Advanced Topics in the Theory of Fundamental Interactions

F. Feruglio

January 14, 2020

1. Strong and electromagnetic interactions of two massless quarks are described by the Lagrangian

$$\mathcal{L} = i\bar{q}\gamma^\mu D_\mu q - \frac{1}{4}F_{\mu\nu}F^{\mu\nu} - \frac{1}{4}G_{a\mu\nu}G_a^{\mu\nu}$$

where

$$D_\mu q = (\partial + ig_s t^a G_{a\mu} + ieQA_\mu)\begin{pmatrix} u \\ d \end{pmatrix} \qquad Q = \begin{pmatrix} +2/3 & 0 \\ 0 & -1/3 \end{pmatrix}$$

Which is the classical global symmetry G_{gl}^c in the $e = 0$ limit?

Which subgroup of G_{gl}^c is anomalous in the $e = 0$ limit?

2. Which is the classical global symmetry G_{gl}^c when $e \neq 0$?

Which subgroup of G_{gl}^c is anomalous when $e \neq 0$?

3. What is the parametric dependence of the width $\Gamma(\pi_0 \to \gamma\gamma)$ on e, f_π, the number of colours N_C and the pion mass m_{π_0}?

(that is the power dependence, without exact coefficients)?