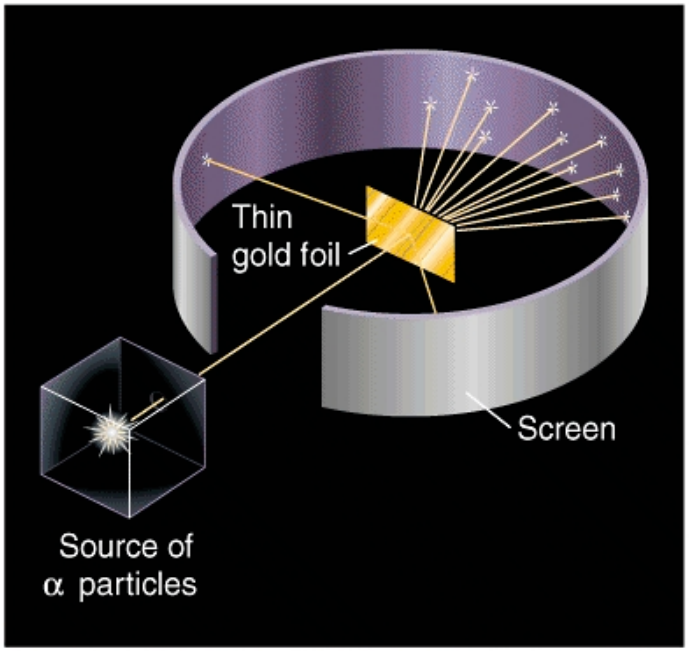
Chapter 30: The Nature of the Atom

Essential Concepts and Summary

Rutherford Scattering and Nuclear Atom

- Rutherford's gold-foil experiment discredited Thomson's plum-pudding model
- Nuclear atom: model in which positive nucleus surrounded by negative electrons
- Although planetary model is more correct than plum pudding, it still has serious flaws



Line Spectra

- Line Spectrum: series of fringes produced when low-pressure gas in sealed tube made to emit e/m waves via large potential difference
- Lyman, Balmer, and Paschen Series (in that order on the right)
- R is the Rydberg constant

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{n^2}\right); n = 2,3,4,\ldots$$

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right); n = 3,4,5,\ldots$$

$$\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{n^2}\right); n = 4,5,6,\ldots$$

$$R = 1.097 \times 10^7\, m^{-1}$$

Bohr Model

- Works best for hydrogen and singly ionized atoms
- Assumes electrons are in circular, stationary orbits
- Photon is emitted when electron goes from higher to lower energy orbit
- Assumes angular momentum is quantized

$$E_i - E_f = hf$$

$$L_n = n\frac{h}{2\pi}; n = 1, 2, 3, \ldots$$

$$r_n = \left(5.29 \times 10^{-11} m\right)\frac{n^2}{Z}; n = 1, 2, 3, \ldots$$

$$E_n = -\left(13.6 eV\right)\frac{Z^2}{n^2}; n = 1, 2, 3, \ldots$$

Visual References

- http://www.geo.arizona.edu/xtal/nats101/s04-15.html