Raw amplitude

$$\frac{e^2}{16\pi^4} g_{\mu\nu} \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} \frac{\bar{u}(p)\gamma^\mu \left(m + \left(-k_{\sigma_2} + p_{\sigma_2}\right)\gamma^{\sigma_2}\right)\gamma^\nu u(p)}{\left(-m^2 + \left(-k_\eta + p_\eta\right)\left(-k^\eta + p^\eta\right)\right)\left(-t + k_\eta k^\eta\right)^2} \tag{1}$$

Simplified numerator

$$\frac{e^2}{16\pi^4} g_{\mu\nu} \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} \frac{m\bar{u}(p)\gamma^\mu\gamma^\nu u(p) - k_{\sigma_2}\bar{u}(p)\gamma^\mu\gamma^{\sigma_2}\gamma^\nu u(p) + p_{\sigma_2}\bar{u}(p)\gamma^\mu\gamma^{\sigma_2}\gamma^\nu u(p)}{\left(-m^2 + \left(-k_\eta + p_\eta\right)\left(-k^\eta + p^\eta\right)\right)\left(-t + k_\eta k^\eta\right)^2} \tag{2}$$

Feynman parameterization

Here, we perform the following expansion:

$$\frac{1}{A_1}\cdots\frac{1}{A_n} = (n-1)! \int_0^1 dz_1 \int_0^{1-z_1} dz_2 \cdots \int_0^{1-z_1-\cdots-z_{n-1}} dz_n \frac{1}{(z_1 A_1 + \cdots + z_n A_n)^n}$$

We use this form because a single denominator raised to a power can be simplified with the Golden Integral.

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} \frac{m\bar{u}(p)\gamma^\mu\gamma^\nu u(p) - k_{\sigma_2}\bar{u}(p)\gamma^\mu\gamma^{\sigma_2}\gamma^\nu u(p) + p_{\sigma_2}\bar{u}(p)\gamma^\mu\gamma^{\sigma_2}\gamma^\nu u(p)}{\left(-m^2 z_3 - t z_1 - t z_2 + z_1 k_\eta k^\eta + z_2 k_\eta k^\eta + z_3 k_\eta k^\eta - z_3 k_\eta p^\eta - z_3 k^\eta p_\eta + z_3 p_\eta p^\eta\right)^3} \tag{3}$$

Expanded numerator

We split the numerator into additive terms, to process individually. The following is a list of such terms:

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} \frac{m\bar{u}(p)\gamma^\mu\gamma^\nu u(p)}{\left(-m^2 z_3 - t z_1 - t z_2 + z_1 k_\eta k^\eta + z_2 k_\eta k^\eta + z_3 k_\eta k^\eta - z_3 k_\eta p^\eta - z_3 k^\eta p_\eta + z_3 p_\eta p^\eta\right)^3} \tag{4}$$

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} \frac{p_{\sigma_2}\bar{u}(p)\gamma^\mu\gamma^{\sigma_2}\gamma^\nu u(p)}{\left(-m^2 z_3 - t z_1 - t z_2 + z_1 k_\eta k^\eta + z_2 k_\eta k^\eta + z_3 k_\eta k^\eta - z_3 k_\eta p^\eta - z_3 k^\eta p_\eta + z_3 p_\eta p^\eta\right)^3} \tag{5}$$

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} - \frac{k_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{\left(-m^2 z_3 - t z_1 - t z_2 + z_1 k_\eta k^\eta + z_2 k_\eta k^\eta + z_3 k_\eta k^\eta - z_3 k_\eta p^\eta - z_3 k^\eta p_\eta + z_3 p_\eta p^\eta\right)^3} \tag{6}$$

Golden Integral

We resolve internal momentas with this transformation:

$$\int \frac{d^d q}{(2\pi)^d} \frac{(q^2)^a}{(q^2 + D)^b} = i \frac{\Gamma(b - a - \frac{1}{2}d)\Gamma(a + \frac{1}{2}d)}{(4\pi)^{d/2}\Gamma(b)\Gamma(\frac{1}{2}d)} D^{-(b-a-d/2)}$$

After this section, all internal momenta should disappear. We will now resolve each term in a queue. Each term may produce additional terms, which are pushed to the back of the queue and resolved later.

Evaluating internal momenta in this term (2 terms left)

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} \frac{m \bar{u}(p) \gamma^\mu \gamma^\nu u(p)}{\left(-m^2 z_3 - t z_1 - t z_2 + z_1 k_\eta k^\eta + z_2 k_\eta k^\eta + z_3 k_\eta k^\eta - z_3 k_\eta p^\eta - z_3 k^\eta p_\eta + z_3 p_\eta p^\eta\right)^3} \tag{7}$$

Integrating over k
Completing the square

$$A = z_1 + z_2 + z_3 \tag{8}$$

$$B = -2 z_3 p^\eta \tag{9}$$

$$C = -m^2 z_3 - t z_1 - t z_2 + z_3 p_\eta p^\eta \tag{10}$$

After $k \to q_1$ substitutions

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} \frac{m \bar{u}(p) \gamma^\mu \gamma^\nu u(p)}{(z_1 + z_2 + z_3)^{0.5} \left(-m^2 z_3 - t z_1 - t z_2 - \frac{{z_3}^2 p_\eta p^\eta}{4z_1 + 4z_2 + 4z_3} + z_3 p_\eta p^\eta + {q_1}_\eta {q_1}^\eta\right)^3} \tag{11}$$

Expanding numerator into 1 term(s)

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} \frac{m\bar{u}(p)\gamma^\mu \gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{{z_3}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta + {q_1}_\eta {q_1}^\eta\right)^3} \tag{12}$$

Integrating this term:

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} \frac{m\bar{u}(p)\gamma^\mu \gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{{z_3}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta + {q_1}_\eta {q_1}^\eta\right)^3} \tag{13}$$

Found 0 q-vector terms in the numerator.
Apply golden integral

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \frac{m\bar{u}(p)\gamma^\mu \gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{{z_3}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta\right)} \tag{14}$$

Evaluating internal momenta in this term (2 terms left)

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} \frac{p_{\sigma_2}\bar{u}(p)\gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{(-m^2 z_3 - tz_1 - tz_2 + z_1 k_\eta k^\eta + z_2 k_\eta k^\eta + z_3 k_\eta k^\eta - z_3 k_\eta p^\eta - z_3 k^\eta p_\eta + z_3 p_\eta p^\eta)^3} \tag{15}$$

Integrating over k
Completing the square

$$A = z_1 + z_2 + z_3 \tag{16}$$

$$B = -2z_3 p^\eta \tag{17}$$

$$C = -m^2 z_3 - tz_1 - tz_2 + z_3 p_\eta p^\eta \tag{18}$$

After $k \to q_1$ substitutions

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} \frac{p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta + q_{1\eta} q_1{}^\eta\right)^3} \tag{19}$$

Expanding numerator into 1 term(s)

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} \frac{p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta + q_{1\eta} q_1{}^\eta\right)^3} \tag{20}$$

Integrating this term:

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} \frac{p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta + q_{1\eta} q_1{}^\eta\right)^3} \tag{21}$$

Found 0 q-vector terms in the numerator.
Apply golden integral

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \frac{p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta\right)} \tag{22}$$

Evaluating internal momenta in this term (2 terms left)

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d k}{(2\pi)^4} - \frac{k_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{\left(-m^2 z_3 - tz_1 - tz_2 + z_1 k_\eta k^\eta + z_2 k_\eta k^\eta + z_3 k_\eta k^\eta - z_3 k_\eta p^\eta - z_3 k^\eta p_\eta + z_3 p_\eta p^\eta\right)^3} \tag{23}$$

Integrating over k
Completing the square

$$A = z_1 + z_2 + z_3 \tag{24}$$

$$B = -2z_3 p^{\eta} \tag{25}$$

$$C = -m^2 z_3 - tz_1 - tz_2 + z_3 p_{\eta} p^{\eta} \tag{26}$$

After $k \to q_1$ substitutions

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} - \frac{\left(\frac{1}{2} z_3 \left(z_1 + z_2 + z_3\right)^{0.5} p_{\sigma_2} + \left(z_1 + z_2 + z_3\right) q_{1\sigma_2}\right) \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_2} \gamma^{\nu} u(p)}{\left(z_1 + z_2 + z_3\right)^{2.0} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_{\eta} p^{\eta}}{4z_1 + 4z_2 + 4z_3} + z_3 p_{\eta} p^{\eta} + q_{1\eta} q_1{}^{\eta}\right)^3} \tag{27}$$

Expanding numerator into 4 term(s)

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} - \frac{z_1 q_{1\sigma_2} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_2} \gamma^{\nu} u(p)}{\left(z_1 + z_2 + z_3\right)^{2.0} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_{\eta} p^{\eta}}{4z_1 + 4z_2 + 4z_3} + z_3 p_{\eta} p^{\eta} + q_{1\eta} q_1{}^{\eta}\right)^3} \tag{28}$$

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} - \frac{z_2 q_{1\sigma_2} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_2} \gamma^{\nu} u(p)}{\left(z_1 + z_2 + z_3\right)^{2.0} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_{\eta} p^{\eta}}{4z_1 + 4z_2 + 4z_3} + z_3 p_{\eta} p^{\eta} + q_{1\eta} q_1{}^{\eta}\right)^3} \tag{29}$$

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} - \frac{z_3 q_{1\sigma_2} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_2} \gamma^{\nu} u(p)}{\left(z_1 + z_2 + z_3\right)^{2.0} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_{\eta} p^{\eta}}{4z_1 + 4z_2 + 4z_3} + z_3 p_{\eta} p^{\eta} + q_{1\eta} q_1{}^{\eta}\right)^3} \tag{30}$$

$$\frac{e^2}{8\pi^4} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \int \frac{d^d q_1}{(2\pi)^4} - \frac{z_3 p_{\sigma_2} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_2} \gamma^{\nu} u(p)}{2\left(z_1 + z_2 + z_3\right)^{1.5} \left(-m^2 z_3 - tz_1 - tz_2 - \frac{z_3{}^2 p_{\eta} p^{\eta}}{4z_1 + 4z_2 + 4z_3} + z_3 p_{\eta} p^{\eta} + q_{1\eta} q_1{}^{\eta}\right)^3} \tag{31}$$

Integrating this term:

$$\frac{e^{2}}{8\pi^{4}} g_{\mu\nu} \int\limits_{0}^{1} dz_{1} \int\limits_{0}^{-z_{1}+1} dz_{2} \int\limits_{0}^{-z_{1}-z_{2}+1} dz_{3} \int\limits_{\lambda^{2}}^{\Lambda^{2}} dt \int \frac{d^{d}q_{1}}{(2\pi)^{4}} - \frac{z_{1} q_{1\sigma_{2}} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_{2}} \gamma^{\nu} u(p)}{(z_{1}+z_{2}+z_{3})^{2.0} \left(-m^{2} z_{3} - t z_{1} - t z_{2} - \frac{z_{3}^{2} p_{\eta} p^{\eta}}{4z_{1}+4z_{2}+4z_{3}} + z_{3} p_{\eta} p^{\eta} + q_{1\eta} q_{1}{}^{\eta}\right)^{3}} \tag{32}$$

Found 1 q-vector terms in the numerator.
Term vanishes due to Ward identity

Integrating this term:

$$\frac{e^{2}}{8\pi^{4}} g_{\mu\nu} \int\limits_{0}^{1} dz_{1} \int\limits_{0}^{-z_{1}+1} dz_{2} \int\limits_{0}^{-z_{1}-z_{2}+1} dz_{3} \int\limits_{\lambda^{2}}^{\Lambda^{2}} dt \int \frac{d^{d}q_{1}}{(2\pi)^{4}} - \frac{z_{2} q_{1\sigma_{2}} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_{2}} \gamma^{\nu} u(p)}{(z_{1}+z_{2}+z_{3})^{2.0} \left(-m^{2} z_{3} - t z_{1} - t z_{2} - \frac{z_{3}^{2} p_{\eta} p^{\eta}}{4z_{1}+4z_{2}+4z_{3}} + z_{3} p_{\eta} p^{\eta} + q_{1\eta} q_{1}{}^{\eta}\right)^{3}} \tag{33}$$

Found 1 q-vector terms in the numerator.
Term vanishes due to Ward identity

Integrating this term:

$$\frac{e^{2}}{8\pi^{4}} g_{\mu\nu} \int\limits_{0}^{1} dz_{1} \int\limits_{0}^{-z_{1}+1} dz_{2} \int\limits_{0}^{-z_{1}-z_{2}+1} dz_{3} \int\limits_{\lambda^{2}}^{\Lambda^{2}} dt \int \frac{d^{d}q_{1}}{(2\pi)^{4}} - \frac{z_{3} q_{1\sigma_{2}} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_{2}} \gamma^{\nu} u(p)}{(z_{1}+z_{2}+z_{3})^{2.0} \left(-m^{2} z_{3} - t z_{1} - t z_{2} - \frac{z_{3}^{2} p_{\eta} p^{\eta}}{4z_{1}+4z_{2}+4z_{3}} + z_{3} p_{\eta} p^{\eta} + q_{1\eta} q_{1}{}^{\eta}\right)^{3}} \tag{34}$$

Found 1 q-vector terms in the numerator.
Term vanishes due to Ward identity

Integrating this term:

$$\frac{e^{2}}{8\pi^{4}} g_{\mu\nu} \int\limits_{0}^{1} dz_{1} \int\limits_{0}^{-z_{1}+1} dz_{2} \int\limits_{0}^{-z_{1}-z_{2}+1} dz_{3} \int\limits_{\lambda^{2}}^{\Lambda^{2}} dt \int \frac{d^{d}q_{1}}{(2\pi)^{4}} - \frac{z_{3} p_{\sigma_{2}} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_{2}} \gamma^{\nu} u(p)}{2\left(z_{1}+z_{2}+z_{3}\right)^{1.5} \left(-m^{2} z_{3} - t z_{1} - t z_{2} - \frac{z_{3}^{2} p_{\eta} p^{\eta}}{4z_{1}+4z_{2}+4z_{3}} + z_{3} p_{\eta} p^{\eta} + q_{1\eta} q_{1}{}^{\eta}\right)^{3}} \tag{35}$$

Found 0 q-vector terms in the numerator.
Apply golden integral

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt - \frac{z_3 p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{2 \left(z_1 + z_2 + z_3\right)^{1.5} \left(-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1 + 4z_2 + 4z_3} + z_3 p_\eta p^\eta\right)} \tag{36}$$

Evaluating internal momenta in this term (2 terms left)

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \frac{m \bar{u}(p) \gamma^\mu \gamma^\nu u(p)}{\left(z_1 + z_2 + z_3\right)^{0.5} \left(-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1 + 4z_2 + 4z_3} + z_3 p_\eta p^\eta\right)} \tag{37}$$

Evaluating internal momenta in this term (1 terms left)

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \frac{p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{\left(z_1 + z_2 + z_3\right)^{0.5} \left(-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1 + 4z_2 + 4z_3} + z_3 p_\eta p^\eta\right)} \tag{38}$$

Evaluating internal momenta in this term (0 terms left)

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt - \frac{z_3 p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{2 \left(z_1 + z_2 + z_3\right)^{1.5} \left(-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1 + 4z_2 + 4z_3} + z_3 p_\eta p^\eta\right)} \tag{39}$$

Final amplitudes after momenta integration

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \frac{m \bar{u}(p) \gamma^\mu \gamma^\nu u(p)}{\left(z_1 + z_2 + z_3\right)^{0.5} \left(-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1 + 4z_2 + 4z_3} + z_3 p_\eta p^\eta\right)} \tag{40}$$

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \frac{p_{\sigma_2}\bar{u}(p)\gamma^\mu\gamma^{\sigma_2}\gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5}\left(-m^2z_3 - tz_1 - tz_2 - \frac{{z_3}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta\right)} \tag{41}$$

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt - \frac{z_3 p_{\sigma_2}\bar{u}(p)\gamma^\mu\gamma^{\sigma_2}\gamma^\nu u(p)}{2\left(z_1+z_2+z_3\right)^{1.5}\left(-m^2z_3 - tz_1 - tz_2 - \frac{{z_3}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta\right)} \tag{42}$$

Integrating cutoffs

Here we integrate all t-variables, which represent the upper and lower cutoffs.

Integrating this term

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \int_{\lambda^2}^{\Lambda^2} dt \frac{m\bar{u}(p)\gamma^\mu\gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5}\left(-m^2z_3 - tz_1 - tz_2 - \frac{{z_3}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta\right)} \tag{43}$$

Denominator only

$$\frac{1}{-m^2z_3 - tz_1 - tz_2 - \frac{{z_3}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta} \tag{44}$$

Integrating wrt t...

$$\begin{aligned} &\frac{1}{-4{z_1}^2 - 8z_1z_2 - 4z_1z_3 - 4{z_2}^2 - 4z_2z_3}(4z_1 + 4z_2 \\ &+ 4z_3)\log\left(\Lambda^2\left(-4{z_1}^2 - 8z_1z_2 - 4z_1z_3 - 4{z_2}^2 - 4z_2z_3\right) - 4m^2z_1z_3 - 4m^2z_2z_3 - 4m^2{z_3}^2 + 4z_1z_3p_\eta p^\eta + 4z_2z_3p_\eta p^\eta + 3{z_3}^2p_\eta p^\eta\right) \\ &- \frac{1}{-4{z_1}^2 - 8z_1z_2 - 4z_1z_3 - 4{z_2}^2 - 4z_2z_3}(4z_1 + 4z_2 \\ &+ 4z_3)\log\left(\lambda^2\left(-4{z_1}^2 - 8z_1z_2 - 4z_1z_3 - 4{z_2}^2 - 4z_2z_3\right) - 4m^2z_1z_3 - 4m^2z_2z_3 - 4m^2{z_3}^2 + 4z_1z_3p_\eta p^\eta + 4z_2z_3p_\eta p^\eta + 3{z_3}^2p_\eta p^\eta\right) \end{aligned} \tag{45}$$

Keeping only highest order term...

$$-\frac{2\log(\Lambda)}{z_1+z_2} \tag{46}$$

Integrating this term

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt \frac{p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{(z_1+z_2+z_3)^{0.5} \left(-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta\right)} \tag{47}$$

Denominator only

$$\frac{1}{-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta} \tag{48}$$

Integrating wrt t...

$$\begin{aligned} &\frac{1}{-4z_1{}^2 - 8z_1 z_2 - 4z_1 z_3 - 4z_2{}^2 - 4z_2 z_3} (4z_1 + 4z_2 \\ &\quad + 4z_3) \log\left(\Lambda^2\left(-4z_1{}^2 - 8z_1 z_2 - 4z_1 z_3 - 4z_2{}^2 - 4z_2 z_3\right) - 4m^2 z_1 z_3 - 4m^2 z_2 z_3 - 4m^2 z_3{}^2 + 4z_1 z_3 p_\eta p^\eta + 4z_2 z_3 p_\eta p^\eta + 3z_3{}^2 p_\eta p^\eta\right) \\ &\quad - \frac{1}{-4z_1{}^2 - 8z_1 z_2 - 4z_1 z_3 - 4z_2{}^2 - 4z_2 z_3} (4z_1 + 4z_2 \\ &\quad + 4z_3) \log\left(\lambda^2\left(-4z_1{}^2 - 8z_1 z_2 - 4z_1 z_3 - 4z_2{}^2 - 4z_2 z_3\right) - 4m^2 z_1 z_3 - 4m^2 z_2 z_3 - 4m^2 z_3{}^2 + 4z_1 z_3 p_\eta p^\eta + 4z_2 z_3 p_\eta p^\eta + 3z_3{}^2 p_\eta p^\eta\right) \end{aligned} \tag{49}$$

Keeping only highest order term...

$$-\frac{2\log(\Lambda)}{z_1 + z_2} \tag{50}$$

Integrating this term

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int\limits_0^1 dz_1 \int\limits_0^{-z_1+1} dz_2 \int\limits_0^{-z_1-z_2+1} dz_3 \int\limits_{\lambda^2}^{\Lambda^2} dt - \frac{z_3 p_{\sigma_2} \bar{u}(p) \gamma^\mu \gamma^{\sigma_2} \gamma^\nu u(p)}{2(z_1+z_2+z_3)^{1.5} \left(-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta\right)} \tag{51}$$

Denominator only

$$\frac{1}{-m^2 z_3 - t z_1 - t z_2 - \frac{z_3{}^2 p_\eta p^\eta}{4z_1+4z_2+4z_3} + z_3 p_\eta p^\eta} \tag{52}$$

Integrating wrt t...

$$\frac{1}{-4{z_1}^2-8z_1z_2-4z_1z_3-4{z_2}^2-4z_2z_3}\left(4z_1+4z_2+4z_3\right)\log\left(\Lambda^2\left(-4{z_1}^2-8z_1z_2-4z_1z_3-4{z_2}^2-4z_2z_3\right)-4m^2z_1z_3-4m^2z_2z_3-4m^2{z_3}^2+4z_1z_3p_\eta p^\eta+4z_2z_3p_\eta p^\eta+3{z_3}^2p_\eta p^\eta\right)-\frac{1}{-4{z_1}^2-8z_1z_2-4z_1z_3-4{z_2}^2-4z_2z_3}\left(4z_1+4z_2+4z_3\right)\log\left(\lambda^2\left(-4{z_1}^2-8z_1z_2-4z_1z_3-4{z_2}^2-4z_2z_3\right)-4m^2z_1z_3-4m^2z_2z_3-4m^2{z_3}^2+4z_1z_3p_\eta p^\eta+4z_2z_3p_\eta p^\eta+3{z_3}^2p_\eta p^\eta\right) \tag{53}$$

Keeping only highest order term...

$$-\frac{2\log\left(\Lambda\right)}{z_1+z_2} \tag{54}$$

Integrating z-variables

Here we integrate all z-variables, the Feynman parameters.

Integrating this term

$$\frac{ie^2}{16\pi^2}g_{\mu\nu}\int\limits_0^1 dz_1\int\limits_0^{-z_1+1} dz_2\int\limits_0^{-z_1-z_2+1} dz_3-\frac{2m\log\left(\Lambda\right)\bar{u}(p)\gamma^\mu\gamma^\nu u(p)}{\left(z_1+z_2\right)\left(z_1+z_2+z_3\right)^{0.5}} \tag{55}$$

Integrating wrt z_3...

$$-\frac{4m\log\left(\Lambda\right)\bar{u}(p)\gamma^\mu\gamma^\nu u(p)}{z_1+z_2}+\frac{4m\log\left(\Lambda\right)\bar{u}(p)\gamma^\mu\gamma^\nu u(p)}{\sqrt{z_1+z_2}} \tag{56}$$

Integrating wrt z_2...

$$-8m\sqrt{z_1}\log\left(\Lambda\right)\bar{u}(p)\gamma^\mu\gamma^\nu u(p)+4m\log\left(\Lambda\right)\log\left(z_1\right)\bar{u}(p)\gamma^\mu\gamma^\nu u(p)+8m\log\left(\Lambda\right)\bar{u}(p)\gamma^\mu\gamma^\nu u(p) \tag{57}$$

Integrating wrt z_1...

$$-\frac{4m}{3}\log\left(\Lambda\right)\bar{u}(p)\gamma^\mu\gamma^\nu u(p) \tag{58}$$

Integrating this term

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 - \frac{2\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p)}{(z_1+z_2)(z_1+z_2+z_3)^{0.5}} \tag{59}$$

Integrating wrt z_3...

$$-\frac{4\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}}{z_1+z_2}\gamma^{\sigma_2}\gamma^{\nu} u(p) + \frac{4\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}}{\sqrt{z_1+z_2}}\gamma^{\sigma_2}\gamma^{\nu} u(p) \tag{60}$$

Integrating wrt z_2...

$$-8\sqrt{z_1}\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) + 4\log(\Lambda)\log(z_1) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) + 8\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) \tag{61}$$

Integrating wrt z_1...

$$-\frac{4}{3}\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) \tag{62}$$

Integrating this term

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \int_0^1 dz_1 \int_0^{-z_1+1} dz_2 \int_0^{-z_1-z_2+1} dz_3 \frac{z_3\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p)}{(z_1+z_2)(z_1+z_2+z_3)^{1.5}} \tag{63}$$

Integrating wrt z_3...

$$-\frac{\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}}{z_1+z_2}\left(\frac{4z_1}{\sqrt{z_1+z_2}} + \frac{4z_2}{\sqrt{z_1+z_2}}\right)\gamma^{\sigma_2}\gamma^{\nu} u(p) + \frac{\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}}{z_1+z_2}(2z_1+2z_2+2)\gamma^{\sigma_2}\gamma^{\nu} u(p) \tag{64}$$

Integrating wrt z_2...

$$8\sqrt{z_1}\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) + (-2z_1+2)\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) - 2\log(\Lambda)\log(z_1) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) - 8\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) \tag{65}$$

Integrating wrt z_1...

$$\frac{1}{3}\log(\Lambda) p_{\sigma_2} \bar{u}(p)\gamma^{\mu}\gamma^{\sigma_2}\gamma^{\nu} u(p) \tag{66}$$

Final amplitudes after z-variable integration

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} - \frac{4m}{3} \log{(\Lambda)} \bar{u}(p) \gamma^{\mu} \gamma^{\nu} u(p) \tag{67}$$

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} - \frac{4}{3} \log{(\Lambda)} p_{\sigma_2} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_2} \gamma^{\nu} u(p) \tag{68}$$

$$\frac{ie^2}{16\pi^2} g_{\mu\nu} \frac{1}{3} \log{(\Lambda)} p_{\sigma_2} \bar{u}(p) \gamma^{\mu} \gamma^{\sigma_2} \gamma^{\nu} u(p) \tag{69}$$