QFT II exercises - sheet 8

If you find a mistake in this exercise first check the website if the problem has been resolved already in a newer version. Otherwise, please email rutger.boels@desy.de.

This set of exercises is to be handed in on Monday 16th of June, at the start of the lecture in order to qualify for the bonus. Email submission (of scanned pages) will also be accepted.

Exercise 1

Compute the β function of Yang-Mills theory coupled to a Dirac fermion as well as a scalar to first loop order. Use the ghost-ghost-vector boson ("$\bar{c}A_\mu c$") Greens function. Using technical results from Peskin and Schroeder is allowed *with* explicit reference.

Exercise 2

Consider a Yang-Mills theory with six real, massless scalars and two massless Dirac fields, both in the adjoint representation

a Verify using the result obtained in the previous exercise that the beta function vanishes to the one loop order for this theory

b Count the numbers of degrees of freedom of both bosonic and fermionic fields in this theory on their mass-shell: what do you observe?

Consider a Yang-Mills theory with one massless Dirac field and two real scalars in the adjoint representation of SU(N).

c Find a combination of massless Dirac fields and scalars in the fundamental representation such that when they are added to the theory the beta function vanishes to the one loop order. Hint: start with a combination to satisfy the rule found under b)

d Do mass terms for the fields in the fundamental influence the computation of the β function?