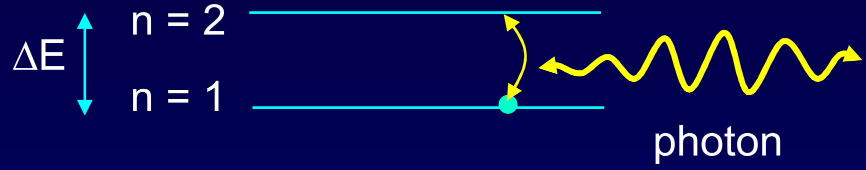
Optical Transitions between Atomic Levels

Consider the n = 1 and 2 levels of hydrogen:



$$f = \frac{\Delta E}{h} = \frac{c}{\lambda}$$

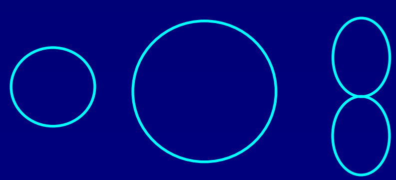
$$\lambda = \frac{hc}{\Delta E} = \frac{1240\ \mathrm{eV \cdot nm}}{\Delta E}$$

The atom can make transitions by emitting (n: 2→1) or absorbing (n: 1→2) a photon. In general, the time-dependent solution of the SEQ in the time-dependent EM field shows the wave function oscillating between the two eigenstates of the energy (that is, they were eigenstates before the field showed up!).

Not all transitions are possible.
For example, one must conserve angular momentum (and the photon has l = 1).

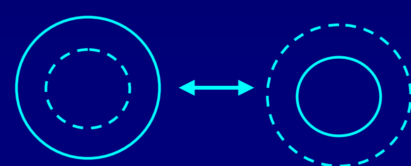
Superpositions:

Stationary States:



1s 2s 2p

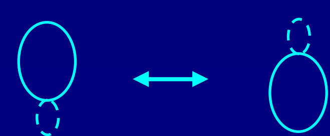
1s ± 2s



No electric-dipole moment

Forbidden transition
$\Delta l = 0$

1s ± 2p



Oscillating electric-dipole couples to photons

Allowed transition
$\Delta l = \pm 1$

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Each photon carries 1 ħ of angular momentum.