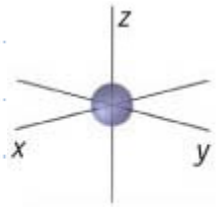
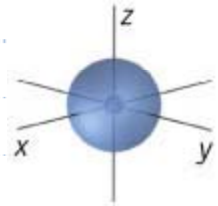
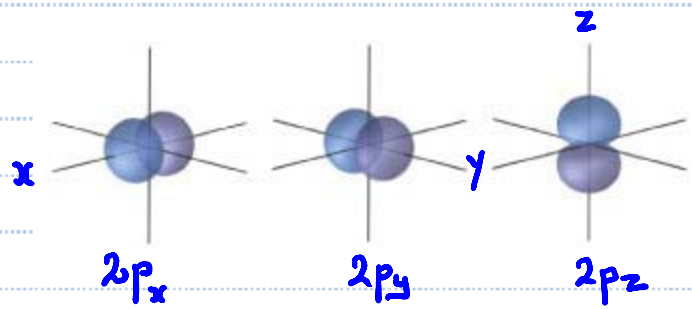
Announcements – Lecture VIII – Monday, June 1st

1. Third Lab: Tuesday, June 2nd, ISB 155B

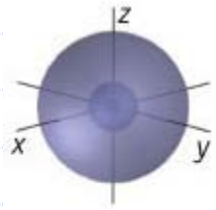
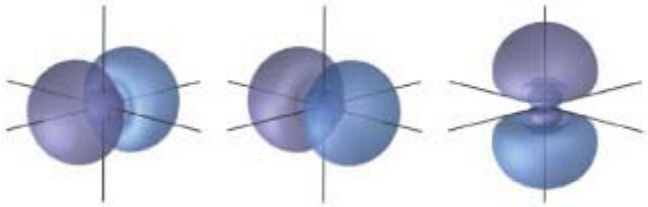
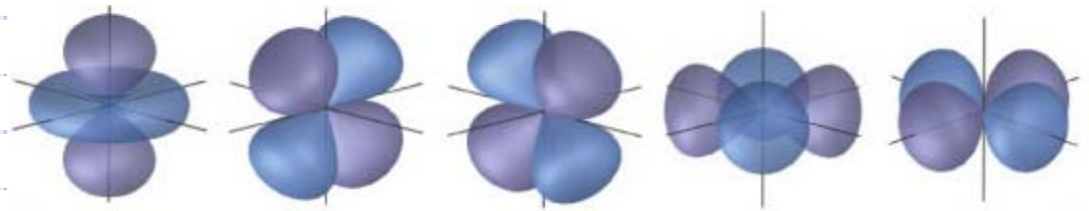
6.5 Quantum Numbers, Orbitals, and Nodes

B: Orbitals – n = 1 and 2

n	Orbitals		#	Label
1	1		1	1s
2	4		1	2s
			3	2p

6.5 Quantum Numbers, Orbitals, and Nodes

B: Orbitals – n = 3

n	Orbitals		#	Label
			1	3s
3	9		3	3p
		 $3d_{z^2}$ $3d_{xy}$ $3d_{yz}$ $3d_{xy}$ $3d_{x^2-y^2}$	5	3d

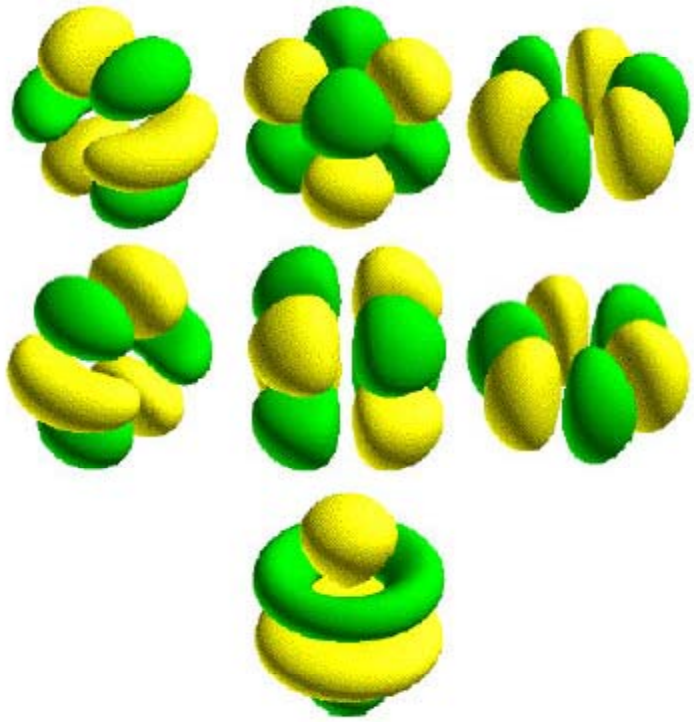
6.5 Quantum Numbers, Orbitals, and Nodes

B: Orbitals – n = 4

n = 4 16 Orbitals

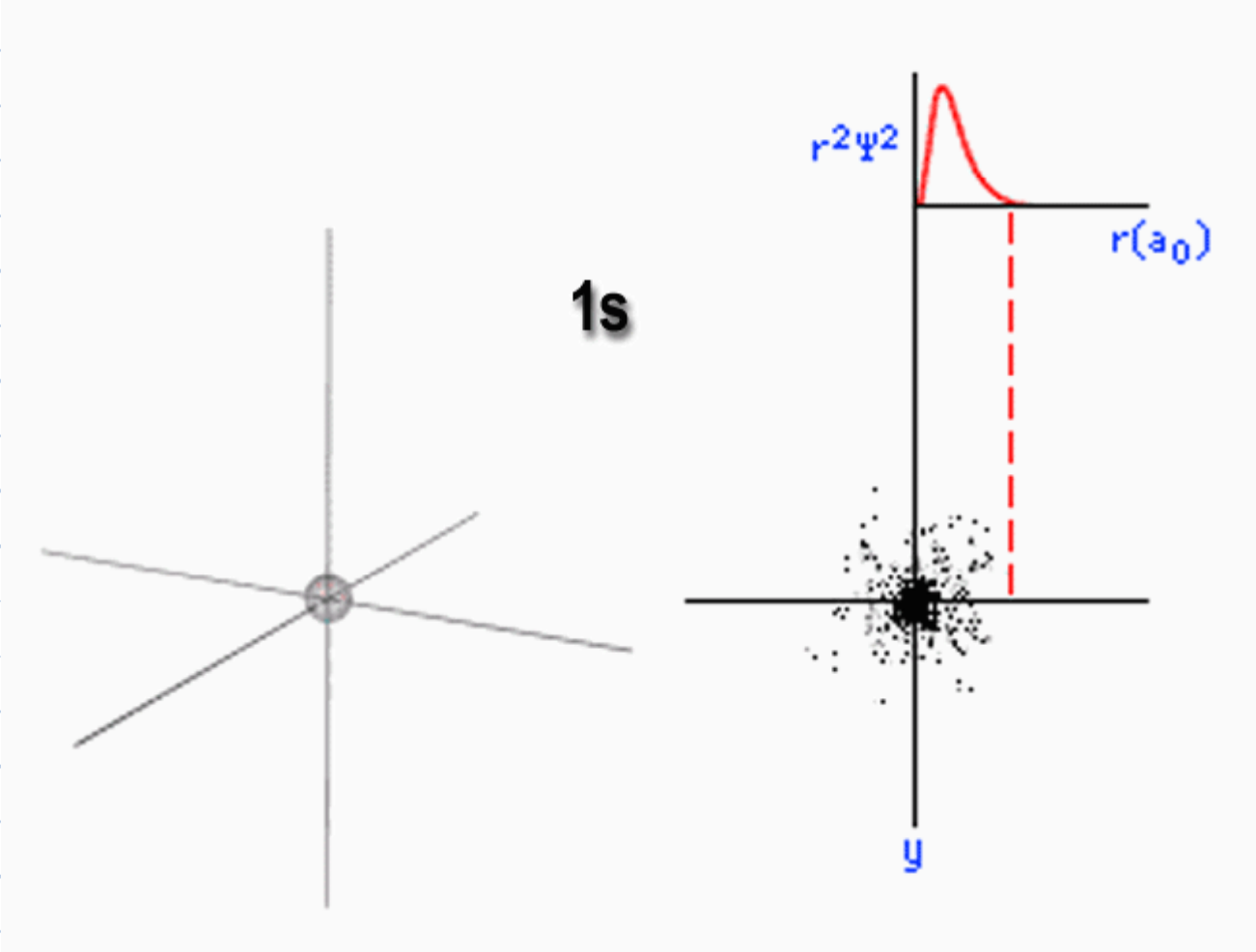
1	4s
3	4p
5	4d
7	4f

f orbitals



6.5 Quantum Numbers, Orbitals, and Nodes

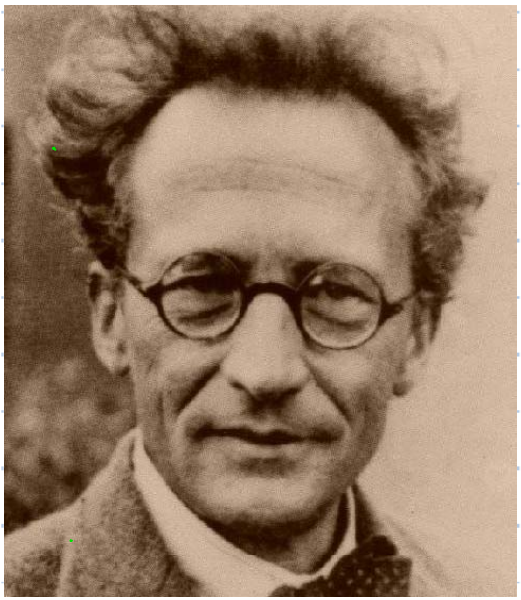
B: Orbital Shapes with Increasing n



6.5 Quantum Numbers, Orbitals, and Nodes

C: Quantum Numbers

Erwin Schrödinger (1887- 1961)



Schrödinger's Equation

$$i\hbar \frac{\partial}{\partial t}\psi(\mathbf{r},t) = -\frac{\hbar^2}{2m}\nabla^2\psi(\mathbf{r},t) + V(\mathbf{r},t)\psi(\mathbf{r},t)$$

i is the imaginary number, $\sqrt{-1}$.

$\hbar$ is Planck's constant divided by 2π: 1.05459×10^{-34} joule·second.

$\psi(\mathbf{r},t)$ is the wave function, defined over space and time.

m is the mass of the particle.

∇^2 is the Laplacian operator, $\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}$.

$V(\mathbf{r},t)$ is the potential energy influencing the particle.

Principal Quantum Number = n ... number of solutions ... n^2

... number of nodes ... n-1 { planar nodes + spherical nodes

6.5 Quantum Numbers, Orbitals, and Nodes

C: Nodes

	1s	2s	3s	4s
Planar nodes:	0	0	0	0
Spherical nodes:	0	1	2	3

Increasing size

Getting further away from the nucleus

	2p	3p	4p
Planar nodes:	1	1	1
Spherical nodes:	0	1	2

	3d	4d
Planar nodes	2	2
Spherical nodes	0	1