Bohr model of a hydrogenic atom

Dr French. March 2017.

$$E_n = -\frac{m_e Z^2 e^4}{8\varepsilon_0^2 h^2}\frac{1}{n^2} \approx \frac{-13.6\text{eV}}{n^2}$$

Energy levels of a single electron (of charge e) bound to a nucleus of charge Z x e

$$\lambda_{nm} = \frac{8\varepsilon_0^2 h^3 c}{m_e Z^2 e^4}\left(\frac{1}{m^2} - \frac{1}{n^2}\right)^{-1}$$

Wavelength of photons emitted as a results of a transition of electron energy from state n to state m. Note m < n since E becomes more negative (i.e. electron is more bound) when quantum number n decreases.

$$\varepsilon_0 = 8.854187817\times10^{-12}\,\text{Fm}^{-1}$$
$$e = 1.6021766208(98)\times10^{-19}\,\text{C}$$
$$c = 2.99792458\times10^{8}\,\text{ms}^{-1}$$
$$h = 6.626070040(81)\times10^{-34}\,\text{kgm}^2\text{s}^{-1}$$
$$m_e = 9.10938356(11)\times10^{-31}\,\text{kg}$$

Alternatively, the frequencies of photons *absorbed* to promote an electron from energy state m to energy state n

Electron mass /kg	9.1093835611E-31
charge on electron /C	1.6021766209E-19
Planck's constant /Js	6.6260700408E-34
Permittivity of free space	8.8541878170E-12
Speed of light /ms^-1	2.99792458E+08

A	13.6056930149 eV
B	91.12670503 nm

Z	Number of protons	1

$$E_n = -\frac{Z^2}{n^2}\times A$$
$$A = 13.605693015\,\text{eV}$$
$$\lambda_{nm} = B\times\frac{1}{Z^2}\left(\frac{1}{m^2} - \frac{1}{n^2}\right)^{-1}$$
$$B = 91.12670503\text{nm}$$

It is almost always a good idea to write complicated formulae in terms of a quantity of the same dimensions you want (e.g. energy in eV or wavelength in nm) times some dimensionless constant

Niels Bohr
1885-1962
Nobel Prize 1922

Photon wavelengths /nm

n \ m	1	2	3	4	5	6	7	8	9	10
1										
2	121.502									
3	102.518	656.1123								
4	97.2018	486.0091	1874.607							
5	94.9237	433.9367	1281.469	4050.076						
6	93.7303	410.0702	1093.52	2624.449	7455.821					
7	93.0252	396.9074	1004.672	2164.95	4651.259	12365.19				
8	92.5732	388.8073	954.3451	1944.036	3738.531	7498.426	19051.56			
9	92.2658	383.4422	922.6579	1816.926	3295.207	5905.01	11302.56	27788.28		
10	92.0472	379.6946	901.2531	1735.747	3037.557	5125.877	8755.311	16200.3	38848.75	
infinite	91.1267	364.5068	820.1403	1458.027	2278.168	3280.561	4465.209	5832.109	7381.263	9112.671
	Lyman	**Balmer**	**Paschen**	**Brackett**	**Pfund**	**Humphrey's**				
	UV	Visible	IR	IR	IR	IR