

# Exercise for Colours and Flavours and their consequences

## Autumn 2019: lecture 3

### 1 Sum rules

What would happen if you need two subtractions? I.e. use

$$\frac{q^4 \Pi(s)}{s^2(s - q^2)}.$$

### 2 Correlators

Calculate the object

$$\Pi_{\mu\nu}^V = i \int d^d x e^{-iq \cdot x} \langle 0 | T (J_\mu(x) J_\nu^\dagger(0)) | 0 \rangle$$

to one-loop in dimensional regularization.

$$J_\mu(x) = \bar{q}(x) \gamma_\mu q(x)$$

You can also pick different quarks if you like, just do it for one quark. You can do it for the massless case (massive is not that much more difficult).

**Notes:**

- The solution is in the lecture notes but try to do it yourself first.
- What would happen if I take  $J_\mu^5 = \bar{q}(x) \gamma_\mu \gamma_5 q(x)$  instead.
- At which order in  $\alpha_S$  does the difference start between the correlator for currents with equal quarks and with different quarks?