

Particle Physics Seminar #9

Textbook: Griffiths - Introduction to Elementary Particles

Website: (all notes referred to below are on web site)

http://chaos.swarthmore.edu/courses/Phys131_2007/index.html

Readings:

REQUIRED: Griffiths - Chapter - 6
06 QFT3

Topic(s):

(1) Quantum Electrodynamics

Professor Lecture Topic(s): Quantum Field Theory

Problems:

1. Griffiths 6-13 In the CM frame
2. Griffiths 6-14
3. Griffiths 6-15 Lowest order amplitude
4. EP-11 Neutrino mean free path
5. EP-12 Zappa particle

Extra Problem 11 - The (approximate) total cross-section for the charged current interaction of a ν_μ on a nucleon is given as a function of the neutrino energy by

$$\sigma_{tot} = 0.7 \times 10^{-38} \text{ cm}^2 \times \frac{E_\nu}{1 \text{ GeV}}$$

Consider a neutrino beam with a mean energy of 10 GeV. The beam is incident on an infinitely thick slab of lead. Calculate the mean distance that a neutrino in this beam will travel before interacting.

Extra Problem 12 - The Zappa particle (to be discovered in 2012) has three decay modes. In the first mode, it decays into a yellow shark, in the second, it decays into dental floss, and in the third, it decays into plastic people. A collection of Zappa decays is observed and the mean time between particle creation and each kind of decay is found to be

| Mode | Mean Lifetime |
|----------------|---------------|
| yellow shark | 5 μ sec |
| dental floss | 50 msec |
| plastic people | 20 μ sec |

What is the mean lifetime of the Zappa particle and what are the branching ratios for each of its three modes?