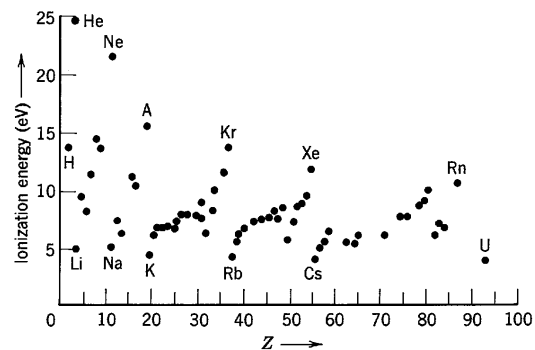
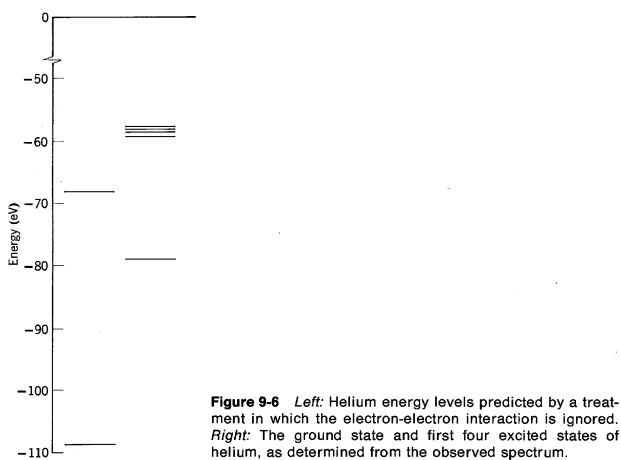


PHYS4702 Atomic, Nuclear, & Particle Physics Fall 2015 HW #8

*Due at the start of class on Thursday 15 Oct 2015*

(1) You know that for a (charged) particle moving in any spherically symmetric potential, the wave function will be proportional to  $Y_{lm}(\theta, \phi)$  where  $l$  and  $m$  are the usual orbital angular momentum quantum numbers. Use the form of the  $Y_{lm}$  to show that electric dipole transitions imply the selection rule  $\Delta m = 0, \pm 1$ .

(2) Using, from the textbook, figures 9-6 and 9-15 (below) estimate the energy required to remove the remaining electron from the ground state of a singly ionized helium atom. Compare this to the exact value, which you already know how to calculate.



(3) The  $2p \rightarrow 1s$  transition in atomic hydrogen has a lifetime of about  $10^{-8}$  sec. Use this to estimate the lifetime of the  $K_{\alpha}$  X-ray transition in lead. Can you find a reference that confirms your answer?