

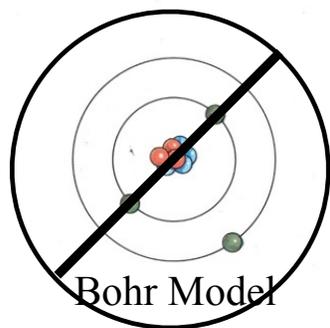
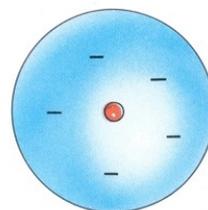
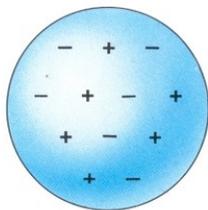
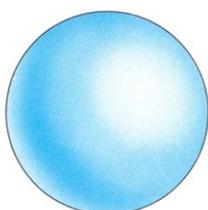
# Quantum Theory

Replacing the Bohr Model

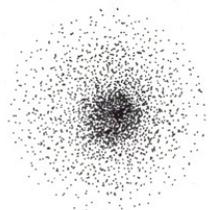
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## Flame Test Lab

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Bohr Model



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## Quantum Theory

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### Our Goals

- To determine why the Bohr Model is incomplete
- To gather the information we need to build a better model
  - We are not going to completely build a new model
  - Only collect the building blocks

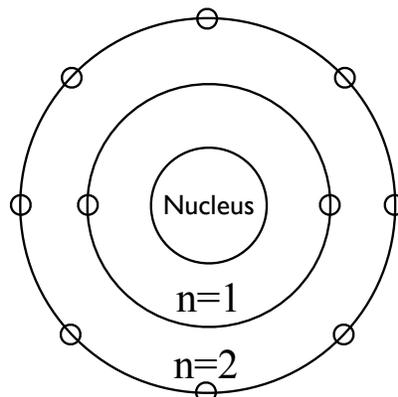
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## Quantum Theory

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### Bohr Model

- By studying the light released by falling electrons....
  - Describe electrons as little particles revolving around the nucleus
  - Model depended on our ability to locate and track these electrons
  - Used a single variable ( $n$ ) to describe the size of the orbit



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## Quantum Theory

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### Bohr's Model Falls Apart

- Heisenberg Uncertainty Principle
  - We can't know exactly where an electron is and where it is going
  - The problem wasn't with our experiments
  - Instead, there is something fundamentally unusual about electrons themselves that don't allow this study

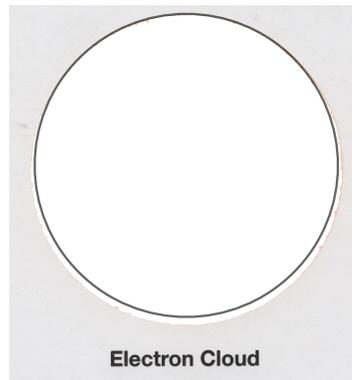
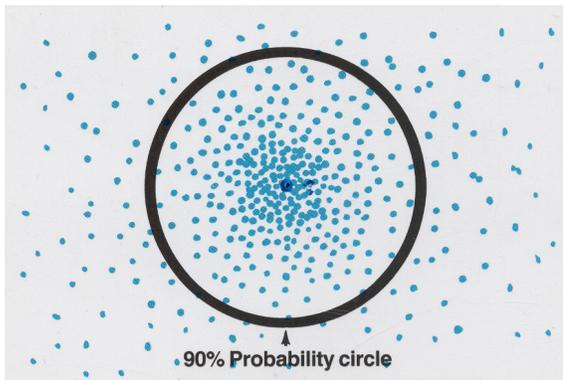
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## Quantum Theory

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### Schrodinger Saves the Day

- Probability
  - Ability to know where an electron is most of the time



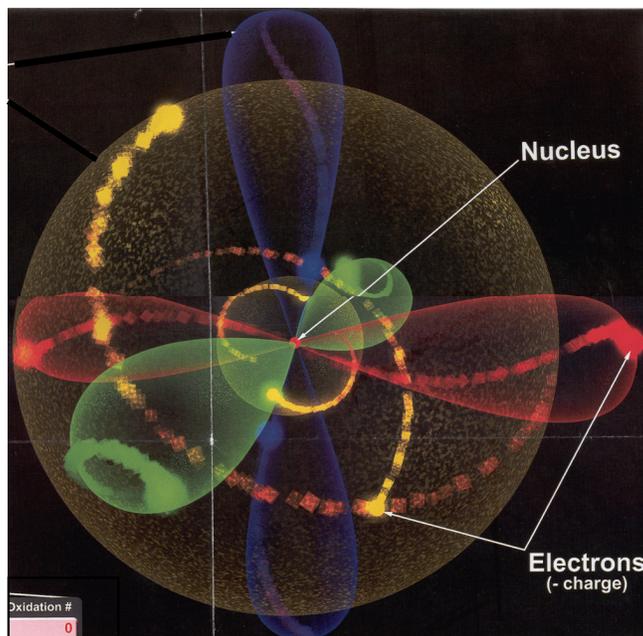
- Treats electrons as if they occupy the whole space, rather than as points along a path
  - We call these spaces "electron clouds" or "orbitals"

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## Quantum Theory

### Orbitals

- Not only are these orbitals more like clouds than orbits
- They aren't always spherical



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## Quantum Theory

### A New Way of Thinking

| <b><i><u>Bohr</u></i></b> | <b><i><u>Schrodinger</u></i></b> |
|---------------------------|----------------------------------|
| 2 dimensional             | 3 dimensional                    |
| Simple                    | Complex                          |
| Solar System              | Electron Cloud                   |
| Orbit                     | Orbital                          |
| Path                      | Probability                      |
| n=size of orbit           | n, l, m, s                       |

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## Quantum Theory

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Quantum Numbers - numbers used to describe the orbitals (electron clouds)

- Principle Quantum Number (n)
  - Size of energy level (cloud)
  - Values on periodic table from 1-7
  - Capacity =  $2n^2$  rule
  - As n increases
    - Size increases
    - Energy increases
    - Capacity increases
- Sub-level Quantum Number (l) - shape
  - The number of sub-levels in an energy level is n
  - Named s, p, d, f
- Orbital Quantum Number (m) - orientation
  - Space occupied by 2 electrons
- Spin Quantum Number (s)
  - In order for electrons to pair in an orbital, they must have opposite spins
  - $+\frac{1}{2}$  (up) or  $-\frac{1}{2}$  (down)