PHY100 — Recitation #8

1) The 2008 Nobel prize in Physics was awarded to Y. Nambu “for the discovery of the mechanism of spontaneous broken symmetry in subatomic physics”, and to M. Kobayashi, and T. Maskawa “for the discovery of the origin of the broken symmetry which predicts the existence of at least three families of quarks in nature”. Your TA will give you a copy of the “Information for the public” document from the Nobel Foundation:
http://nobelprize.org/nobel_prizes/physics/laureates/2008/info.html

   How do we know there are three “generations” of particles?

   Which generation makes up ordinary matter?

   How do we know there are no galaxies of anti-matter?

   Give two examples of “spontaneous” symmetry breaking.

2) When the atomic (fission) bomb was developed one of the scientists on the Manhattan project supported that the detonation of the bomb might trigger **fusion** reactions in the atmosphere of the earth. Other scientists calculated that under worst case scenario assumptions the temperature needed to ignite fusion reaction in the atmosphere was a factor of a 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 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:

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

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

$\Delta \rightarrow p + \pi^0$ (The “Delta” Δ, is sort of an excited state of the proton)

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

$\tau^- \rightarrow \nu_\tau + e^- + \bar{\nu}_e$

4) In the United States the annual energy consumption is approximately 10^{18} Joules (see page 411 in Hobson). 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?

6) What is the Higgs particle and what role does it play in modern physics?

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