Bohr's Simple Shell Model of the Atom

Description

- nucleus at the center
- electrons restricted to fixed distances (*d*) from nucleus, identified as *n* = 1, 2, 3…, which we call shells
- potential energy of electron in a shell described by Coulomb's Law $\left(V \propto {}^{(q_+ q_-)}/_{d}\right)$

Strengths

- predicts the visible spectrum for emission of H atoms
  - Balmer (1880s): $\lambda = 365\ \text{nm}\left(\frac{m^2}{m^2-2^2}\right)$ where *m* > 2
  - Bohr (1913): $\frac{1}{\lambda} = (1.09737\times10^7\ \text{m}^{-1})\times\left\{\frac{1}{n_f^2}-\frac{1}{n_i^2}\right\}$ where $n_i > n_f = 2$
- generalizes to predict spectrum for emission of H atoms in the ultraviolet $\left(n_f = 1\right)$ and the infrared $\left(n_f = 3\right)$ regions of the electromagnetic spectrum
- predicts the ionization energy of electron in H atom

Weakness

- cannot predict properties—emission spectra or ionization energies—of atoms or ions with more than one electron
- provides no guidance on how multiple electrons are distributed among shells