

ELEMENTARY PARTICLE PHYSICS

WS 2016/2017: Exercise sheet 11

32. Rewrite the QED Lagrangian in terms of the chiral fermion fields $\psi_{L,R} = P_{L,R}\psi$. $P_{L,R}$ are defined in exercise 23.
33. The $\Delta^{++}, \Delta^+, \Delta^0, \Delta^-$ are an isospin $I = 3/2$ multiplet with $I_3 = 3/2, 1/2, -1/2, -3/2$ and $B = 1$. Using isospin invariance compare the probability for producing Δ^{++} in $\pi^+p \rightarrow \Delta^{++}$ with the probability of producing Δ^0 in $\pi^-p \rightarrow \Delta^0$.
34. Write down the quark content of all the states in the baryon decuplet.
35. a) Verify for the Gell-Mann matrices $\lambda_i, i = 1, \dots, 8$, that

$$\text{tr}\{\lambda_i\lambda_j\} = 2\delta_{ij}$$

- b) The Gell-Mann matrices satisfy the so-called Lie-algebra

$$[\lambda_i, \lambda_j] = 2if_{ijk}\lambda_k$$

with the coefficients (structure constants) f_{ijk} . Verify this through explicit computation of $f_{123}, f_{147}, f_{246}, f_{257}, f_{345}, f_{516}, f_{637}, f_{458}, f_{678}$.

- c) Using a) and b) show that the structure constants are antisymmetric under exchange of an arbitrary pair of indices.
Hint: Consider $\text{tr}\{[\lambda_i, \lambda_j]\lambda_m\}$ and use properties of the trace.