$I_4^{\{D=4-2\epsilon\}}(m^2,0,0,m^2;t,s;0,m^2,m^2,m^2)$

Page contributed by R.K. Ellis

This is the integral taken from ref. [1] where $\beta = \sqrt{(1-\frac{4m^2}{s})}$ and $\lambda_\pm = \frac{1}{2}(1\pm\beta)$. The expression is valid in the unphysical region, $s,t<0, m^2>0$ so that $\beta>1, \lambda_+>1, \lambda_-<0$

$$
\begin{aligned}
& I_4^{\{D=4-2\epsilon\}}(0,m^2,m^2,0;t,s;0,m^2,m^2,m^2) \\
= \; & \frac{1}{s(t-m^2)\beta}\left(\frac{\mu^2}{m^2}\right)^\epsilon \left[\frac{1}{\epsilon}\ln\left(\frac{\beta-1}{\beta+1}\right) - \ln\left(\frac{\beta-1}{\beta+1}\right)\left(2\ln(\frac{m^2-t}{m^2}) - \ln(\frac{-s}{m^2})\right)\right. \\
+ \; & \left. 2\,\mathrm{Li}_2(\frac{-\lambda_-}{\lambda_+}) + 2\,\mathrm{Li}_2(-\lambda_-/\beta) + \ln^2(-\beta/\lambda_-) - \frac{\pi^2}{2}\right] + \mathcal{O}(\epsilon)
\end{aligned}
$$

See the file on notation.

This integral has also been given in Eq. (A3) of ref. [2] (note differing definition of ϵ) and Eq. (6.69) of ref [3]. Their result for the real value of the integral for $s>4m^2, 0<x<1, t<0$ is,

$$x = \frac{1-\beta}{1+\beta}$$

$$
\begin{aligned}
I_4^{\{D=4-2\epsilon\}}(m^2,0,0,m^2;t,s;0,m^2,m^2,m^2) = & \frac{1}{s(t-m^2)\beta}\left(\frac{\mu^2}{m^2}\right)^\epsilon \left[\frac{1}{\epsilon}\ln x - 2\ln x\ln(1-x) + 2\ln x\ln(1+x)\right. \\
- \; & \left. 2\ln x\ln\left(\frac{m^2-t}{m^2}\right) - 2\,\mathrm{Li}_2(x) + 2\,\mathrm{Li}_2(-x) - \frac{\pi^2}{2}\right]
\end{aligned}
$$

Information about terms of order ϵ and ϵ^2 can be obtained in ref. [4].

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References

[1] P. Nason, S. Dawson and R. K. Ellis, (unpublished)

[2] W. Beenakker, H. Kuijf, W. L. van Neerven and J. Smith, Phys. Rev. D **40**, 54 (1989). Inspire

[3] R. Höpker, Hadroproduction and decay of squarks and gluinos, (in german), DESY Internal report DESY-T-96-02, (Relevant excerpt)

[4] J. G. Korner, Z. Merebashvili and M. Rogal, Phys. Rev. D **71**, 054028 (2005) [arXiv:hep-ph/0412088] see also for a report on the formula in this paper in Mathematica Format