Massachusetts Institute of Technology
Department of Physics

8.276 Nuclear and Particle Physics [February 6, 2007]

Topics (2/6, 2/8):	Introduction to particles and nuclei Terminology, scattering, cross sections
Topics (2/13, 2/15):	Size and shape of nuclei, electron scattering

Reading Assignment for 2/8, 2/13, 2/15:

Particles and Nuclei, Chapter 1
Chapter 2, Sections 2.1 and 2.2
Chapter 4
Chapter 5, Sections 5.1-5.4

Optional Reading: Appendices A.1 and A.2

Problem Set #1 (due 2/15):

1. *P&N, 4-1*

2. *P&N, 4-2*

3. A copper target of thickness 0.1 cm intercepts a particle beam of 4 cm^2 area. Nuclear scattering is observed.

   (a) Compute the number of scattering centers intercepted by the beam.

   (b) Assuming the total scattering cross section to be 10 mb, what fraction of the incident beam is scattered? (1 b = 10^{-24} cm^2.)

4. Calculate the counting rate that would be observed in the Rutherford scattering of 10 MeV α-particles from the Pb nucleus at an angle $\theta = \pi/2$. Assume an incident flux of 10^6 α-particles per second on a Pb foil of thickness 0.1 cm and a detector of transverse dimensions 1 cm x 1 cm placed 100 cm from the interaction point. The density of lead is 11.3 g/cm^3.

5. Consider the collision of an α-particle with an electron. Using one-dimensional, nonrelativistic kinematics, show that the maximum energy loss and the maximum momentum transfer are small. Compute the maximum energy loss that a 10 MeV α-particle can suffer bv striking an electron at rest.