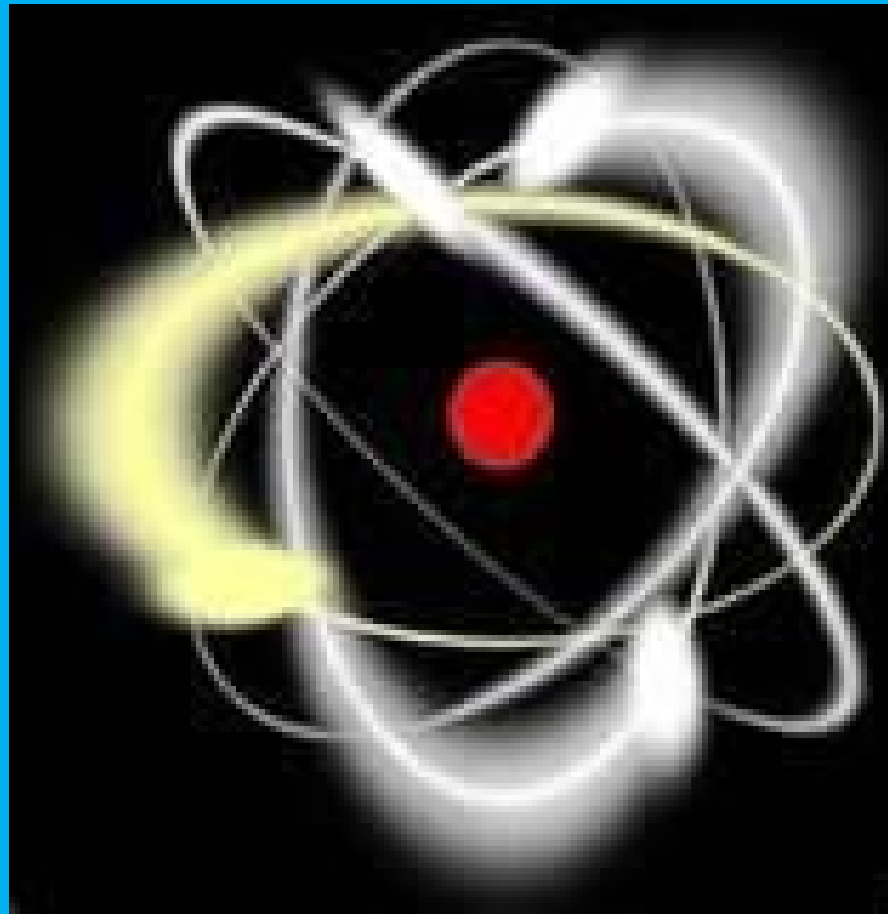


# Historical Perspective



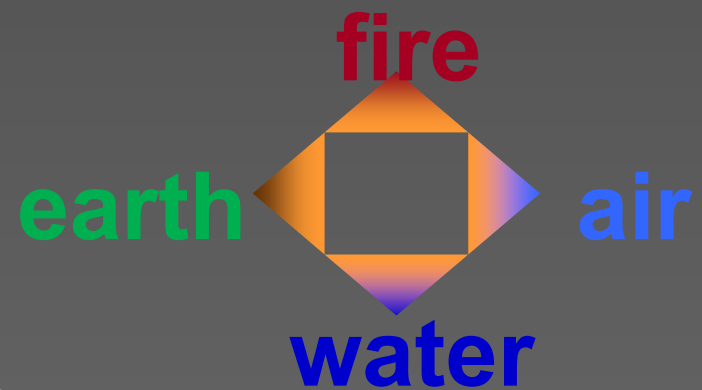
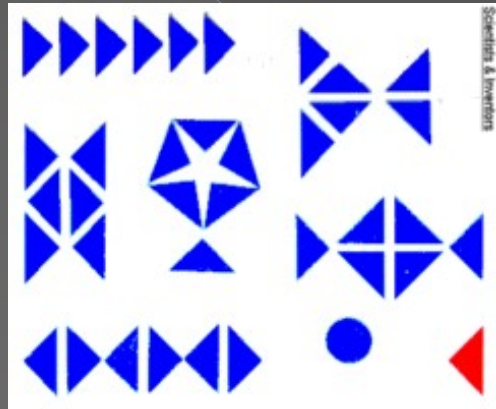
# THE ATOM

Democritus

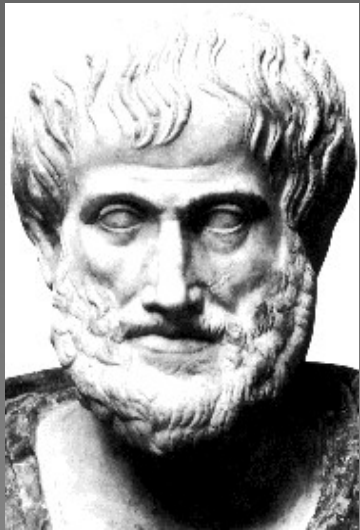


# Early Greek Theories

- 400 B.C. - Democritus thought matter could not be divided indefinitely.
- This small particle he called “atomos”.



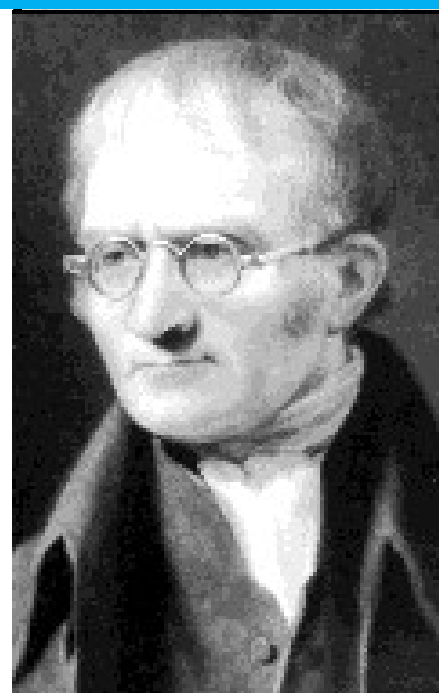
- 350 B.C - Aristotle modified an earlier theory that matter was made of four “elements”: earth, fire, water, air.
- Aristotle was wrong. However, his theory persisted for 2000 years.



Aristotle

# JOHN DALTON

- 1808 -Dalton proposed a modern atomic model based on experimentation not on pure reason.



- All matter is made of atoms.
- Atoms of an element are identical.
- Atoms of different elements are distinctively different
- Atoms are rearranged in chemical reactions
- Atoms of different elements combine in constant ratios to form compounds.
- Atoms of one element cannot be changed into an atoms of different elements.

- His ideas account for the law of conservation of mass (atoms are neither created nor destroyed) and the law of constant composition (elements combine in fixed ratios).

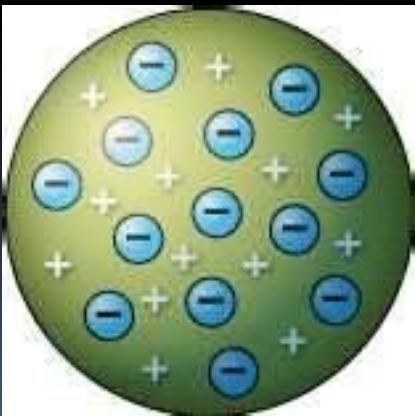
# HISTORY OF THE ATOM

## Joseph John Thompson



1856 -1940

In 1904, Thompson develops the idea that an atom was made up of electrons scattered unevenly within an elastic sphere surrounded by a soup of positive charge to balance the electron's charge



It is called the plums pudding model.

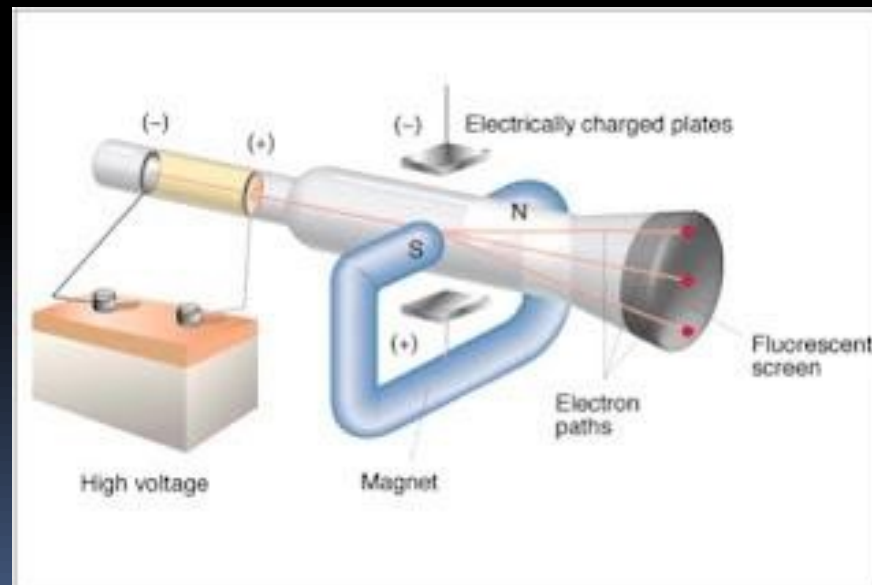
He was awarded a Nobel Prize in 1906 for discovering the Electron.



# HISTORY OF THE ATOM

## Cathode Ray Tube

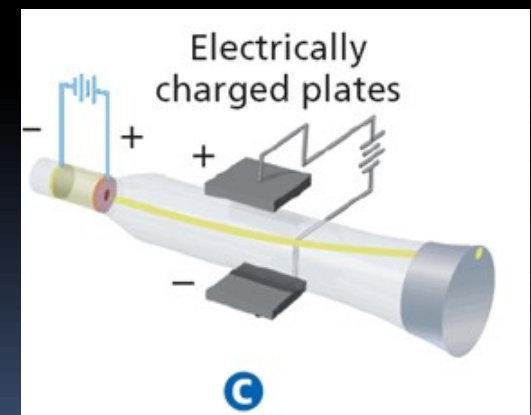
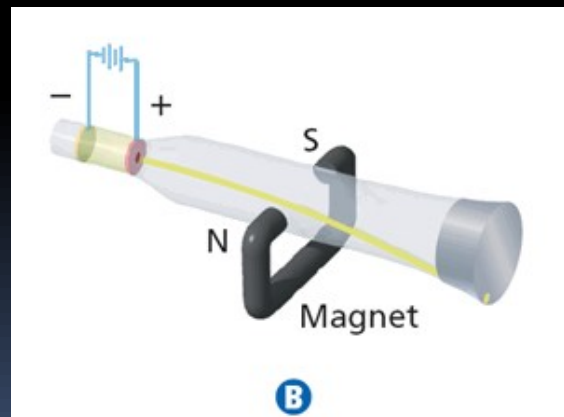
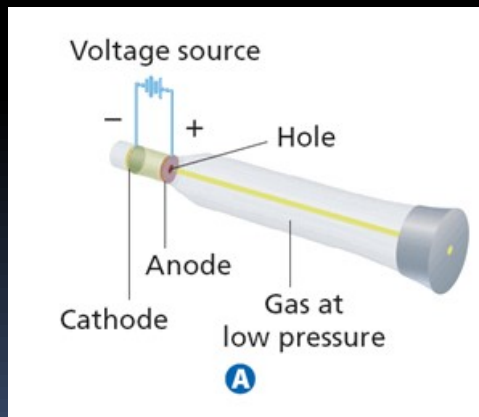
- The **cathode ray tube (CRT)** is a vacuum tube containing a gas at (low pressure) with an electron emitter and a fluorescent screen used to view images. It has a means to accelerate and deflect the electron beam onto the fluorescent screen to create the images



# HISTORY OF THE ATOM

## Joseph John Thompson

- Thompson discovered by mathematical means that these rays have a small mass and are negative.
- Thompson noted that these negative subatomic particles were a fundamental part of all atoms.

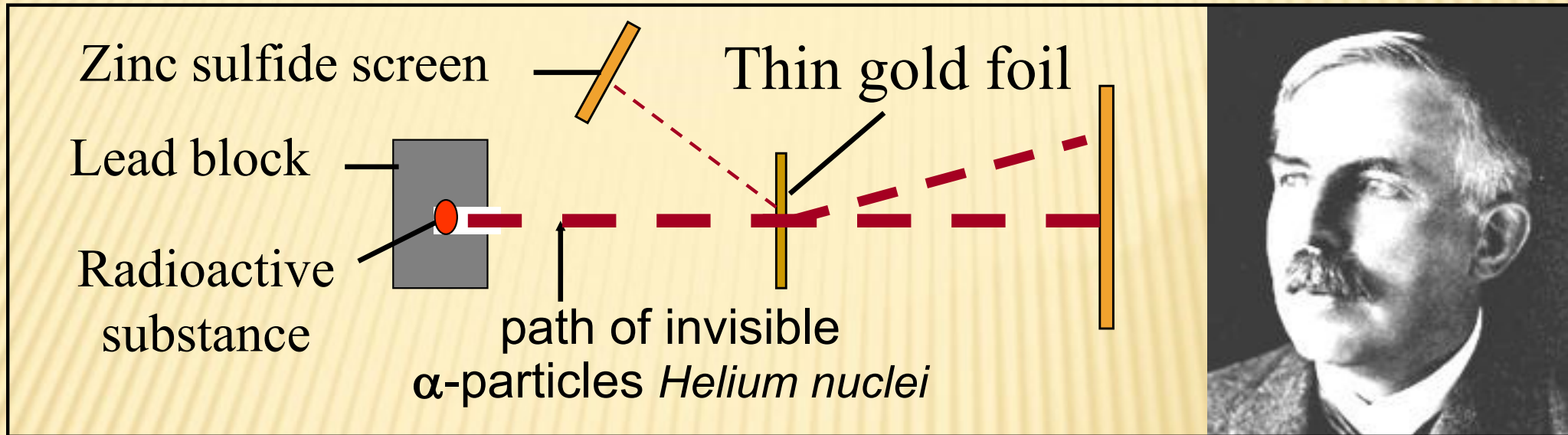


# Cathode Ray Tube (CRT)

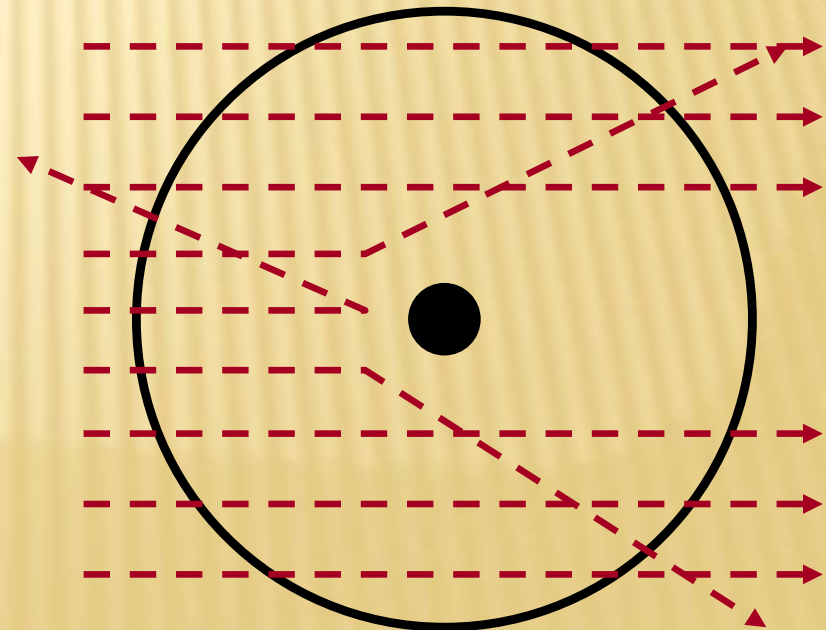
- [http://www.youtube.com/watch?v=IdTxGJjA4Jw&list=LPGSFwN1M7s3Q&index=4&feature=plcp&safety\\_mode=true&persist\\_safety\\_mode=1&safe=active](http://www.youtube.com/watch?v=IdTxGJjA4Jw&list=LPGSFwN1M7s3Q&index=4&feature=plcp&safety_mode=true&persist_safety_mode=1&safe=active)

# ERNEST RUTHERFORD

✦ Rutherford shot alpha ( $\alpha$ ) particles at gold foil.



- He thought particles would pass through and most particles did. So, atoms are mostly empty.
- But some positive  $\alpha$ -particles deflected or bounced back!
- He concluded that a “nucleus” existed, is positive and holds most of an atom’s mass.

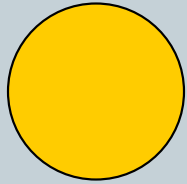


# ERNEST RUTHERFORD

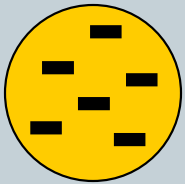
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- ✗ [http://www.youtube.com/watch?v=bSE00Ms5VNU&safety\\_mode=true&persist\\_safety\\_mode=1&safe=active](http://www.youtube.com/watch?v=bSE00Ms5VNU&safety_mode=true&persist_safety_mode=1&safe=active)  
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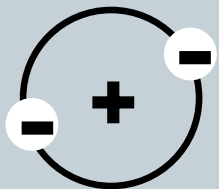
# Evolving Electrons Model



- 1) Dalton's "Billiard ball" model (1808)  
Atoms are solid and indivisible.



- 2) Thompson "Plum pudding" model  
(1904) Negative electrons in a positive framework.



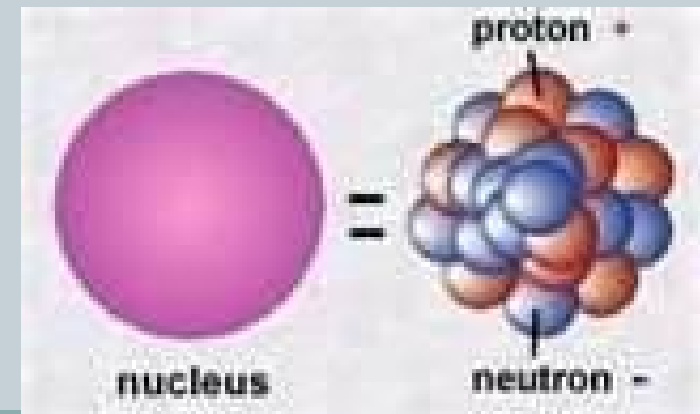
- 3) The Rutherford model (around 1911)  
Atoms are mostly empty space.  
Negative electrons orbit a positive nucleus.



# The Nucleus of an Atom

## Beryllium Experiment

- In 1932, Chadwick observed that beryllium, when exposed to bombardment by alpha particles, released an unknown radiation that in turn ejected protons from the nuclei of various substances.
- Chadwick interpreted this radiation as being composed of particles of mass approximately equal to that of the proton.
- These newly discovered particles were neutrons.



# The Atom



- The nucleus of an Atom contains **PROTONS** and **NEUTRONS**
- Protons are Positive and Neutrons are Neutral
- The **ELECTRONS** in an atom are responsible for the chemical properties of the element
- The **PROTONS** and **NEUTRONS** make up the mass of an atom and are responsible for the stability of the atom.
- The identity of an atom is determined by the number of **PROTONS**.
- Atoms of an element with different numbers of **NEUTRONS** are called **ISOTOPES**.

# Atomic numbers, Mass numbers

- There are 3 types of subatomic particles:  
Electrons ( $e^{-}$ ) Protons ( $p^{+}$ ) and Neutrons ( $n^0$ ).
- Neutrons have no charge and a mass similar to protons
- Elements are often symbolized with their **mass number** and **atomic number**

E.g. Oxygen:  $O^{16}_8$

- These values are given on the periodic table.
- For now, round the mass # to a whole number.
- These numbers tell you a lot about atoms.
  - # of protons = # of electrons = atomic number
  - # of neutrons = mass number – atomic number

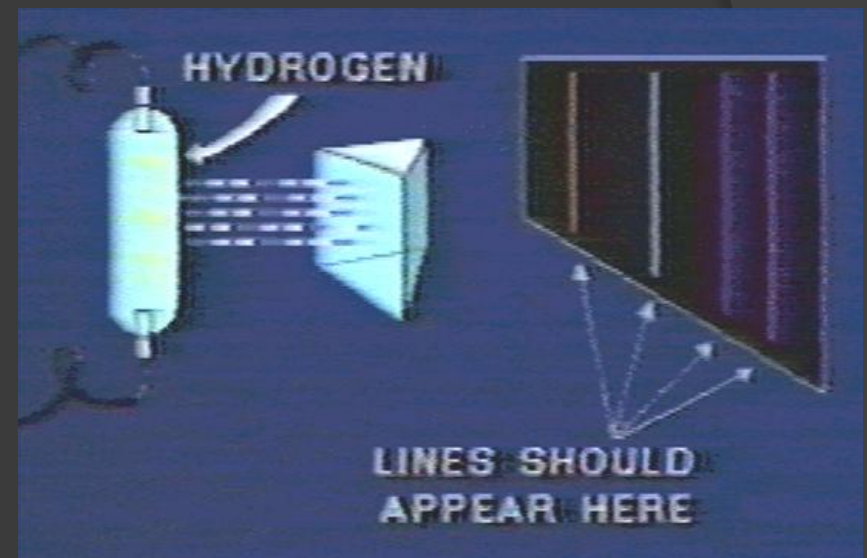
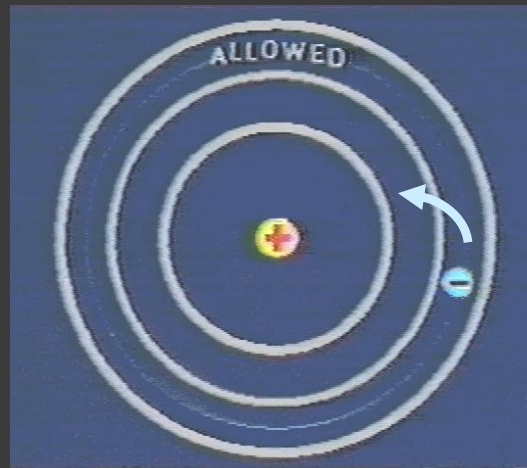
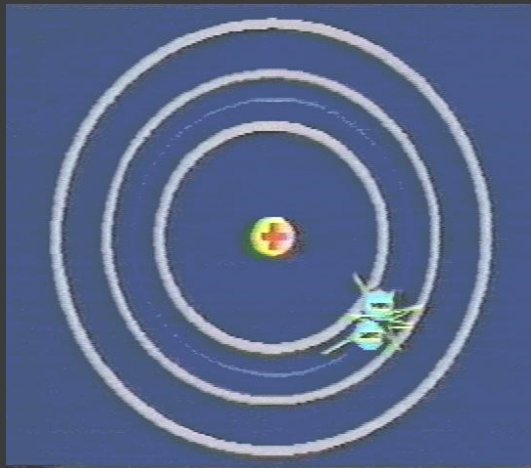
# Atomic Information

1. The **Atomic Number** of an atom  
= number of protons in the nucleus.
2. The **Atomic Mass** of an atom  
= number of Protons + Neutrons in the nucleus
3. The number of **Protons**  
= Number of **Electrons**.
4. **Electrons** orbit the nucleus in shells.
5. Each shell can only carry a set number of electrons.



# Bohr's model

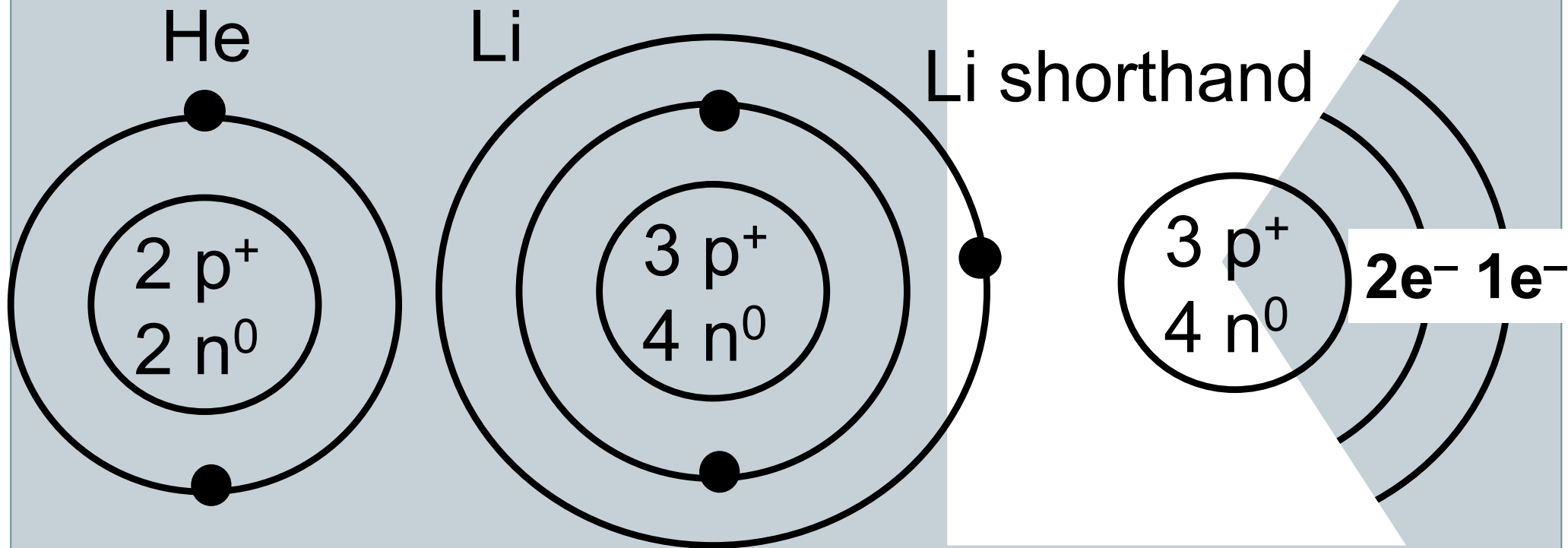
- Electrons orbit the nucleus in “shells”
- Electrons can be bumped up to a higher shell if hit by an electron or a photon of light.



There are 2 types of spectra: continuous spectra & line spectra. It's when electrons fall back down that they release a photon. These jumps down from “shell” to “shell” account for the line spectra seen in gas discharge tubes (through spectrosopes).

# Bohr - Rutherford diagrams

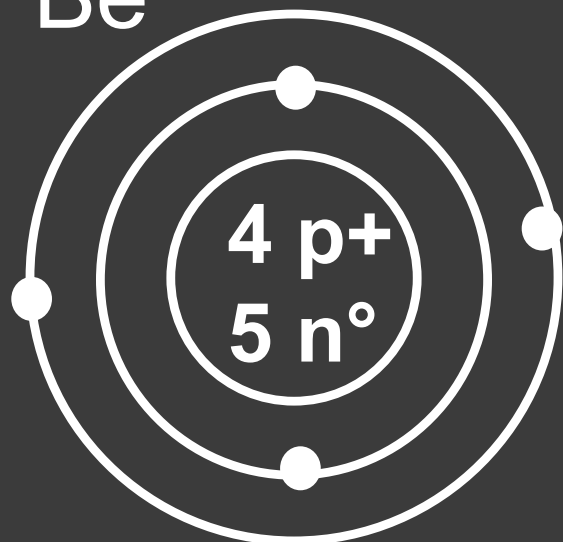
- Putting all this together, we get B-R diagrams
- To draw them you must know the # of protons, neutrons, and electrons (2,8,8,2 filling order)
- Draw protons ( $p^+$ ), ( $n^0$ ) in circle (i.e. “nucleus”)
- Draw electrons around in shells



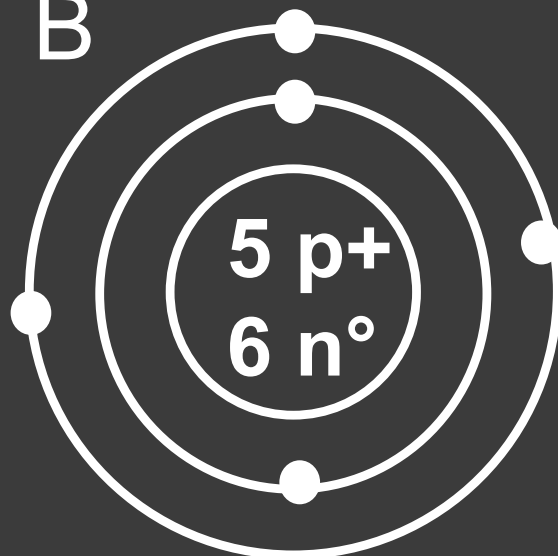
Draw Be, B, Al and shorthand diagrams for O, Na



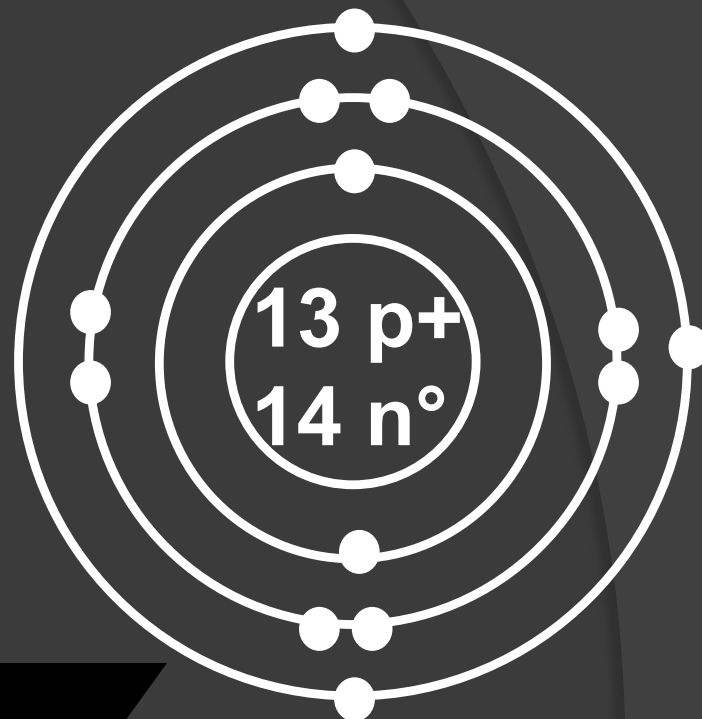
Be



B



Al



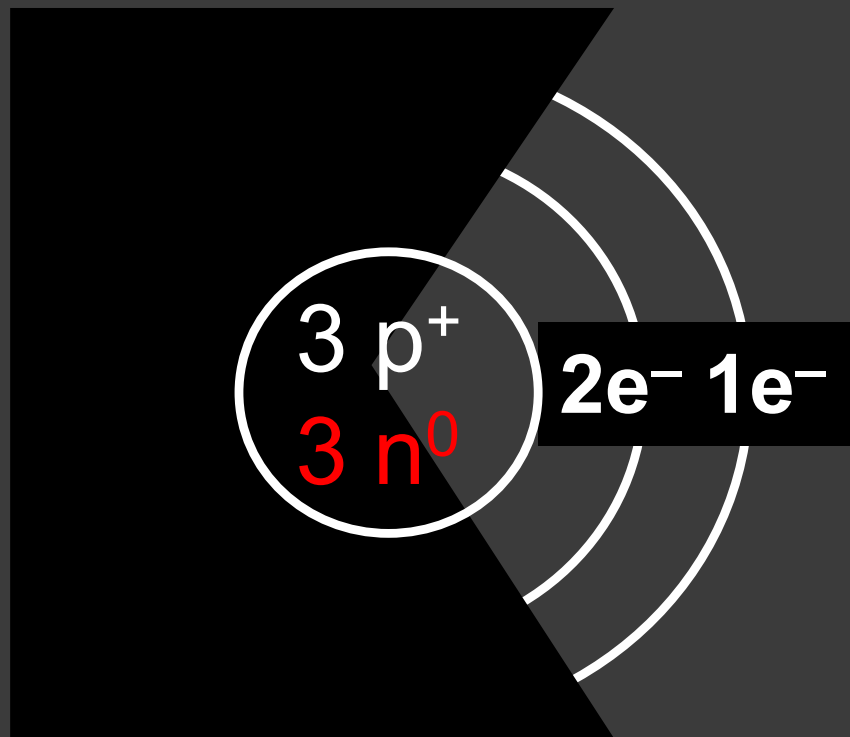
O



Na



${}^6\text{Li}$



${}^7\text{Li}$

