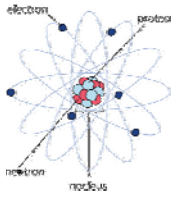
atom – the smallest particle of an element that retains the chemical properties of that element

An atom is composed of…

- Nucleus
  - Protons
  - Neutrons
- Electrons

} Subatomic Particles



Discovery of the Electron

Cathode Ray Tubes (CRT) were experimented with in the late 1800s.

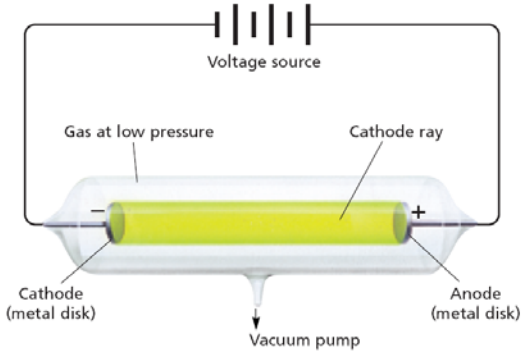
How they work…

Gases at very low pressures can conduct electrical current. (vacuum tubes)

Cathode ray tubes are still used today

- TVs and computer monitors
- Neon Lights

Cathode Ray Tube p70



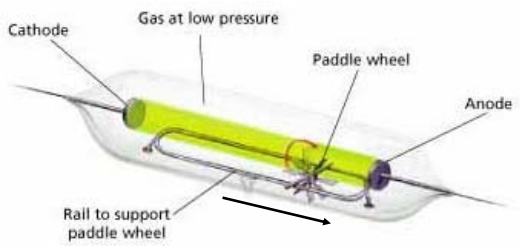
CRT Hypothesis

The glow of a CRT is caused by a stream of particles that travels from cathode to anode…

Experiments were used to test this hypothesis:

1) Objects placed between the cathode and the end of the tube cast a shadow
   - Ray travels from cathode to anode
2) A paddle wheel placed on rails moved from the cathode to the anode
   - Cathode rays have mass

Cathode Ray Tube (p71)



A paddle wheel placed on rails moved from the cathode to the anode when current was passed

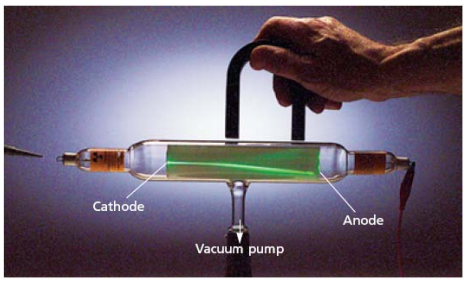
Even more experiments were performed!

3) Cathode rays could be deflected using a magnet
   - A wire carrying current, known to be negative, could also do the same thing
4) Rays were deflected by negatively charged objects

A new hypothesis!

Particles of a cathode ray are negatively charged

Cathode Ray Tube with a Magnet



Cathode rays are deflected by magnets

DO NOT TRY THIS WITH A TV!!

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Thomson's Experiments (1897)

Thomson measured the charge / mass ratio of cathode ray particles

He found this ratio to be the same for all metals he tested as a cathode and any gas used.

Thomson concluded that cathode rays were made of identical negatively charged particles

Thomson discovered the Electron!!

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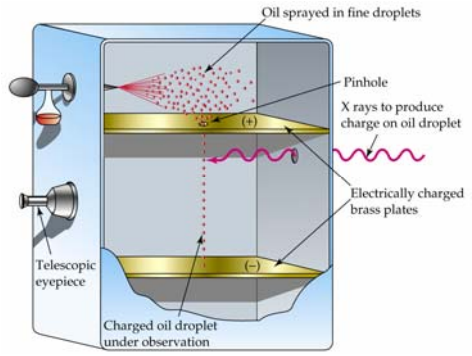
Millikan's Oil Drop Experiments



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Millikan's Experiments (1909)

1) Millikan found the mass of the electron to be about 1 / 2000th the mass of a hydrogen atom

2) He proved electrons had a negative charge

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Millikan's Experiments (1909)

Two inferences could be made:

1) Atoms are neutral. Something must have an equal positive charge somewhere.

2) Electrons have very little mass compared to an atom. There must be other particles in an atom to account for most of their mass

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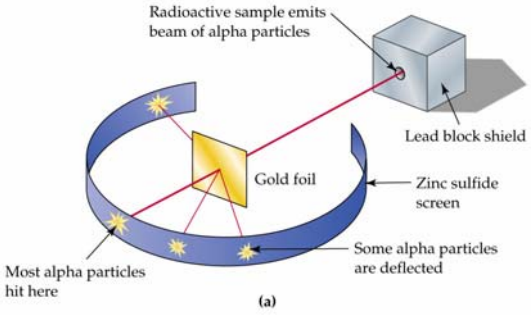
Rutherford's Gold Foil Experiment



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Rutherford's Experiments (1911)

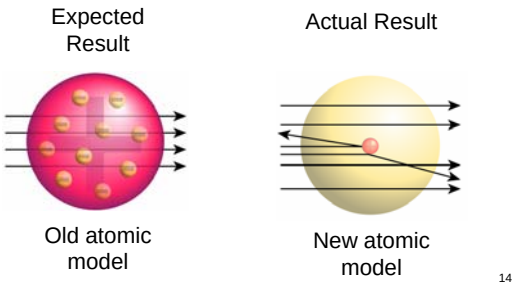
Hypothesis: Atoms are uniform in structure

Test: Rutherford shot a beam of *alpha particles* (Positively charged particles) into thin gold foil

Expectation: Alpha particles will pass through the gold foil with slight deflection

Result: 1 in 8000 particles were redirected back to the source

Rutherford's Experiments



Rutherford's Experiments (1911)

Rutherford's quote about the experience

"as if you fired a 15 inch artillery shell at a piece of tissue paper and it came back and hit you"

After about **2 years** of thinking he came up with his conclusion:

There is a positive, densely packed center

Rutherford discovered the Nucleus!!

Atom Basics

The number of protons determines the element

Neutrons and protons are about the same weight

An electron is about 1/2000 the mass of a proton

A teaspoon of nuclei would weigh more than a battleship!

The nucleus is held together by **nuclear forces**

Atom Basics

The electrons determine the size of the atom

Electrons move so fast in such a tiny area they make the atom seem solid (Like a moving fan blade)

Size: If the nucleus was a marble… then the entire atom would be the size of a football field.

Sizes of atoms are measured in picometers
1,000,000,000,000 picometers = 1 meter