PHY 491, Fall 2024 - Homework 2

DUE: Friday 09/13/24, 11:59pm

Problem 2.1 Assume Li can be treated as a hydrogen-like multi-electron atom (electron configuration $1s^2 2s^1$) in which the 1s shell screens the nuclear charge.

2.1.1 Calculate its first ionization energy (removing the 2s electron) and discuss why this result differs from the experimentally observed value of 5.4 eV. (3 Points)

2.1.2 Calculate the 3rd ionization energy of the Li atom. Why/why not is this calculation exact? (3 Points)

Problem 2.2 Kr^{35+} is a an ion with only one remaining 1s electron and a nuclear radius of $R = 4.19fm$.

2.2.1 Assuming a hydrogenic ground state wavefunction (n=1, l=0, m=0) with Bohr radius a_0, calculate the probability to find the electron inside the nucleus. (5 Points)

Problem 2.3 Any region of space in which the kinetic energy of a particle would become negative is classically forbidden. For a hydrogen atom in its ground state

2.3.1 Find the classically forbidden region. (3 points)

2.3.2 Calculate the quantum mechanical probability to find the electron in this forbidden region. (6 points)