HW10

Yukawa theory at one loop

In this homework you are asked to find one-loop beta-function in Yukawa theory (in 4 dimensions):

$$\mathcal{L} = \frac{1}{2}(\partial\phi)^2 + i\bar{\psi}\partial\!\!\!/\psi - m_\psi\bar{\psi}\psi - g\phi\bar{\psi}\psi - \frac{m_\phi^2}{2}\phi^2 - \frac{\lambda}{4!}\phi^4. \tag{1}$$

Note, that the Lagrangian is given in Minkowski space. Even though Feynman rules haven't been discussed it is straightforward to derive those. For instance, the fermion propagator is given by

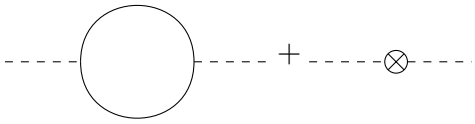
 $= \dfrac{i(\not{p} + m_\psi)}{p^2 - m_\psi^2 + i\varepsilon}.$ (2)

For boson we use

 $= \dfrac{i}{p^2 - m_\phi^2 + i\varepsilon}.$ (3)

We will be working in the regime $m_\phi = m_\psi = 0$

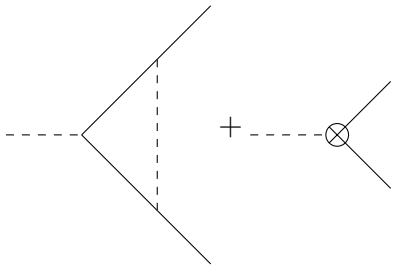
- Diagrams contributing to bosonic 2-pt function:

 (4)

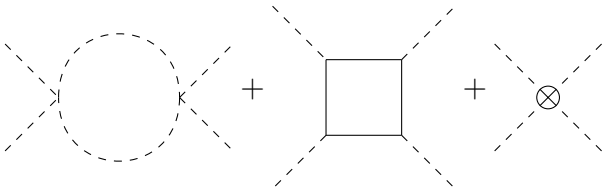
- Diagrams contributing to fermionic 2-pt function:

 (5)

- 3-pt function $\phi\bar{\psi}\psi$:

 (6)

- 4-pt function $\phi\phi\phi\phi$ (do not forget other channels):



(7)

- Compute beta-functions