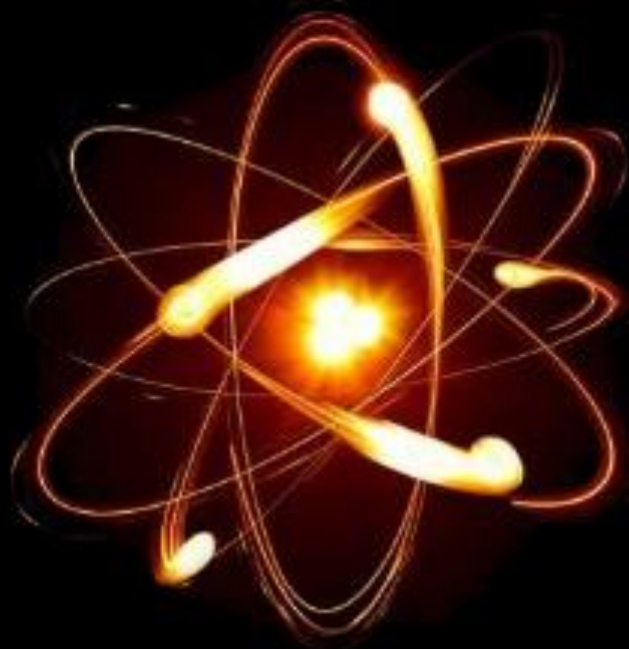
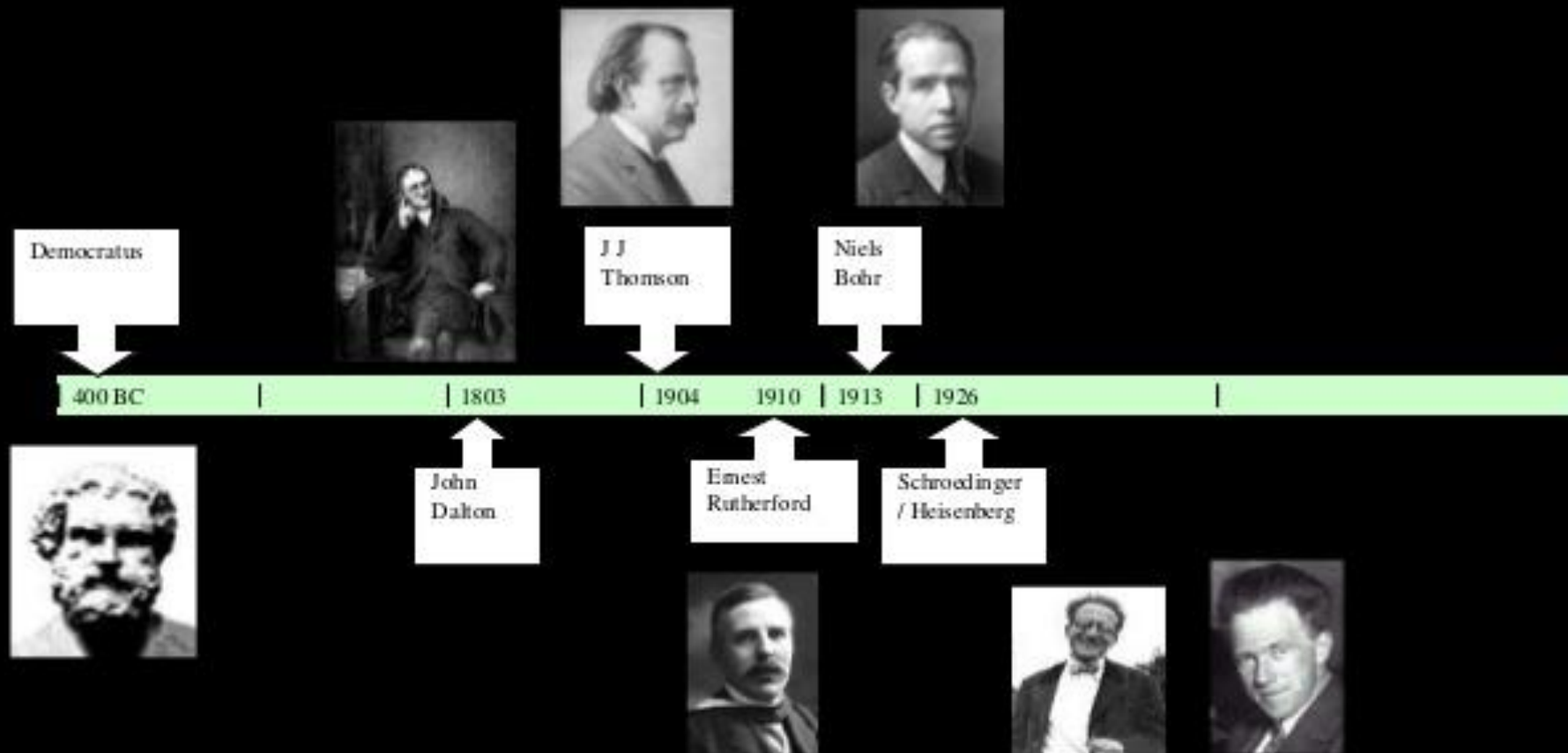


COURSE TITLE:
PHYSICAL CHEMISTRY
COURSE CODE:CHEM 5101
CREDIT HOURS:(3+1)=04

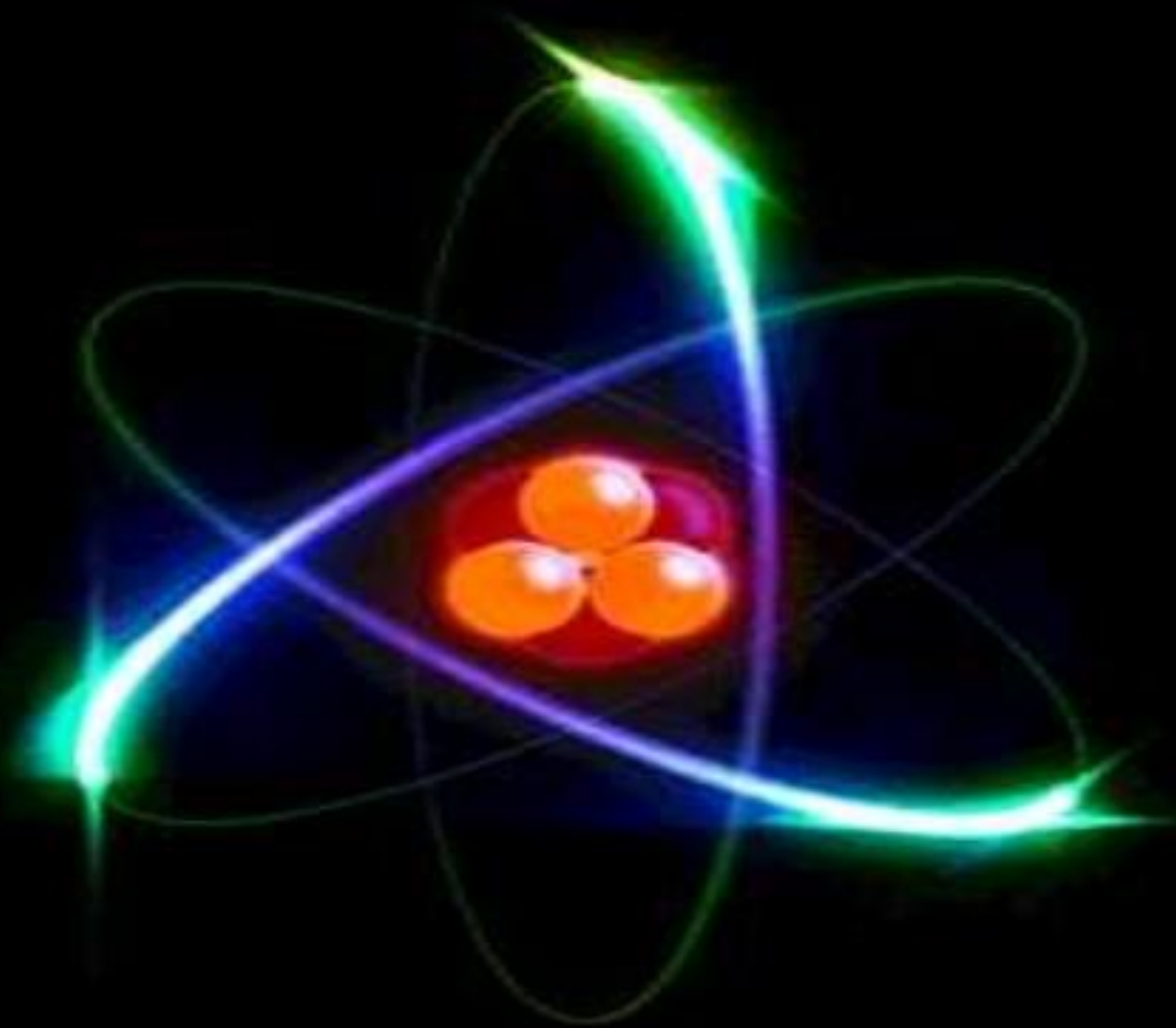
INTRODUCTION



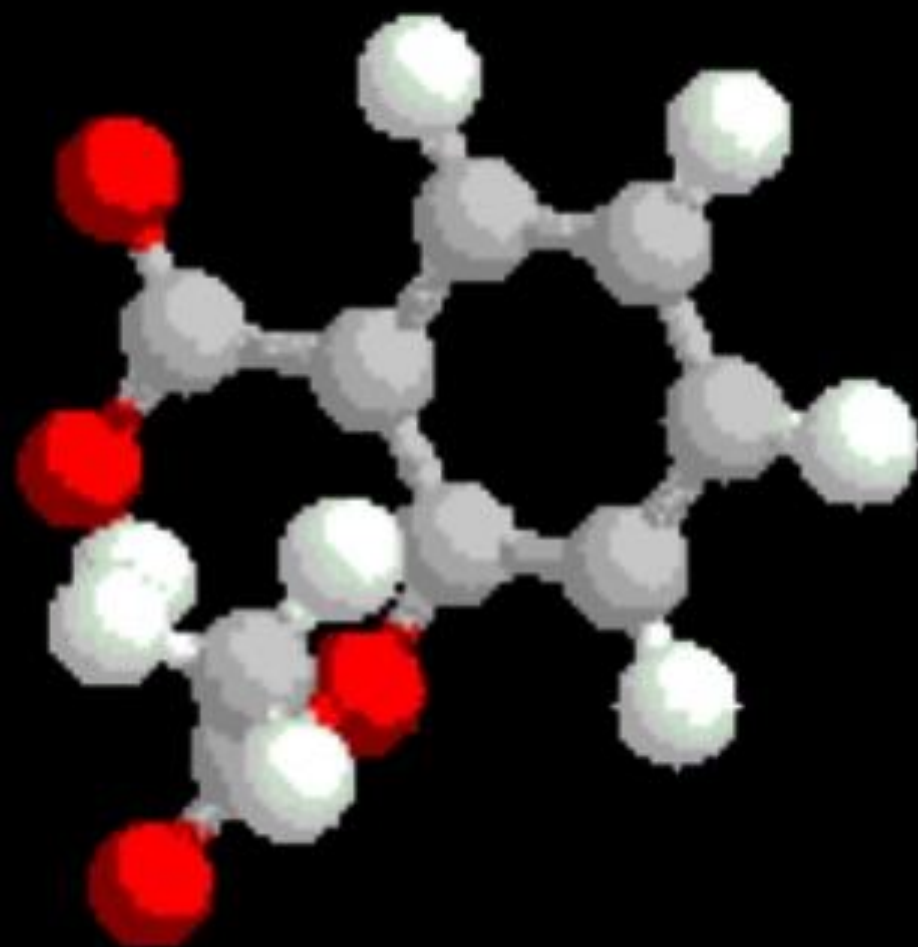
Atomic Theory



What is an Atom?



Early Atomic Models



DEMOCRITUS

(460 B.C. – 370 B.C.)

1. All matter composed of atoms in void.
2. Atoms were indivisible & indestructible.
3. Properties of atom differ in shape, arrangement and sizes.
4. Shape of atom determined the substance properties.



FIRST CONCEPT OF AN ATOM



**Democritus
(400 B.C.)**

JOHN DALTON

(1766 – 1844)

- ▣ He developed a theory to explain why the elements in a compound always join in the same way.
- ▣ He proposed explanations for many of the known laws describing the behaviour of matter.
- ▣ Dalton's theory states "All matter is made up of individual particles called atoms, which cannot be divided".

DALTON'S THEORY

The main points of Dalton's theory are as follows.

- ▣ All matter is composed of tiny, indivisible particles called ATOM.
- ▣ All atoms of an element have identical properties.
- ▣ Atoms of two or more elements can combine in constant ratios to form new substances.
- ▣ In chemical reactions, atom join together or separate from each other but not destroyed.

DALTON'S THEORY

- ▣ **Law of Conservation of Matter**

“Atoms are neither created nor destroyed in any chemical reaction”.

- ▣ **Law of Conservation of Mass**

“Atoms are separate, join or rearrange during a chemical reaction but remain unchanged. Therefore, there will be no change in mass.”

- ▣ **Law of Definite Composition**

“Atoms of different elements can physically mix together or chemically combine with one another in single whole number ratios to form compounds”.

The Billiard Ball Model



- ▣ proposed by **John Dalton** in 1804
- ▣ this theory proposed that matter was composed of small, spherical particles

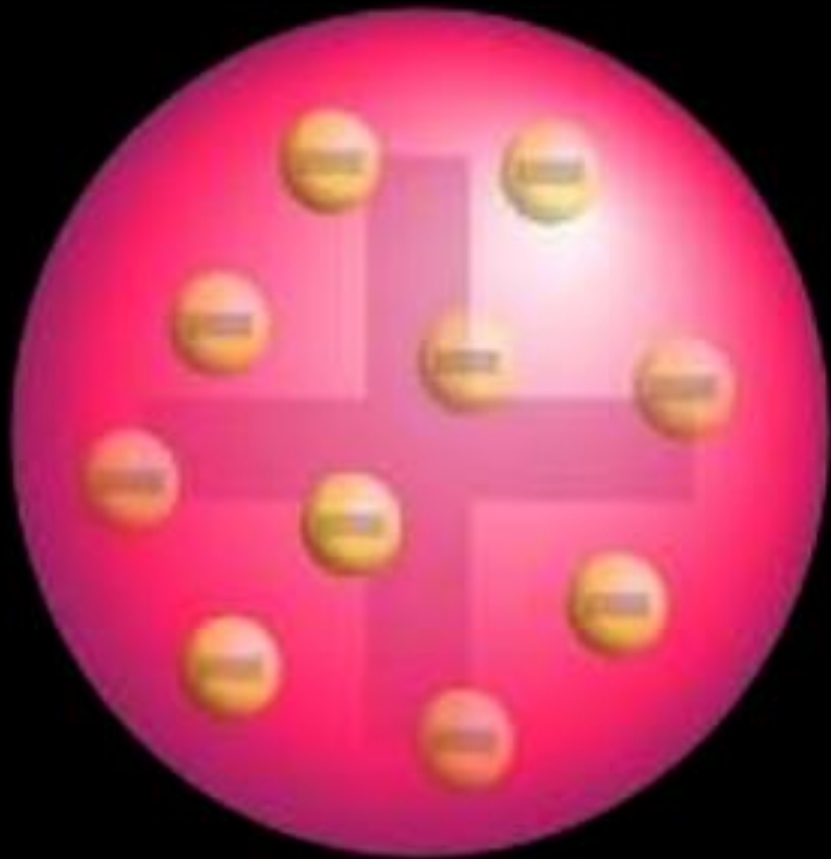
J.J. THOMSON

1856-1940

- ▣ Discovered electron 1897 – **Cathode Ray Experiment**
- ▣ “**Plum Pudding**” model 1904
 - Electrons in a *soup* of positive charges
- ▣ Discovered **isotopes** 1913.

- ❖ Thomson’s experiments provided the first evidence that atoms are made of even smaller particles.

Plum Pudding Model



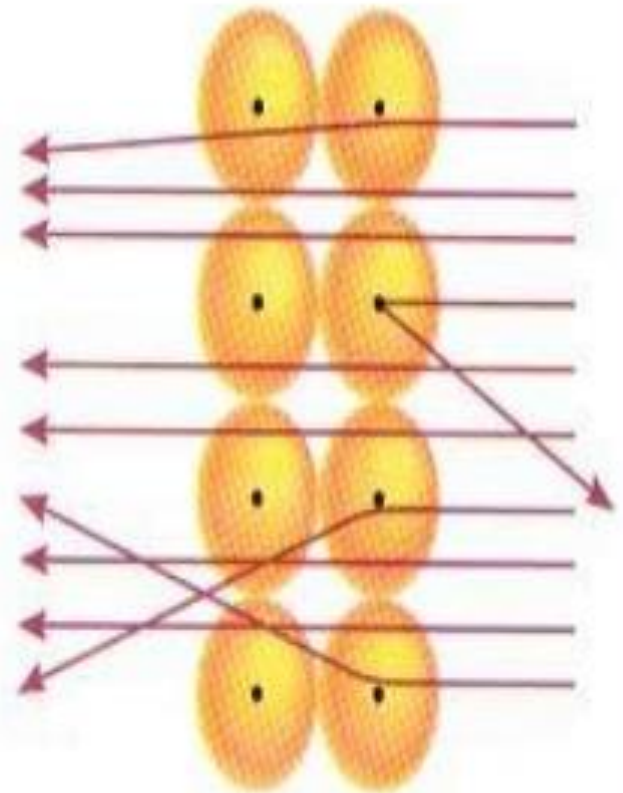
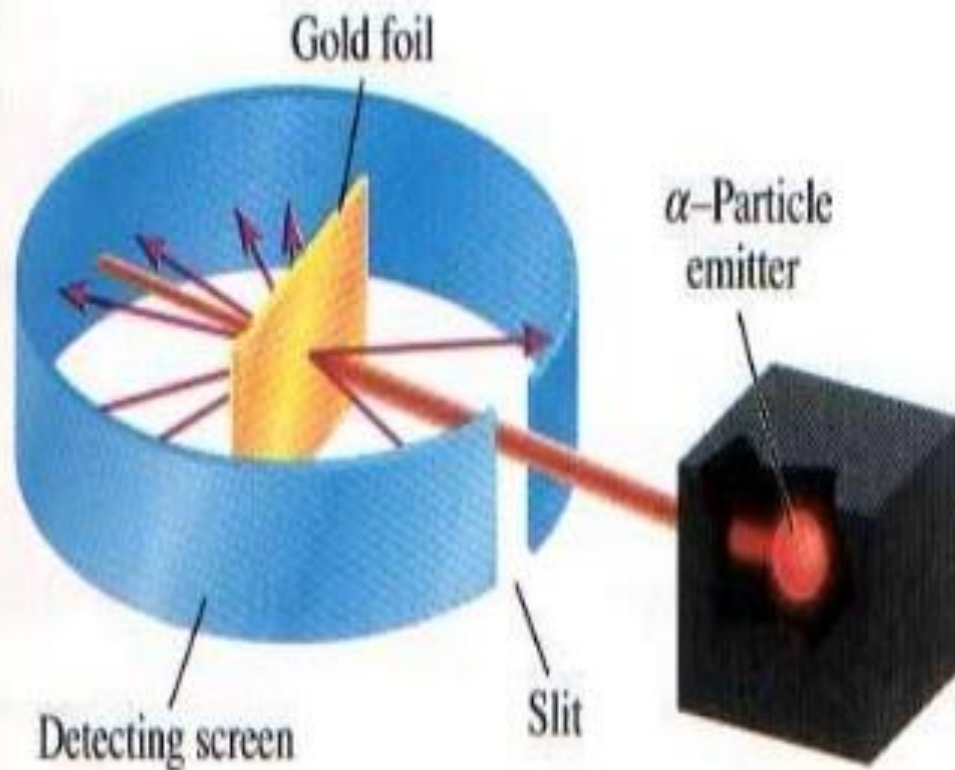
ERNEST RUTHERFORD

1871-1937



- ▣ Nucleus Theory 1910
 - “alpha particle gold-foil” experiment.
- ▣ Rutherford’s model states “All of an atom’s positive charge is concentrated in its nucleus.”
- ▣ An atom’s mass is mostly in the nucleus.
- ▣ He coined the word “Proton” for the smallest unit of positive charge in the nucleus.

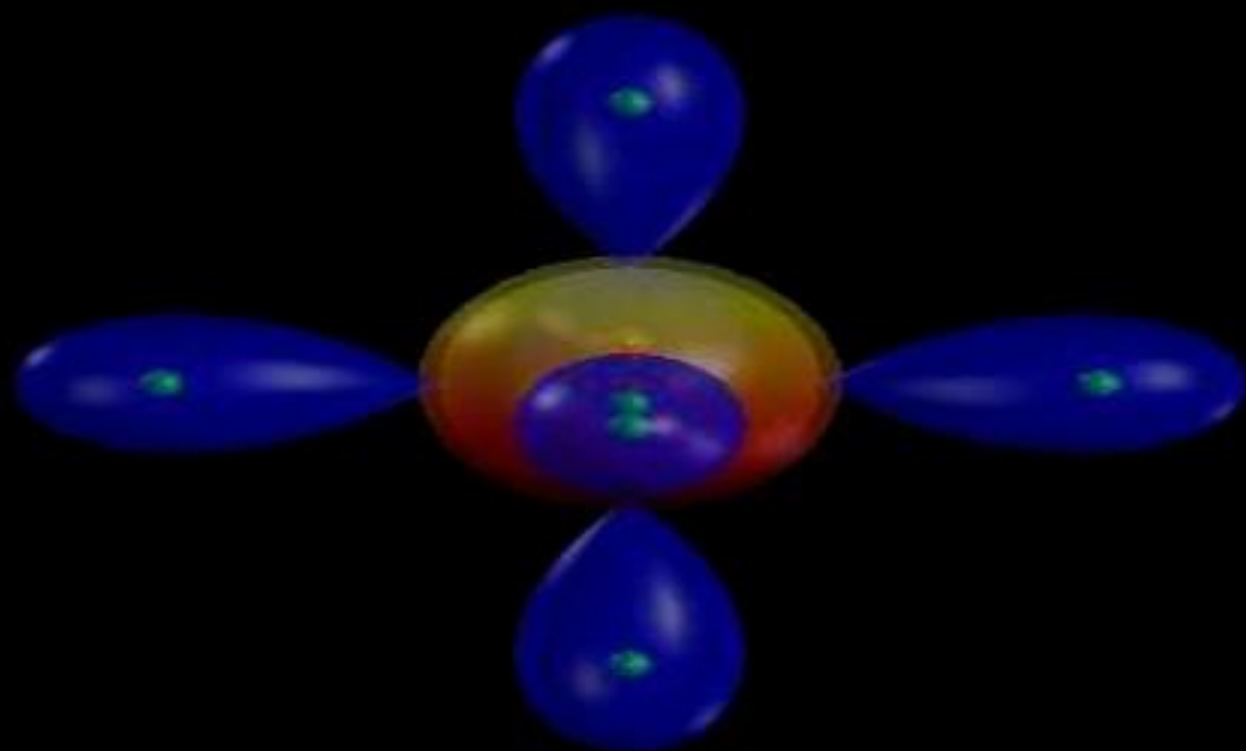
Alpha Particle Experiment

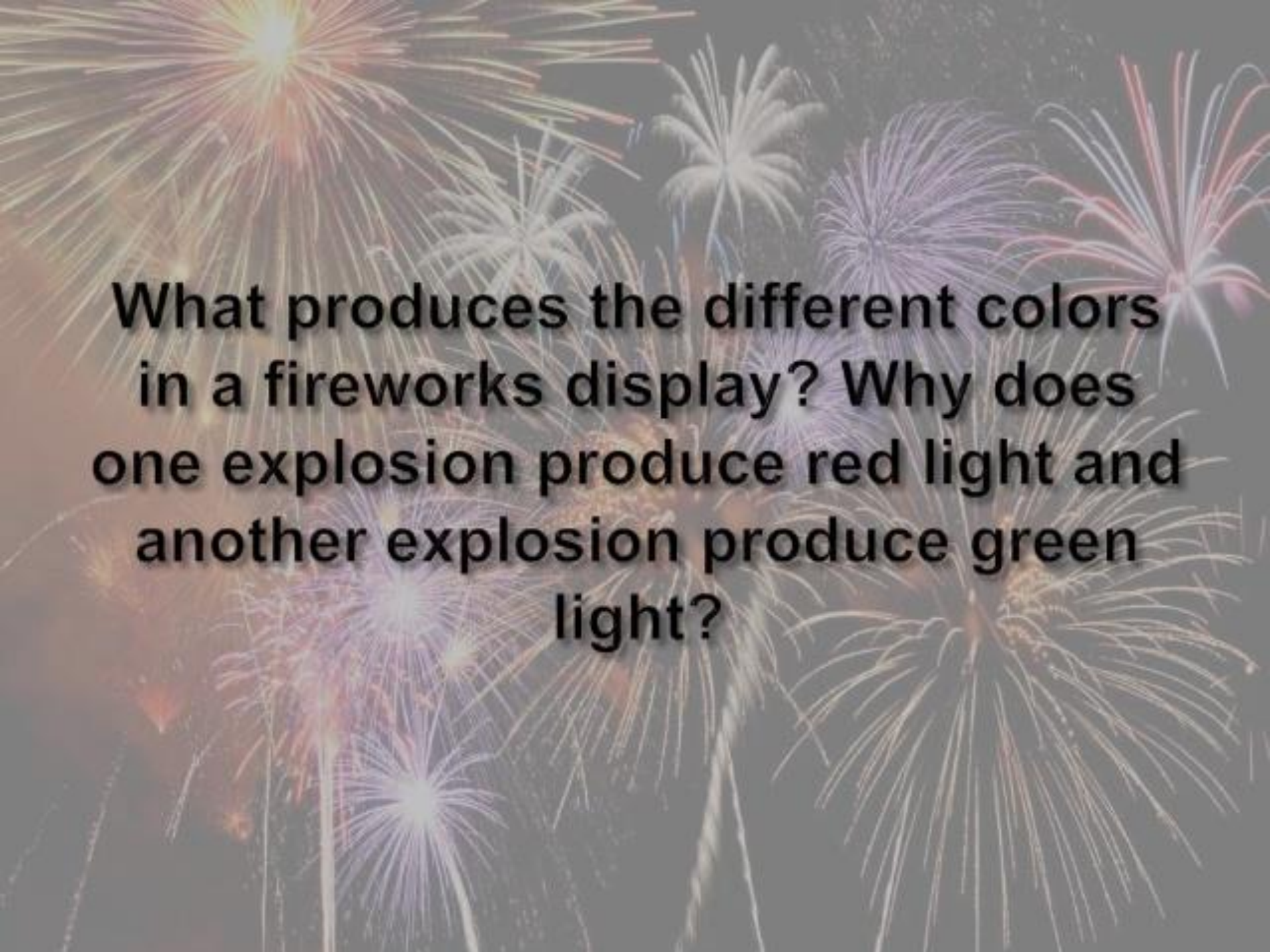


Rutherford's theory raised some difficult questions

- ▣ If the nucleus of an atom contained several protons that repelled each other, how did it stay together?
- ▣ Why didn't the negatively charged electrons rush toward and crash into the positively charged nucleus?

MODERN ATOMIC THEORY





What produces the different colors in a fireworks display? Why does one explosion produce red light and another explosion produce green light?

Niels Bohr

1885-1962

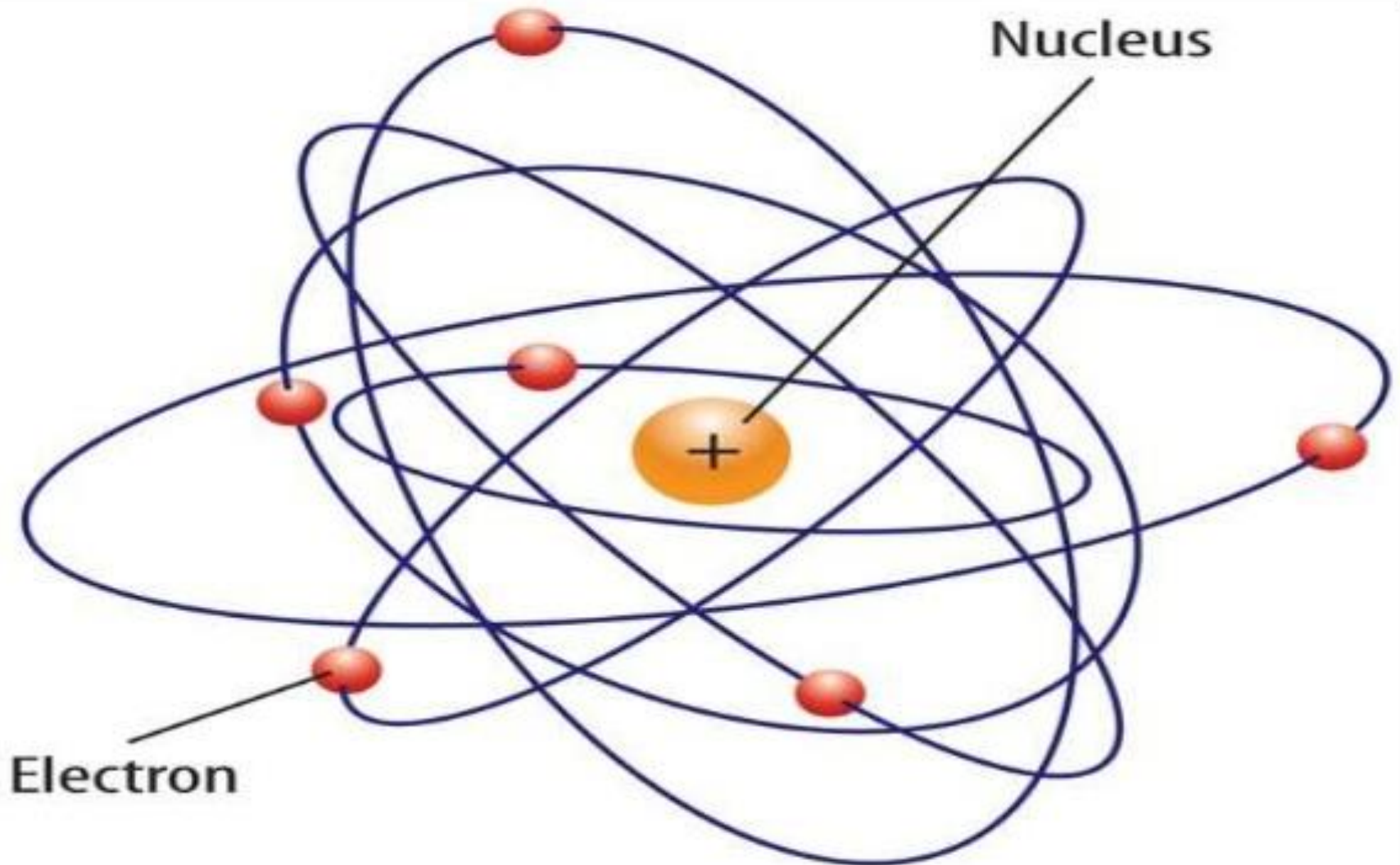
▣ Planetary Model

1913

- Nucleus surrounded by orbiting electrons at different energy levels
- Electrons have definite orbits



Bohr's Model



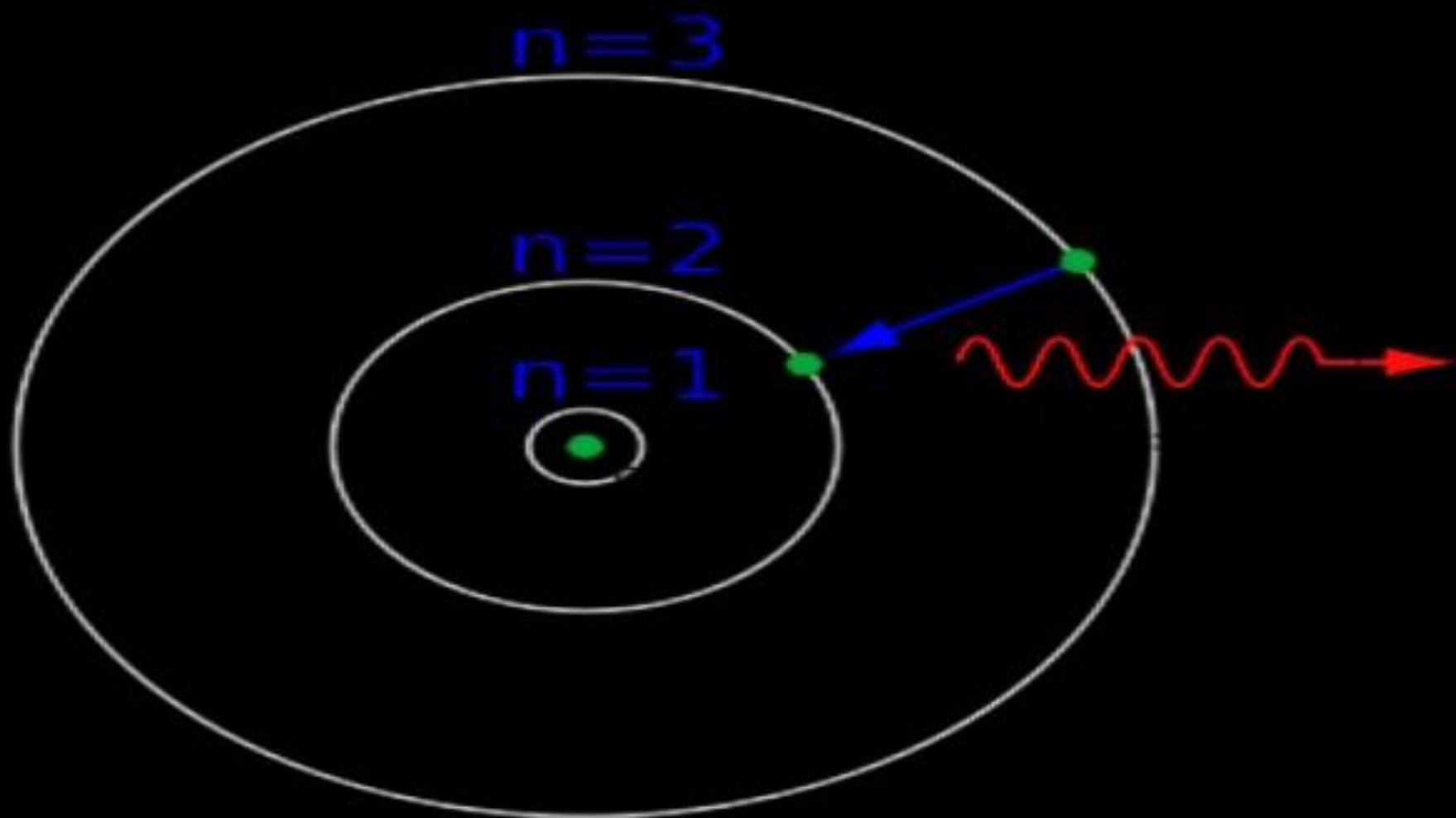
BOHR'S MODEL OF THE ATOM

- ▣ It focused on the electrons.

ENERGY LEVELS

- The possible energies that electrons in an atom can have.
- ▣ Each electrons in an atom has a specific amount of energy.
- ▣ If an atom gains or loses energy, the energy of an electron can change.

Bohr's Model



LOUIE DE BROGLIE
ERNST SCHRÖDINGER
WERNER HEISENBERG

- ▣ DE BROGLIE proposed that electron could also be thought of as a wave.
- ▣ SCHRÖDINGER used this idea to develop a mathematical equation to describe the hydrogen atom.
- ▣ HEISENBERG discovered that for a very small particle like the electron, its location cannot be exactly known and how it is moving.

LOUIE DE BROGLIE
ERNST SCHRÖDINGER
WERNER HEISENBERG

- ▣ Quantum Mechanical Model 1926
 - Electrons are in **probability zones** called "**orbitals**", not orbits and the location cannot be pinpointed
 - Electrons are **particles and waves at the same time**
 - Developed quantum numbers based on theories of Einstein and Planck

ELECTRON CLOUD MODEL

ELECTRON CLOUD

- Is a visual model of the most likely locations for electrons in an atom.
- ▣ The cloud is denser at those locations where the probability of finding an electron is high.
- ▣ Scientists use the electron cloud model to describe the possible locations of electrons around the nucleus.

ELECTRON CLOUD MODEL

