

$$\begin{aligned}
& \hbar \left(\frac{1}{324} \frac{1}{m_e^2} (\overline{y_d}^{pi3} (27 \overline{y_u}^{ri1} (-y_d^{ri4} y_u^{pi2} (c_\gamma^2 + s_\gamma^2)^2 + 6 s_\gamma^2 c_\gamma^2 y_d^{pi4} y_u^{ri2}) - 2 g_1^2 s_\gamma^2 y_d^{pi4} \delta_{i1i2}) + \right. \\
& \quad 7 g_1^2 c_\gamma^2 \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) - \frac{8}{243} \sum_{\mathbf{p}} g_1^4 \text{LF}_{3,0} [m_d^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{5}{81} \sum_{\mathbf{p}} g_1^4 \text{LF}_{4,-1} [m_d^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \frac{32}{1215} \sum_{\mathbf{p}} g_1^4 \text{LF}_{5,-2} [m_d^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{8}{81} \sum_{\mathbf{p}} g_1^4 \text{LF}_{3,0} [m_e^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} + \frac{5}{27} \sum_{\mathbf{p}} g_1^4 \text{LF}_{4,-1} [m_e^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{32}{405} \sum_{\mathbf{p}} g_1^4 \text{LF}_{5,-2} [m_e^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \frac{4}{81} \sum_{\mathbf{p}} g_1^4 \text{LF}_{3,0} [m_l^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{5}{54} \sum_{\mathbf{p}} g_1^4 \text{LF}_{4,-1} [m_l^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \frac{16}{405} \sum_{\mathbf{p}} g_1^4 \text{LF}_{5,-2} [m_l^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{4}{243} \sum_{\mathbf{p}} g_1^4 \text{LF}_{3,0} [m_q^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} + \frac{5}{162} \sum_{\mathbf{p}} g_1^4 \text{LF}_{4,-1} [m_q^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{16}{1215} \sum_{\mathbf{p}} g_1^4 \text{LF}_{5,-2} [m_q^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \frac{32}{243} \sum_{\mathbf{p}} g_1^4 \text{LF}_{3,0} [m_u^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{20}{81} \sum_{\mathbf{p}} g_1^4 \text{LF}_{4,-1} [m_u^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} - \frac{128}{1215} \sum_{\mathbf{p}} g_1^4 \text{LF}_{5,-2} [m_u^{\mathbf{p}}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{1}{54} (\overline{y_d}^{pi3} (9 \overline{y_u}^{ri1} (y_d^{ri4} y_u^{pi2} (c_\gamma^2 - s_\gamma^2)^2 + 6 s_\gamma^2 c_\gamma^2 y_d^{pi4} y_u^{ri2}) - 4 g_1^2 s_\gamma^2 y_d^{pi4} \delta_{i1i2}) + \\
& \quad 2 g_1^2 c_\gamma^2 \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) \text{LF}_{1,2} [m_\Phi] + \\
& \quad \frac{1}{18} (s_\gamma^2 \overline{y_d}^{pi3} (3 c_\gamma^2 \overline{y_u}^{ri1} (2 y_d^{ri4} y_u^{pi2} - 3 y_d^{pi4} y_u^{ri2}) + 2 g_1^2 y_d^{pi4} \delta_{i1i2}) + \\
& \quad g_1^2 c_\gamma^2 \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) \text{LF}_{2,1} [m_\Phi] - \\
& \quad \frac{1}{162} g_1^2 (18 s_\gamma^2 \overline{y_d}^{pi3} y_d^{pi4} \delta_{i1i2} + (9 c_\gamma^2 \overline{y_u}^{pi1} y_u^{pi2} + 8 g_1^2 \delta_{i1i2}) \delta_{i3i4}) \text{LF}_{3,0} [m_\Phi] + \\
& \quad \frac{5}{54} g_1^4 \text{LF}_{4,-1} [m_\Phi] \delta_{i1i2} \delta_{i3i4} - \frac{16}{405} g_1^4 \text{LF}_{5,-2} [m_\Phi] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{4}{81} g_1^4 \text{LF}_{3,0} [\tilde{\mu}] \delta_{i1i2} \delta_{i3i4} - \frac{2}{27} g_1^4 \text{LF}_{4,-1} [\tilde{\mu}] \delta_{i1i2} \delta_{i3i4} + \frac{32}{405} g_1^4 \text{LF}_{5,-2} [\tilde{\mu}] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{2}{243} g_1^4 \text{LF}_{2,1,0} [m_1, m_d^{i4}] \delta_{i1i2} \delta_{i3i4} - \frac{2}{243} g_1^4 \text{LF}_{2,2,-1} [m_1, m_d^{i4}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{4}{243} g_1^4 \text{LF}_{3,1,-1} [m_1, m_d^{i4}] \delta_{i1i2} \delta_{i3i4} - \frac{2}{243} g_1^4 \text{LF}_{4,1,-2} [m_1, m_d^{i4}] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{8}{243} g_1^4 \text{LF}_{2,1,0} [m_1, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} - \frac{8}{243} g_1^4 \text{LF}_{2,2,-1} [m_1, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{16}{243} g_1^4 \text{LF}_{3,1,-1} [m_1, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} - \frac{8}{243} g_1^4 \text{LF}_{4,1,-2} [m_1, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{8}{81} g_1^2 g_3^2 \text{LF}_{2,1,0} [m_3, m_d^{i4}] \delta_{i1i2} \delta_{i3i4} - \frac{8}{81} g_1^2 g_3^2 \text{LF}_{2,2,-1} [m_3, m_d^{i4}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{16}{81} g_1^2 g_3^2 \text{LF}_{3,1,-1} [m_3, m_d^{i4}] \delta_{i1i2} \delta_{i3i4} - \frac{8}{81} g_1^2 g_3^2 \text{LF}_{4,1,-2} [m_3, m_d^{i4}] \delta_{i1i2} \delta_{i3i4} - \\
& \quad \frac{8}{81} g_1^2 g_3^2 \text{LF}_{2,1,0} [m_3, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} - \frac{8}{81} g_1^2 g_3^2 \text{LF}_{2,2,-1} [m_3, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{16}{81} g_1^2 g_3^2 \text{LF}_{3,1,-1} [m_3, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} - \frac{8}{81} g_1^2 g_3^2 \text{LF}_{4,1,-2} [m_3, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{4}{243} g_1^4 \text{LF}_{2,1,0} [m_d^{i4}, m_1] \delta_{i1i2} \delta_{i3i4} - \frac{2}{243} g_1^4 \text{LF}_{3,1,-1} [m_d^{i4}, m_1] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{16}{81} g_1^2 g_3^2 \text{LF}_{2,1,0} [m_d^{i4}, m_3] \delta_{i1i2} \delta_{i3i4} - \frac{8}{81} g_1^2 g_3^2 \text{LF}_{3,1,-1} [m_d^{i4}, m_3] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{1}{27} g_1^2 (-2 \overline{y_d}^{pi3} y_d^{pi4} \delta_{i1i2} + \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) \text{LF}_{2,1,0} [m_q^{\mathbf{p}}, \tilde{\mu}] + \\
& \quad \frac{1}{54} g_1^2 (2 \overline{y_d}^{pi3} y_d^{pi4} \delta_{i1i2} - \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) \text{LF}_{2,2,-1} [m_q^{\mathbf{p}}, \tilde{\mu}] + \\
& \quad \frac{1}{54} g_1^2 (2 \overline{y_d}^{pi3} y_d^{pi4} \delta_{i1i2} - \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) \text{LF}_{3,1,-1} [m_q^{\mathbf{p}}, \tilde{\mu}] + \\
& \quad \frac{16}{243} g_1^4 \text{LF}_{2,1,0} [m_u^{i2}, m_1] \delta_{i1i2} \delta_{i3i4} - \frac{8}{243} g_1^4 \text{LF}_{3,1,-1} [m_u^{i2}, m_1] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{16}{81} g_1^2 g_3^2 \text{LF}_{2,1,0} [m_u^{i2}, m_3] \delta_{i1i2} \delta_{i3i4} - \frac{8}{81} g_1^2 g_3^2 \text{LF}_{3,1,-1} [m_u^{i2}, m_3] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{1}{54} g_1^2 (2 \overline{y_d}^{pi3} y_d^{pi4} \delta_{i1i2} - \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) \text{LF}_{2,1,0} [\tilde{\mu}, m_q^{\mathbf{p}}] + \\
& \quad \frac{1}{54} g_1^2 (14 \overline{y_d}^{pi3} y_d^{pi4} \delta_{i1i2} + 11 \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) \text{LF}_{3,1,-1} [\tilde{\mu}, m_q^{\mathbf{p}}] - \\
& \quad \frac{2}{27} g_1^2 (\overline{y_d}^{pi3} y_d^{pi4} \delta_{i1i2} + \overline{y_u}^{pi1} y_u^{pi2} \delta_{i3i4}) \text{LF}_{4,1,-2} [\tilde{\mu}, m_q^{\mathbf{p}}] + \\
& \quad \frac{4}{81} g_1^4 \text{LF}_{2,1,1,-1} [m_1, m_d^{i4}, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} + \frac{8}{81} g_1^4 m_1^2 \text{LF}_{2,1,1,0} [m_1, m_d^{i4}, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{2}{9} g_3^4 \text{LF}_{2,1,1,-1} [m_3, m_d^{i4}, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} + \frac{4}{9} g_3^4 m_3^2 \text{LF}_{2,1,1,0} [m_3, m_d^{i4}, m_u^{i2}] \delta_{i1i2} \delta_{i3i4} + \\
& \quad \frac{1}{6} \overline{y_d}^{pi3} y_d^{ri4} \overline{y_u}^{ri1} y_u^{pi2} \text{LF}_{2,1,1,-1} [\tilde{\mu}, m_q^{\mathbf{p}}, m_q^{\mathbf{r}}] - \\
& \quad \frac{1}{3} \tilde{\mu}^2 \overline{y_d}^{pi3} \overline{y_u}^{ri1} (y_d^{ri4} y_u^{pi2} - 3 y_d^{pi4} y_u^{ri2}) \text{LF}_{2,1,1,0} [\tilde{\mu}, m_q^{\mathbf{p}}, m_q^{\mathbf{r}}] \Big)
\end{aligned}$$