu} y_e^{pr}) LF_{3,1,0}[m_l^{pr}, m_e^{pr}] - \\
& \quad 3 C_{H^2} c_\gamma y_e^{i1i2} (c_\gamma \overline{a_e}^{pr} - s_\gamma \tilde{\mu} \overline{y_e}^{pr}) (c_\gamma a_e^{pr} - s_\gamma \tilde{\mu} y_e^{pr}) LF_{4,1,-1}[m_l^{pr}, m_e^{pr}] + \\
& \quad 2 C_{H^2} c_\gamma y_e^{i1i2} (c_\gamma \overline{a_e}^{pr} - s_\gamma \tilde{\mu} \overline{y_e}^{pr}) (c_\gamma a_e^{pr} - s_\gamma \tilde{\mu} y_e^{pr}) LF_{5,1,-2}[m_l^{pr}, m_e^{pr}] - \\
& \quad c_\gamma \overline{y_e}^{pr} y_e^{pi2} y_e^{i1r} LF_{1,1,0}[m_l^{pr}, \tilde{\mu}] + \\
& \quad \frac{3}{2} \frac{1}{m_\Phi^2} y_e^{i1i2} (\overline{a_d}^{pr} (m_\Phi^2 c_\gamma^2 + 2 C_{H^2} s_\gamma^2) + s_\gamma \tilde{\mu} c_\gamma \overline{y_d}^{pr} (2 C_{H^2} - m_\Phi^2)) \\
& \quad (c_\gamma a_d^{pr} - s_\gamma \tilde{\mu} y_d^{pr}) LF_{2,1,0}[m_q^{pr}, m_d^{pr}] - \frac{3}{2} \frac{1}{m_\Phi^2} y_e^{i1i2} \\
& \quad (\overline{a_d}^{pr} (m_\Phi^2 c_\gamma^2 + 2 C_{H^2} s_\gamma^2) + s_\gamma \tilde{\mu} c_\gamma \overline{y_d}^{pr} (2 C_{H^2} - m_\Phi^2)) (c_\gamma a_d^{pr} - s_\gamma \tilde{\mu} y_d^{pr}) LF_{3,1,-1}[m_q^{pr}, m_d^{pr}] + \\
& \quad 3 C_{H^2} c_\gamma y_e^{i1i2} (c_\gamma \overline{a_d}^{pr} - s_\gamma \tilde{\mu} \overline{y_d}^{pr}) (c_\gamma a_d^{pr} - s_\gamma \tilde{\mu} y_d^{pr}) LF_{3,1,0}[m_q^{pr}, m_d^{pr}] - \\
& \quad 9 C_{H^2} c_\gamma y_e^{i1i2} (c_\gamma \overline{a_d}^{pr} - s_\gamma \tilde{\mu} \overline{y_d}^{pr}) (c_\gamma a_d^{pr} - s_\gamma \tilde{\mu} y_d^{pr}) LF_{4,1,-1}[m_q^{pr}, m_d^{pr}] + \\
& \quad 6 C_{H^2} c_\gamma y_e^{i1i2} (c_\gamma \overline{a_d}^{pr} - s_\gamma \tilde{\mu} \overline{y_d}^{pr}) (c_\gamma a_d^{pr} - s_\gamma \tilde{\mu} y_d^{pr}) LF_{5,1,-2}[m_q^{pr}, m_d^{pr}] + \\
& \quad 3 s_\gamma \frac{1}{m_\Phi^4} y_e^{i1i2} (C_{H^2} - m_\Phi^2) (s_\gamma \overline{a_u}^{pr} - \tilde{\mu} c_\gamma \overline{y_u}^{pr}) (c_\gamma a_u^{pr} + s_\gamma \tilde{\mu} y_u^{pr}) LF_{1,1,0}[m_q^{pr}, m_u^{pr}] - \\
& \quad \frac{3}{2} \frac{1}{m_\Phi^2} y_e^{i1i2} (s_\gamma \overline{a_u}^{pr} - \tilde{\mu} c_\gamma \overline{y_u}^{pr}) (s_\gamma c_\gamma a_u^{pr} (2 C_{H^2} - m_\Phi^2) + \tilde{\mu} y_u^{pr} (m_\Phi^2 c_\gamma^2 + 2 C_{H^2} s_\gamma^2)) \\
& \quad LF_{2,1,0}[m_u^{pr}, m_q^{pr}] + \frac{3}{2} \frac{1}{m_\Phi^2} y_e^{i1i2} (s_\gamma \overline{a_u}^{pr} - \tilde{\mu} c_\gamma \overline{y_u}^{pr}) \\
& \quad (s_\gamma c_\gamma a_u^{pr} (2 C_{H^2} - m_\Phi^2) + \tilde{\mu} y_u^{pr} (m_\Phi^2 c_\gamma^2 + 2 C_{H^2} s_\gamma^2)) LF_{3,1,-1}[m_u^{pr}, m_q^{pr}] + \\
& \quad 3 C_{H^2} c_\gamma y_e^{i1i2} (-s_\gamma \overline{a_u}^{pr} + \tilde{\mu} c_\gamma \overline{y_u}^{pr}) (-s_\gamma a_u^{pr} + \tilde{\mu} c_\gamma y_u^{pr}) LF_{3,1,0}[m_u^{pr}, m_q^{pr}] - \\
& \quad 9 C_{H^2} c_\gamma y_e^{i1i2} (-s_\gamma \overline{a_u}^{pr} + \tilde{\mu} c_\gamma \overline{y_u}^{pr}) (-s_\gamma a_u^{pr} + \tilde{\mu} c_\gamma y_u^{pr}) LF_{4,1,-1}[m_u^{pr}, m_q^{pr}] + \\
& \quad 6 C_{H^2} c_\gamma y_e^{i1i2} (-s_\gamma \overline{a_u}^{pr} + \tilde{\mu} c_\gamma \overline{y_u}^{pr}) (-s_\gamma a_u^{pr} + \tilde{\mu} c_\gamma y_u^{pr}) LF_{5,1,-2}[m_u^{pr}, m_q^{pr}] - \\
& \quad \frac{3}{4} c_\gamma g_1^2 y_e^{i1i2} LF_{2,1,-1}[\tilde{\mu}, m_1] - m_1 s_\gamma \tilde{\mu} g_1^2 \frac{1}{m_\Phi^2} y_e^{i1i2} \\
& \quad (c_\gamma^2 (-C_{H^2} + m_\Phi^2) + C_{H^2} s_\gamma^2) LF_{2,1,0}[\tilde{\mu}, m_1] + \frac{1}{2} c_\gamma g_1^2 y_e^{i1i2} LF_{3,1,-2}[\tilde{\mu}, m_1] + \\
& \quad g_1^2 \frac{1}{m_\Phi^2} y_e^{i1i2} (-2 C_{H^2} c_\gamma m_\Phi^2 + m_1 s_\gamma \tilde{\mu} (c_\gamma^2 (-C_{H^2} + m_\Phi^2) + C_{H^2} s_\gamma^2)) LF_{3,1,-1}[\tilde{\mu}, m_1] - \\
& \quad 2 m_1 s_\gamma C_{H^2} \tilde{\mu} g_1^2 c_\gamma^2 y_e^{i1i2} LF_{3,1,0}[\tilde{\mu}, m_1] + 4 C_{H^2} c_\gamma g_1^2 y_e^{i1i2} LF_{4,1,-2}[\tilde{\mu}, m_1] + \\
& \quad 6 m_1 s_\gamma C_{H^2} \tilde{\mu} g_1^2 c_\gamma^2 y_e^{i1i2} LF_{4,1,-1}[\tilde{\mu}, m_1] - 2 C_{H^2} c_\gamma g_1^2 y_e^{i1i2} LF_{5,1,-3}[\tilde{\mu}, m_1] - \\
& \quad 4 m_1 s_\gamma C_{H^2} \tilde{\mu} g_1^2 c_\gamma^2 y_e^{i1i2} LF_{5,1,-2}[\tilde{\mu}, m_1] - \frac{9}{4} c_\gamma g_2^2 y_e^{i1i2} LF_{2,1,-1}[\tilde{\mu}, m_2] - 3 m_2 s_\gamma \tilde{\mu} g_2^2 \\
& \quad \frac{1}{m_\Phi^2} y_e^{i1i2} (c_\gamma^2 (-C_{H^2} + m_\Phi^2) + C_{H^2} s_\gamma^2) LF_{2,1,0}[\tilde{\mu}, m_2] + \frac{3}{2} c_\gamma g_2^2 y_e^{i1i2} LF_{3,1,-2}[\tilde{\mu}, m_2] + \\
& \quad 3 g_2^2 \frac{1}{m_\Phi^2} y_e^{i1i2} (-2 C_{H^2} c_\gamma m_\Phi^2 + m_2 s_\gamma \tilde{\mu} (c_\gamma^2 (-C_{H^2} + m_\Phi^2) + C_{H^2} s_\gamma^2)) LF_{3,1,-1}[\tilde{\mu}, m_2] - \\
& \quad 6 m_2 s_\gamma C_{H^2} \tilde{\mu} g_2^2 c_\gamma^2 y_e^{i1i2} LF_{3,1,0}[\tilde{\mu}, m_2] + 12 C_{H^2} c_\gamma g_2^2 y_e^{i1i2} LF_{4,1,-2}[\tilde{\mu}, m_2] + \\
& \quad 18 m_2 s_\gamma C_{H^2} \tilde{\mu} g_2^2 c_\gamma^2 y_e^{i1i2} LF_{4,1,-1}[\tilde{\mu}, m_2] - \\
& \quad 6 C_{H^2} c_\gamma g_2^2 y_e^{i1i2} LF_{5,1,-3}[\tilde{\mu}, m_2] - 12 m_2 s_\gamma C_{H^2} \tilde{\mu} g_2^2 c_\gamma^2 y_e^{i1i2} LF_{5,1,-2}[\tilde{\mu}, m_2] + \\
& \quad \frac{1}{4} c_\gamma \overline{y_e}^{pr} y_e^{pi2} y_e^{i1r} LF_{2,1,-1}[\tilde{\mu}, m_e^{pr}] + \frac{1}{2} c_\gamma \overline{y_e}^{pr} y_e^{pi2} y_e^{i1r} LF_{2,1,-1}[\tilde{\mu}, m_l^{pr}] + \\
& \quad m_1 g_1^2 (c_\gamma a_e^{i1i2} - s_\gamma \tilde{\mu} y_e^{i1i2}) LF_{1,1,1,0}[m_1, m_e^{i2}, m_l^{i1}] + \\
& \quad \frac{1}{4} m_1 C_{H^2} g_1^2 (-c_\gamma a_e^{i1i2} + s_\gamma \tilde{\mu} y_e^{i1i2}) LF_{2,2,1,-1}[m_1, m_e^{i2}, m_l^{i1}] + \\
& \quad c_\gamma g_1^2 y_e^{i1i2} LF_{1,1,1,-1}[m_1, m_e^{i2}, \tilde{\mu}] + m_1 s_\gamma \tilde{\mu} g_1^2 y_e^{i1i2} LF_{1,1,1,0}[m_1, m_e^{i2}, \tilde{\mu}] + \\
& \quad \frac{1}{4} m_1 C_{H^2} g_1^2 (-c_\gamma a_e^{i1i2} + s_\gamma \tilde{\mu} y_e^{i1i2}) LF_{2,2,1,-1}[m_1, m_l^{i1}, m_e^{i2}] - \\
& \quad \frac{1}{2} c_\gamma g_1^2 y_e^{i1i2} LF_{1,1,1,-1}[m_1, m_l^{i1}, \tilde{\mu}] - \frac{1}{2} m_1 s_\gamma \tilde{\mu} g_1^2 y_e^{i1i2} LF_{1,1,1,0}[m_1, m_l^{i1}, \tilde{\mu}] + \\
& \quad \frac{1}{2} C_{H^2} c_\gamma g_1^2 y_e^{i1i2} LF_{2,2,1,-2}[m_1, \tilde{\mu}, m_e^{i2}] + \frac{1}{2} m_1 s_\gamma C_{H^2} \tilde{\mu} g_1^2 y_e^{i1i2} LF_{2,2,1,-1}[m_1, \tilde{\mu}, m_e^{i2}] - \\
& \quad \frac{1}{4} C_{H^2} c_\gamma g_1^2 y_e^{i1i2} LF_{2,2,1,-2}[m_1, \tilde{\mu}, m_l^{i1}] - \frac{1}{4} m_1 s_\gamma C_{H^2} \tilde{\mu} g_1^2 y_e^{i1i2} LF_{2,2,1,-1}[m_1, \tilde{\mu}, m_l^{i1}] + \\
& \quad \frac{3}{2} c_\gamma g_2^2 y_e^{i1i2} LF_{1,1,1,-1}[m_2, m_l^{i1}, \tilde{\mu}] + \frac{3}{2} m_2 s_\gamma \tilde{\mu} g_2^2 y_e^{i1i2} LF_{1,1,1,0}[m_2, m_l^{i1}, \tilde{\mu}] + \\
& \quad \frac{3}{4} C_{H^2} c_\gamma g_2^2 y_e^{i1i2} LF_{2,2,1,-2}[m_2, \tilde{\mu}, m_l^{i1}] + \frac{3}{4} m_2 s_\gamma C_{H^2} \tilde{\mu} g_2^2 y_e^{i1i2} LF_{2,2,1,-1}[m_2, \tilde{\mu}, m_l^{i1}] + \\
& \quad \frac{1}{2} m_1 C_{H^2} g_1^2 (c_\gamma a_e^{i1i2} - s_\gamma \tilde{\mu} y_e^{i1i2}) LF_{2,1,1,0}[m_e^{i2}, m_1, m_l^{i1}] + \\
& \quad \frac{1}{2} m_1 C_{H^2} g_1^2 (-c_\gamma a_e^{i1i2} + s_\gamma \tilde{\mu} y_e^{i1i2}) LF_{3,1,1,-1}[m_e^{i2}, m_1, m_l^{i1}] + \\
& \quad \frac{1}{2} m_1 C_{H^2} g_1^2 (c_\gamma a_e^{i1i2} - s_\gamma \tilde{\mu} y_e^{i1i2}) LF_{2,1,1,0}[m_l^{i1}, m_1, m_e^{i2}] + \\
& \quad \frac{1}{2} m_1 C_{H^2} g_1^2 (-c_\gamma a_e^{i1i2} + s_\gamma \tilde{\mu} y_e^{i1i2}) LF_{3,1,1,-1}[m_l^{i1}, m_1, m_e^{i2}])
\end{aligned}$$