Steps Toward Quantum Theory

I. Quantized Energy Levels

1. Heat Capacity less than predicted: Failure of Equipartition Theory
2. Blackbody Radiation Spectrum: $p = h/\lambda$: $h = 6.6261 \times 10^{-34}$ J s $\quad \lambda = h/m_e v$
3. Atomic and Molecular Spectra: $\tilde{\nu} = \Re_h \left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = 109677.5 \text{ cm}^{-1} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

II. Quantum Nature of Light

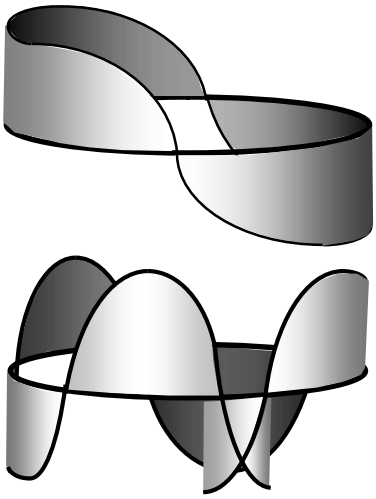
1. Photoelectric Effect: $E = h\nu$
2. Compton Effect: $p = h\nu/c$ or $p = h/\lambda$

$\hbar = h/2\pi = 1.0546 \times 10^{-34}$ J s

$c = 2.9979 \times 10^8$ m s^{-1}

III. Structure of the Atom

1. Cathode Rays: Thomson (e/m), Mulliken (e)
2. Nucleus, Rutherford Scattering
3. Canal Rays, Goldstein
4. Electronic Structure: Bohr : circumference = integer number of wavelengths : $2\pi r = n\lambda$



$m_e v r = n\hbar$

$$E_n = -\frac{e^4 m_e}{32\pi^2 \varepsilon_o^2 \hbar^2}\left(\frac{Z^2}{n^2}\right) = -\Re_h \left(\frac{1}{n^2}\right)$$

$$\Delta E = h\nu = \Re_h \left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

radius of first Bohr orbit = $a_o = \frac{4\pi e_o \hbar^2}{m_e e^2} = 0.529$ Å

$e = 1.60218 \times 10^{-19}$C

$m_e = 9.1093897 \times 10^{-31}$ kg

$\varepsilon_o = 8.85419 \times 10^{-12}$ J^{-1} c^2 m^{-1}

IV. Wave Nature of Particles

1. de Broglie Relationship, $E = h\nu = mc^2$, $\quad p = h/\lambda$
2. Diffraction of Electrons: Davisson and Germer, $p = h/\lambda$
3. Diffraction of Protons and Neutrons