Atoms Formulas

Rydberg for 1-electron atoms: $R = 1.097 \times 10^7 \text{ m}^{-1} = \dfrac{1}{91.13 \text{ nm}}$ $\quad Z =$ atomic number

Wavelength: $\dfrac{1}{\lambda} = RZ^2 \left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2} \right)$ with $n_2 > n_1$

Photon energy: $E = E_{\text{Bohr}} Z^2 \left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2} \right)$ with $E_{\text{Bohr}} = 13.6 \text{ eV}$

Electron orbit in Coulomb field: $E = -\dfrac{1}{2} \dfrac{q^2 Z}{4\pi\varepsilon_0} \dfrac{1}{r} = -Z \cdot \dfrac{0.7202 \text{ eV-nm}}{r} = -\dfrac{m_e}{2} \left(\dfrac{q^2 Z}{4\pi\varepsilon_0} \right)^2 \dfrac{1}{L^2}$

Bohr Model, $L = \hbar$, $Z = 1$:

$$E_{\text{Bohr}} = -\frac{m_e}{2} \cdot \left(\frac{q^2}{4\pi\varepsilon_0 \hbar} \right)^2 = -13.6 \text{ eV} \quad a_0 = \frac{4\pi\varepsilon_0 \hbar^2}{m_e q^2} = 52.97 \text{ pm} \quad \beta_{\text{Bohr}} = \frac{q^2}{4\pi\varepsilon_0 \hbar c} = 7.293 \times 10^{-3}$$

Bohr with general Z and n: $\quad E_n = -\dfrac{Z^2}{n^2} \cdot E_{\text{Bohr}} \quad r_n = \dfrac{n^2}{z} \cdot a_0 \quad \beta = \dfrac{Z}{n} \cdot \beta_{\text{Bohr}}$

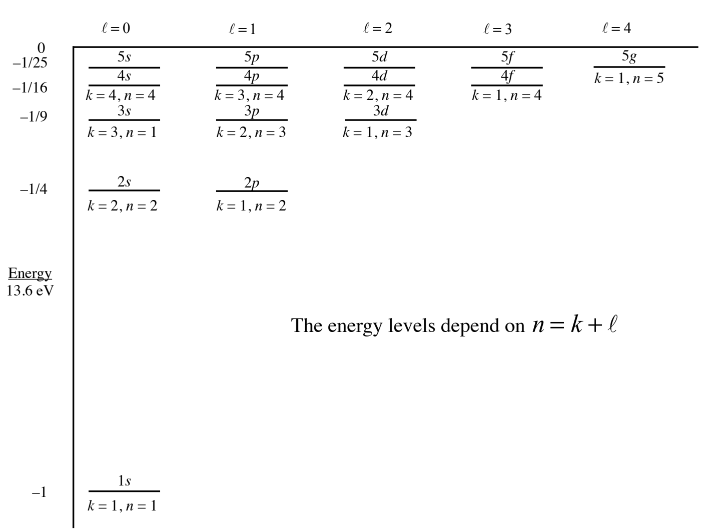
Moseley's Law for X-Rays: $E = 13.6 \text{ eV} \cdot \left(\dfrac{1}{n_{\text{final}}^2} - \dfrac{1}{n_{\text{intial}}^2} \right) \cdot (Z - b)^2$

with $b = 1$ for $n_{\text{final}} = 1$ and $b = 7.4$ for $n_{\text{final}} = 2$ $\quad E_{K\alpha} = 10.2 \text{ eV} \cdot (Z-1)^2$

de Broglie Relation: $\lambda = \dfrac{h}{p}$ for any particle as well as for photons

for non-relativistic particles: $\lambda = \dfrac{h}{\sqrt{2mE_{\text{kinetic}}}} = \dfrac{hc}{\sqrt{2mc^2 E_{\text{eV}}}} = \dfrac{1.227\sqrt{\text{eV}} \cdot \text{nm}}{\sqrt{E_{\text{eV}}}}$ for electrons

Hydrogen energy levels



Atomic energy levels