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

Page contributed by R.K. Ellis

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

$$
\begin{aligned}
I_4^{\{D=4-2\epsilon\}}(0,m^2,p_3^2,p_4^2;s_{12},s_{23},0,0,m^2,m^2) &= \left(\frac{\mu^2}{m^2}\right)^\epsilon \frac{1}{(s_{12}-m^2)(s_{23}-m^2)} \\
\times \Bigg[\frac{1}{2}\frac{1}{\epsilon^2} - \frac{1}{\epsilon}\Big\{ \ln\left(1-\frac{s_{12}}{m^2}\right) &+ \ln\left(1-\frac{s_{23}}{m^2}\right) - \ln\left(1-\frac{p_4^2}{m^2}\right)\Big\} \\
&- \sum_{\rho=\pm1} \mathcal{L}i_2\left(\frac{p_4^2-m^2}{s_{12}-m^2}, x_{p_3^2}^\rho\right) - 2\,\mathrm{Li}_2\left(\frac{s_{23}-p_4^2}{s_{23}-m^2}\right) + 2\ln\left(1-\frac{s_{12}}{m^2}\right)\ln\left(1-\frac{s_{23}}{m^2}\right) \\
&- \ln^2\left(1-\frac{p_4^2}{m^2}\right) - \ln^2(x_{p_3^2}) - \frac{\pi^2}{12}\Bigg],
\end{aligned}
$$

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

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

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

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

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

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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]