

The ground state of the hydrogen and hydrogen like atoms will have quantum numbers:

$$n=1 \quad l=0 \quad m_l=0$$

$$E_1 = -13.6 Z^2 \text{ (eV)}$$

$$\psi_{100} = R_{10} Y_0^0 = \frac{1}{\sqrt{\pi}} \left(\frac{Z}{a_0}\right)^{3/2} e^{-\frac{Zr}{a_0}}$$

ψ_{100} does not depend on θ and ϕ and is spherically symmetric so are all $l=0$ (s-states).

The radial probability density for ANY state is

$$P(r) = r^2 |R(r)|^2$$

$R(r)$ is the radial wavefunction.

also $\int_0^{\infty} P(r) dr = 1$ and $\langle r \rangle = \int_0^{\infty} r P(r) dr$

↑
average distance of the electron from the nucleus.

The excited states of hydrogen like atoms are

$$n=2 \quad l=0 \quad m_l=0 \quad E_2 = -3.4 Z^2 \text{ (eV)}$$

$$n=2 \quad l=1 \quad m_l=1, 0, -1$$