Ernest Rutherford
and
the gold foil experiment

Thomson's 1897 experiment

had given some new

fundamental information

about the structure of matter

The main consequences of Thomson's experiment are:

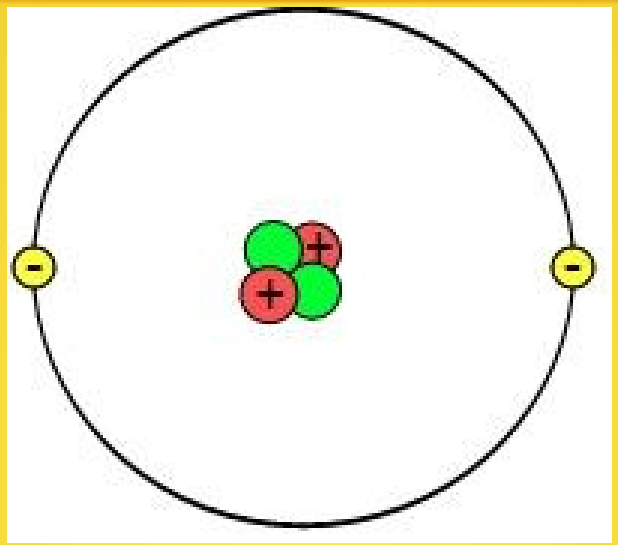
- Atoms are not indivisible:
there are particles smaller than atoms

- Electric charge is quantized

- Electrons carry the "**electricity quantum**"

Electron was the **first elementary particle**
to be discovered

Matter is neutral.



So every atom must contain

both negative and

positive charge in equal quantity.

After the discovery of the electron

identifying the nature

of the positive charged matter

inside the atoms

became very important.

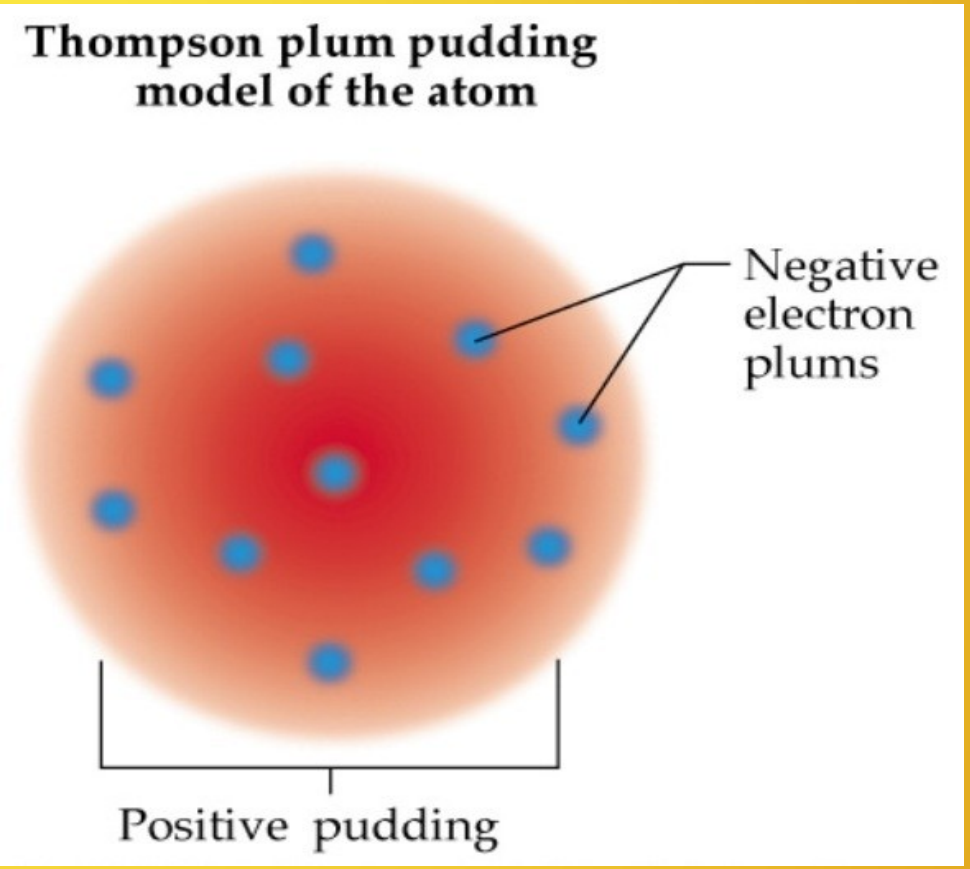
Thomson proposed the ***plum pudding model***:

Elecrons are in motion in

a positive sea of matter.

They are like raisins

in a cake.



The Japanese physicist Nagaoka

suggested a saturnian model.

Electrons orbit around

a central positive center

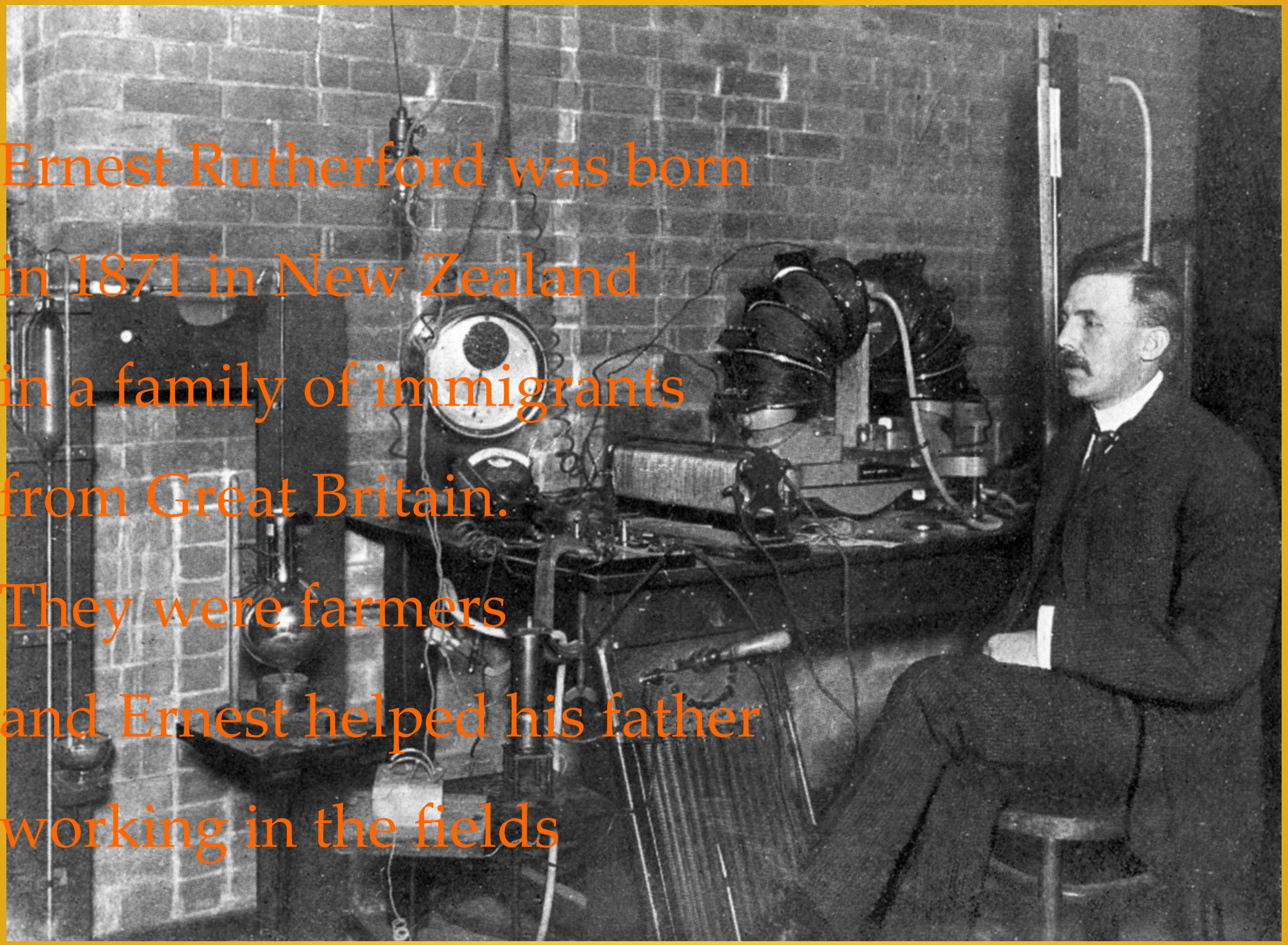
like the rings

surrounding Saturn.

Now we can say that he was closer to the truth

than Thomson was.

Nagaoka's conjecture
was verified by Ernest Rutherford
with a series of experiments
he performed
between 1909 and 1911
at Manchester University.



Ernest Rutherford was born
in 1871 in New Zealand
in a family of immigrants
from Great Britain.
They were farmers
and Ernest helped his father
working in the fields

He was a brilliant student especially

in Mathematics and Physics.

So he won a scholarship

and he could come to Europe.

He was accepted

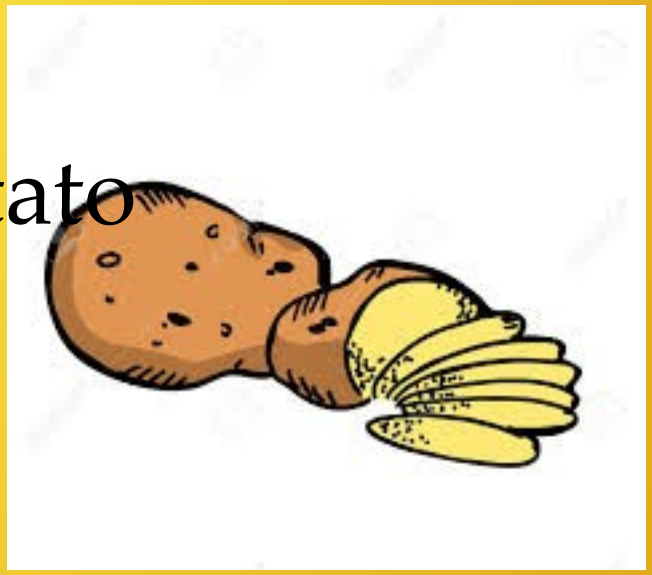
at the Cavendish Laboratory

by J.J. Thomson in 1895.

He told that he was picking up potatoes when someone announced that he had won a scholar ship.

He watched a potato in his hand and said:

“This is the last potato I pick up”



Becquerel's discovery of radioactivity
was fundamental for Rutherford.
At Cavendish laboratory
he directed his studies on the effects
produced by radioactivity and X-rays
on the electrical conduction through gases.

He worked with **cathode rays tubes**

just like everyone did at that time.

He proved that X-rays and radioactivity

act in the same way:

they can ionise a gas or the air.

So the gas becomes a conductor

and can carry an electric current.

In addition he recognized

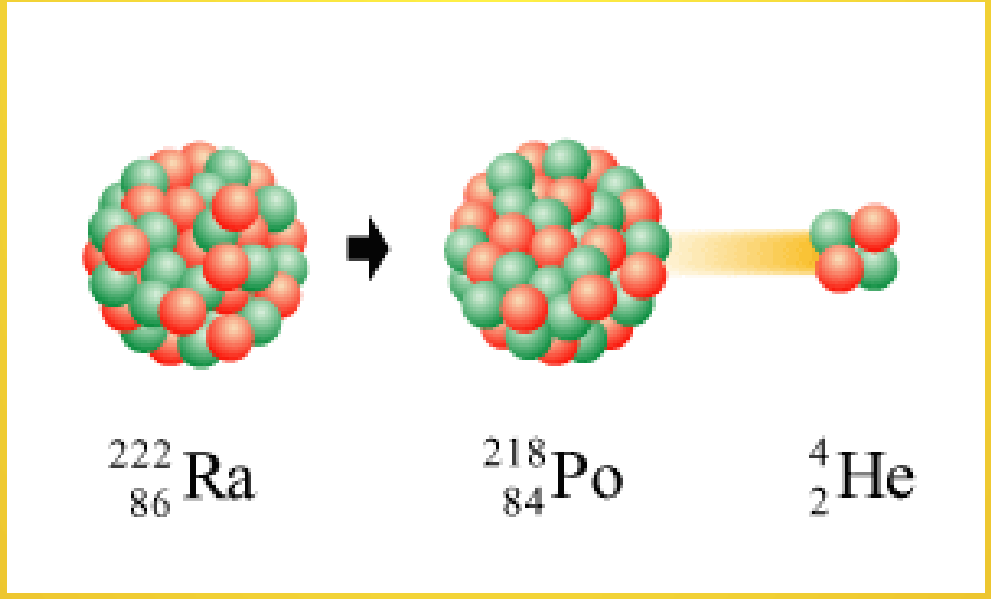
two kinds of radioactivity

that he called:

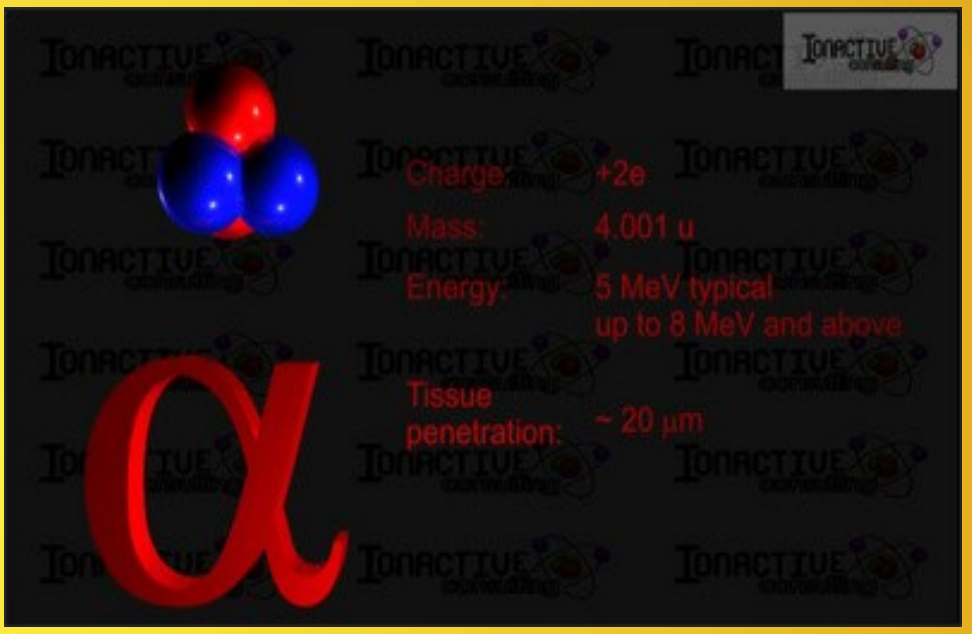
Alpha rays and Beta rays

These results earned him a professorship
at the Montreal University, Canada.
But in 1907 he came back to Great Britain
and started a new career in Manchester.
There he took up researches
on the distribution
of matter and charge
into the atoms.

He also verified that alpha particles
were **ions of helium**,
carrying a positive charge.
He proved this fact
through some spectroscopy experiments.



Now we know that a **alpha particle** is a nucleus of **helium** containing **two protons and two neutrons.**

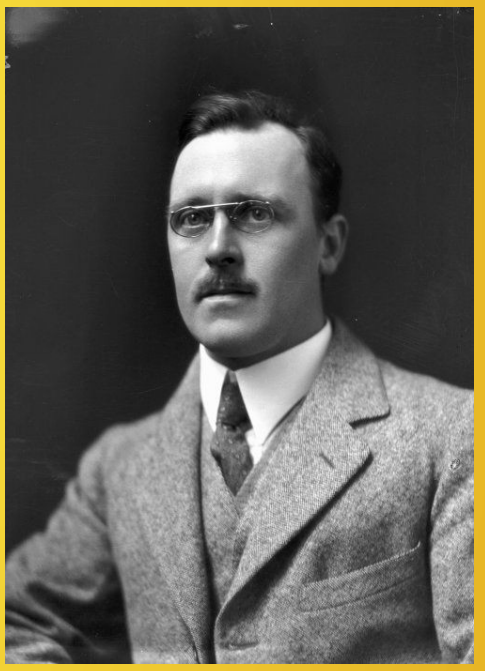


Its charge is q = +2e.

Alpha particles can be generated in the radioactive decay of Radium.

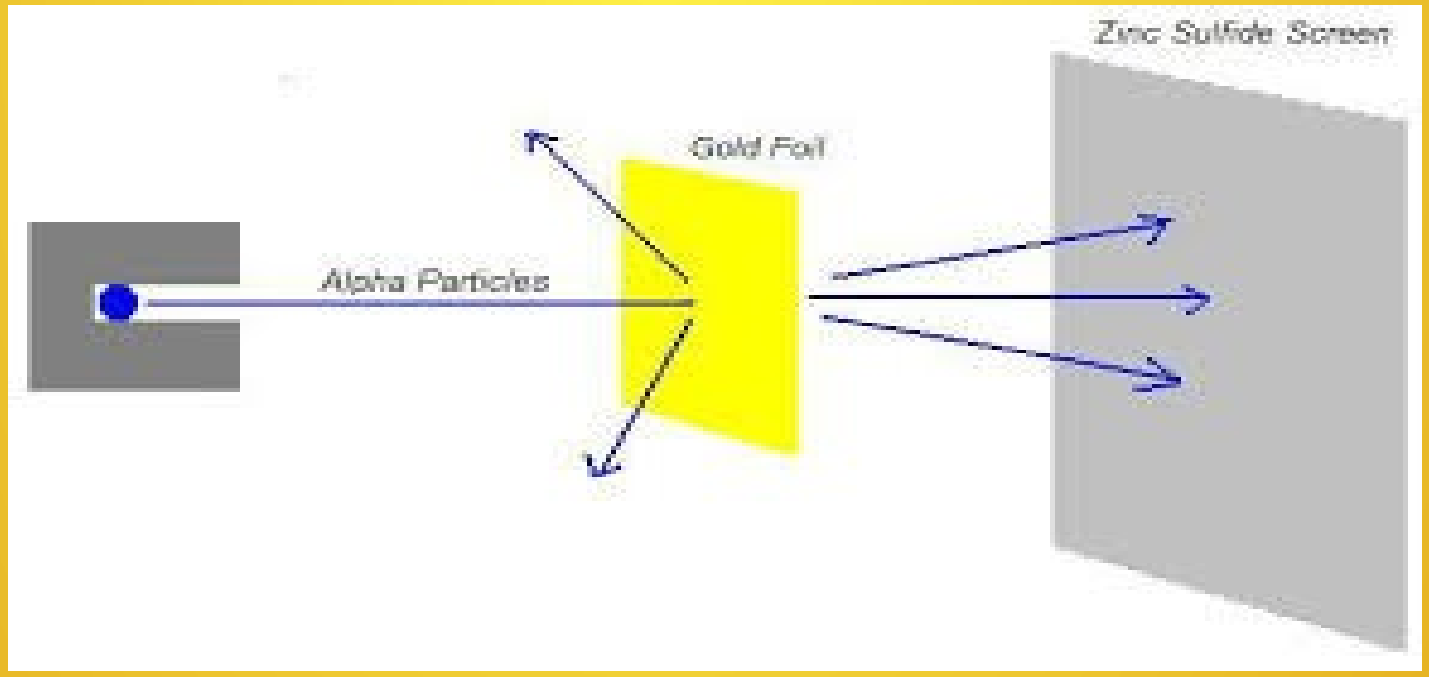
Rutherford chose two young collaborators:

Hans Geiger, a researcher



and Ernest Marsden, a student

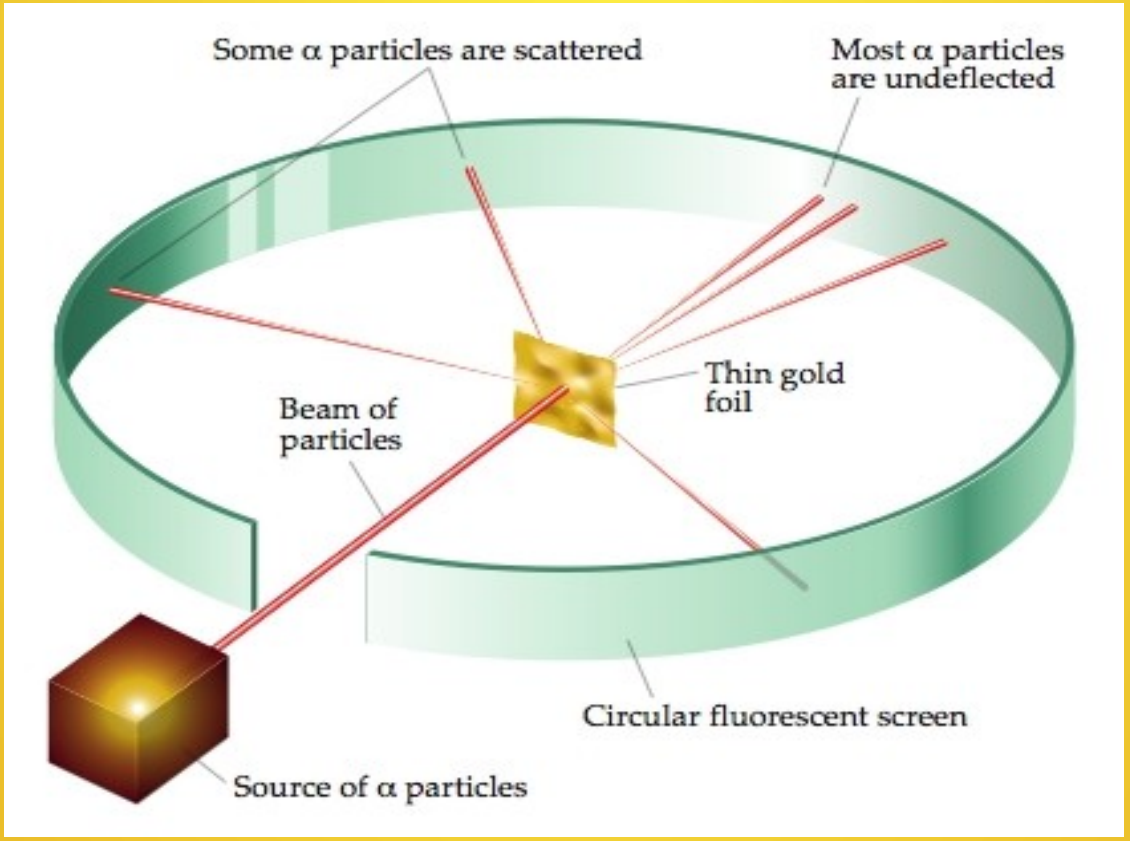
Geiger began a research program
on the scattering of particles
passing through thin sheets of metal.
Rutherford had been
studying this phenomenon
since from 1906 in Canada.



A radiation (alpha particles)
was produced by
the radioactive decay
of a piece of Radium,
closed in a lead shielding.

The beam of particles
was send through a slit of a screen.
Then the concentrated beam
passed through a thin metal sheet.

The beam widened passing through the metal.
The particles issued a flash of light
when they hit the screen
that was a plate
covered with zinc sulfide.



Rutherford decided to assign
a task to the young Marsden.
He had to verify if some alpha particle
could be deflected at a great angle.

This fact was very unlikely
because these particles
have a big mass and
carry a great energy.

But Marsden, after a few days,

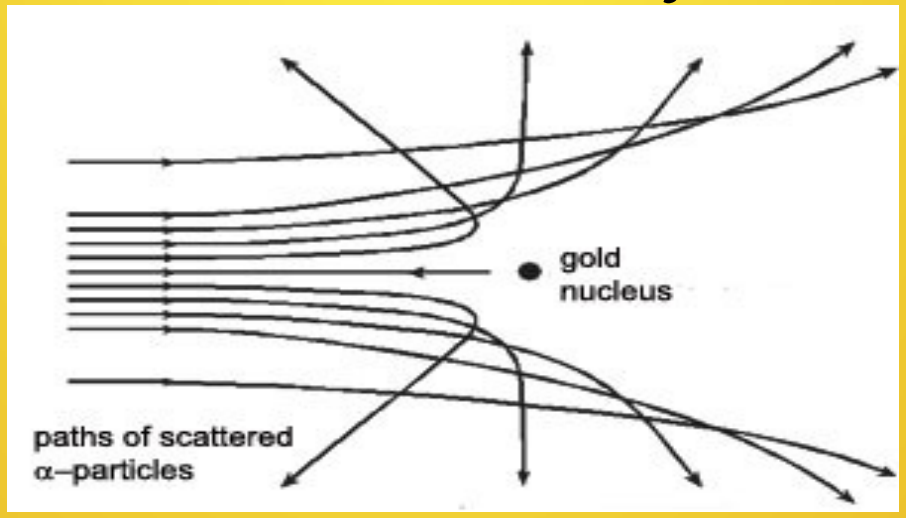
went to Mr. Rutherford.

Marsden was very excited and told him

that he had seen some alpha particles

go back in the opposite direction

like a ball reflected by a wall.



Rutherford was very surprised and said

"It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you."

Video Rutherford

This was the birth of nuclear physics

and a crucial result

in order to determine

the structure of atoms.

Rutherford created a new atomic model.

Electrons orbit in a circular motion

around the nucleus

like the planets

in the solar system.