

$$I_4^{\{D=4-2\epsilon\}}(0, m^2, p_3^2, p_4^2; s_{12}, s_{23}, 0, 0, m^2, m^2)$$

Integral obtained from Eq.(A4), Equation 4 of ref. [1]

$$\begin{aligned} I_4^{\{D=4-2\epsilon\}}(0, m^2, p_3^2, p_4^2; s_{12}, s_{23}, 0, 0, m^2, m^2) &= \left(\frac{\mu^2}{m^2}\right)^\epsilon \frac{1}{(s_{12} - m^2)(s_{23} - m^2)} \\ &\times \left[\frac{1}{2} \frac{1}{\epsilon^2} - \frac{1}{\epsilon} \left\{ \ln\left(1 - \frac{s_{12}}{m^2}\right) + \ln\left(1 - \frac{s_{23}}{m^2}\right) - \ln\left(1 - \frac{p_4^2}{m^2}\right) \right\} \right. \\ &\quad - \sum_{\rho=\pm 1} \mathcal{L}i_2\left(\frac{p_4^2 - m^2}{s_{12} - m^2}, x_{p_3^\rho}\right) - 2 \text{Li}_2\left(\frac{s_{23} - p_4^2}{s_{23} - m^2}\right) + 2 \ln\left(1 - \frac{s_{12}}{m^2}\right) \ln\left(1 - \frac{s_{23}}{m^2}\right) \\ &\quad \left. - \ln^2\left(1 - \frac{p_4^2}{m^2}\right) - \ln^2(x_{p_3^2}) - \frac{\pi^2}{12} \right], \end{aligned}$$

See the file on **notation**. We make use of the quantities

$$\beta_r = \sqrt{1 - \frac{4m^2}{r}}, \quad x_r = \frac{\beta_r - 1}{\beta_r + 1},$$

where r represents a generic invariant. The following specific combination of logarithms and dilogarithms was used,

$$\mathcal{L}i_2(x, y) = \text{Li}_2(1 - xy) + \ln(1 - xy) \left[\ln(xy) - \ln(x) - \ln(y) \right],$$

Analytic continuation by the replacements $s_{ij} \rightarrow s_{ij} + i\epsilon, p_j^2 \rightarrow p_j^2 + i\epsilon$.

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References

- [1] W. Beenakker, S. Dittmaier, M. Kramer, B. Plumper, M. Spira and P. M. Zerwas, Nucl. Phys. B **653**, 151 (2003) [arXiv:hep-ph/0211352]. [\[arXiv:hep-ph/0211352\]](#)