Standard Model Theory – Tutorial 3

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1. **Passarino-Veltman Reduction:** Use the Passarino-Veltman method to reduce the integrals

$$B^{\mu}(p,m,0) = \int \frac{d^Dk}{(2\pi)^D} \frac{k^{\mu}}{k^2((k+p)^2-m^2)}\,, \tag{1}$$

$$B^{\mu\nu}(p,m,0) = \int \frac{d^Dk}{(2\pi)^D} \frac{k^{\mu}k^{\nu}}{k^2((k+p)^2-m^2)}\,, \tag{2}$$

$$C^{\mu}(p_1,p_2,m,m,m) = \int \frac{d^Dk}{(2\pi)^D} \frac{k^{\mu}}{(k^2-m^2)((k+p_1)^2-m^2)((k-p_2)^2-m^2)} \tag{3}$$

   to scalar integrals. ($(p_1+p_2)^2 = P^2$) Use, that the Integrals are tensors under Lorentz transformation, and make an appropriate ansatz. $B^{\mu\nu}(p,m,0)$ can first be reduced to $B^{\mu}(p,m,0)$.

2. **One-loop integrals:** Calculate the one-loop integrals

$$B_0(p^2,m,0) = \int \frac{d^Dk}{(2\pi)^D} \frac{1}{k^2((k+p)^2-m^2+i\epsilon)}\,,$$

$$C_0(p^2,0,0,0,0,0) = \int \frac{d^Dk}{(2\pi)^D} \frac{1}{k^2((k+p_1)^2)(k-p_2)^2)}\,,$$

   with $(p_1+p_2)^2 = p^2$

3. **Higgs Decay:**

   Calculate the decay width for the process $H \to \gamma\gamma$ mediated by a closed top-quark or W-boson loop.