

# Massachusetts Institute of Technology

## Department of Physics

Course: 8.701 – Introduction to Nuclear and Particle Physics

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### Discussion Problems

from recitation on **October 15th, 2020**

#### Problem 1: Color Transformations

Color SU(3) transformations relate 'red', 'blue', and 'green' according to the transformation rule  $c \rightarrow c' = Uc$ , where  $U$  is any unitary ( $UU^\dagger = 1$ )  $3 \times 3$  matrix of determinant 1, and  $c$  is a three-element column vector. See below for example. would

$$U = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{pmatrix}$$

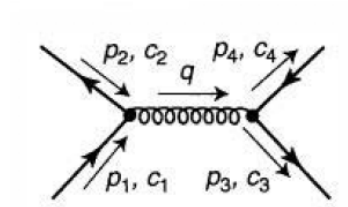
take  $r \rightarrow g$ ,  $g \rightarrow b$ , and  $b \rightarrow r$ . Show that go into linear combinations of one another:

$$|3'\rangle = \alpha |3\rangle + \beta |8\rangle, |8'\rangle = \gamma |3\rangle + \delta |8\rangle$$

Find numbers for  $\alpha$ ,  $\beta$ ,  $\gamma$ , and  $\delta$ .

## Problem 2: QCD Amplitude

Find the amplitude  $M$  for the diagram below. What is the color factor in this case? Evaluate  $f$  in the color singlet configuration. Can you explain this result?



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