process:

$$\gamma^*(q) + g(k_1) \to Q(p_1) + \bar{Q}(p_2) \tag{1}$$

use c.m.s. of incoming particles:

$$q = \left(\frac{s+q^2}{2\sqrt{s}}, 0, 0, \dots, -\frac{s-q^2}{2\sqrt{s}}\right) \tag{2}$$

$$k_1 = \frac{s-q^2}{2\sqrt{s}} (1, 0, 0, \dots, 1) \tag{3}$$

such that

$$q + k_1 = (\sqrt{s}, \vec{0}) \qquad k_1^2 = 0 \tag{4}$$

for the outgoing particles it follows

$$p_1 = \frac{\sqrt{s}}{2} (1, 0, \beta \sin\theta, \dots, \beta\cos\theta) \tag{5}$$

$$p_2 = \frac{\sqrt{s}}{2} (1, 0, -\beta \sin\theta, \dots, -\beta\cos\theta) \tag{6}$$

with $\beta = \sqrt{1 - 4m^2/s}$ such that

$$p_1 + p_2 = (\sqrt{s}, \vec{0}) \qquad p_1^2 = p_2^2 = m^2 \tag{7}$$

use n-sphere:

$$d^D x = \Omega_D x^{D-1} dx = \frac{2\pi^{D/2}}{\Gamma(D/2)} x^{D-1} dx = \frac{\pi^{D/2}}{\Gamma(D/2)} (x^2)^{(D-2)/2} dx^2 \tag{8}$$

$$\begin{aligned}
PS_2 &= \int \frac{d^n p_1}{(2\pi)^{n-1}} \frac{d^n p_1}{(2\pi)^{n-1}} \delta^{(4)}(q + k_1 - p_1 - p_2) \delta(p_1^2 - m^2) \delta(p_2^2 - m^2) && (9)\\
&= \frac{1}{(2\pi)^{n-2}} \int d^n p_1 \, \delta((q + k_1 - p_2)^2 - m^2) \delta(p_1^2 - m^2) && (10)\\
&= \frac{1}{(2\pi)^{n-2}} \int dp_{1,0} dp_{1,||} d^2 p_{1,\perp} d^{n-4} \hat{p}_1 \, \delta(s - 2p_{1,0}\sqrt{s}) \delta(p_{1,0}^2 - p_{1,||}^2 - p_{1,\perp}^2 - \hat{p}_1^2 - m^2) && (11)\\
&= \frac{\pi}{(2\pi)^{n-2} 2\sqrt{s}} \int dp_{1,||} dp_{1,\perp}^2 d^{n-4} \hat{p}_1 \, \delta(p_{1,0}^2 - p_{1,||}^2 - p_{1,\perp}^2 - \hat{p}_1^2 - m^2) && (12)\\
&= \frac{\pi}{(2\pi)^{n-2} 2\sqrt{s}} \int dp_{1,||} d\hat{p}_1^2 \, \frac{\pi^{(n-4)/2}}{\Gamma((n-4)/2)} (\hat{p}_1^2)^{(n-6)/2} && (13)\\
&= \frac{1}{2\sqrt{s}\Gamma((n-4)/2)(4\pi)^{(n-2)/2}} \int dp_{1,||} d\hat{p}_1^2 \, (\hat{p}_1^2)^{(n-6)/2} && (14)
\end{aligned}$$

Integration borders are

$$p_{1,||} \in \frac{\sqrt{s}}{2} \beta \cdot [-1, 1] \qquad \hat{p}_1^2 \in \left(\frac{s\beta^2}{4} - p_{1,||}^2\right) \cdot [0, 1] \tag{15}$$

rewrite $p_{1,||}$ to $\cos\theta$:

$$dp_{1,||} = \frac{\sqrt{2}}{2} \beta \, d\cos\theta \qquad \cos\theta \in [-1, 1], \, \hat{p}_1^2 \in \frac{s\beta^2}{4} \left(1 - \cos^2\theta\right) \cdot [0, 1] \tag{16}$$