Physics 492 homework VII, due Fri Mar 5

Reading: Chapters 7 and 14.4

Problems:

1. Williams, Problem 7.5. In one of his considerations, Chadwick compared maximum velocities of protons and of nitrogen nuclei struck by the radiation from the alpha-beryllium reactions. He assumed that the radiation interacted elastically with the matter.

2. Williams, Problem 7.6. What is the mass defect of ${}^{12}_{6}C$?

3. Williams, Problem 7.8. Start out by finding the general relation between proton laboratory energy and c.m. kinetic energy of the p-^{19}F system. Further find the general relation between c.m. kinetic energy of the α-^{20}Ne system and α c.m.-energy. Refer all energies in the mass-energy diagram (cf. Figs. 7.3, 7.6 and 7.8) to one common energy, such as the sum of mass energies for p and ^{19}F. Disregard any possible Doppler effect for the gammas. Levels in nuclei are commonly resolved using data such as in this problem.

4. (a) In Coulomb scattering of 7.50-MeV protons by a target of ^{7}Li, what is the energy of the elastically scattered protons at 90°? (b) What is the energy of the inelastically scattered protons at 90° when the ^{7}Li is left in its first excited state at the excitation energy of 0.477 MeV above the ground state? The atomic mass of ^{7}Li is 7.016003 u.

5. The (n,p) reaction, $n + A \rightarrow p + B$, can be regarded as equivalent to β^+ decay in that the same initial and final nuclei are involved. Derive a general expression relating the Q-value of the (n,p) reaction to the energy release Q_{β^+} in β^+ decay.

Reminder!
An outline for your term paper, together with a list of research to be done, is due this Monday, Mar 1.