Physics 100 - Fall 2007 - Recitation 8

(1)

$u \equiv$ up quark, charge $= +2/3$

$d \equiv$ down quark, charge $= -1/3$

$s \equiv$ strange quark, charge $= -1/3$

Suppose only 3 quarks (u, d, s) existed.

How many baryons with what charges can you make from these quarks?

How many mesons with what charges can you make from these quarks?

(2) When the atomic (fission) bomb was being developed, one of the scientists on the Manhattan project suggested that the detonation of the bomb might trigger fusion reactions in the atmosphere, causing a fusion chain reaction that could burn up the entire atmosphere of the earth. Other scientists calculated that under worst-case scenario assumptions the temperature needed to ignite fusion reactions in the atmosphere was a factor of 100 higher than that expected to occur in the midst of the fission explosion. So, these scientists were confident that the atmosphere would not be destroyed. This issue and the potential risk was not made public at the time.

What do you think about this?

Was the risk justified?

How certain should the science be to make you comfortable with such a risk?

What would you have done in such a situation if you were one of the scientists?

. . . What would you have done if you were the President at the time?

(3) Identify the fundamental force of nature responsible for the following particle interactions –

$$e^- + p \rightarrow n + \nu_e$$

$$\gamma + Ne \rightarrow Ne^* \longrightarrow Ne + \gamma$$

(excited STATE)

$$\Delta \longrightarrow p + \pi^0$$

↑

SORT of an excited STATE of a proton called the "Delta"

$$\mu^- \longrightarrow e^- + \bar{\nu}_e$$

(4) (See p.411 in Hobson)

In the United States the annual energy consumption is approximately 10^{18} Joules.

Suppose you were able to find a source of antimatter and perfected the design of a matter-antimatter power reactor (a la Star Trek warp engines) ....

What mass of matter/antimatter would it take to supply the energy needs of the United States for 1 year?

(5)

Suppose you were immortal. -- with no breaks. -- no need to sleep or eat ——

how long would it take you to run a distance of one light year?

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What is the Higgs particle ... or should I say, what role does it play in modern physics?

Why is it important to you that we understand what it is that does what the Higgs does?