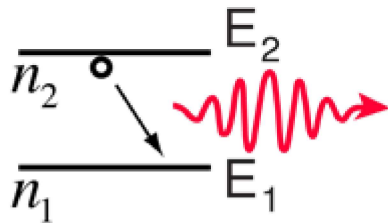


Electron Transitions

The [Bohr model](#) for an electron transition in hydrogen between [quantized energy levels](#) with different quantum numbers n yields a photon by [emission](#) with [quantum energy](#):



A downward transition involves emission of a photon of energy:

$$E_{\text{photon}} = h\nu = E_2 - E_1$$

Given the expression for the energies of the hydrogenic electron states for atoms of atomic number Z :

$$h\nu = \frac{Z^2 m e^4}{8 h^2 \epsilon_0^2} \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right] = -13.6 Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right] eV$$

This is often expressed in terms of the inverse wavelength or "wave number" as follows:

$$\frac{1}{\lambda} = R_H Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ where } R_H = \frac{m e^4}{8 h^3 c \epsilon_0^2} \text{ is called the Rydberg constant.}$$

$$R_H = 1.09677576 \times 10^7 \text{ m}^{-1} \text{ for hydrogen.}$$

$$R_\infty = 1.0973731 \times 10^7 \text{ m}^{-1} \text{ in the limiting case for heavy elements}$$

The reason for the variation of R is that for hydrogen the mass of the orbiting electron is not negligible compared to the proton at the high accuracy at which spectral measurement is done. So the [reduced mass](#) of the electron is needed. But for heavier elements the movement of the nucleus can be neglected.

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Hydrogen Energy Levels

The basic hydrogen energy level structure is in agreement with the [Bohr model](#). Common pictures are those of a shell structure with each main shell associated with a value of the principal quantum number n .

