# Physics II

## Quantum Mechanics

Equations of the Bohr model

Radius of an orbit $r = \frac{n^2}{Z} a_\circ$, where $a_\circ = 0.529 \times 10^{-10}\,\mathrm{m}$

Energy level of a hydrogenic atom $E = -\frac{Z^2}{n^2}(13.6\mathrm{eV})$

Emitted wavelength for an electronic transition:

$\frac{1}{\lambda} = Z^2\left(\frac{1}{n_2^{\,2}} - \frac{1}{n_1^{\,2}}\right)R_y$, where $R_y = 1.09 \times 10^7\,\mathrm{m}^{-1}$

**Problem 1.-** What is the ionization potential of $He^+$?

**Solution:** We find the energy to get the electron from the ground state to n=infinity:

$$E = -\frac{2^2}{\infty^2}(13.6\mathrm{eV}) - \left(-\frac{2^2}{1^2}(13.6\mathrm{eV})\right) = \mathbf{54.4\ eV}$$

**Problem 2.-** Calculate the wavelength of the light emitted by a hydrogen atom when it changes from the n=4 state to the n=3 state. What kind of radiation is this, ultraviolet, visible, or infrared?

**Solution**: We use the Rydberg equation:

$$\frac{1}{\lambda} = Z^2\left(\frac{1}{n_2^{\,2}} - \frac{1}{n_1^{\,2}}\right)R_y = 1^2\left(\frac{1}{3^2} - \frac{1}{4^2}\right)1.09 \times 10^7 \rightarrow \lambda = \mathbf{1.88\ \mu m\ (infrared)}$$