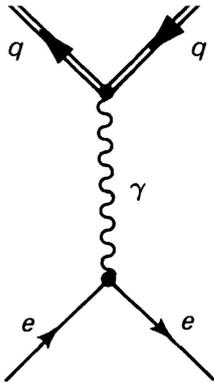## Lecture 4 : Quantum Electrodynamics of Quarks and Hadrons - 1

Quarks may interact electromagnetically, also via weak forces and by the strong forces as well.
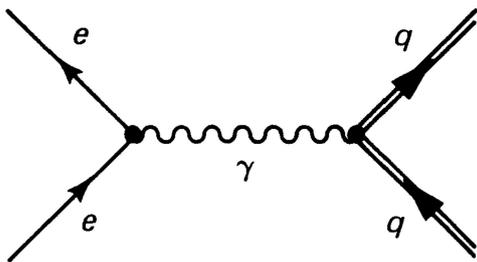
The Feynman diagram for the quark-photon interecation :
A diagram for the hadron production via electron-positron collision

or a high energy the electron-proton sacattering
for hadron production

$$e^+ + e^- \longrightarrow \gamma \longrightarrow q + \bar{q} \cdot$$

 If the initial CM energy of the elctron is well above the threshold then the cross section is

$$\sigma = \frac{\pi}{3}\left(\frac{\hbar Q c \alpha}{E}\right)^2$$

Consider the ratio :

$$R = \frac{\sigma(e^+ + e^- \rightarrow hadrons)}{\sigma(e^+ + e^- \rightarrow \mu^+ + \mu^-)}$$

Experimental result is plotted in Fig 8.3 in D.Griffiths' textbook
Interpretation of the Figure.
Evidence for the color degrees of freedom for the quarks.

- Elastic electron-proton scattering

Differential cross section is given by the Rosenbluth formula.
Work out all the details of the calculations.

Homework Problems :

Solve the following problems from the textbook D.Griffiths' "Int. to
Elementary Particles"

Solve Problem 8.1

Solve Problem 8.2

Solve Problem 8.3

Solve Problem 8.4

Solve Problem 8.5

Solve Problem 8.6

Solve Problem 8.7

Solve Problem 8.8

Solve Problem 8.9

Solve Problem 8.10