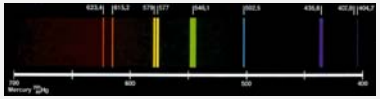


[TP] Mercury atoms have bright emission lines at 435.835 nm (blue), 546.074 nm (green), and a pair at 576.959 nm and 579.065 nm (yellow-orange). The photon energy of the line at 579.065 nm is given by ...



10% 1. 13.6 eV 80^2 (1 – 1/4)
10% 2. 13.6 eV 80^2 (1/4 – 1/9)
10% 3. 13.6 eV 80^2 (1/4)
10% 4. 13.6 eV 80^2 (1/9)
10% 5. $h\,c$ / (579.065 nm)
10% 6. 1 and 5
10% 7. 2 and 5
10% 8. 3 and 5
10% 9. 4 and 5
10% 10. some other expression

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0 of 0

1

Lecture 32 CH101 A1 (MWF 9 am)

Wednesday, November 30, 2016

- Review: H atom photon energies
- Hydrogen atom electron clouds http://goo.gl/XPkcxv
- Review: Electron clouds

Next lecture: More than one electron: Orbital (yikes!) approximation; Electrical shielding of one electron by others http://goo.gl/hMNPLA; Building electron configurations

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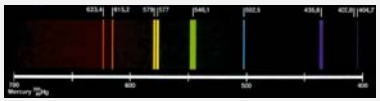

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6

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Review: H atom energies

$E_n = -13.6$ eV Z^2/n^2 only when there is single electron.

Soon we'll learn how to modify things when there is more than one electron.

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7

Hydrogen atom electron clouds: http://goo.gl/XPkcxv

1D Particle in a box:

1D example of a standing wave

Major Lesson: lowest energy has 1 loop (0 nodes)

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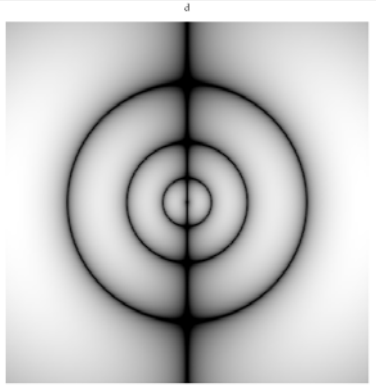
Extend into 3D



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Hydrogen atom family album: http://goo.gl/XPkcxv

1D Particle in a box:

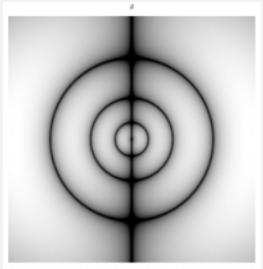
1D example of a standing wave

Major Lesson: lowest energy has 1 loop (0 nodes)

Extend into 3D:

Atoms are spheres!! (not wires)

Two types of loops: radial and angular



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Clouds and probability

The density of an electron cloud is a measure of the fraction of the electron in that region.

For this reason, clouds are sometimes referred to in terms of probability density.

It is crucial to understand that the cloud *is* the electron, and not a time exposure of a point particle.

Probability density is due to spatial extent rather than motion.

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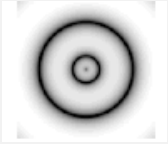
Radial loops

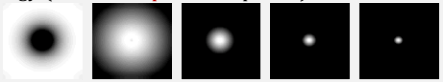
Concentric rings around nucleus
(distance from the nucleus)



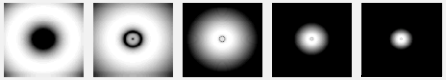
j = # radial loops

Radial loops only (known as "s")

Lowest Energy (1 radial loop, 0 nodal planes):



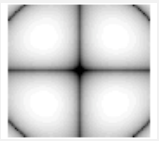
2nd Lowest Energy (2 radial loops, 0 nodal planes):



Etc.

Nodal planes

- Will look like planes (lines) of zero probability



ℓ = # of nodal planes

Radial + 1 nodal plane (known as "p")

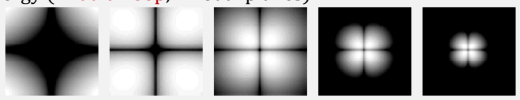
Lowest Energy (1 radial loop, 1 nodal plane):

2nd Lowest Energy (2 radial loops, 1 nodal plane):

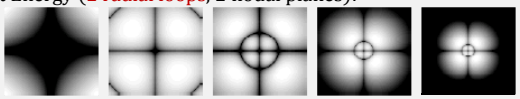
Etc.

Radial + 2 nodal planes (known as "d")

Lowest Energy (1 radial loop, 2 nodal planes):



2nd Lowest Energy (2 radial loops, 2 nodal planes):

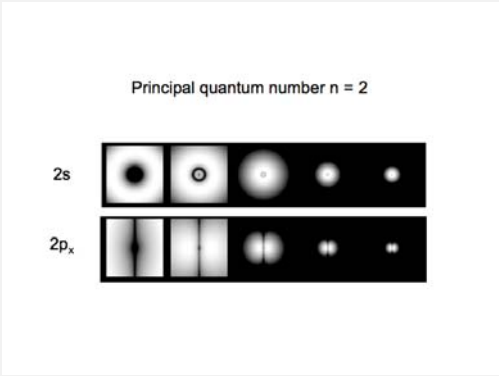


Etc.

Loops, planes, and quantum number *n*

Electron wave	Radial loops	Nodal planes	n = loops + planes
1s	1	0	**1 = 1 + 0**
2s			
2p			
3s			
3p			
3d			

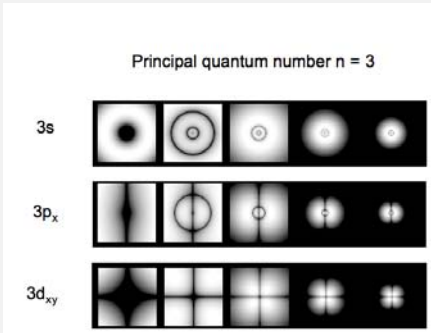
$E_n = -13.6 \text{ eV}/n^2 \rightarrow E_1 = -13.6 \text{ eV}$



Loops, planes, and quantum number *n*

Electron wave	Radial loops	Nodal planes	n = loops + planes
1s	1	0	1 = 1 + 0
2s	2	0	**2 = 2 + 0**
2p	1	1	**2 = 1 + 1**
3s			
3p			
3d			

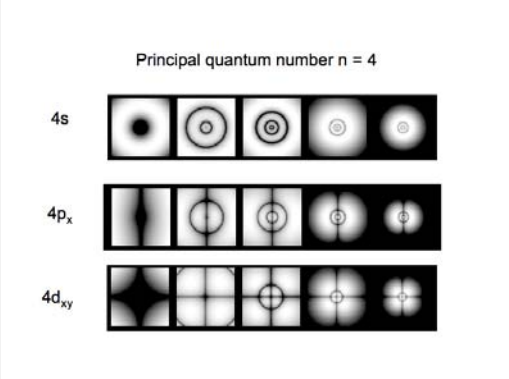
$E_n = -13.6 \text{ eV}/n^2 \rightarrow E_2 = -13.6/\mathbf{4} \text{ eV}$



Loops, planes, and quantum number *n*

Electron wave	Radial loops	Nodal planes	n = loops + planes
1s	1	0	1 = 1 + 0
2s	2	0	2 = 2 + 0
2p	1	1	2 = 1 + 1
3s	3	0	**3 = 3 + 0**
3p	2	1	**3 = 2 + 1**
3d	1	2	**3 = 1 + 2**

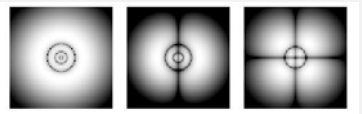
$E_n = -13.6 \text{ eV}/n^2 \rightarrow E_3 = -13.6/9 \text{ eV}$



[TP] What electron cloud has 3 radial loops and 1 nodal plane?

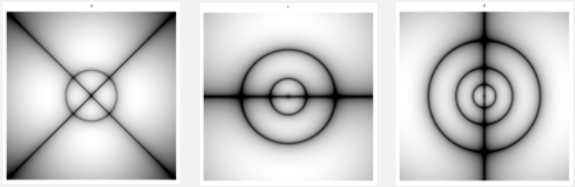
11% 1. 1s
11% 2. 2s
11% 3. 2p
11% 4. 3s
11% 5. 3p
11% 6. 3d
11% 7. 4s
11% 8. 4p
11% 9. 4d

[TP] What is the ionization energy of H atom electrons with these electron clouds?



20% 1. 13.6 eV
20% 2. 13.6/4 eV
20% 3. 13.6/9 eV
20% 4. 13.6/16 eV
20% 5. They have different ionization energies

[Quiz] Which hydrogen atom electron cloud has the smallest ionization energy?



25% 1. Left
25% 2. Middle
25% 3. Right
25% 4. They all have the **same** ionization energy

Review: Electron clouds

[Quiz] Which electron cloud has the most radial loops?

17% 1. 1s
17% 2. 2s
17% 3. 2p
17% 4. 3s
17% 5. 3p
17% 6. 3d

