Massachusetts Institute of Technology
Department of Physics

8.276 Nuclear and Particle Physics **February 27, 2007**

Reading Assignment for 3/1, 3/6, and 3/8

Particles and Nuclei, Chapter 7, Sections 3 and 4;
Chapter 8, Sections 1-3;
Chapter 9, Sections 3 and 4

Optional Reading: *Particles and Nuclei*, Section 8.4
Coughlan and Dodd, Chapters 28, 30, 31-34

Problem Set #3 (due Thursday 3/8)

1. Comment on the behavior of the Rosenbluth formula [Eq. (6.10)] at $\theta = 180°$. What physical effect is responsible for the scattering at this angle?

2. The Rosenbluth formula is sometimes written in terms of form factors K_1 and K_2 where

$$K_1 = -q^2 G_M^2$$

and

$$K_2 = -q^2 [(G_E^2 + \tau G_M^2)/(1+\tau)] /\tau$$

Show that the Rosenbluth formula agrees with the Mott formula in the intermediate energy regime ($mc^2 << E << Mc^2$), if K_1 and K_1 are taken as the form factors of a pure "Dirac" proton (point charge): $K_1 = -q^2$ and $K_2 = (2Mc)^2$ [m is the electron mass and M is the proton mass].

3. An electron beam of energy 15 GeV and intensity 10^{14} particles/sec impinges on a liquid-hydrogen target of length 1 m parallel to the beam and of cross section sufficient to cover the beam. Estimate the number of electrons per second scattered elastically through 0.1 rad and into a solid angle of 10^{-4} sr for (a) pointlike protons, (b) protons of finite size. The density of liquid hydrogen is 0.06 g/cm^3.

4. A 10-GeV electron collides with a proton and emerges with a 10° deflection and an energy of 7 GeV. Calculate the rest mass W of the recoiling hadronic state.

5. *P & N*, 7-2

6. *P & N*, 7-3. Omit part e).