

From 1512.02860:

$$\frac{1}{D_1 D_2 D_3 D_4} = \sum_{i=1}^4 \frac{1}{D_i} \prod_{j \neq i} \frac{1}{D_j - D_i} \quad (0.1)$$

1 i=1

1.1 +++++, massless: iooooopppp

$$D_1 = \ell^2 + i\epsilon \quad (1.1)$$

$$D_2 = 2p_1 \ell + i\epsilon \quad (1.2)$$

$$D_3 = 2(p_1 + p_2) \ell + 2p_1 p_2 + i\epsilon \quad (1.3)$$

$$D_4 = 2(p_1 + p_2 + p_3) \ell + 2(p_1 p_2 + p_3 p_2 + p_1 p_3) + i\epsilon \quad (1.4)$$

$$p_1^2 \rightarrow 0, p_2^2 \rightarrow 0, p_3^2 \rightarrow 0, p_1 p_2 \rightarrow \frac{s}{2}, p_2 p_3 \rightarrow \frac{t}{2}, p_1 p_3 \rightarrow \frac{1}{2}(-s - t) \quad (1.5)$$

$$x = \frac{t}{s} \quad (1.6)$$

Master Integrals:

$$F[1010] = \int \frac{d^d \ell}{i\pi^{d/2}} \frac{1}{D_1 D_3}; \quad F[1111] = \int \frac{d^d \ell}{i\pi^{d/2}} \frac{1}{D_1 D_2 D_3 D_4} \quad (1.7)$$

UT basis:

$$g_1(x) = -\frac{1}{2}(1 - 2\epsilon)e^{\gamma_E \epsilon}(-s)^\epsilon F[1010], \quad g_2(x) = \frac{1}{4}\epsilon e^{\gamma_E \epsilon}(-s)^{\epsilon+2} st F[1111] \quad (1.8)$$

result:

$$g_1(x) = -\frac{1}{4} - \frac{i\pi\epsilon}{4} + \frac{\pi^2\epsilon^2}{48} \quad (1.9)$$

$$g_2(x) = \frac{1}{4} + \epsilon \left(-\frac{1}{4}G(0, x) + \frac{i\pi}{2} \right) + \frac{1}{48}\epsilon^2 (12i\pi G(-1, x) - 24i\pi G(0, x) - 12G(-1, 0, x) + 12G(0, 0, x) - 17\pi^2)$$

2 temp

$$D_1 = \ell^2 + i\epsilon \quad (2.1)$$

$$D_2 = 2p_1 \ell + p_1^2 + i\epsilon \quad (2.2)$$

$$D_3 = 2p_1 \ell + 2p_2 \ell + p_1^2 + 2p_2 p_1 + p_2^2 + i\epsilon \quad (2.3)$$

$$D_4 = 2p_1 \ell + 2p_2 \ell + 2p_3 \ell + p_1^2 + 2p_2 p_1 + 2p_3 p_1 + p_2^2 + p_3^2 + 2p_2 p_3 + i\epsilon \quad (2.4)$$