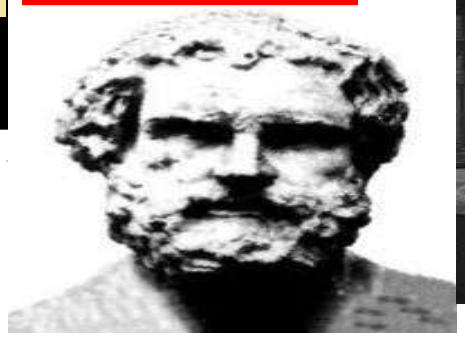
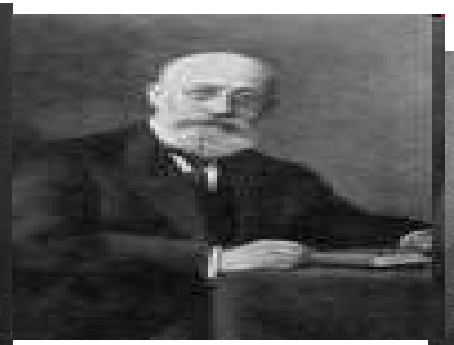


Democritus (460-370 B.C)

John Dalton (1766-1844)



Eugene Goldstein (1850-1930)

JJ Thomson (1856-1940)

Honors Chemistry – PowerPoint 5 History of the atomic model.

(There will not be a daily quiz covering this content.)

Erwin Schroedinger (1887-1961)

Earnest Rutherford (1871-1937)

James Chadwick (1871-1974)

Robert A. Millikan (1868-1953)

Return to TOC

Early History of Chemistry

Greeks were the first to attempt to explain why chemical changes occur.
Alchemy dominated for 2000 years.

- Several elements discovered.
- Mineral acids prepared.
- One goal was to convert metals to gold

Democritus

He hypothesized that matter is made of atoma (in
That was how we got the idea of the atom.
He did not do any experiments

Early History of Chemistry

Robert Boyle was the first real "chemist".

- Performed quantitative experiments
- Pioneer of the scientific method
- Best known for Boyles law which describes the inverse relationship between the pressure and volume of a gas when the temperature is kept constant.

Robert Boyle
(1627–91)

Three Important Laws

Law of conservation of mass (Lavoisier):

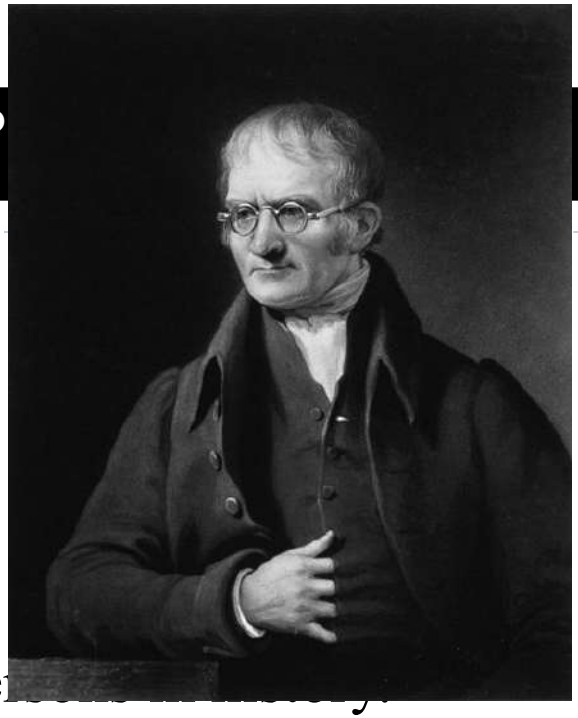
- Mass is neither created nor destroyed.

Law of definite proportion (Proust):

- A given compound always contains exactly the same proportion of elements by mass.

Law of multiple proportions (Dalton):

- When two elements form a series of compounds, the ratios of the masses of the second element that combine with 1 gram of the first element can always be reduced to small whole numbers.



John Dalton

Background-

(1766-1844)

British

Belonged to The Royal Society

Is said to one of the top 50 most influential pe

Experiment-

Measured Atomic Weight, and came up with The Atomic Theory.

Dalton's Atomic Theory

Each element is made up of tiny particles called atoms.

The atoms of a given element are identical; the atoms of different elements are different in some fundamental way or ways.

Chemical compounds are formed when atoms of different elements combine with each other. A given compound always has the same relative numbers and types of atoms.

Chemical reactions involve reorganization of the atoms—changes in the way they are bound together.

The atoms themselves are not changed in a chemical reaction.

Concept Check

Which of the following statements regarding Dalton's atomic theory are still believed to be true?

I. Elements are made of tiny particles called atoms.
II. All atoms of a given element are identical.
III. A given compound always has the same relative numbers and types of atoms.
IV. Atoms are indestructible.

Return to TOC

Gay-Lussac and Avogadro (1809—1811)

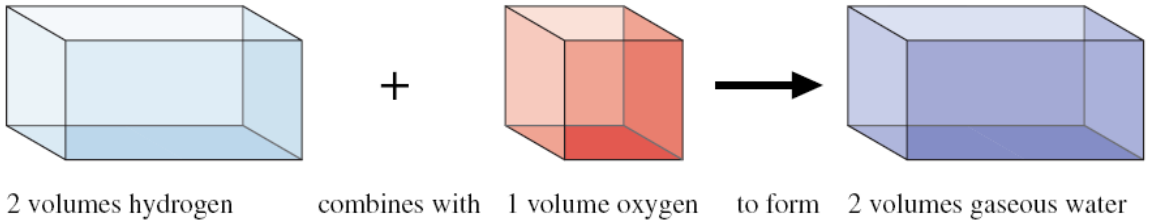
Gay—Lussac

- Measured (under same conditions of T and P) the volumes of gases that reacted with each other.

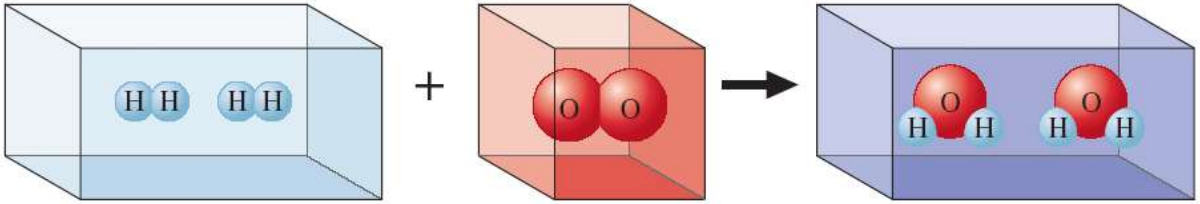
Avogadro's Hypothesis

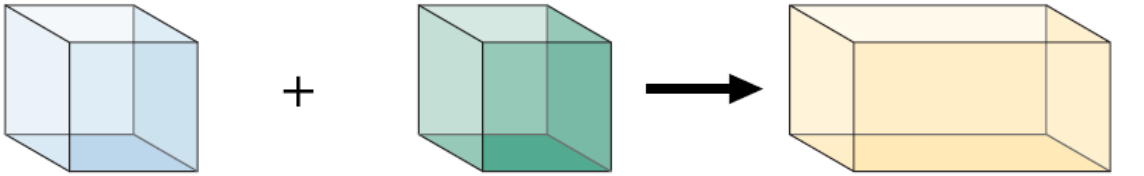
- At the same T and P, equal volumes of different gases contain the same number of particles.

Diagrams representing Gay—Lussac's Results

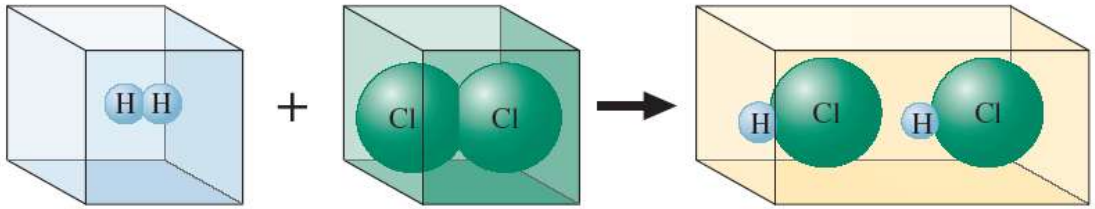


2 volumes hydrogen combines with 1 volume oxygen to form 2 volumes gaseous water





1 volume hydrogen combines with 1 volume chlorine to form 2 volumes hydrogen chloride



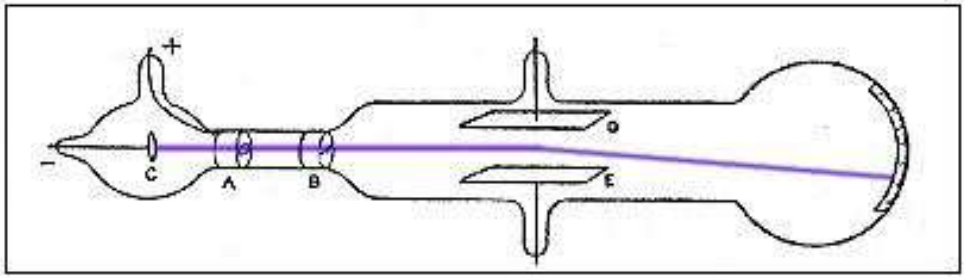
Return to TOC

JJ Thomson

Background-

(1856-1940)
Fellow of the Royal Society
Order of Merit (bestowed by the monarch)
Knighted {1908}
Royal Medal {1894}
Hughes Medal {1902}
Nobel Prize in Physics {1906}

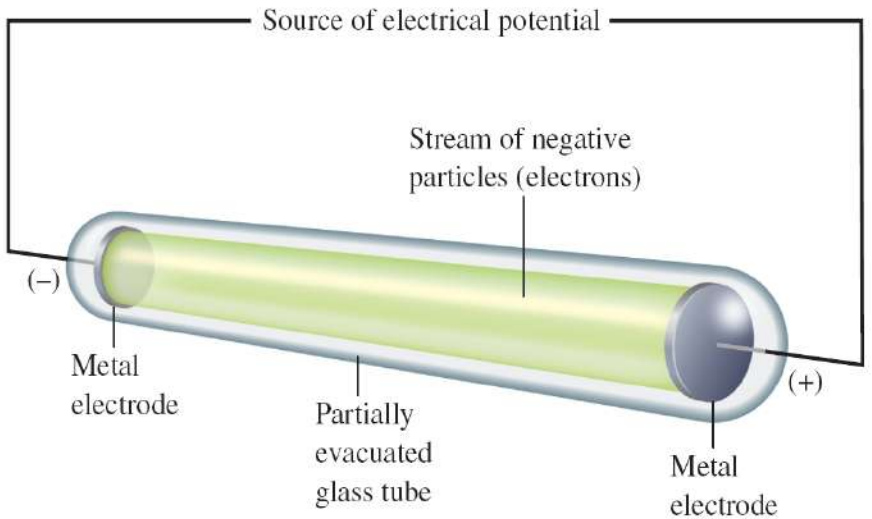
JJ's Experiments



Experiment 1 – Using a cathode ray tube, he wanted to test if the rays were charged particles by seeing if they could be deflected by and electrical field.

Success!

Because he concealed the rays in a vacuum, the experiment worked.



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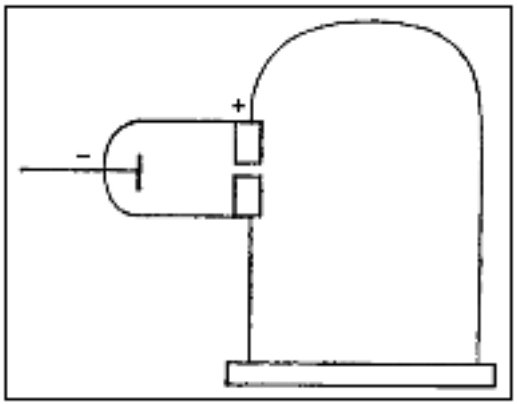
JJ's Experiments

In this experiment, Thomson measured the Mass-to-charge ratio of the rays by how much they were deflected by a magnetic field.
He found that the ratio was over 1000x lower than a H+ ion. That means the ray is either very light or highly charged.



Return to TOC

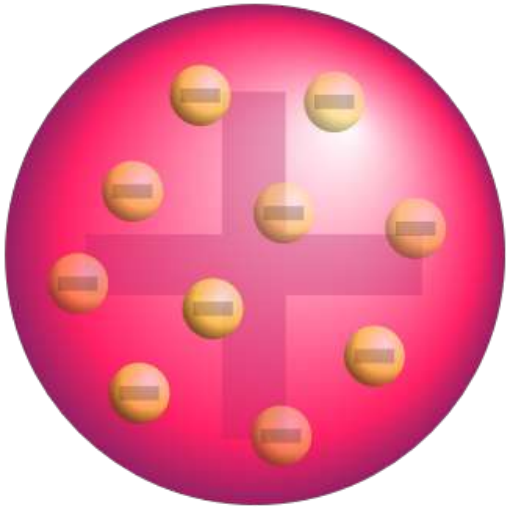
J. J. Thomson – summary of findings

Postulated the existence of electrons using cathode-ray tubes.
Determined the charge-to-mass ratio of an electron.
The atom must also contain positive particles that balance exactly the negative charge carried by particles that we now call electrons.

The Modern View of Atomic Structure: An Introduction

Thomson's experiments with cathode rays later lead to his discovery of Isotopes and Electrons.
He also published a model of what he thought the atom to look like called the Plum Pudding Model.

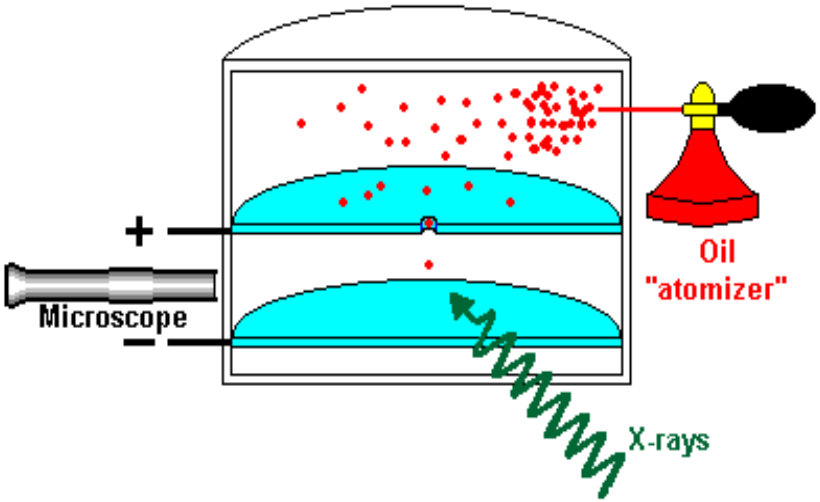
This Model was Later proven to be incorrect by Earnest Rutheford.



Robert A. Millikan

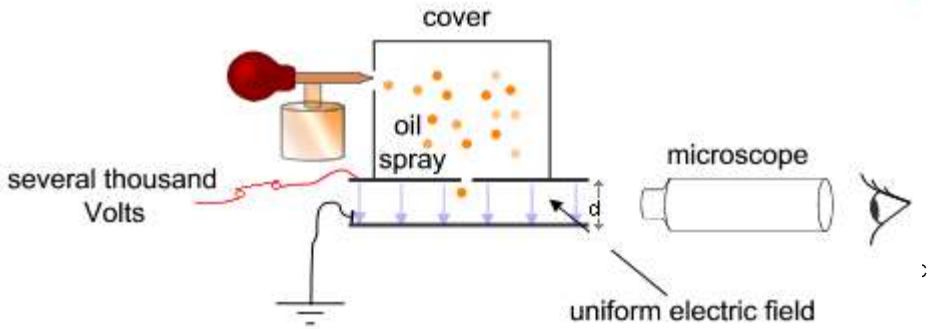
Background-

(1868-1953)
Born in Morrison Illinois
Attended Oberlin College
Won The Nobel Prize in Physics in 1923
Was The President of Caltech 1921-1945



Robert A. Millikan

He Measured the charge of electrons in his oil drop experiment in 1909.
They balanced the gravitational and electric forces of tiny, charged droplets of oil suspended between 2 electrodes.
Knowing the electric field, the charge on the oil droplet could be determined.
After repeating the experiment, they found that the values measured were always multiples of the same number.
They found the charge of a single electron to be 1.602x10^-19C.



Millikan Oil Drop Experiment –

2 Points to his theory

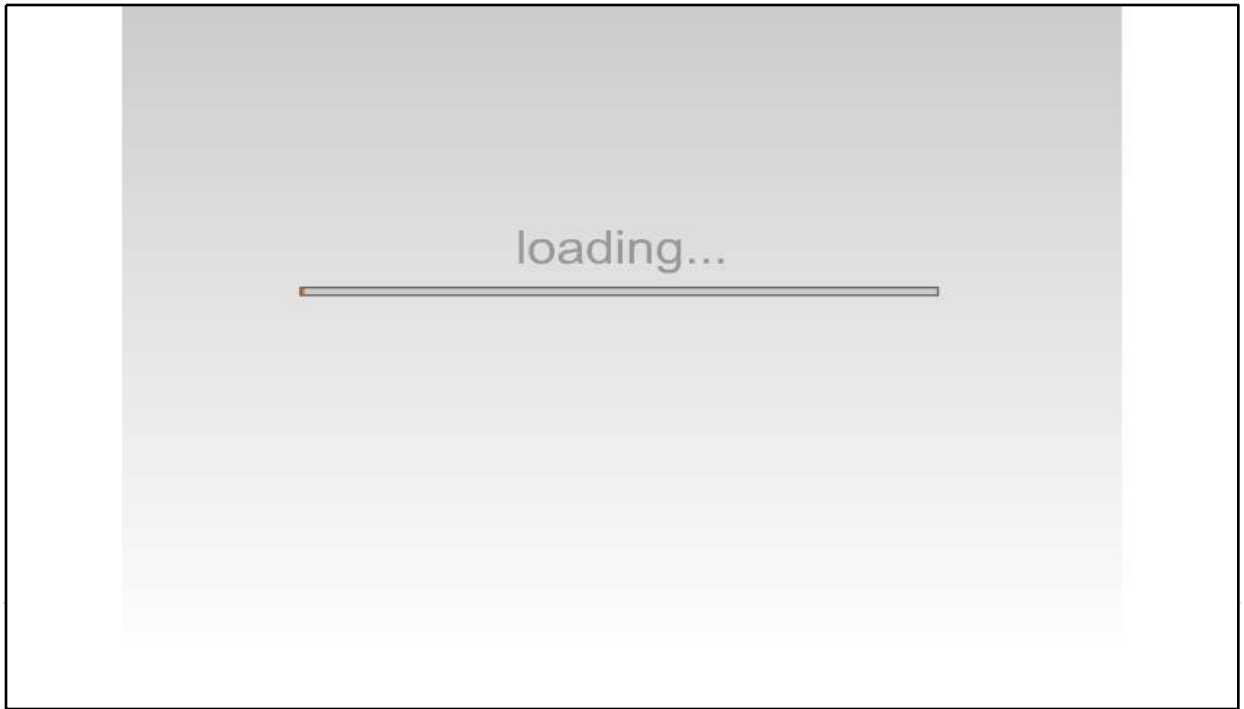
All electrons have the same mass

About 1/2000 atomic mass unit

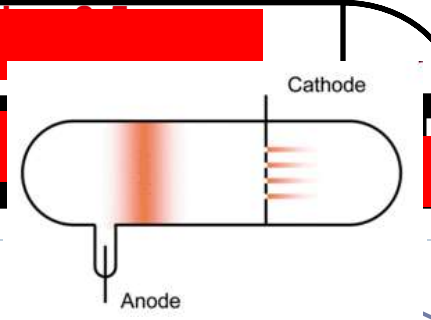
All electrons have the same charge

-1.6×10^{-19} Coulomb

The atom was still thought to resemble Plum Pudding



Return to TOC



Eugene Goldstein

Background-

German Physicist
Studied in Berlin under Herman Helmholtz
Discovered Anode Rays.

Experiment-

He Experimented with Cathode Rays.
He Said That Atoms contain + charged particles called Protons.
If Atoms have (-) charge they must have a (+) charge also.
The atom was still thought to resemble Plum pudding

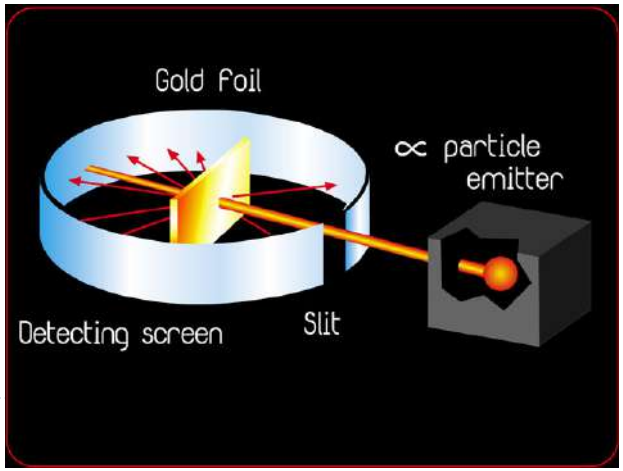
Sir Earnest Rutherford

Background-

(1871-1937)
Born In New Zealand
Nobel prize in chemistry {1908}
Knighted {1914}
Rutherfordium(Rf) was named after him.

Experiment-

He shot alpha particles at gold foil.
He Noticed some went right through, and others came out at an angel or bounced directly back.
He Hypothesized that the foil(and matter in general) had small holes in it.



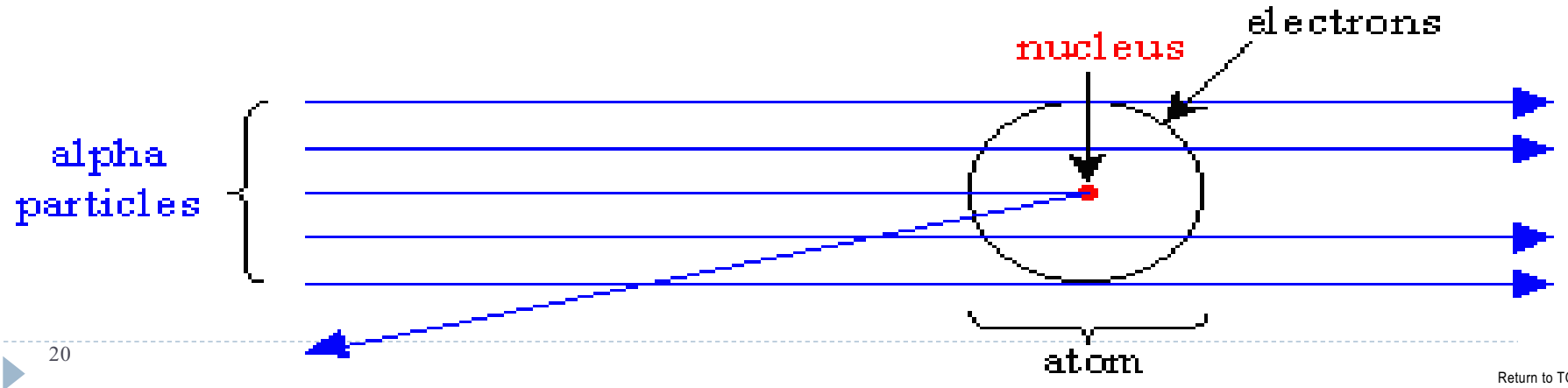
Sir Earnest Rutherford

His studies with alpha particles allowed him to make a modern model of the atom.

3 Points to his theory

1. Most alpha particle went through = Atom is mostly empty space (area of electrons)
2. Some alpha particles bounced straight back = atom has a solid mass (nucleus)
3. Some alpha particles reflected = nucleus is positively charged

New Model = Nuclear Model



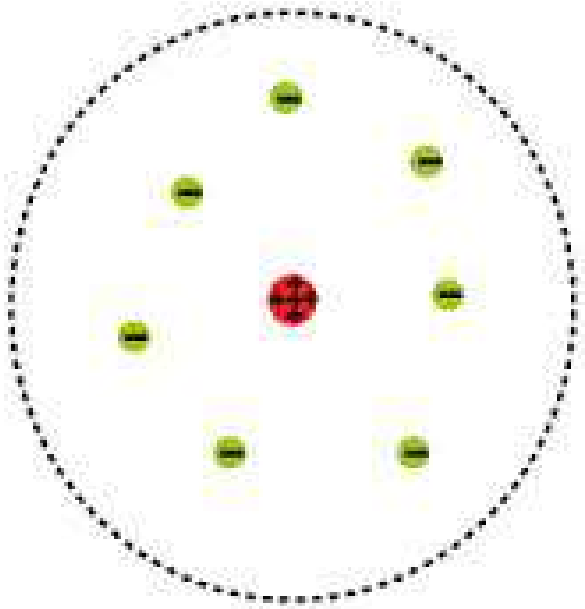
Return to TOC

Ernest Rutherford

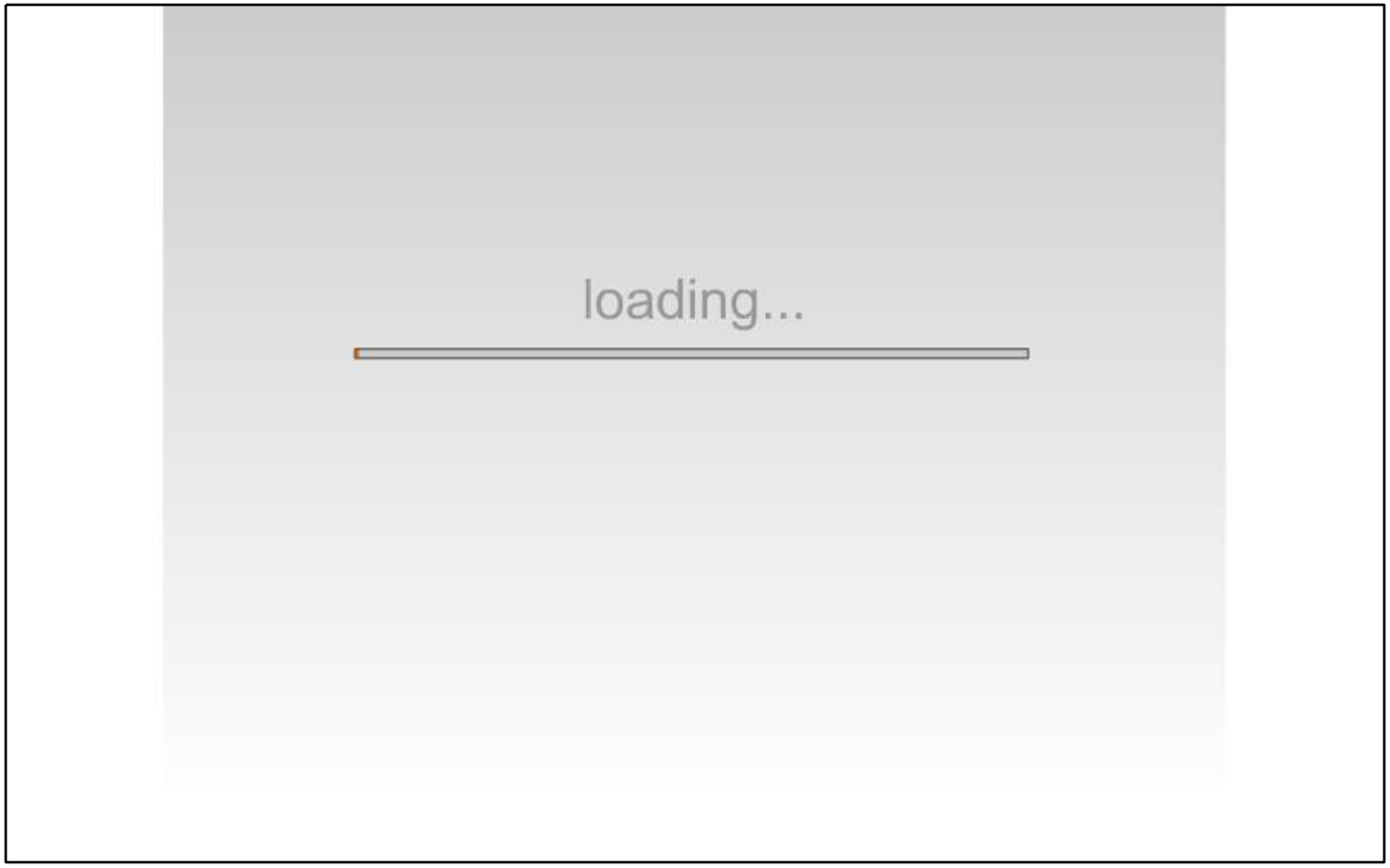
Explained the nuclear atom.

Atom has a dense center of positive charge called the nucleus.

Electrons travel around the nucleus at a relatively large distance.



Rutherford's Gold Foil Experiment



Erwin Shroedinger

Background-

(1887-1961)

Thought Experiments (Schroedinger's Cat)

Excelled in Quantum Mechanics

Born in Vienna Austria & Fled Germany in 1933

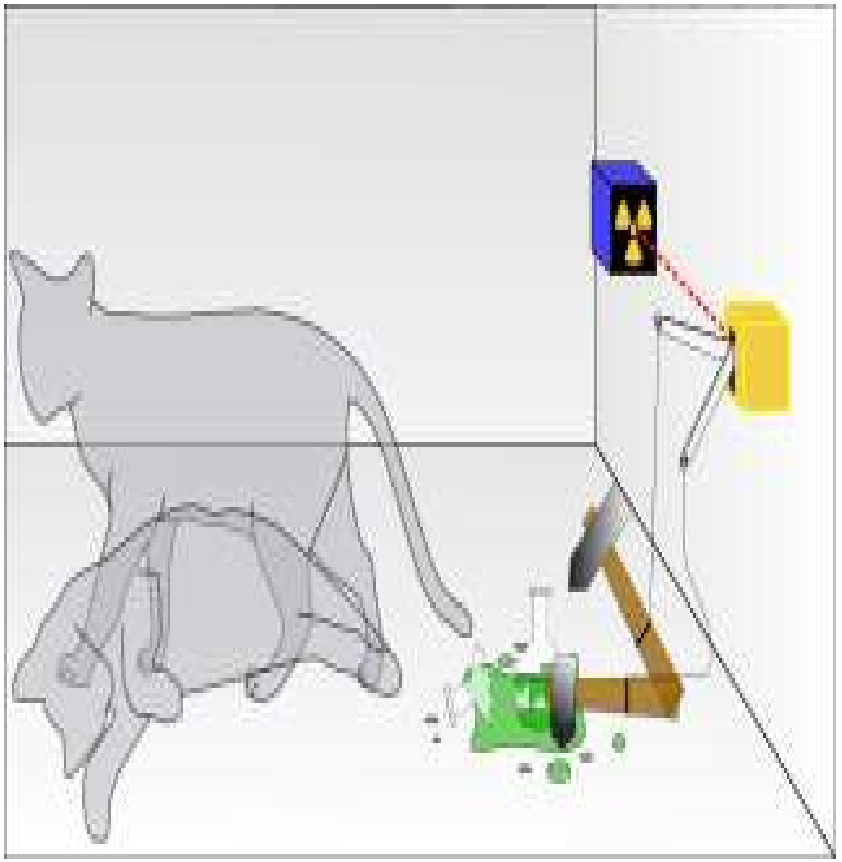
Nobel Prize in Physics, 1933

Did work on color, color perception, and Colorimetry.

Erwin Shroedinger - The Cat Paradox

He said if you put a Live cat in a chamber for and hour with a Geiger Counter attached to a hammer aimed at a glass jar of Hydrocyanic Acid, and release some toxins into the box the cat may live or die.

The paradox is that for a moment the cat is a mixture of Live and Dead though we see it as either one or the other.



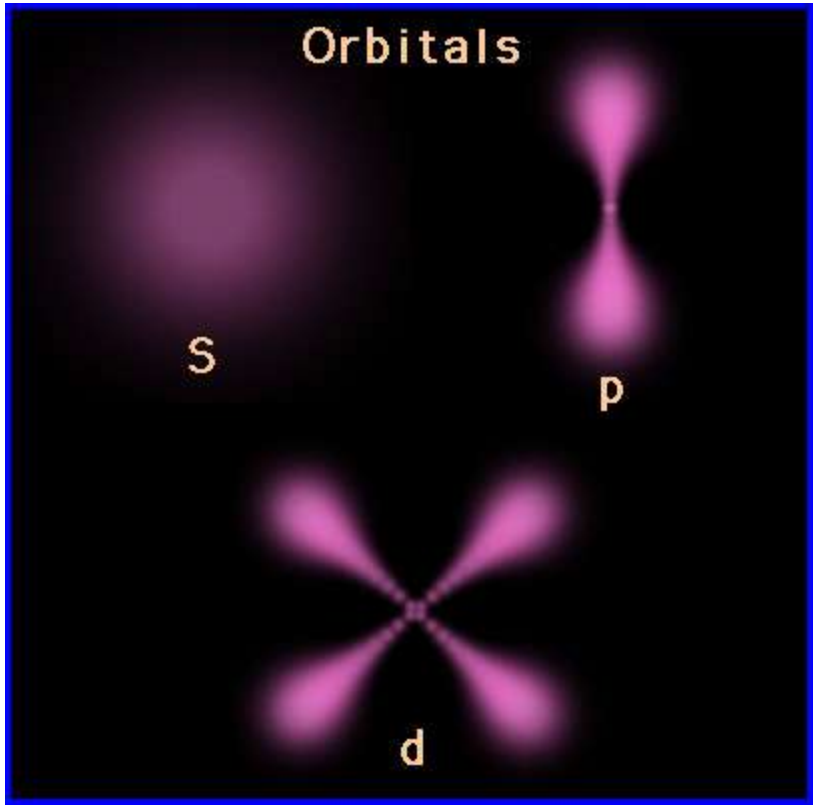
Schrödinger

Major points

1. Electrons do not follow fixed paths
2. They move randomly in areas of probability (orbitals)
3. There are specific energies associated with each orbital

New Model =

Quantum Mechanical Model



James Chadwick

Background-

(1871-1974)
English
Hughes Medal, 1932
Nobel Prize in Physics, 1935
Professor of Physics at University of Liverpool.
Joined the Maud Committee (British) and then the Manhattan Project.
He proposed that there was a 3rd subatomic particle he called the Neutron.
It Helped to stabilize the protons in the Nucleus.
Worked to Make The ATOM BOMB!

Chadwick

2 Points to his theory

1. Discovered the Neutron – Same mass as a proton, but without a charge
2. Mass could be converted into energy

Model was still thought to resemble the Quantum Mechanical Model