Representations of Orbitals

1. *Radial Plot*: Ψ vs. r or Ψ^2 vs. r

   Two-dimensional plot of Ψ or Ψ^2 versus the distance, r, from the nucleus, without trying to show the three dimensional aspects of the distribution. Sometimes a particular direction in space is chosen (x, y, z) instead of any direction r.

2. *Radial Distribution Function*: $4\pi r^2\Psi^2$ vs. r

   Probability of finding the electron within a vanishingly thin spherical shell with a radius of r from the nucleus. Going out from the nucleus, this shows the variation in probability on the surface of increasingly larger spherical shells.

3. *Electron Charge Cloud (Electron Density) Diagram*

   Three-dimensional picture of Ψ^2 in which higher probability is rendered by darker shading or stippling. Most of such diagrams are meant to show approximately 90-99% of the total probability.

Representations of Orbitals

4. *Contour Diagram*

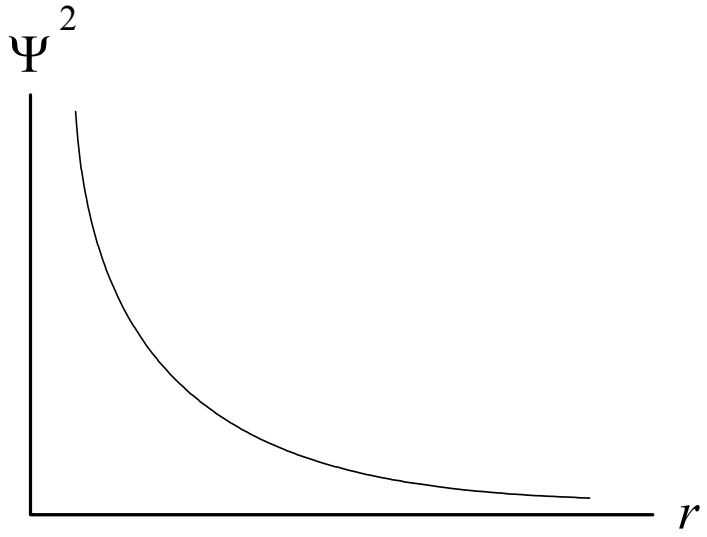
   Two-dimensional cross section (slice) through the probability distribution. Lines on the drawing connect regions of equal probability, much like isobars on a weather map connect regions of equal pressure.

5. *Boundary Surface Diagram*

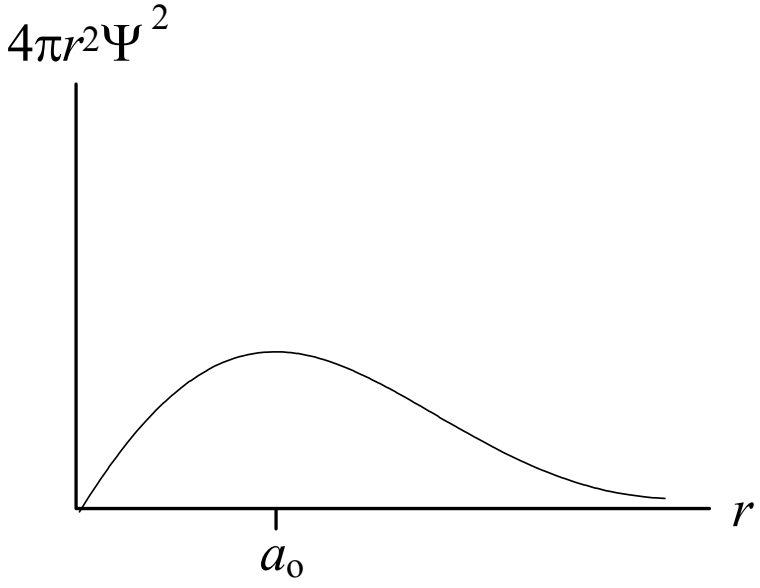
   Three-dimensional solid model (or a picture of such a model) constructed so as to represent a surface that encloses approximately 90-99% of the total probability. These are sometimes called "balloon models". Sketches of orbitals used in routine work are generally two-dimensional representations of "balloon models".

Probability vs. Distance from Nucleus
1*s* Wave Function

$n = 1, l = 0, m_l = 0$

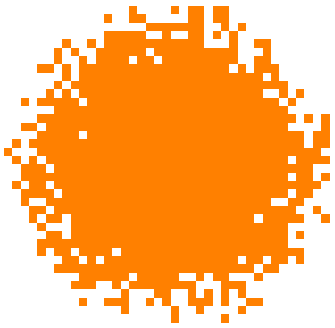


Radial plot

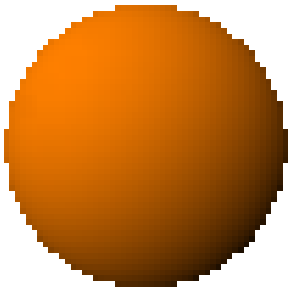


Radial distribution plot

Three-Dimensional Representation of a 1*s* Orbital

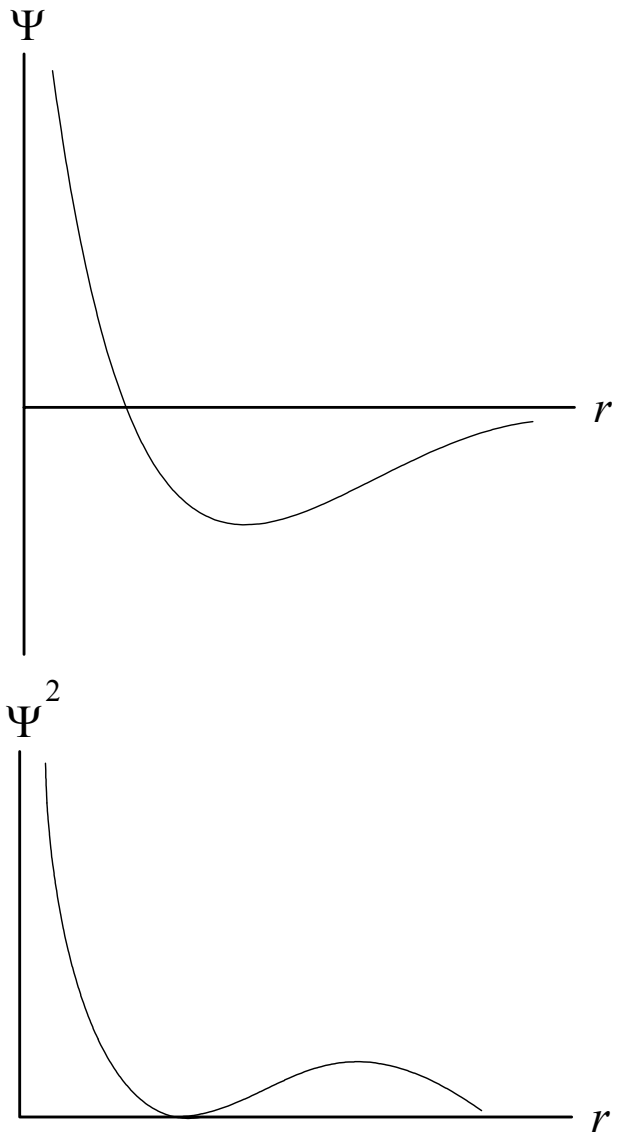


Electron Cloud Representation

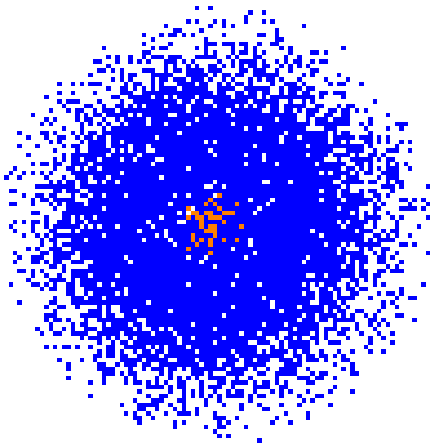


Boundary Surface Model

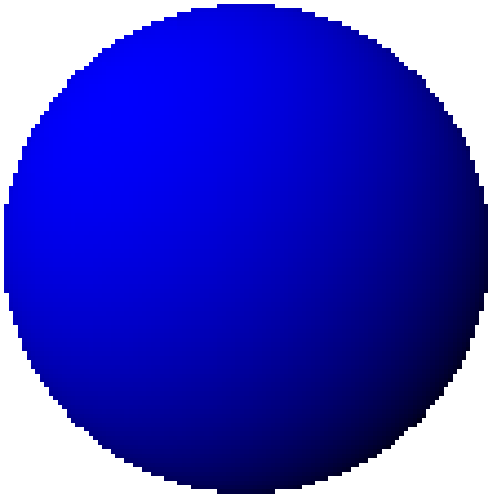
Ψ and Ψ^2 vs. Distance from the Nucleus
2*s* Wave Function
$n = 2, l = 0, m_l = 0$



Three-Dimensional Representation of a 2*s* Orbital

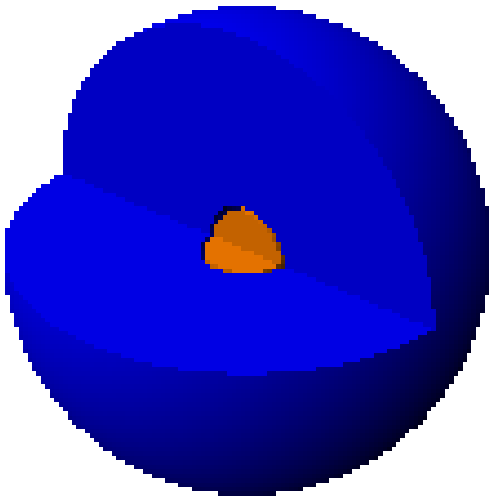


Electron Cloud Representation



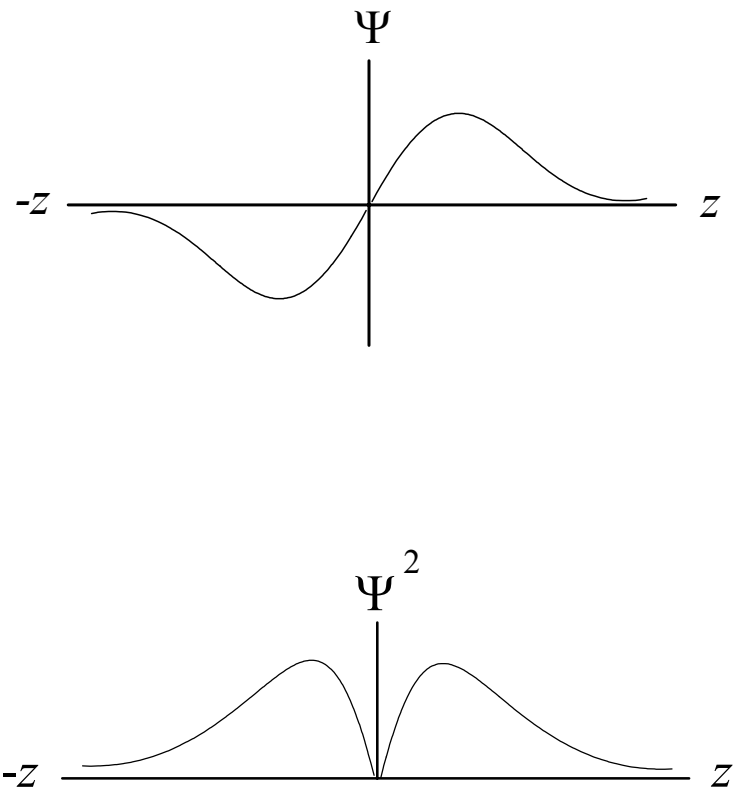
Boundary Surface Model

Cutaway Model of 2*s* Orbital

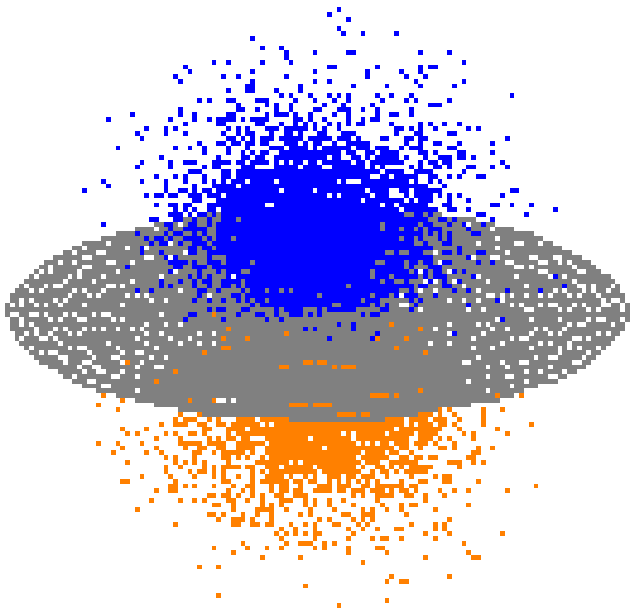


The 2*s* orbital has one spherical node.

Ψ and Ψ^2 vs. Distance from the Nucleus
$2p_z$ Wave Function



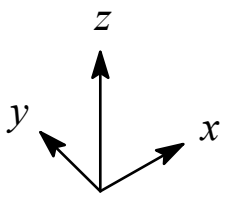
Electron Cloud Representation of a $2p_z$ Orbital

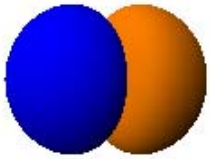


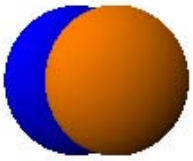
The plane perpendicular to z (xy plane) passing through the nucleus is a node.

The Three Degenerate 2*p* Orbitals

$n = 2, l = 1, m_l = +1, 0, -1$



$2p_x$ 

$2p_y$ 

$2p_z$