

15. Electron Waves: Radial Loops

While it helps to think about quantized electron waves as 1D standing waves (like waves on a rope), they are three dimensional inside of an atom. These 3D loops, or radial loops, form spheres. The following activity is designed to help you identify the number of radial loops (3D loops) an electron cloud has by looking at it. We will indicate the number of radial loops by the letter “ j ”.

Go to the following applet: (*You will have to enable the use of Java for this applet*)
<http://www.bu.edu/dbin/quantumconcepts/Hybridization/explorers.html>

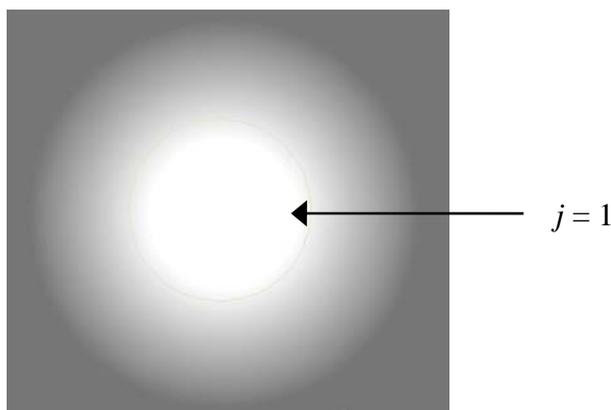
- 1) Select the “**Hydrogen Explorer**” from the radio buttons on the screen.
- 2) Select the “**Slice**” radio button. You can switch between the “Slice” or “3D” radio buttons on the right. The “Slice” view will allow you to look at any cross section of the orbital where the “3D” view will allow you to rotate and see the shape of the orbital.
- 3) Select the “**Density**” radio button on the bottom right of the screen.

You will see an energy diagram on the left hand side of the screen, and a view box on the right hand side. The view box will initially be blank because no energy level has been selected. Once you select an energy level, you will be able to see a 3D rendition of the electron cloud on the right. You can also click on this image and drag to rotate the view of the electron cloud.

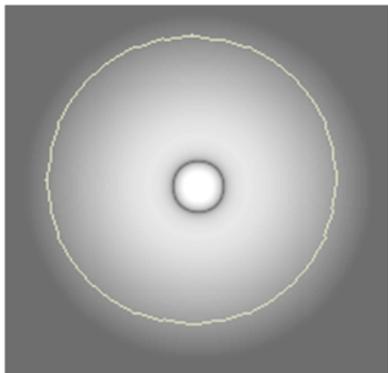
- 4) Select the “**View All Orbitals**” radio button at the top left of the screen.

As you hover your mouse over each energy level, the energy value will be displayed on the left. What you will notice is that there are multiple lines drawn for many of the energy values, or orbitals.

- 1) Select the “1s” orbital. The image you see on your screen should match the image given below. This cloud shows only a single sphere, indicating that it has one radial loop ($j = 1$).



2) On the energy diagram on your screen, select 2s. You should see an image that matches the image given below. How many radial loops does this image have? Indicate where the loops on the drawing.



$j =$

3) Select 3s. Sketch the 3D shape below. How many radial loops does this orbital have?

$j =$

4) Based on the two sketches above, see if you can predict what 4s electron cloud would look like by sketching its 3D shape below. Give an explanation for your drawing, and then check your work using the applet.