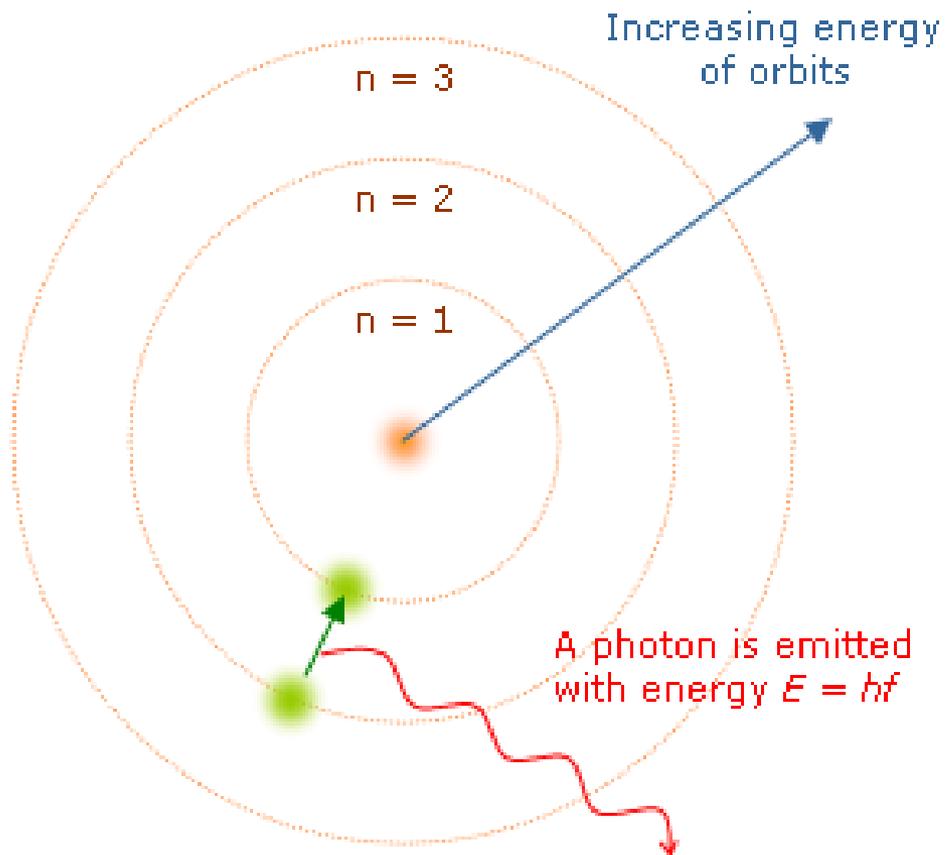


# The Modern Model of the Atom

Bromfield Honors Chemistry

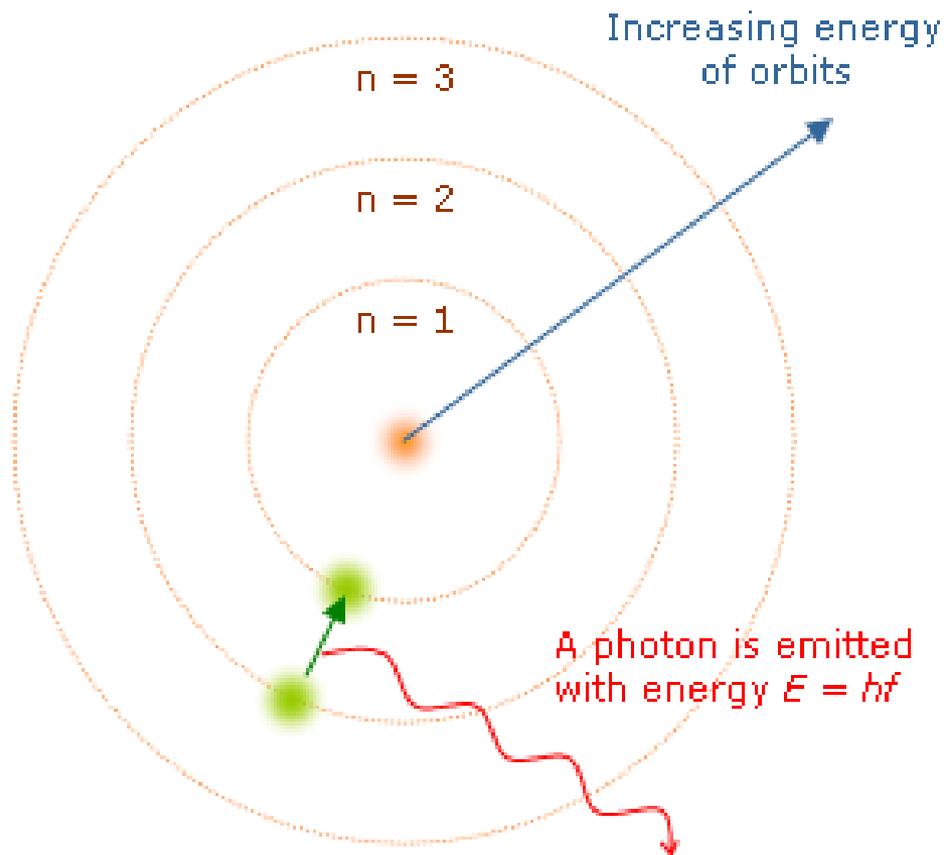
---

# The Bohr Model...recap



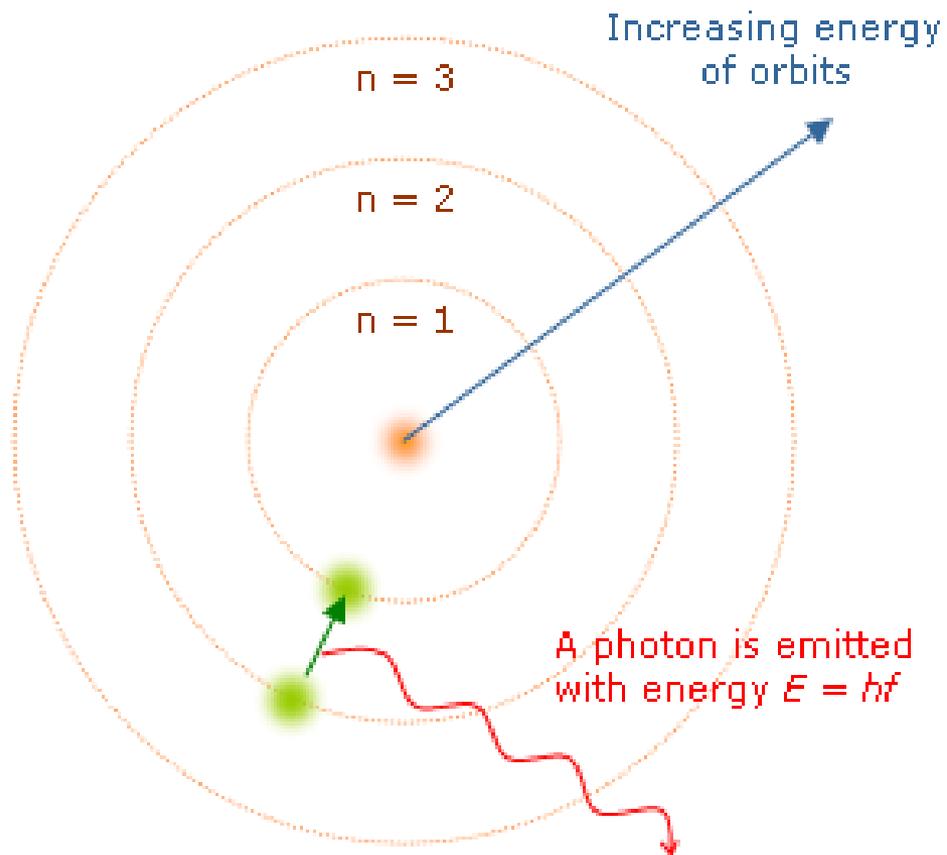
- Electrons travel around the nucleus in fixed circular orbits

# The Bohr Model...recap



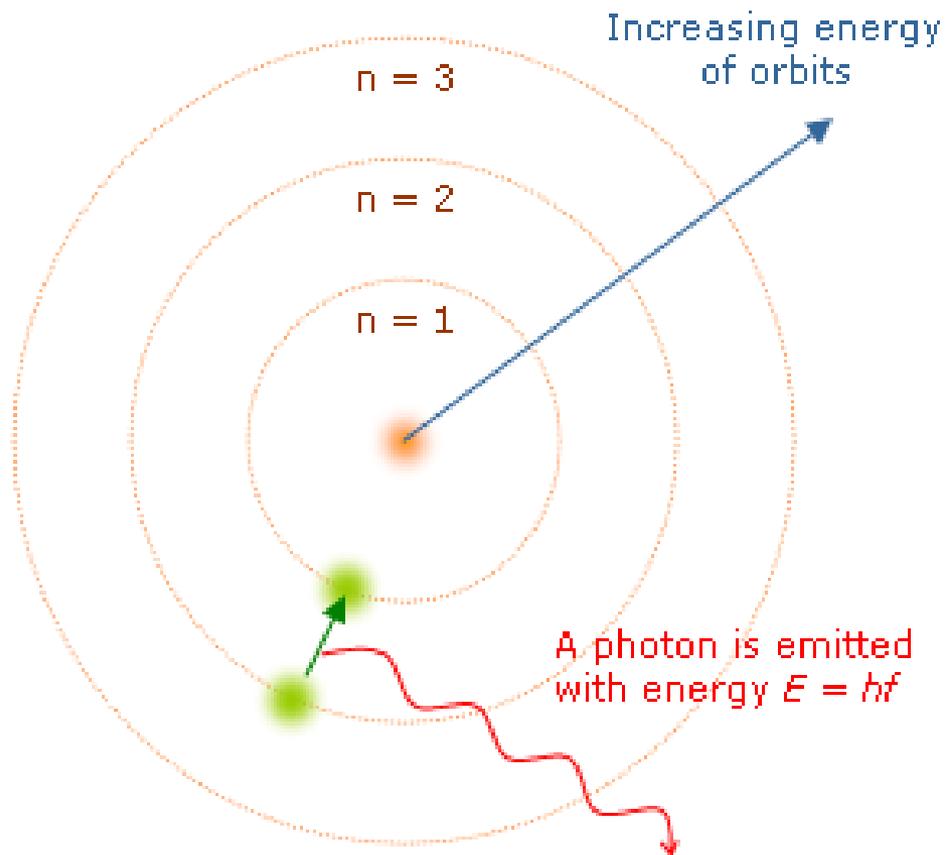
- Electrons travel around the nucleus in fixed circular orbits
- Only certain orbits with certain energies are allowed

# The Bohr Model...recap



- Electrons can transition between energy levels

# The Bohr Model...recap



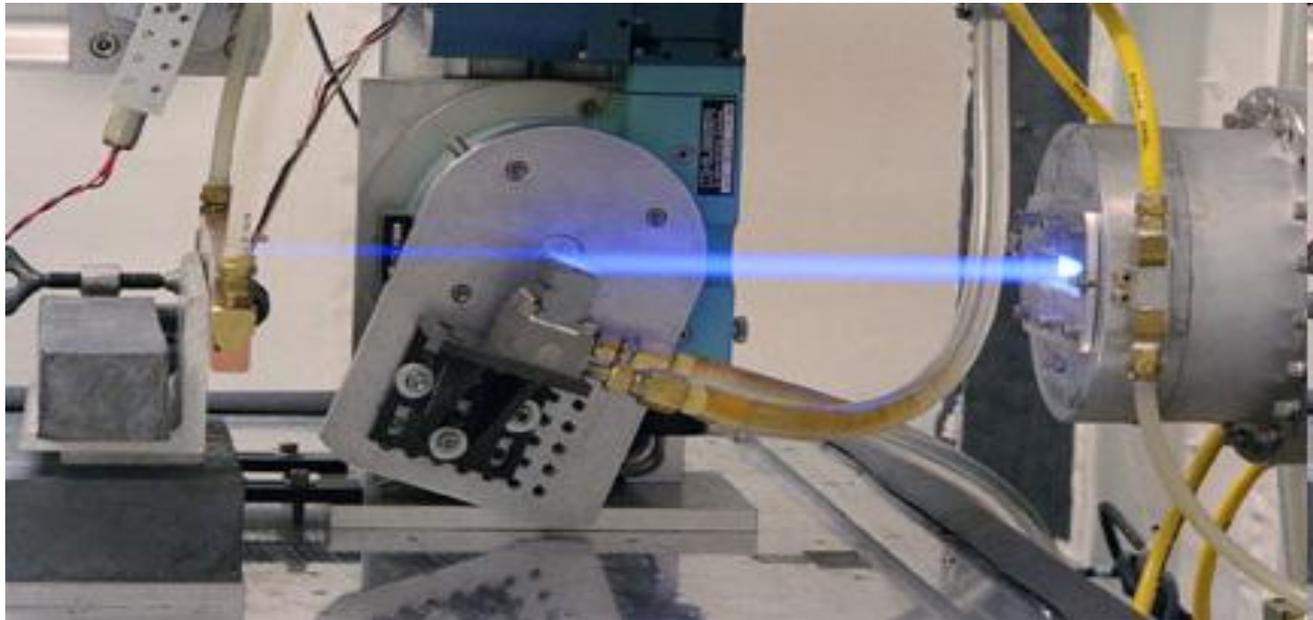
- Electrons can transition between energy levels
- Gives off light of certain wavelength
- [VIDEO](#)

# Problems with the Bohr model

- Only works for one electron atoms

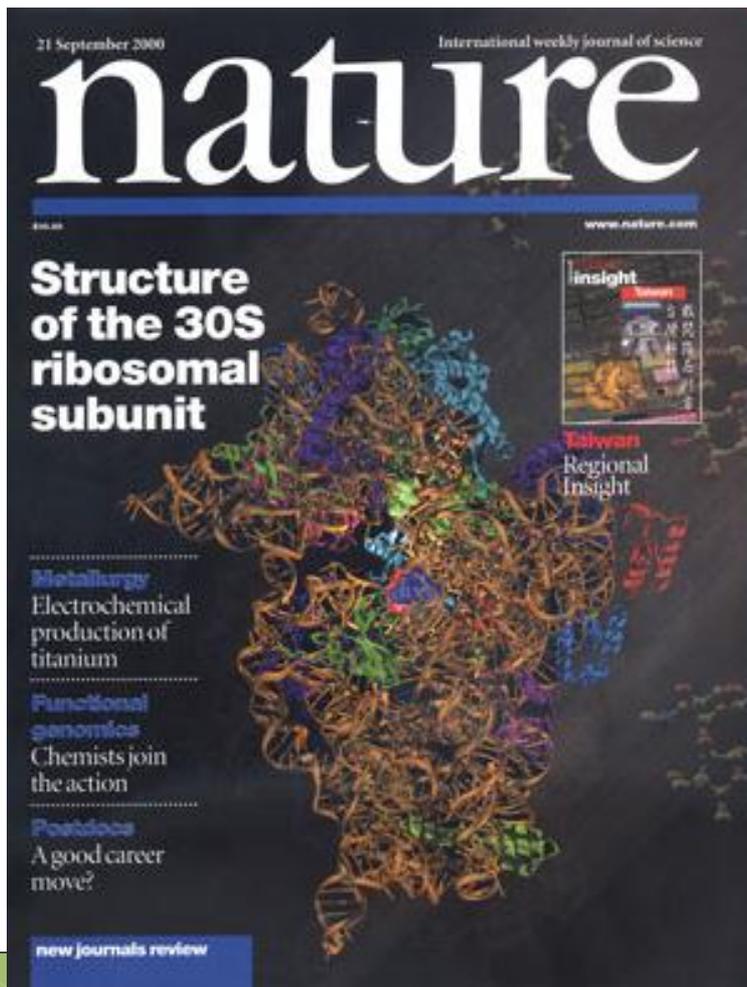
# Synchrotron sources

- Electrons that travel in circular paths give off xrays



Courtesy of NSLS, Brookhaven National Laboratory

# 2009 Nobel Prize in Chemistry



- Structural and functional studies of the ribosome
  - Venkatraman Ramakrishnan
  - Thomas A. Steitz
  - Ada E. Yonath

# The Modern Model

- A mathematical, statistical description of electrons in atoms

# The Modern Model

- A mathematical, statistical description of electrons in atoms

# Louis de Broglie

- Electrons have wave-like properties
  - Can be diffracted



# Werner Heisenberg



- Uncertainty Principle
- VIDEO

# Werner Heisenberg



- Uncertainty Principle
- We can't know the location and momentum of an electron simultaneously.

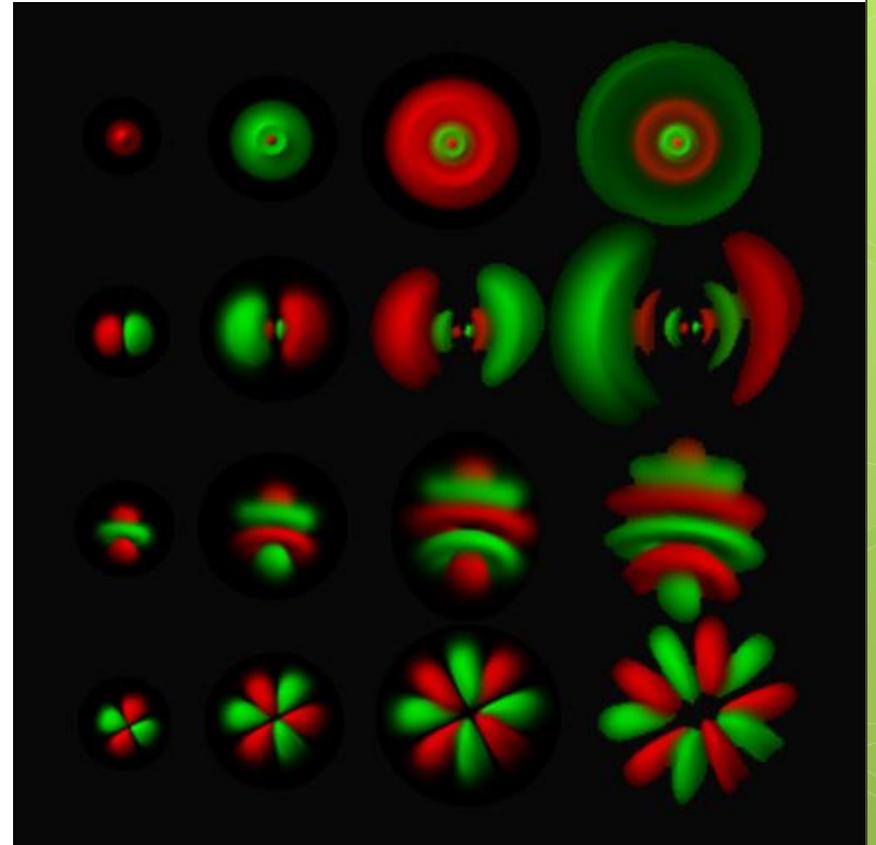
# Erwin Schrödinger



- We can use waves to predict the locations of electrons.
- “wave functions”

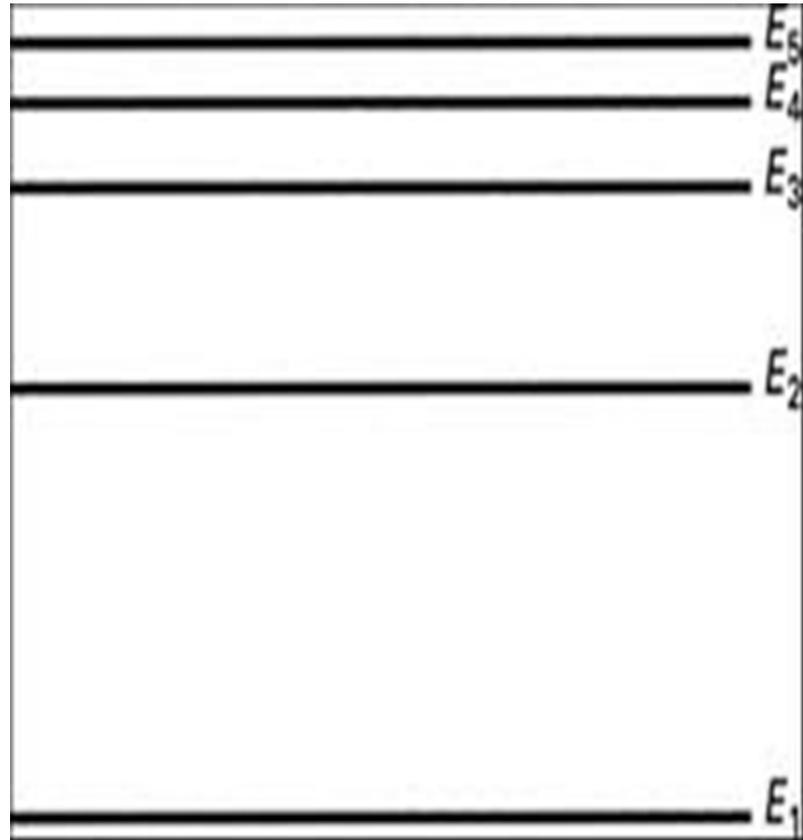
# Modern Model

- Orbital: region of space where electron is likely to be found



# Modern Model

- Orbital: region of space where electron is likely to be found
- Orbitals are arranged in primary energy levels (just like those in the Bohr model)



# 4 basic orbital types

- “s” orbitals

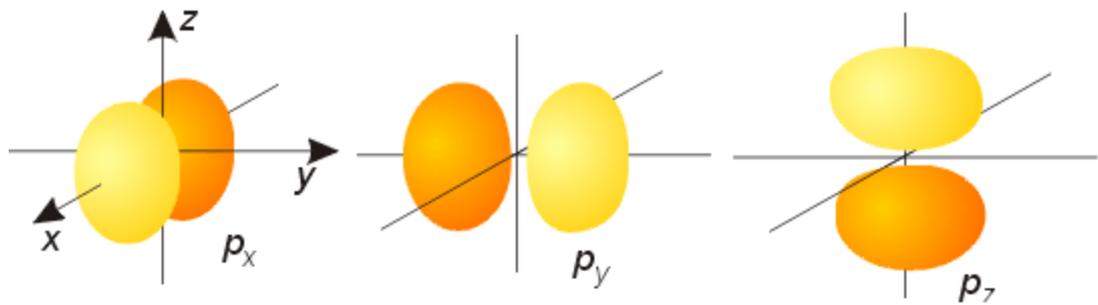
# 4 basic orbital types

- “s” orbitals



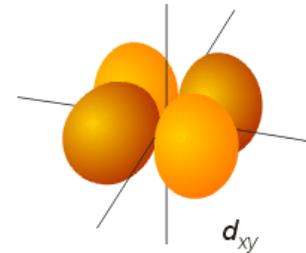
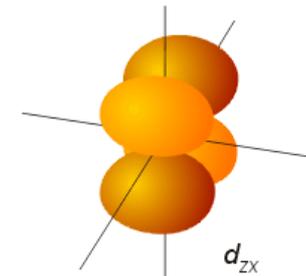
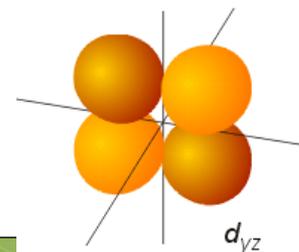
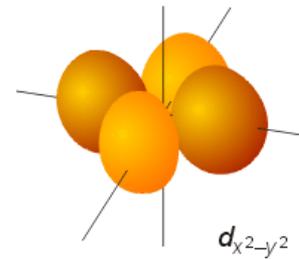
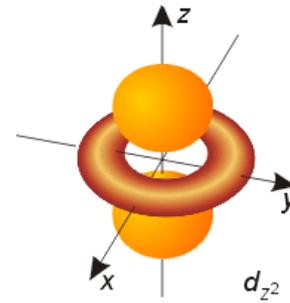
# 4 basic orbital types

- “p” orbitals



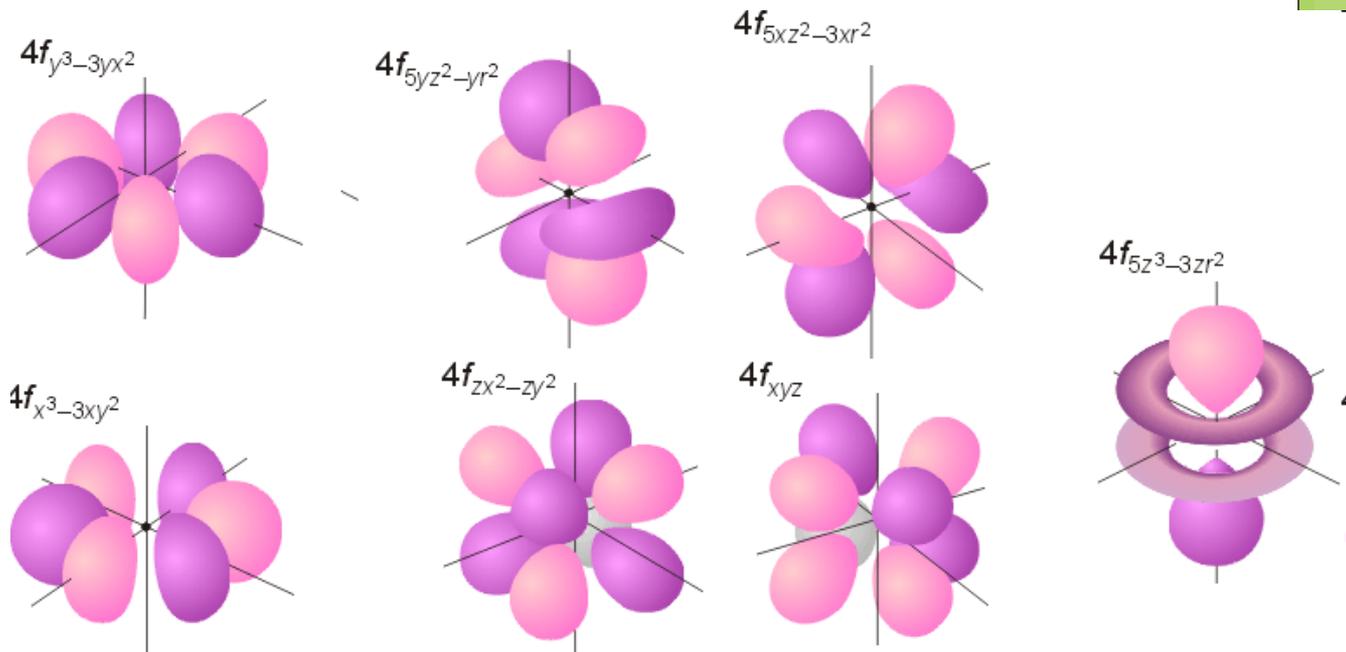
# 4 basic orbital types

- “d” orbitals



# 4 basic orbital types

- “f” orbitals

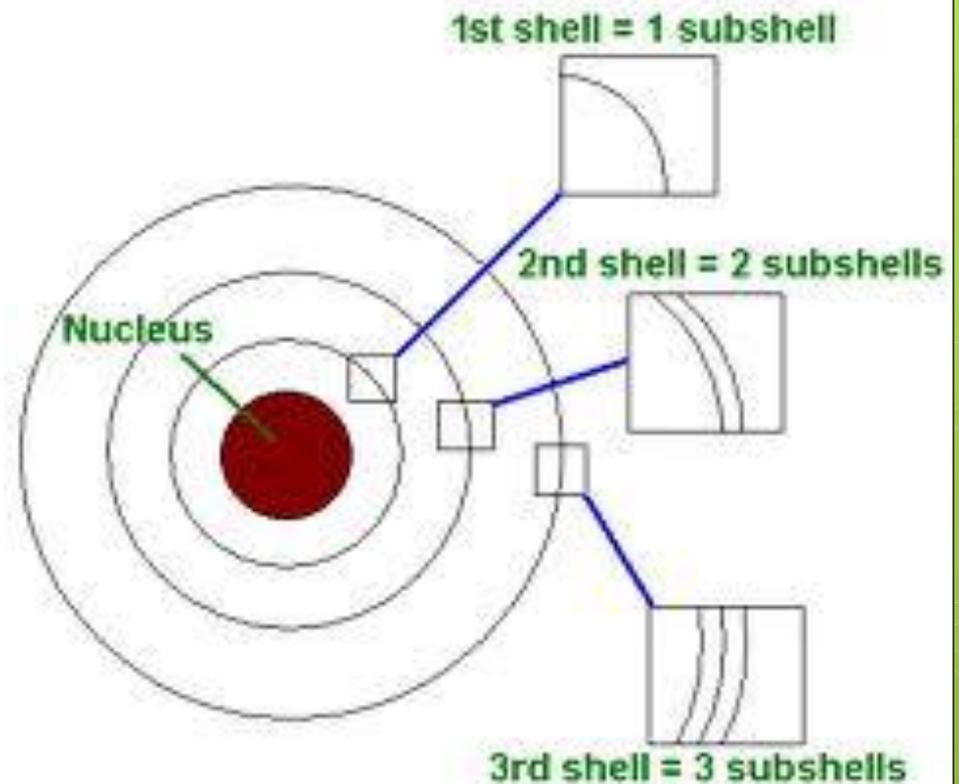


# Principal Energy Level

- $n$

# Principal Energy Level

- Value of  $n$  gives the maximum number of sublevels in level



# Principal Energy Level

- $n^2$  gives the maximum number of orbitals in energy level  $n$

# Principal Energy Level

- $2n^2$  gives the maximum number of electrons in energy level  $n$

# Problems

- What is the maximum number of orbitals permitted in energy level 3?
- What is the maximum number of electrons permitted in energy level 4?
- What is the maximum number of sublevels (types of orbitals) in energy level 5?