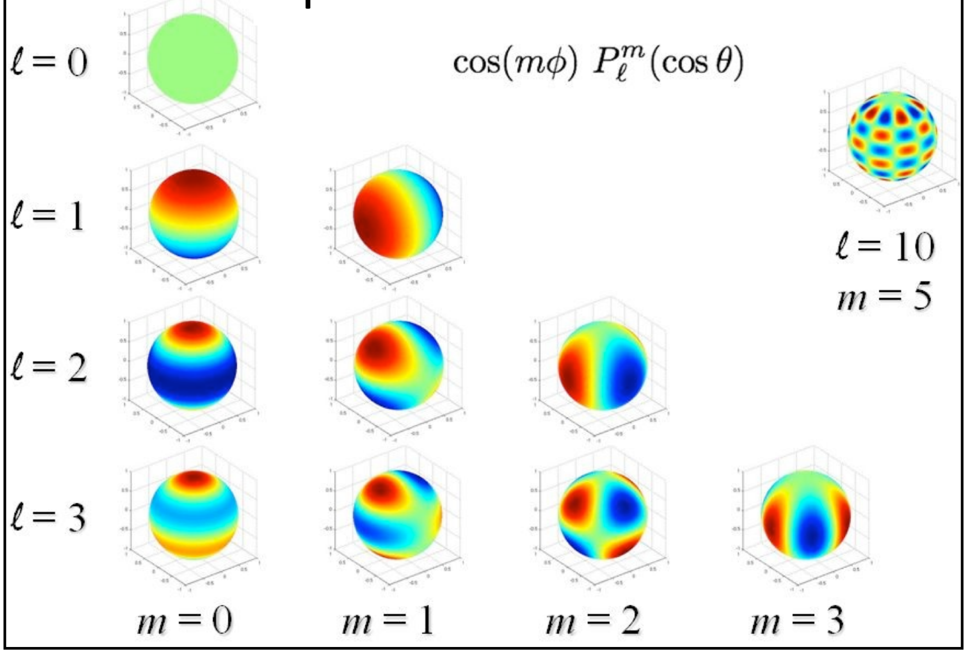
Spherical Harmonics



Vector Model for Quantized Angular Momentum

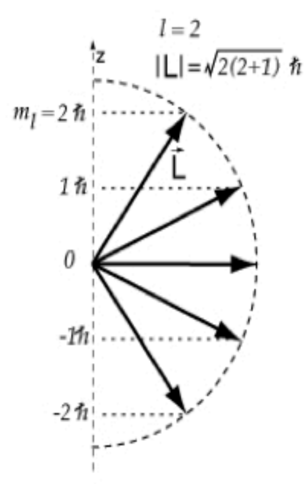


Figure 3.4: The vector model for $l = 2$ with 5 possible projections

The radial wave function and probability densities.

TABLE H-2
RADIAL WAVE FUNCTIONS.

n	ℓ	$R_{n,\ell}$
1	0	$\frac{2}{\sqrt{a_0^3}} e^{-r/a_0}$
2	0	$\frac{1}{\sqrt{2a_0^3}}\left(1-\frac{r}{2a_0}\right)e^{-r/2a_0}$
2	1	$\frac{1}{\sqrt{24a_0^3}}\frac{r}{a_0}e^{-r/2a_0}$
3	0	$\frac{2}{\sqrt{27a_0^3}}\left(1-\frac{2r}{3a_0}+\frac{2r^2}{27a_0^2}\right)e^{-r/3a_0}$
3	1	$\frac{8}{27\sqrt{6a_0^3}}\frac{r}{a_0}\left(1-\frac{r}{6a_0}\right)e^{-r/3a_0}$
3	2	$\frac{4}{81\sqrt{30a_0^3}}\left(\frac{r}{a_0}\right)^2 e^{-r/3a_0}$

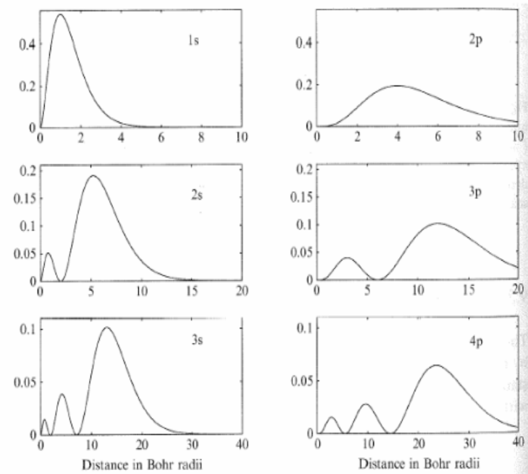
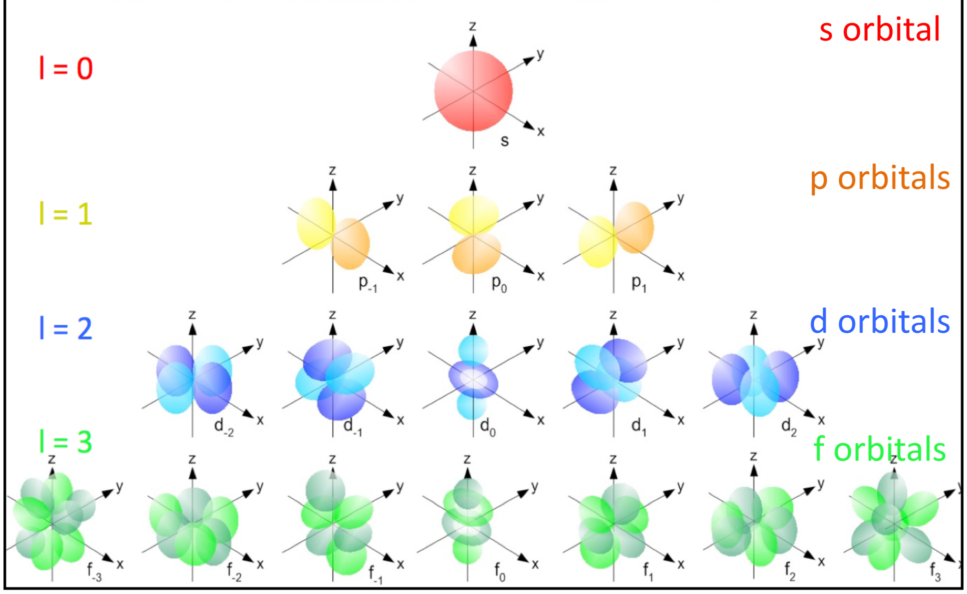
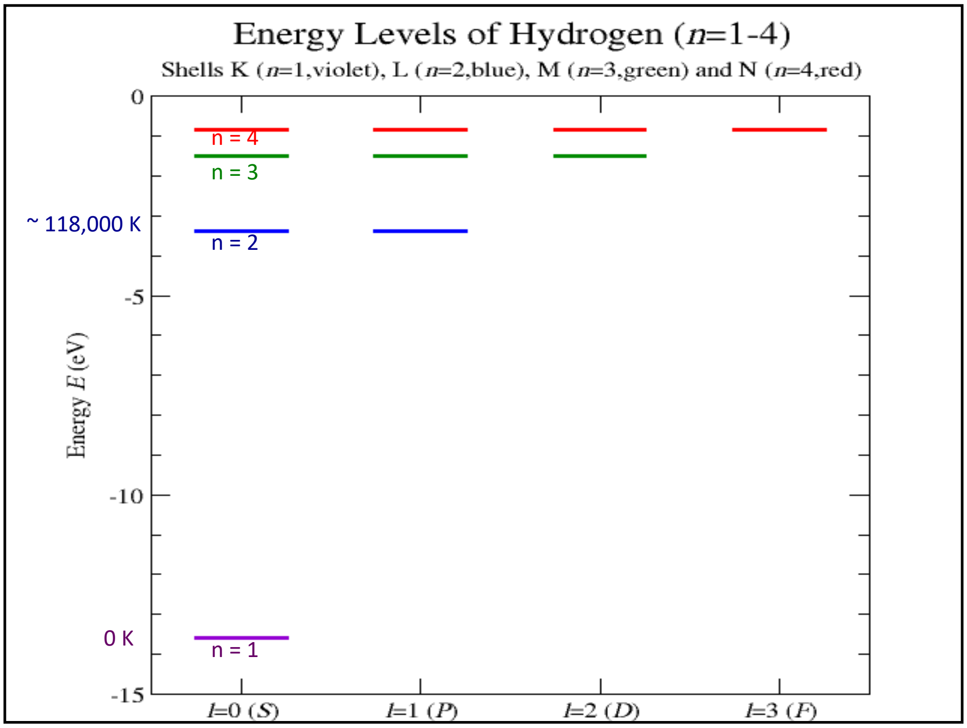


Fig. 9.5 Radial probability densities for the 1s, 2s, 3s, 2p, 3p and 4p states of the hydrogen atom. Note that the unit of distance is the Bohr radius a_0 and that a different scale is used for states with a different number of radial nodes.

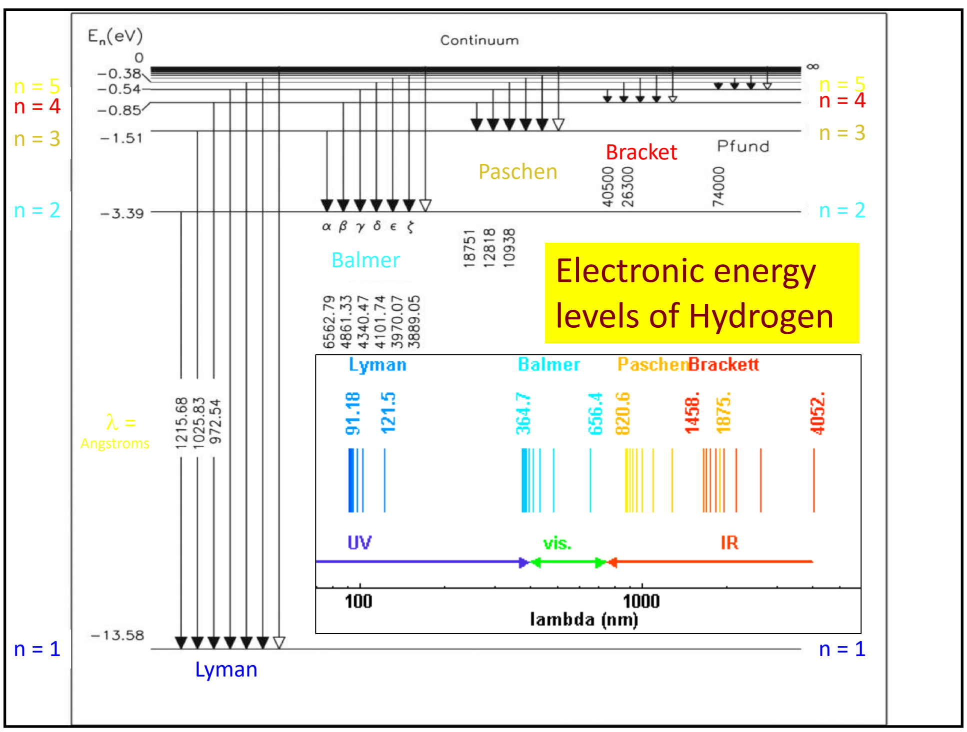
Note: The number of nodes depend not only on n, but on ℓ. The magnetic quantum number m_ℓ does not have any effect on the radial probability.

Atomic Electron Orbitals





Energy Levels of Hydrogen (n=1-4)
Shells K (n=1,violet), L (n=2,blue), M (n=3,green) and N (n=4,red)
Energy E (eV)
0
-5
-10
-15
n = 4
n = 3
~ 118,000 K
n = 2
0 K
n = 1
l=0 (S)
l=1 (P)
l=2 (D)
l=3 (F)



Electronic energy levels of Hydrogen
En(eV)
Continuum
n = 5
n = 4
n = 3
n = 2
n = 1
Paschen
Bracket
Pfund
Balmer
Lyman
λ = Angstroms
UV
vis.
IR
100
1000
lambda (nm)