Bohr described atoms as being like solar system. The electrons orbiting around the nucleus.

Schrodinger described atomic model with electrons in three dimensions.

He described where electrons could be found in terms of three coordinates:

Prinicpal quantum number – n

Angular quantum number – l

Magnetic quantum number - m

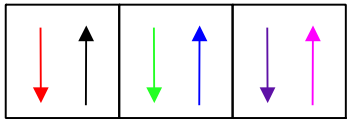
- Principal Quantum number – n
  - Describes the energy level within the atom, i.e. the shell number – 1, 2, 3, etc
- Angular (momentum) quantum number - l
  - Describes the sublevel in the principal quantum number
  - Sublevels in the atoms are *s, p, d, f*
    - For s sublevel $l = 0$
    - For p sublevel $l = 1$
    - For d sublevel $l = 2$

- Magnetic quantum number – m
  - Describes the orbital within the sublevel
    - s has one orbital – m = 0
    - p has three orbitals – m = -1, 0, +1
    - d has five orbitals – m = -2, -1, 0, +1, +2
- The fourth quantum number is the one known as the Spin Quantum number
  - This describes the spin of the electron
  - Electrons in the same orbital must have opposite
  - Possible spins are clockwise and anticlockwise

• Shell number	• 1, 2, 3	• n (1, 2, 3)
• Sub-shell	• s, p, d	• l (0, 1, 2)
• Energy shift	• $-l - l$	• m_l (0;-1,0,1; ...)
• Spin	• -½ – ½	• m_s

n	Principal Quantum number (Shell number – 1, 2, 3, ...)
ℓ	Orbital shape/angular quantum number (Sub-shell – s (0), p (1) d(2)) 0 – n-1
m_ℓ	Magnetic quantum number (energy shift) -ℓ– ℓ
m_s	Electron spin quantum number (electron spin -½ or ½

2p



$n = 2$ $l = 1$ $m_l = 1$ $ms = -½$

$n = 2$ $l = 1$ $m_l = 1$ $ms = ½$

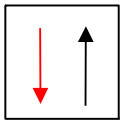
$n = 2$ $l = 1$ $m_l = 0$ $ms = -½$

$n = 2$ $l = 1$ $m_l = 0$ $ms = ½$

$n = 2$ $l = 1$ $m_l = -1$ $ms = -½$

$n = 2$ $l = 1$ $m_l = -1$ $ms = ½$

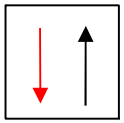
2s



$n = 2$ $l = 0$ $m_l = 0$ $ms = -½$

$n = 2$ $l = 0$ $m_l = 0$ $ms = ½$

1s



$n = 1$ $l = 0$ $m_l = 0$ $ms = -½$

$n = 1$ $l = 0$ $m_l = 0$ $ms = ½$

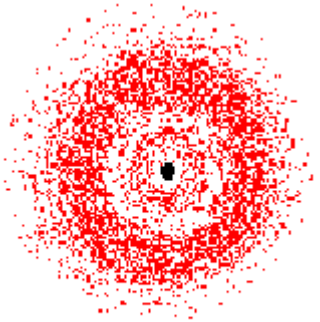
Quantum Numbers

n	l	m_l	Orbital	Elements		Shell
$n = 1$	0	0	1*s*	2	} 2	*K*
$n = 2$	0	0	2*s*	2	} 8	*L*
	1	−1, 0, 1	2*p*	6		
$n = 3$	0	0	3*s*	2	} 18	*M*
	1	−1, 0, 1	3*p*	6		
	2	−2, −1, 0, 1, 2	3*d*	10		
$n = 4$	0	0	4*s*	2	} 32	*N*
	1	−1, 0, 1	4*p*	6		
	2	−2, −1, 0, 1, 2	4*d*	10		
	3	−3, −2, −1, 0, 1, 2, 3	4*f*	14		
$n = 5$	0	0	5*s*	2	} 32	*O*
	1	−1, 0, 1	5*p*	6		
	2	−2, −1, 0, 1, 2	5*d*	10		
	3	−3, −2, −1, 0, 1, 2, 3	5*f*	14		
	4	−4, −3, −2, −1, 0, 1, 2, 3, 4	5*g*	18	Unknown Corresponding Elements	
$n = 6$	0	0	6*s*	2	} 18	*P*
	1	−1, 0, 1	6*p*	6		
	2	−2, −1, 0, 1, 2	6*d*	10		
	3	−3, −2, −1, 0, 1, 2, 3	6*f*	14	} 56 Unknown Corresponding Elements	
	4	−4, −3, −2, −1, 0, 1, 2, 3, 4	6*g*	18		
	5	−5, −4, −3, −2, −1, 0, 1, 2, 3, 4, 5	6*h*	22		
$n = 7$	0	0	7*s*	2	} 8	*Q*
	1	−1, 0, 1	7*p*	6		
	2	−2, −1, 0, 1, 2	7*d*	10	} 90 Unknown Corresponding Elements	
	3	−3, −2, −1, 0, 1, 2, 3	7*f*	14		
	4	−4, −3, −2, −1, 0, 1, 2, 3, 4	7*g*	18		
	5	−5, −4, −3, −2, −1, 0, 1, 2, 3, 4, 5	7*h*	22		
	6	−6, −5, −4, −3, −2, −1, 0, 1, 2, 3, 4, 5, 6	7*i*	26		

Orbital Shapes

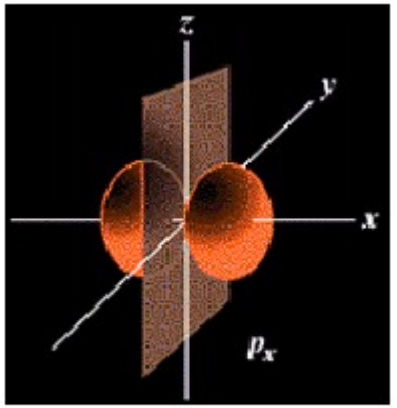
- An atomic orbital can be thought of as a picture that would be obtained if we photograph where the electron has been at different times
- i.e. if we would plot the probability of finding an electron at a particular distance from the nucleus in three dimensions
- It is a sort of a cloud around the nucleus
- Orbitals are 3 dimensional structures with complicated features

- The s orbitals are spherical
- The p orbitals are dumbbell shaped

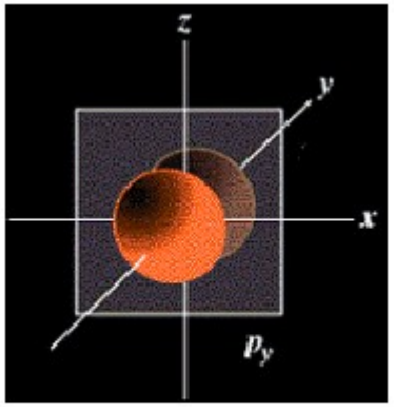


a 2s orbital

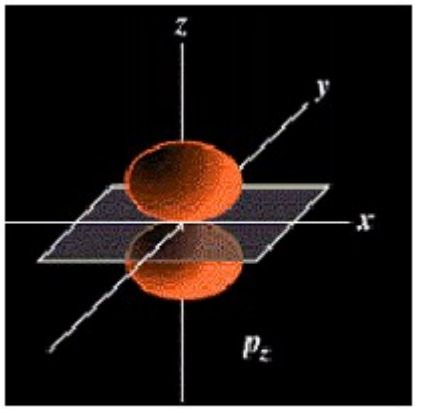
a p orbital



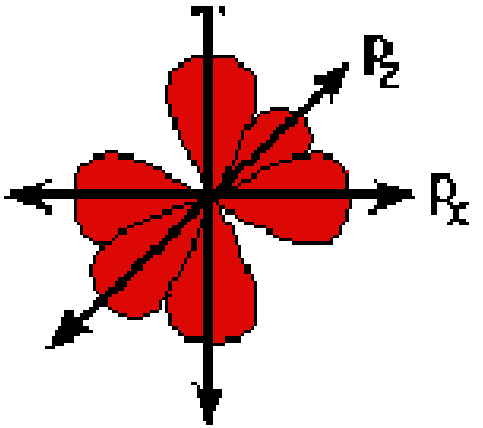
p_x orbital

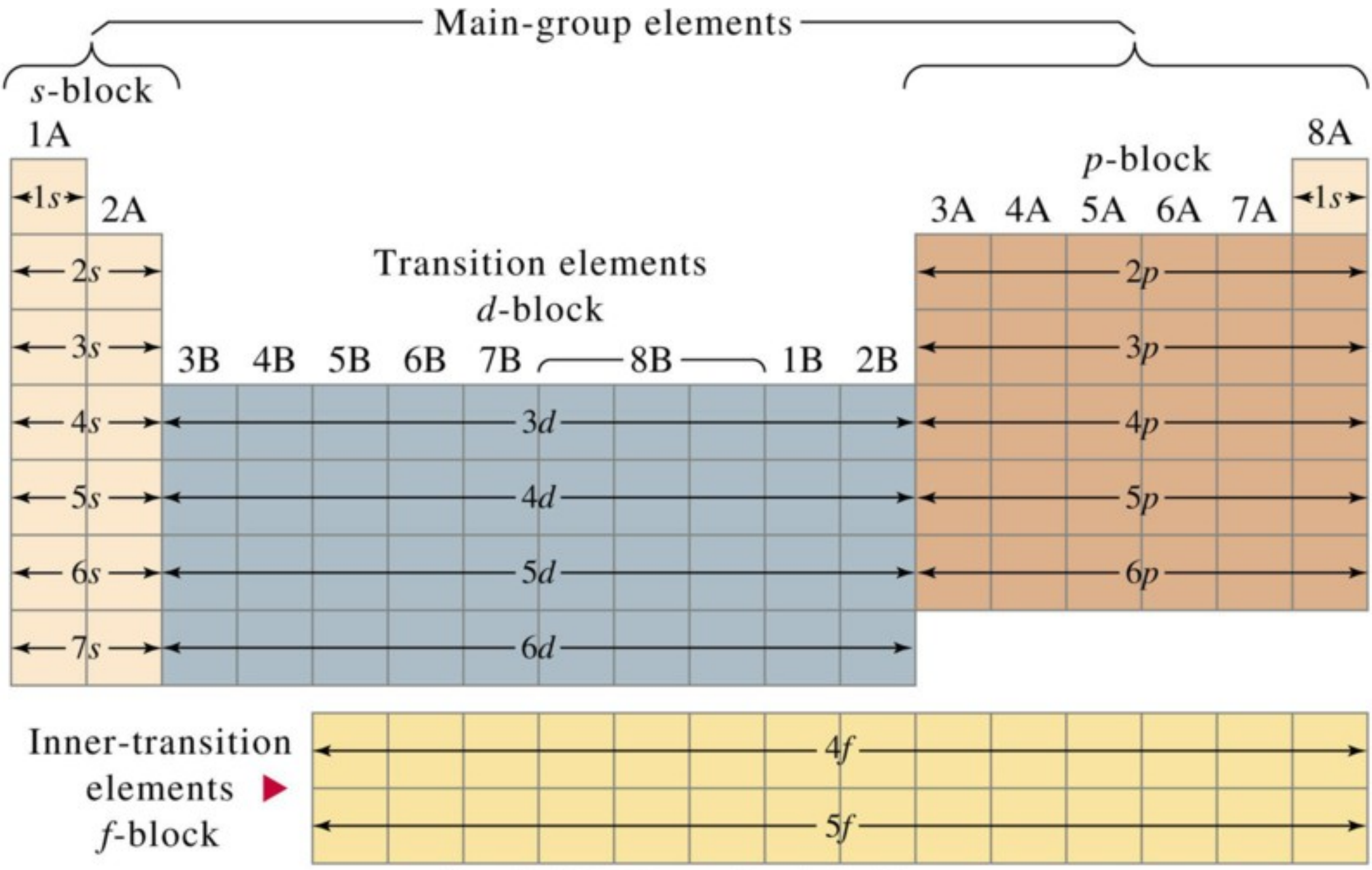


p_y orbital



p_z orbital




Main-group elements
s-block
1A
8A
p-block
1s
2A
3A 4A 5A 6A 7A
1s
2s
2p
Transition elements
d-block
3s
3p
3B 4B 5B 6B 7B 8B 1B 2B
4s
3d
4p
5s
4d
5p
6s
5d
6p
7s
6d
Inner-transition elements
f-block
4f
5f

Blocks in the Periodic Table

- The periodic table is divided into blocks
  - s block: have valence configuration of s^1 or s^2
  - p block: has valence configuration of $s^2\ p^1$ to $s^2\ p^6$
  - d block elements have valence configuration in which d subshells are being filled
- Chemically, elements in the same block show same general characteristics
- e.g. s block elements are all metals with low electronegativity

- P block elements are mixed – with some metals on the left, and non-metals on the right
- Between the metals and non-metals found in the p block are the semi-metals (metalloids)
- The d block elements are the transition metals