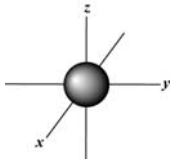
Quantum Model of the Atom (quantum numbers)

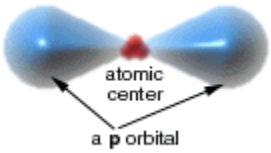
In order to make the energies work out, the Schrodinger equation (the equation that determines the probability densities of the orbitals) has four variables.

- *Principal Quantum Number (n):* Determines energy
    - Allowable values are 1, 2, 3, …, n
    - This number determines the main energy level of an atom
    - The number of electrons present in an energy level can be described by the equation $2n^2$.

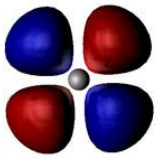
- *Angular Momentum Quantum Number (l):* Determines type (s,p,d,f)
    - Allowable values are 0, 1, 2, …, (n-1)
    - The angular momentum quantum number determines the shape and relative energies of the electrons in an energy level.
        - l=0 defines an "s-orbital" with a spherical probability density:



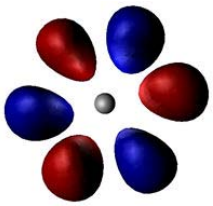
        - l=1 defines a "p-orbital" with a barbell-shaped probability density:



        - l=2 defines a "d-orbital" with variously-shaped probability densities (one of which is shown here):



- l=3 defines an “f-orbital” with variously-shaped probability densities (one of which is shown here):

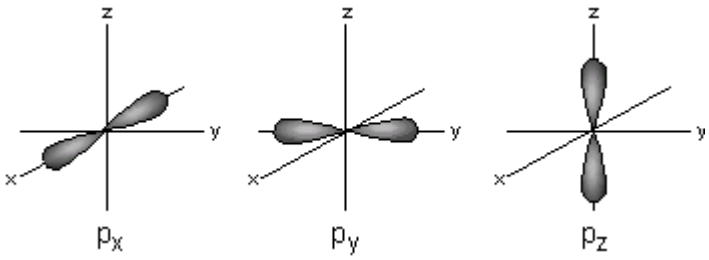


- *Magnetic quantum number (m_l):* Determines spatial orientation

  - Possible values: $-l$, $-l+1$, …, -1, 0, 1, …, $l-1$, l
    - Example: If l=2, m_l can equal -2, -1, 0, 1, 2

  - The magnetic quantum number determines the orientation of the orbitals in space.

    - Example: p-orbitals



- *Spin Quantum Number (m_s):* Identifies which electron in each orbital we’re talking about.

  - Possible values: +1/2, -1/2.