Quantum Field Theory 2 – Tutorial 12

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Problem 1: Group integration

Consider the group $SU(3)$, since is compact it is possible to properly define an integration over the group elements, called Haar measure. This measure has the property to be invariant under left multiplication by an element $V \in SU(3)$, i.e. $dU = d(VU)$. Knowing that the measure is normalize to 1:

$$\int dU \; 1 = 1, \tag{1}$$

show the following integration rules:

$$\int dU \; U^{ab} = 0,$$

$$\int dU \; U^{ab}U^{cd} = 0,$$

$$\int dU \; U^{ab}(U^\dagger)^{cd} = \frac{1}{3}\delta_{ad}\delta_{bc}.$$