CCB 521: Homework 4, Spring 2023

Due in class on Monday, Feb. 27.

(5-2) Given the solution of the Schrodinger equation of the one electron atom, what are the ground-state wavefunction and energy of positronium (e^+e^-)?

(5-6) The wavelength 486.27 nm appears in the Balmer series of hydrogen. What state emits to produce this line? The line has a weak satellite line at 486.14 nm. Show that this is due to small amount of the isotope ^{2}H. (This is how deuterium was actually discovered.)

(5-11) Compute the extremum points for the D_{2s} and D_{2p} radial distribution functions for hydrogen. Also compute $< r >$ for these states and compare. *Note:* you may use the result of Problem 5-13:

$$< r >= \frac{n^2}{Z}\left\{1 + \frac{1}{2}\left[1 - \frac{l(l+1)}{n^2}\right]\right\}$$

(6-4) Express the following in atomic units: 5 nm, Planck's constant, 50 kJ/mol, 5×10^{-5} cm s^{-1}, and the mass of the benzene molecule. Provide both the numerical value, and the associated combination of m_e, e, $\hbar$ and a_0.

(6-6) Convert kT (k is Boltzmann's constant and T is the temperature on the absolute scale) to atomic units when the temperature is 300 K.