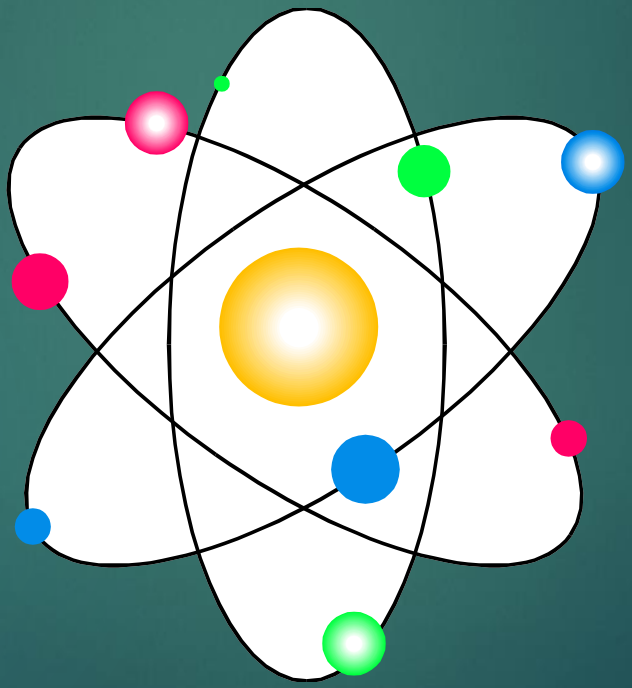
Atoms and Their Structure



Mrs. Ross

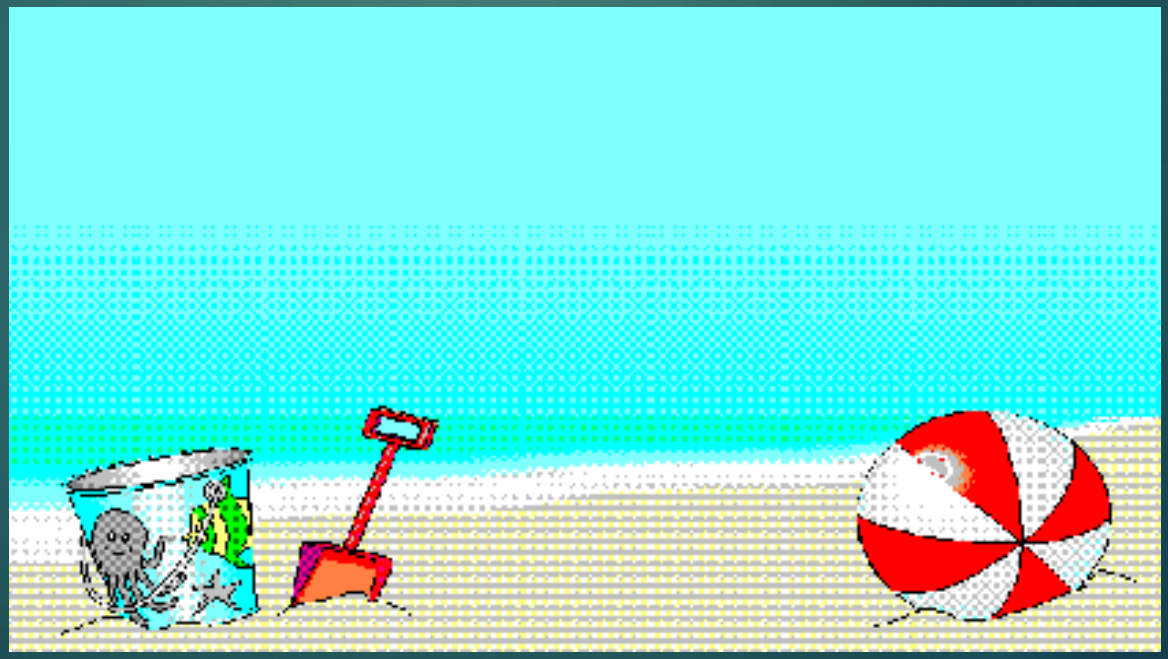
History of the atom

- The first recorded idea of the atom cam about in Ancient Greece (400 B.C.)
- Democritus and Leucippus were the Greek philosophers responsible

History of Atom

- Democritus Looked at a beach
- Looked at the sand and throught…
- If I cut these granules of sand, surely there will be a point when I can no longer cut it.
- Smallest possible piece?
- Coined the word

Atomos - not to be cut



Another Greek

Around the same time as Democritus, Aristotle - a famous philosopher had a very different idea about what everything was made of

- All substances are made of 4 elements
- Fire - Hot
- Air - light
- Earth - cool, heavy
- Water - wet
- His idea was to blend these in different proportions to get all substances

Who Was Right?

- Greek society was slave based
- Beneath Famous to work with hands
- did not experiment
- Greeks settled disagreements by argument
- Aristotle was more famous
- He won
- His ideas carried through middle ages.
- Alchemists change lead to gold

Who's Next?

- Late 1700's - John Dalton- England
- Teacher- summarized results of his experiments and those of other's
- He created his own Theory: Dalton's Atomic Theory
- Combined ideas of elements with that of atoms

Dalton's Atomic Theory

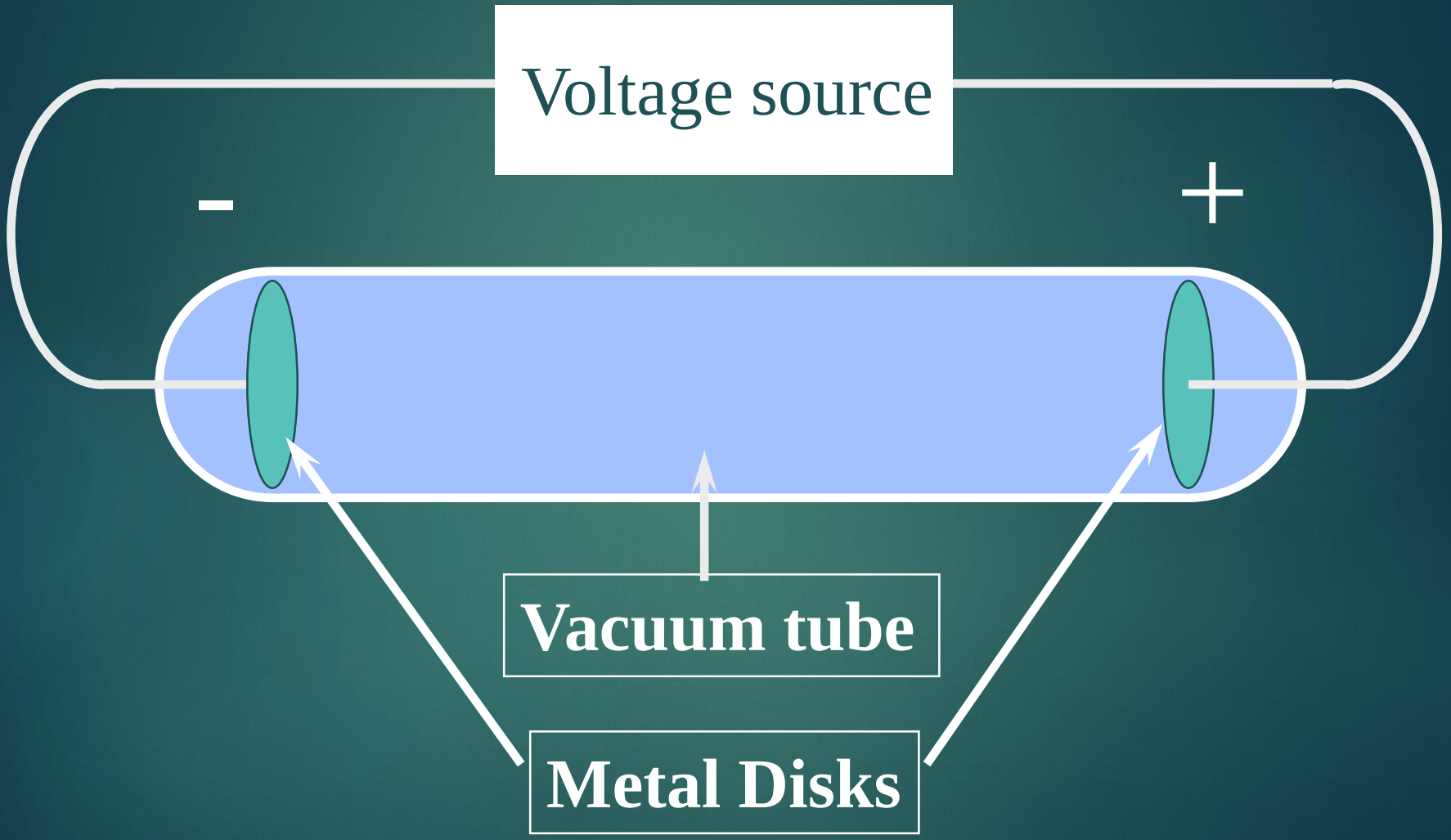
Law of Definite Proportions (#3)

- Each compound has a specific ratio of elements
- It is a ratio by mass
- Water is always 8 grams of oxygen for each gram of hydrogen

Parts of the Atom

- J. J. Thomson - English physicist. 1897
- Made a piece of equipment called a cathode ray tube.
- It is a vacuum tube - all the air has been pumped out.

Thomson's Experiment



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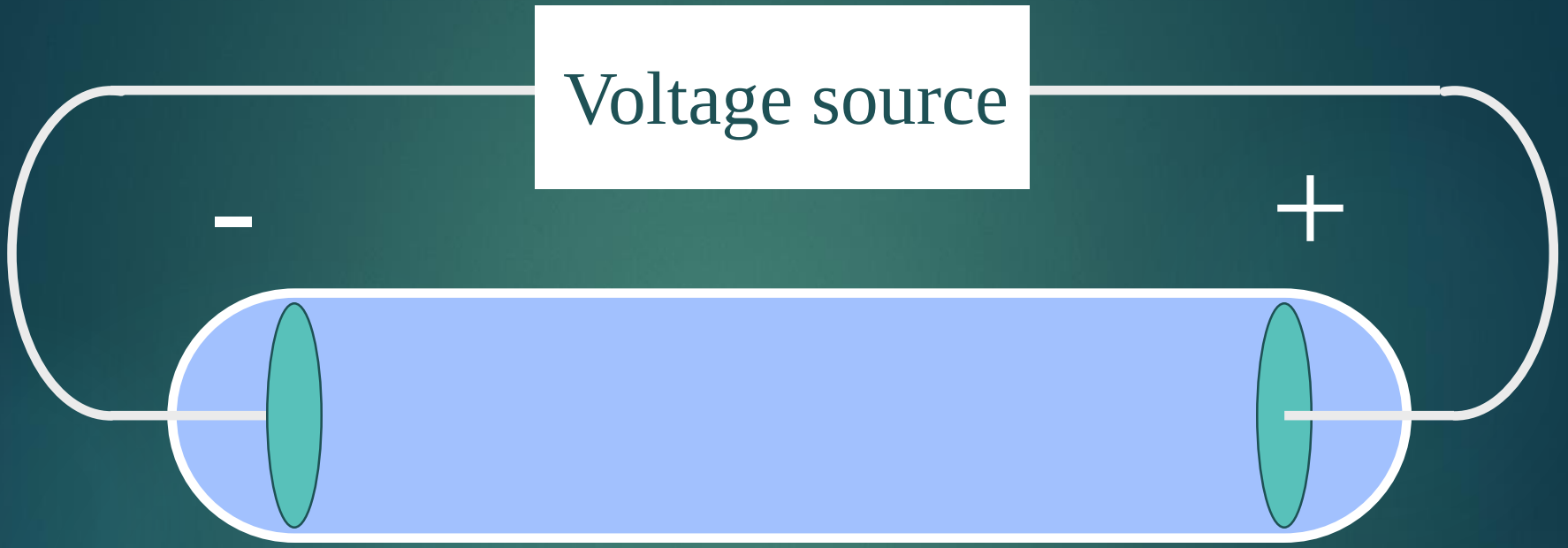

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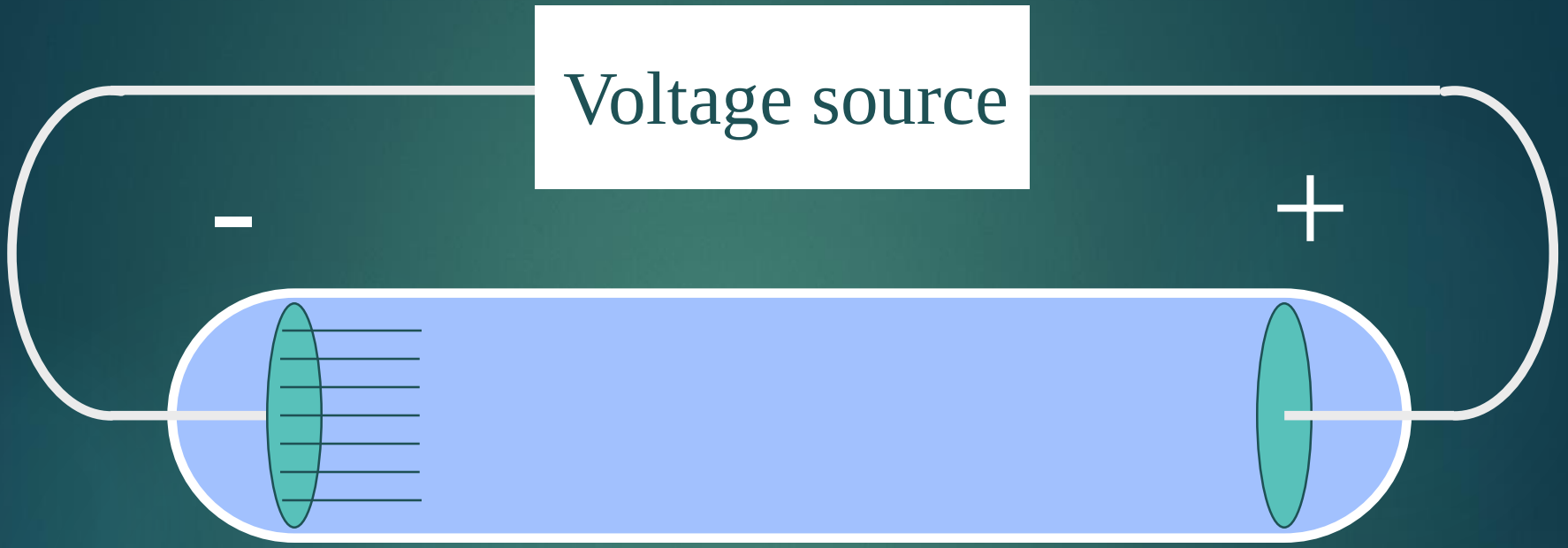

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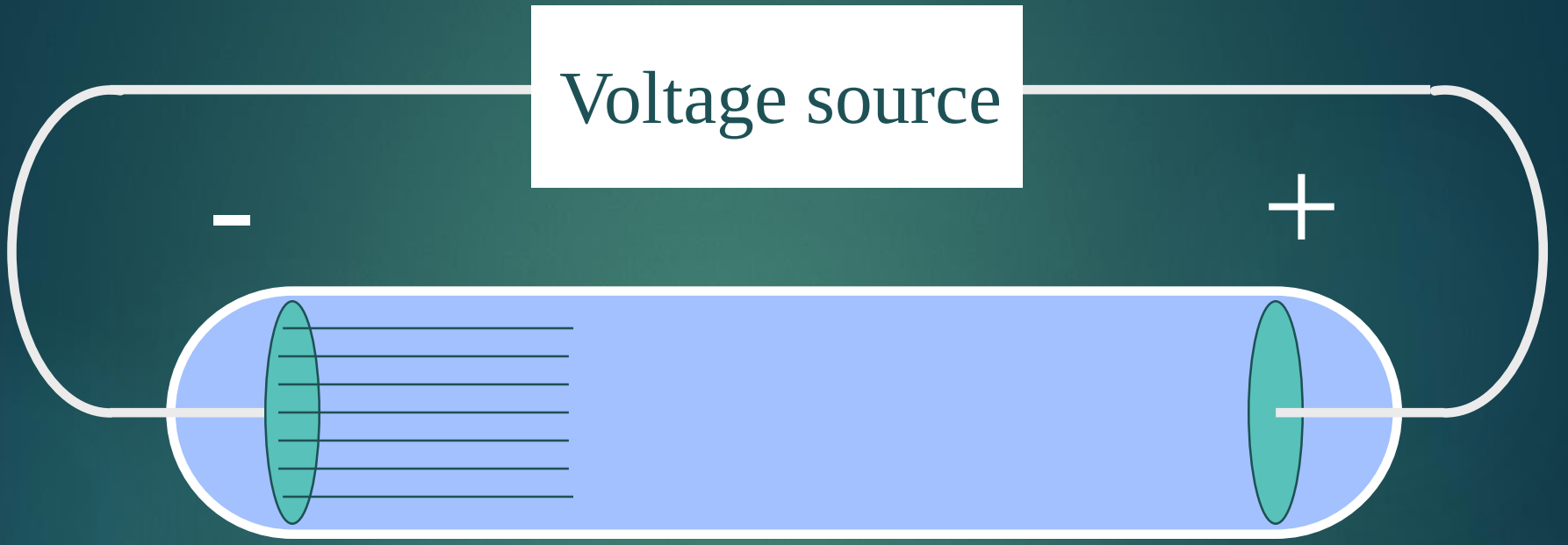

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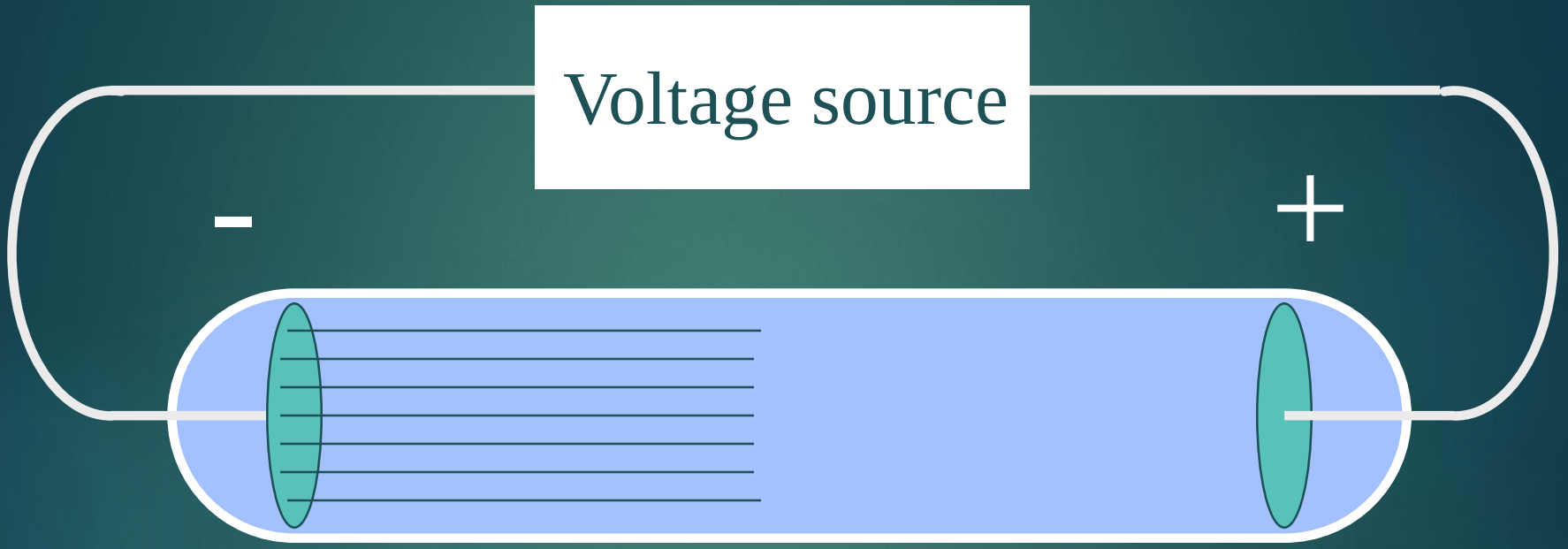
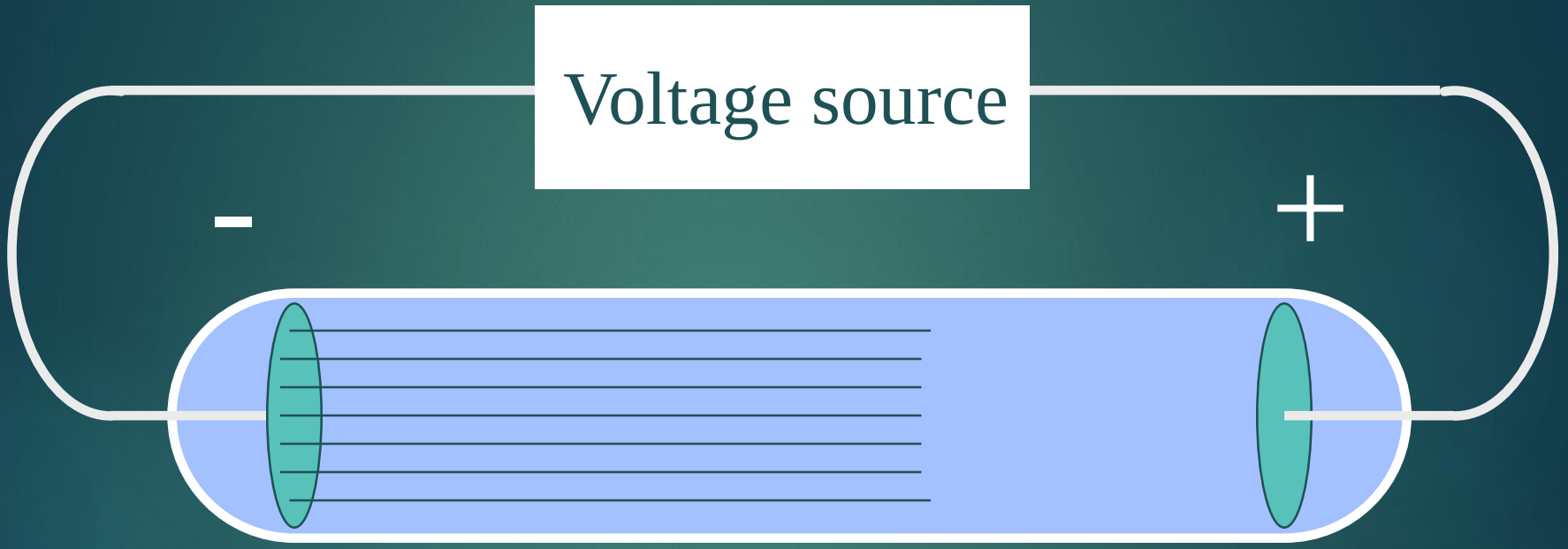


- Passing an electric current makes a beam appear to move from the negative to the positive end

Thomson's Experiment



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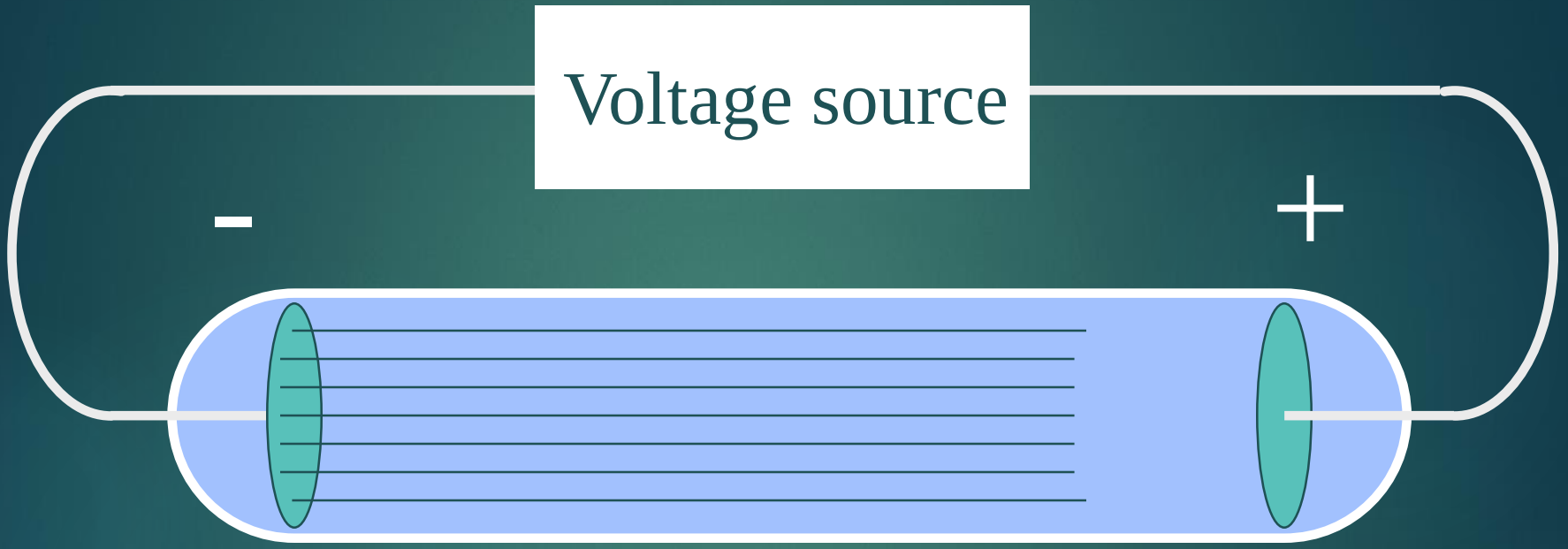

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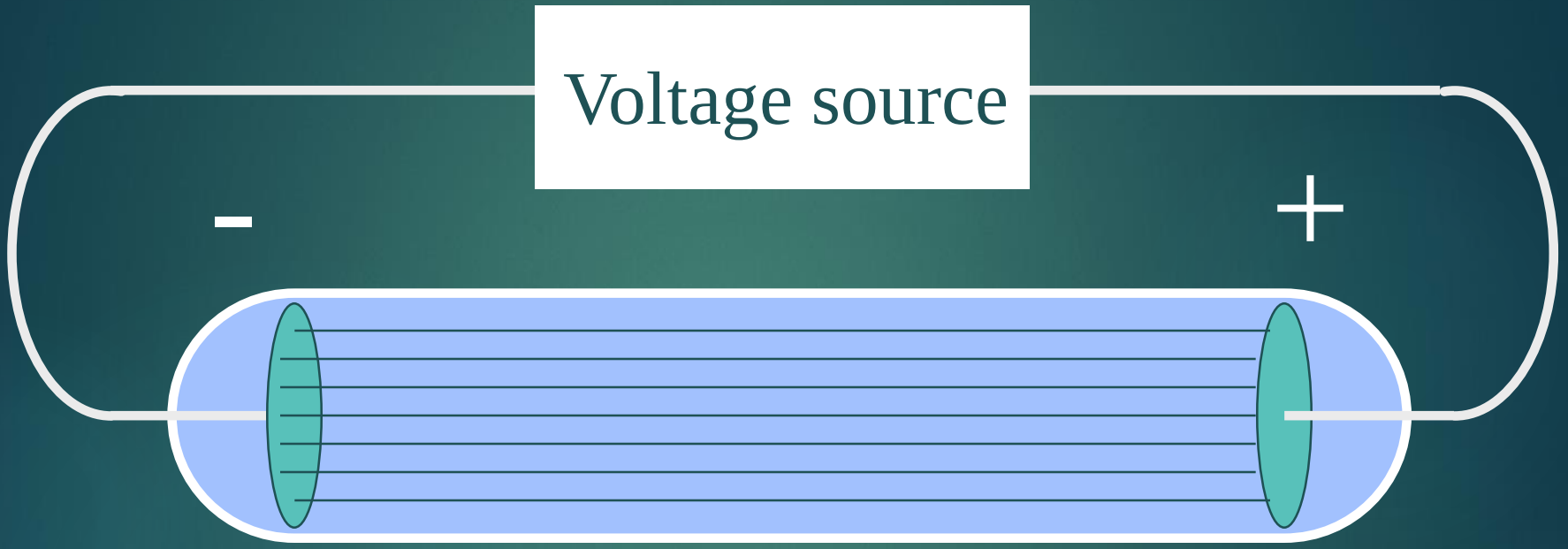

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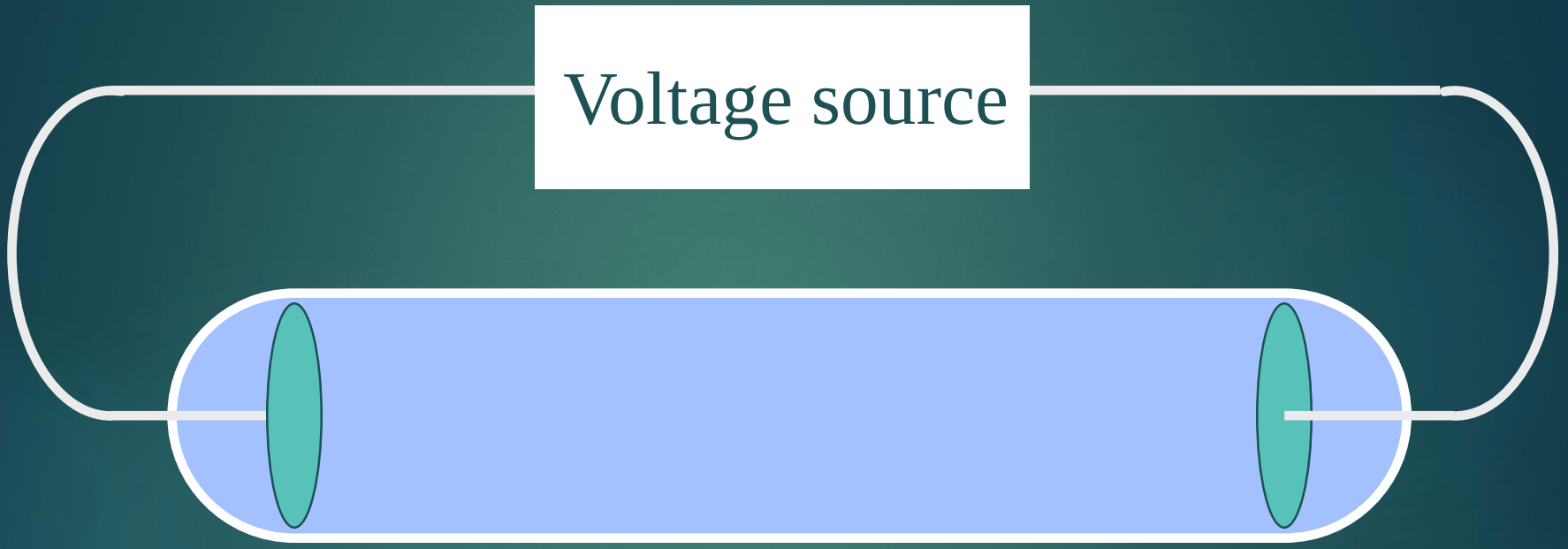
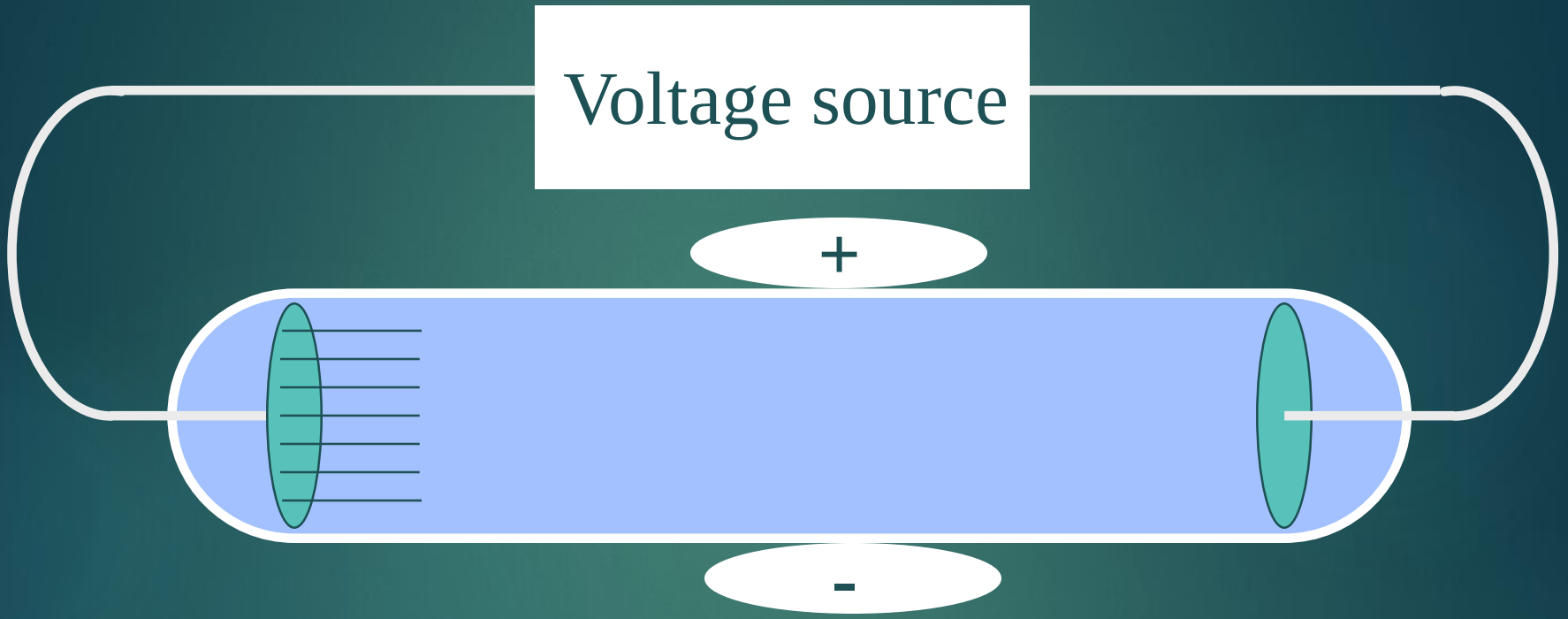


- By adding an electric field

Thomson's Experiment



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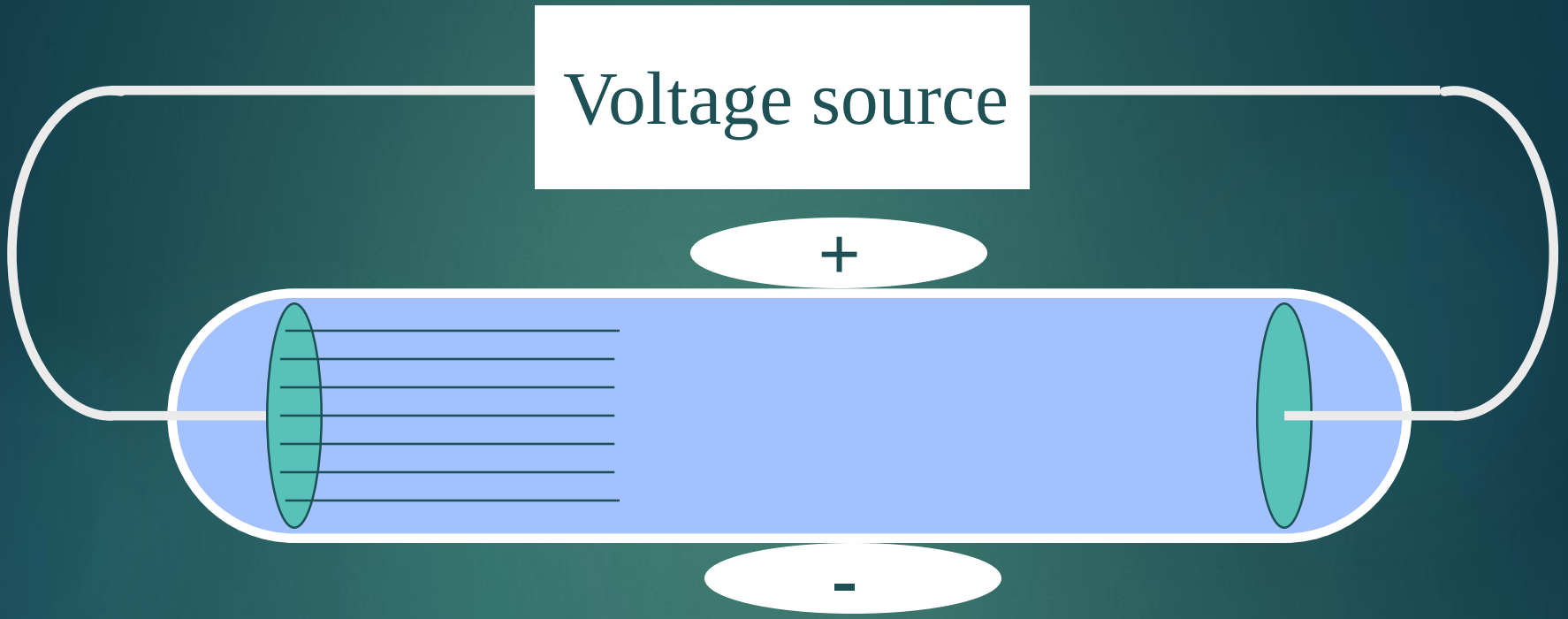

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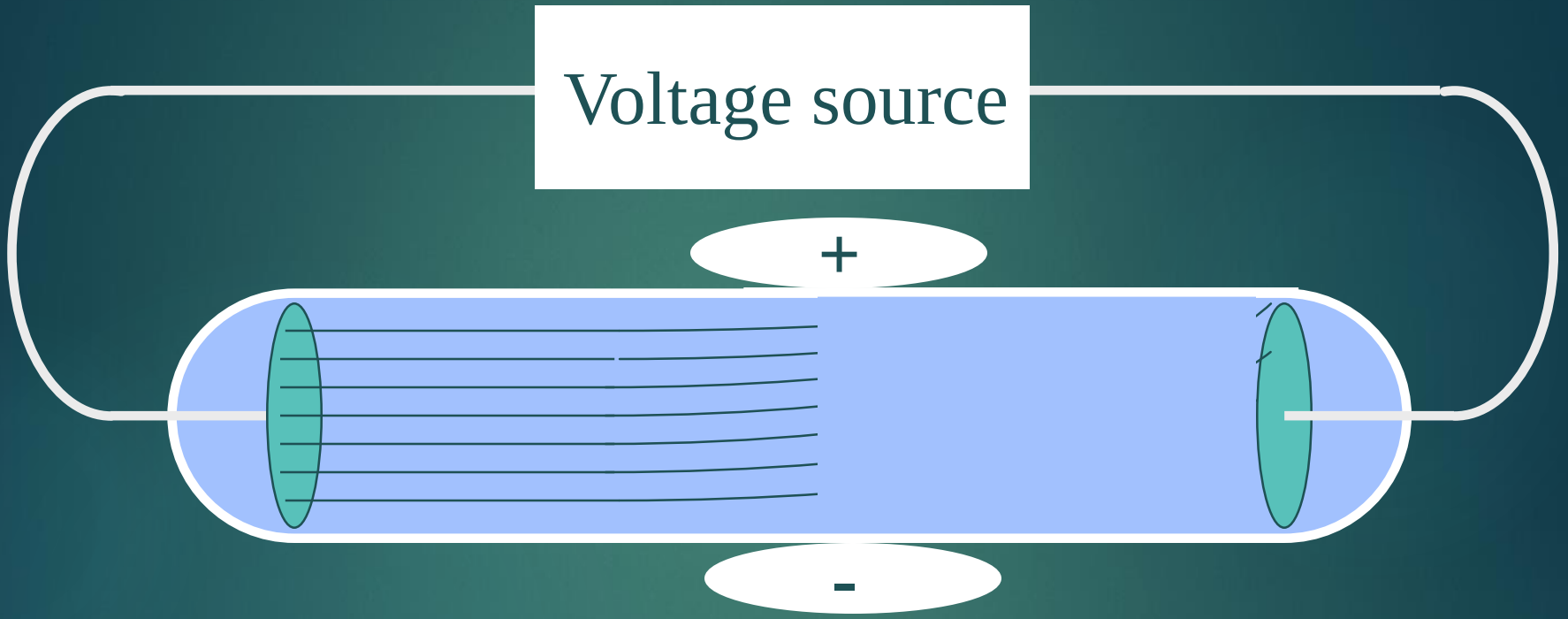

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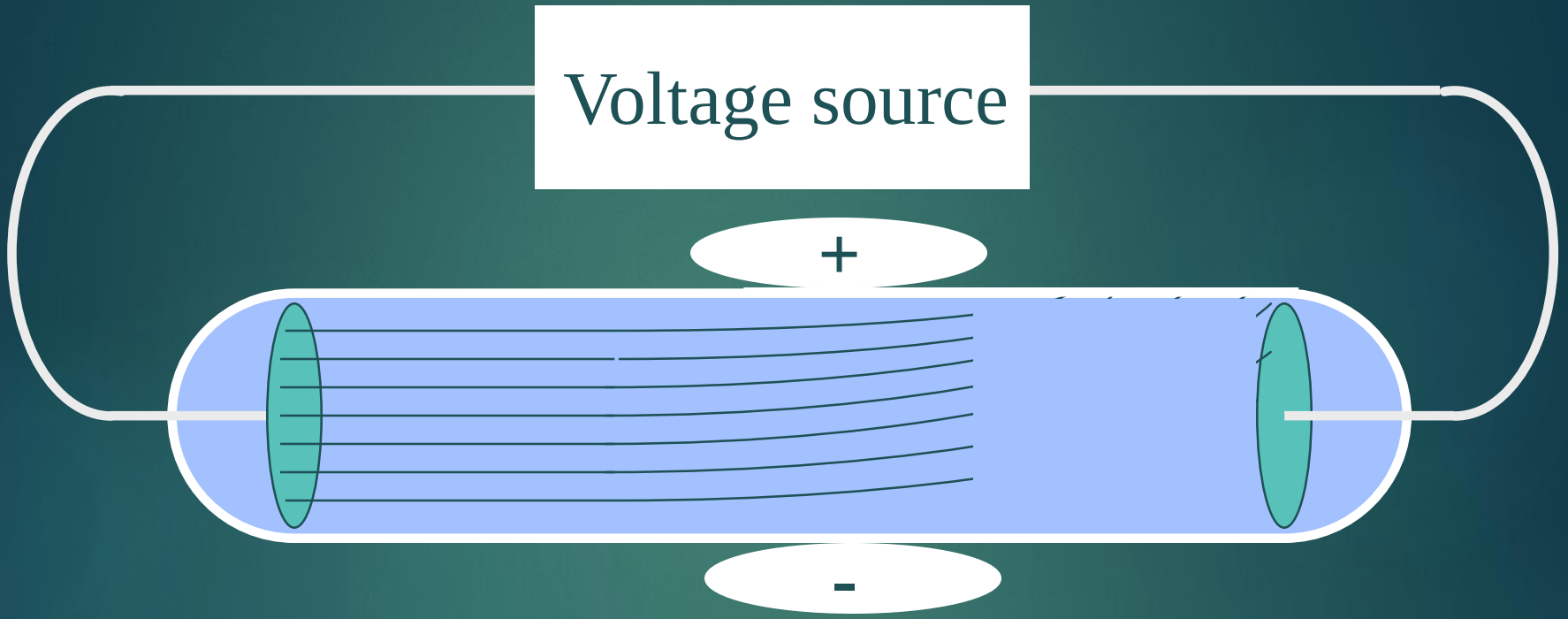

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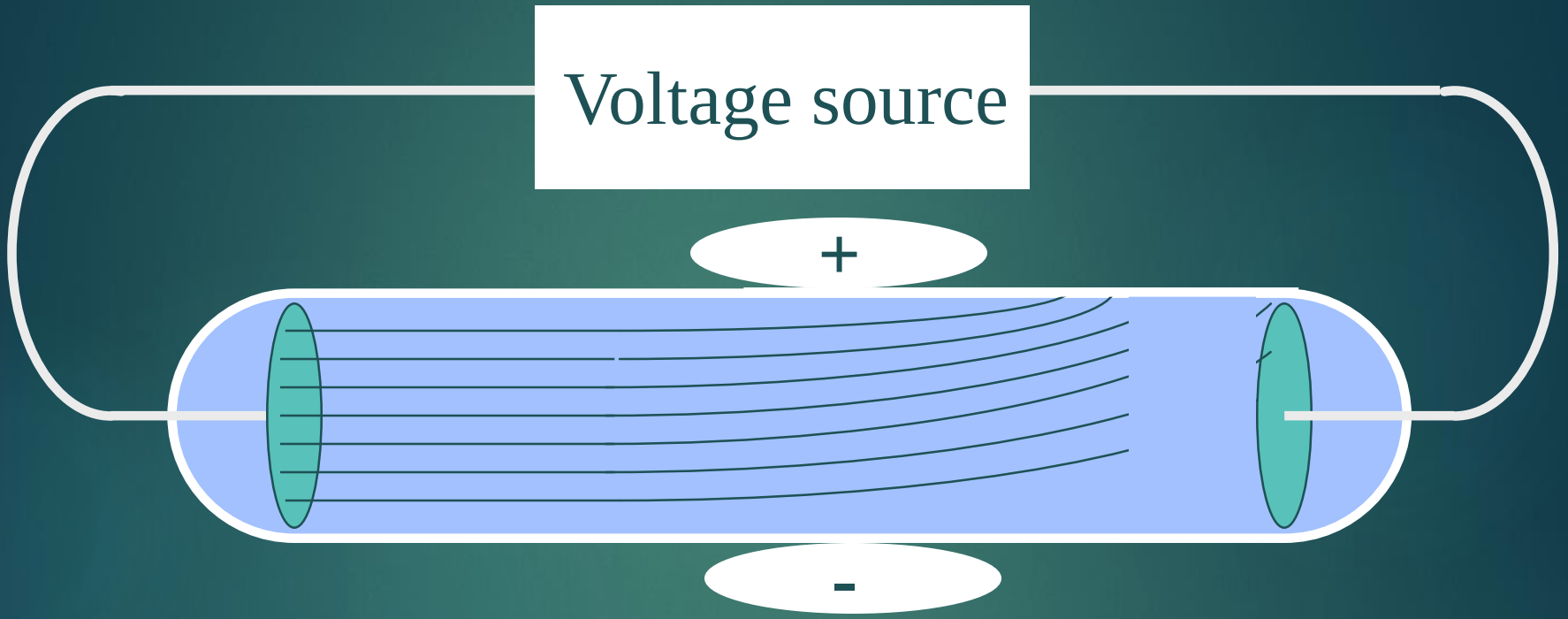

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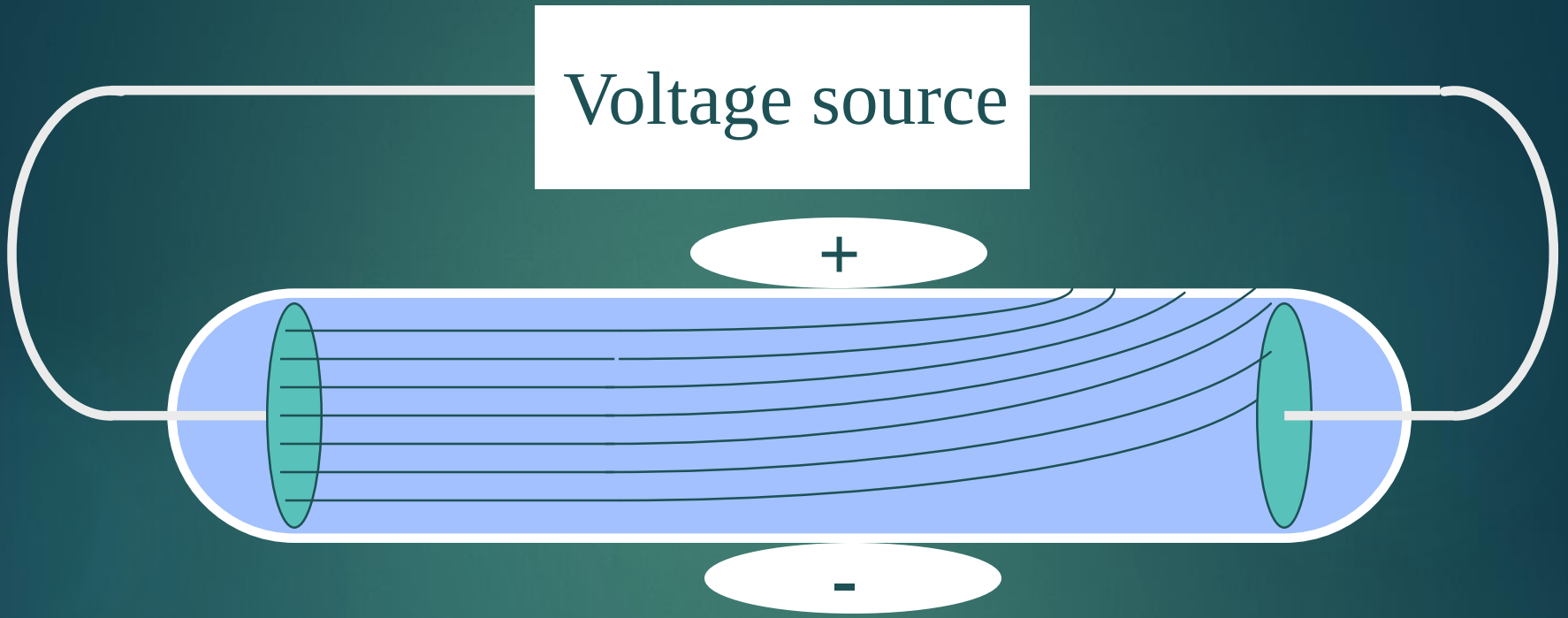
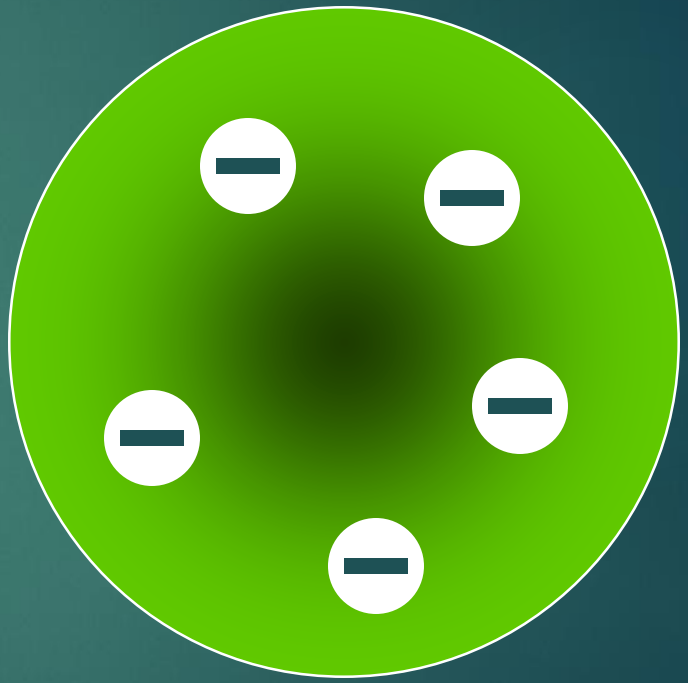
Thomson's Experiment



- By adding an electric field he found that the moving pieces were negative

Thomsom's Model

- Found the electron
- Couldn't find positive (for a while)
- Said the atom was like plum pudding
- A bunch of positive stuff, with the electrons able to be removed

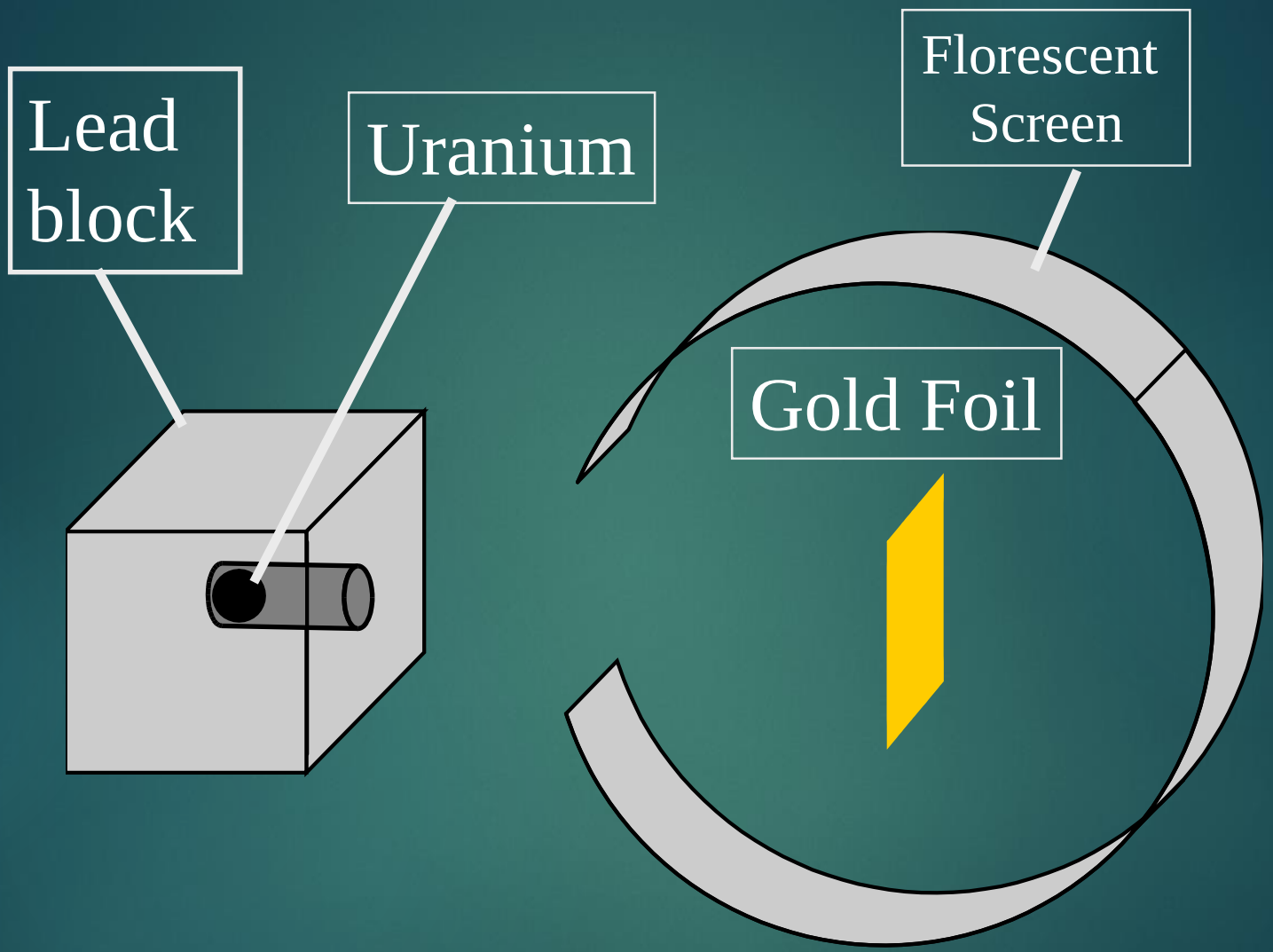


Rutherford's experiment

- Ernest Rutherford English physicist. (1910)
- Believed in the plum pudding model of the atom.
- Wanted to see how big they are
- Used radioactivity
- Alpha particles - positively charged pieces given off by uranium
- Shot them at gold foil which can be made a few atoms thick

Rutherford's experiment

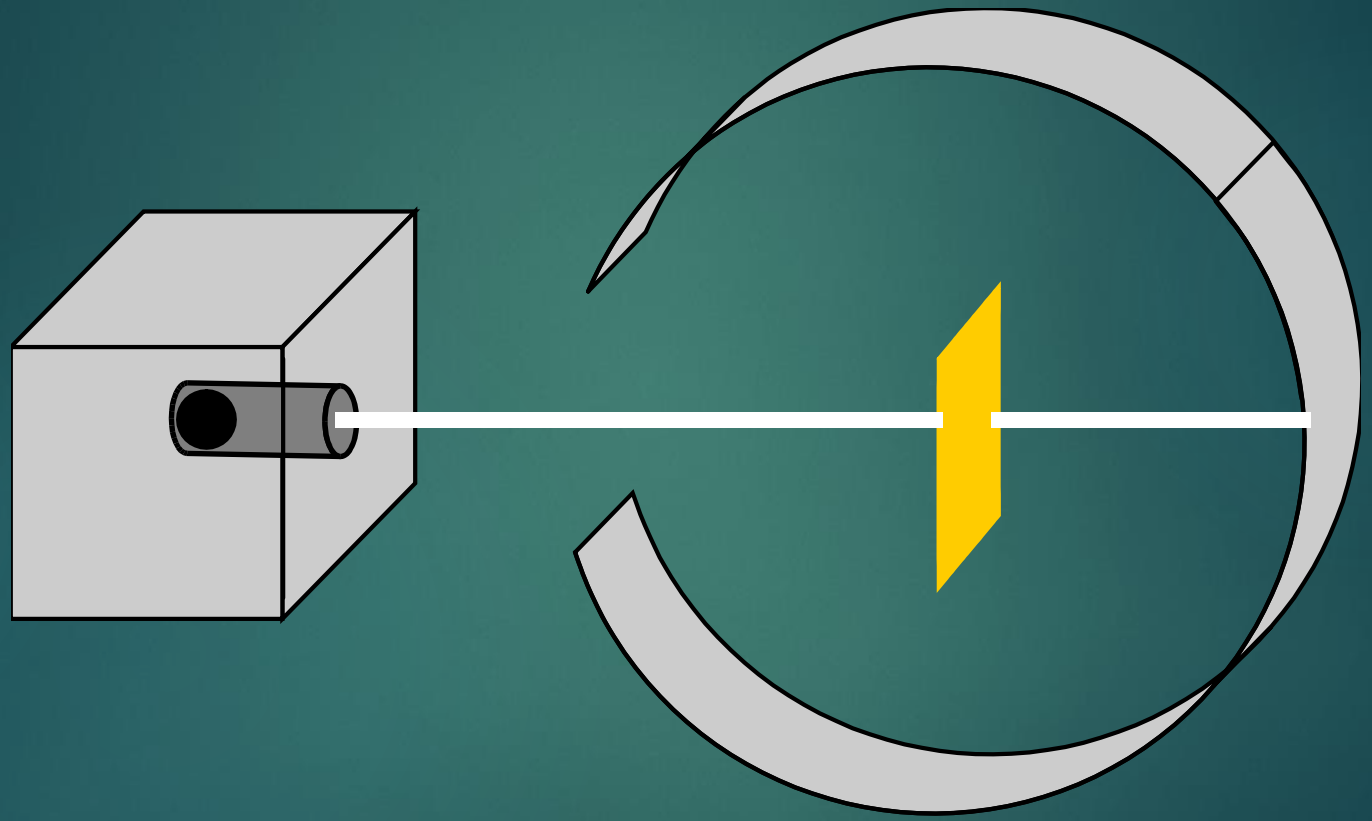
- When the alpha particles hit a florescent screen, it glows.
- Here's what it looked like (pg 72)


Lead block
Uranium
Florescent Screen
Gold Foil

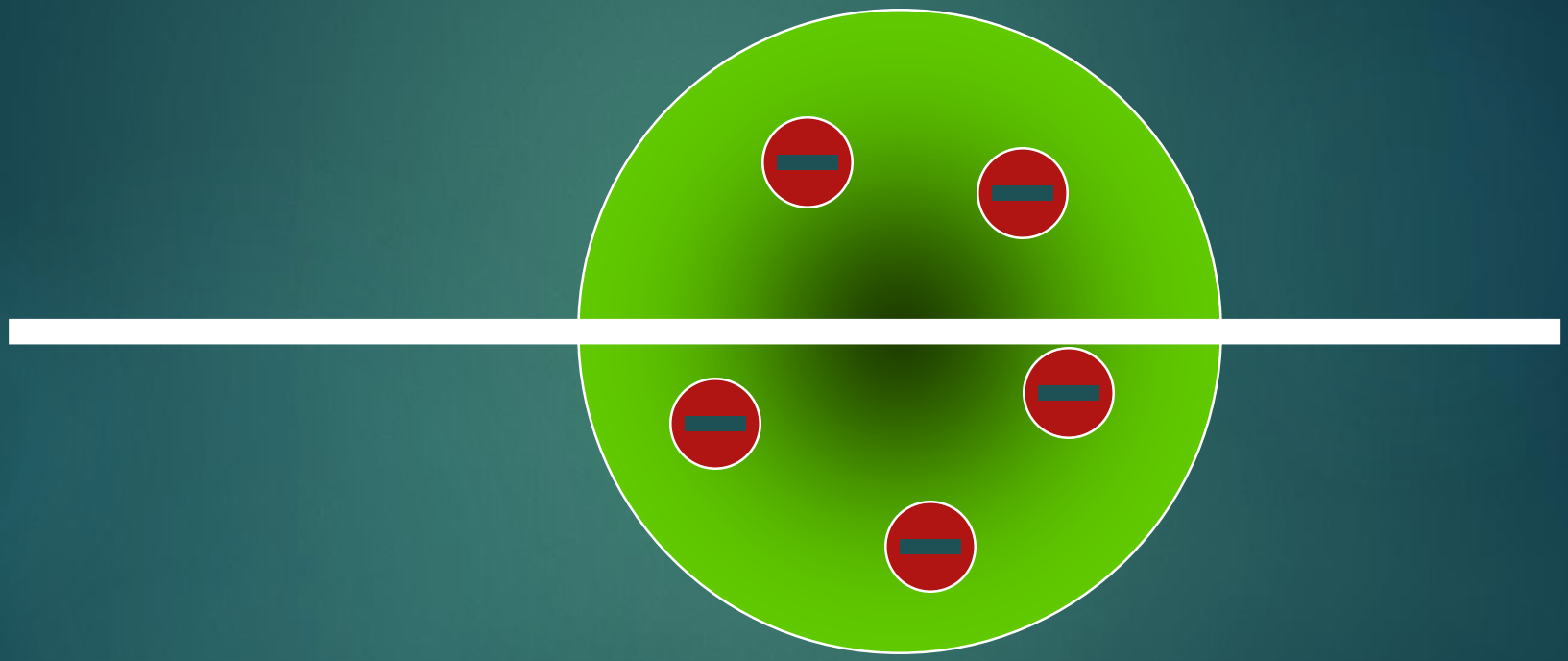
He Expected

- The alpha particles to pass through without changing direction very much
- Because
- The positive charges were spread out evenly. Alone they were not enough to stop the alpha particles

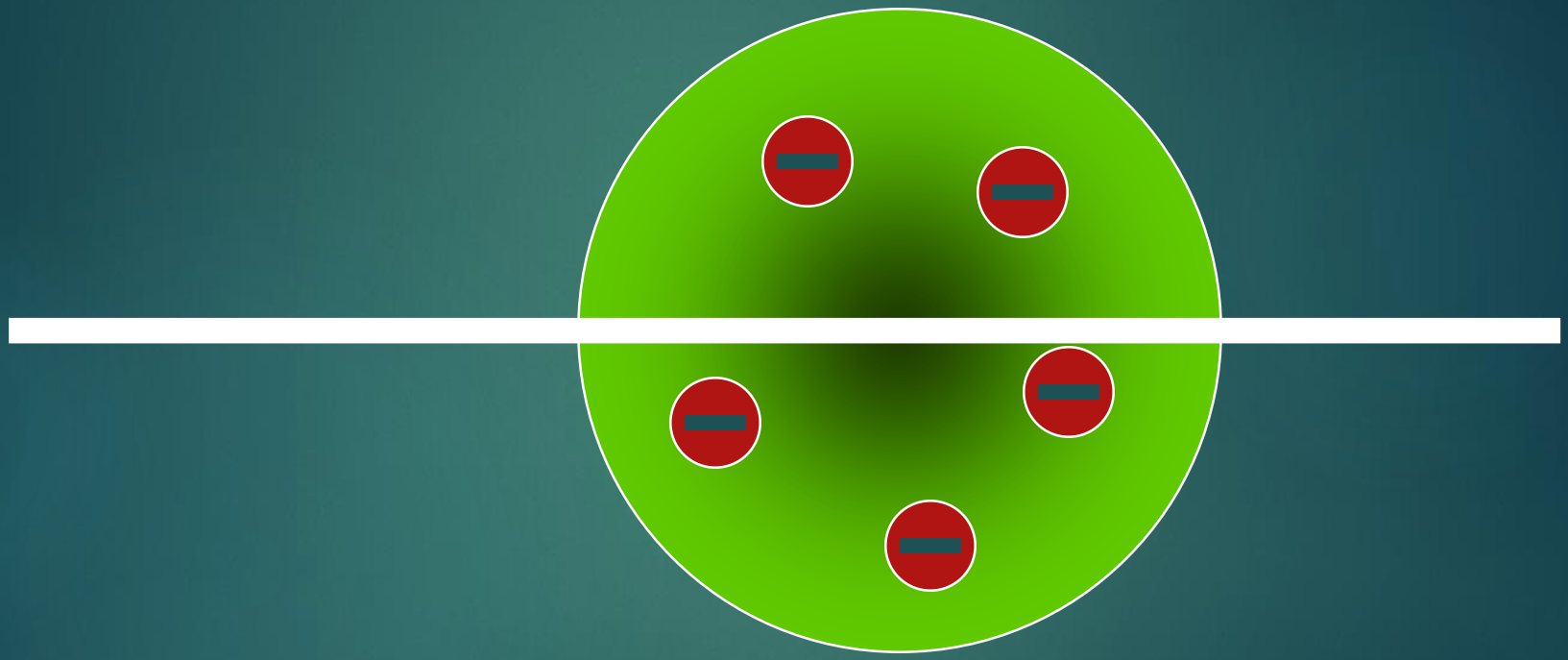
What he expected



Because



Because, he thought the mass was evenly distributed in the atom



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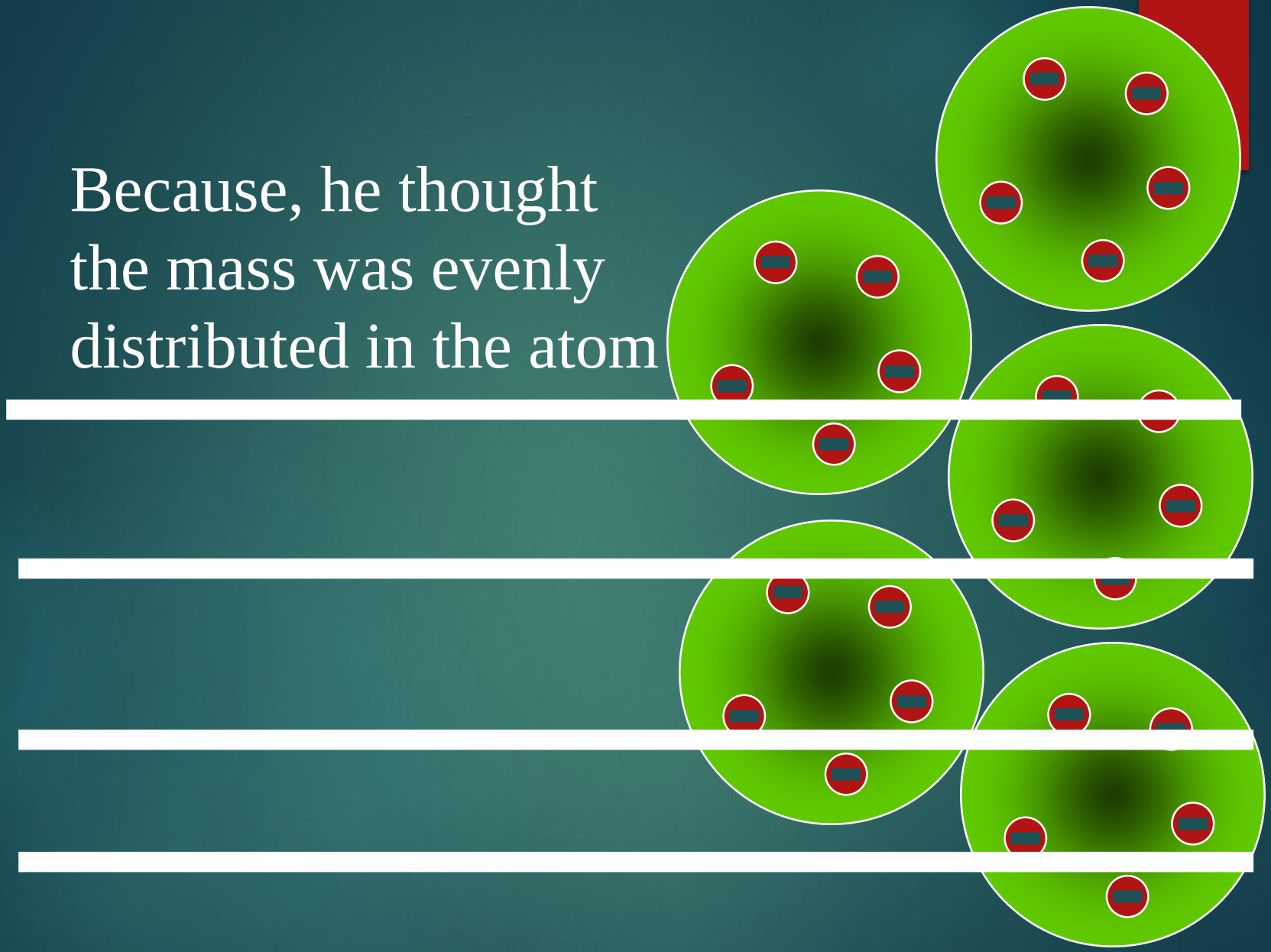
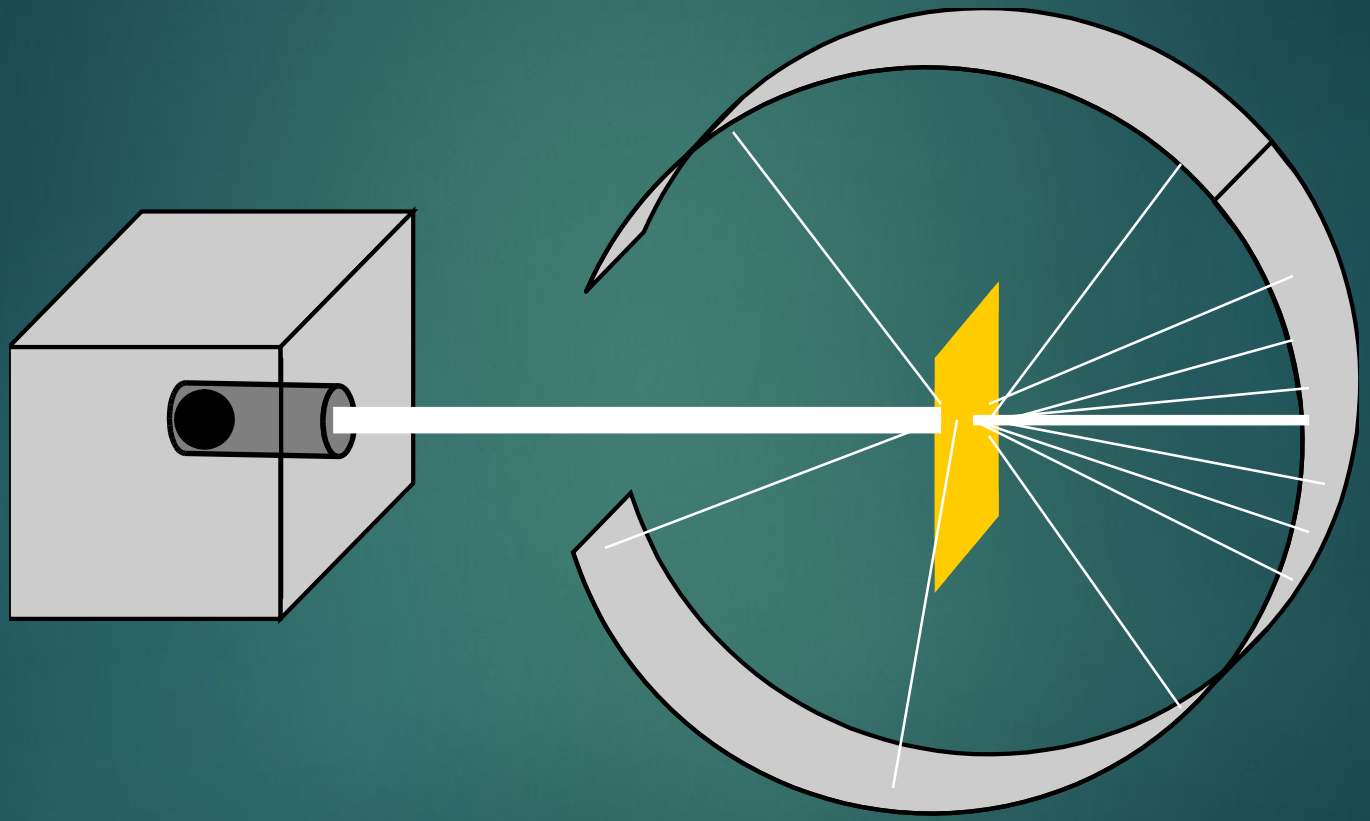
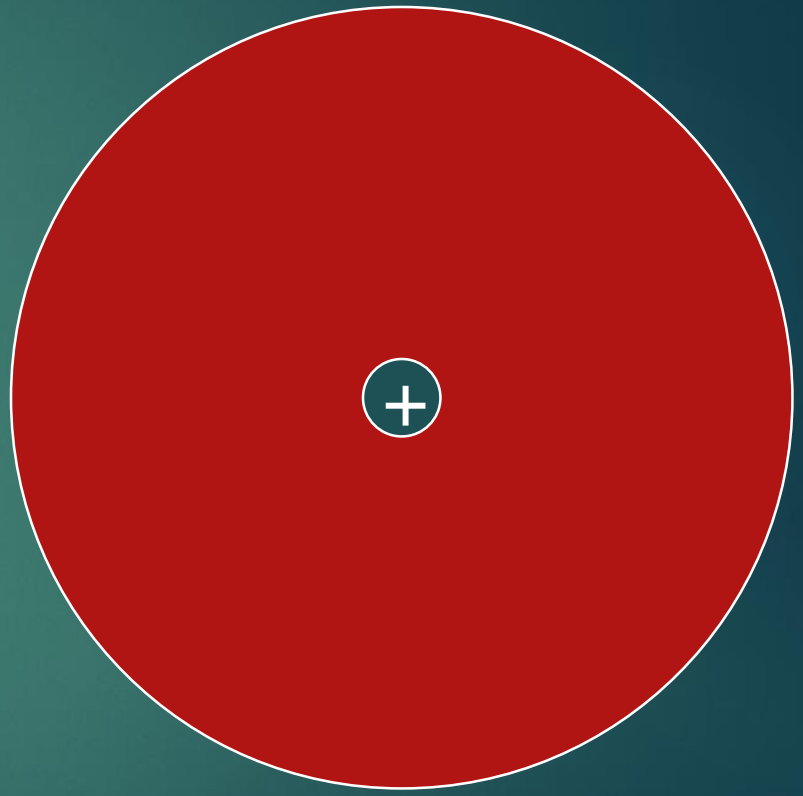


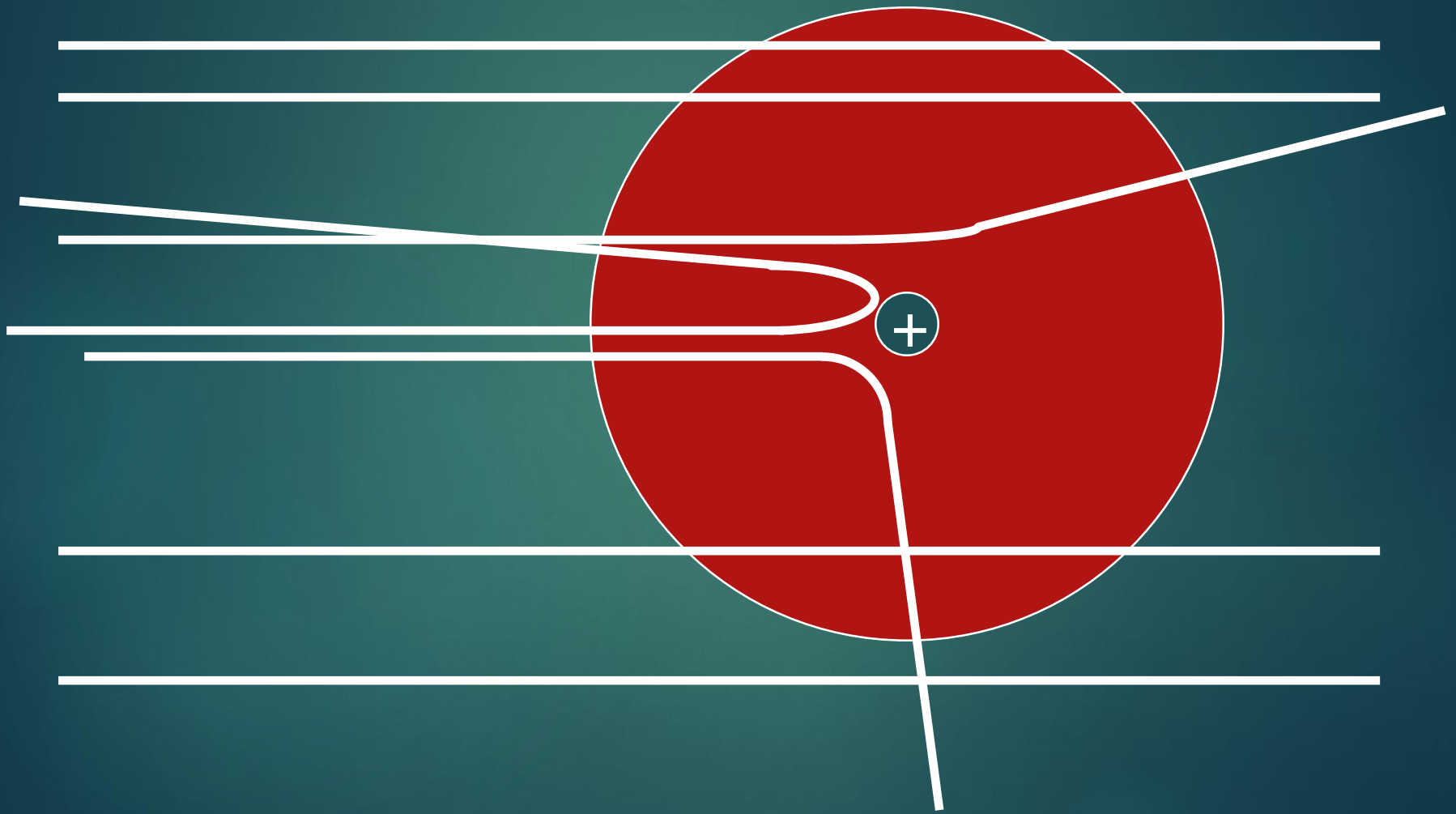
What he got



How he explained it

- Atom is mostly empty
- Small dense, positive piece at center
- Alpha particles are deflected by it if they get close enough

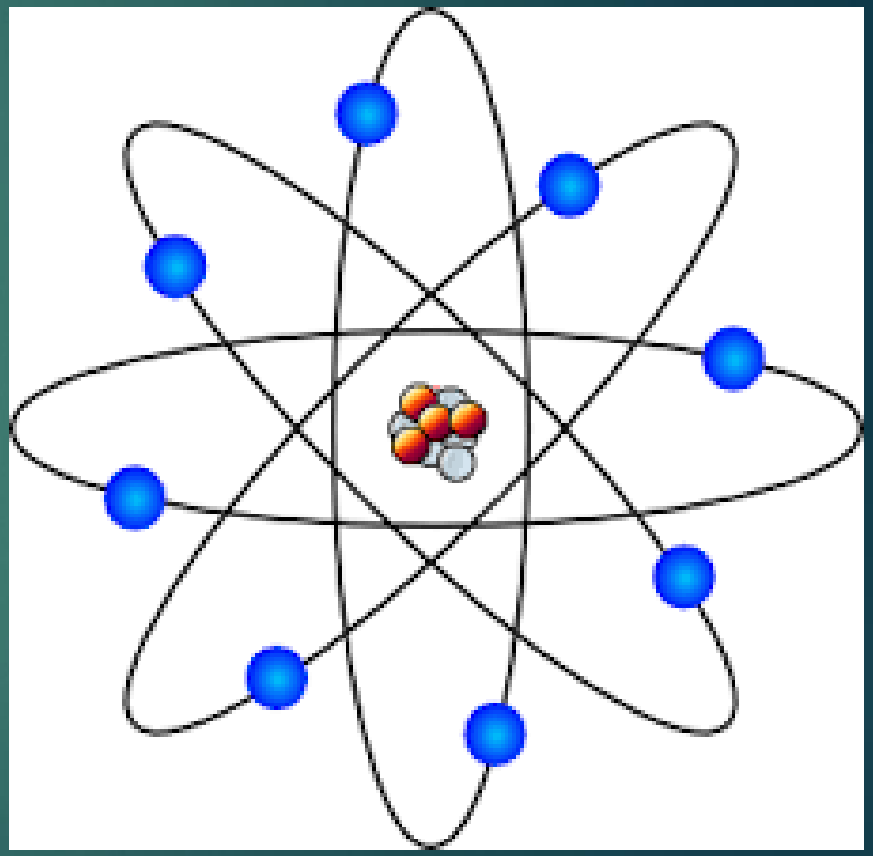




Modern View

The atom is mostly empty space

- Two Regions:
  - The nucleus
    - With protons and neutrons
    - Positive charge
    - Almost all the mass
  - Electron cloud- Most of the volume of an atom
    - The region where the electron can be found



Density and the Atom, as Explained by Rutherford

- Since most of the particles went through, it was mostly empty.
- Because the pieces turned so much, the positive pieces were heavy.
- $Density = \frac{m}{v}$
  - Small volume, big mass= large density
- This small dense positive area is the nucleus

Subatomic particles

Name	Symbol	Charge	Relative mass	Actual mass (g)
Electron	e^-	-1	1/1836	9.11×10^{-28}
Proton	p^+	+1	1	1.67×10^{-24}
Neutron	n^0	0	1	1.67×10^{-24}

Size of an atom

- Atoms are small.
  - Measured in picometers, 10^{-12} meters
  - Hydrogen atom, 32 pm radius
- Nucleus tiny compared to atom
- If the atom was the size of a stadium, the nucleus would be the size of a marble.
  - Radius of the nucleus near 10^{-15}m.
  - Density near 10^{14} g/cm^3

Counting the Pieces

- Atomic Number = number of protons
- # of protons determines kind of atom
- the same as the number of electrons in the neutral atom
- Mass Number = the number of protons + neutrons
- All the things with mass

Symbols

- Contain the symbol of the element, the mass number and the atomic number

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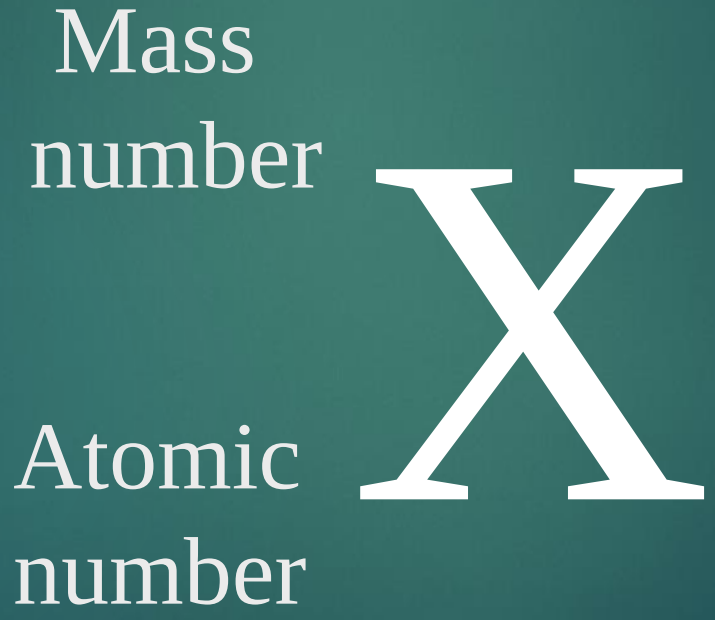

Symbols

- Find the
  - number of protons
  - number of neutrons
  - number of electrons
  - Atomic number
  - Mass Number

$$^{19}_{9}\mathrm{F}$$

Symbols

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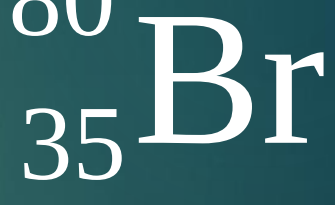

Symbols

If an element has an atomic number of 34 and a mass number of 78 what is the

- number of protons
- number of neutrons
- number of electrons
- Complete symbol

Symbols

If an element has 91 protons and 140 neutrons what is the

- Atomic number
- Mass number
- number of electrons
- Complete symbol

Symbols

If an element has 78 electrons and 117 neutrons what is the

- Atomic number
- Mass number
- number of protons
- Complete symbol

Naming Isotopes

- Put the mass number after the name of the element
- carbon- 12
- carbon -14
- uranium-235

Measuring Atomic Mass

- Unit is the Atomic Mass Unit (amu)
  - Grams would be too small of a number
- Each isotope has its own atomic mass we need the average from percent abundance.
  - That's why you see the different numbers on the PT

Atomic Mass

- Is not a whole number because it is an average.
- is the decimal number for each element on the periodic table.
- Be able to distinguish from mass number
  - Mass # is nearest whole number

Isotopes

- Dalton had very good thoughts, but we know now he was incorrect about some things.
- Atoms of the same element can have different numbers of neutrons
- different mass numbers
- called isotopes

IONS!!!!

- Atoms with a charge
  - # of protons does not equal number of electrons
  - Protons stay the same– does not change the identity of the element
  - Different number of electrons.
    - More electrons= negative ion
    - Fewer electrons= positive ion