Atomic Development Summary

Preliminary Developments

1. Democritus – First notation of the Atom and Elements
2. Greeks – State of Matters first Identified
3. Alchemists – First Written Table of the Elements
4. Dalton – 4 Basic Principles of the Atom

Modern Developments

1. Tompson – Discovery of – particle (electron)
2. Rutherford – Discovery of the protons + nucleus
3. Chadwick – Discovery of the Neutron
4. Bohr – Discovery of the basic atomic structure (Bohr Model)
5. Heisenberg – Electron Locations are predictable

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Dalton's Principles of Atoms

First Principle of Atoms
All Matter is Made of Indivisible Atoms

Second Principle of Atoms
All Atoms of the same type have the same properties, including mass (*elements*)

Third Principle of Atoms
Compounds and Molecules are combinations of two or atoms combined together

Fourth Principle of Atoms
A *Chemical Reaction* occurs when atoms are rearranged forming new combinations

Matters Preliminary Laws

Law of Conservation of Matter
Matter is neither created or destroyed just rearranged in new ways

Law of Conservation of Mass
The physical mass of matter is constant

Law of Definite Composition
All combinations of atoms contain the same ratio (*by mass*) of all atoms that make up the matter

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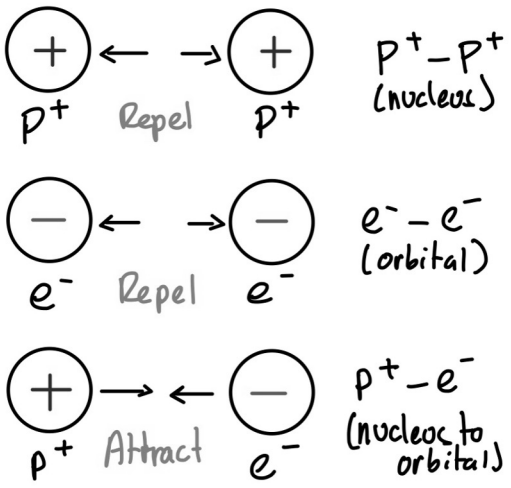
Subatomic Particles

Subatomic Particle Interaction

In the atom, subatomic particles interact based on their charges…

Proton (+): Proton (+) - Repulsion
Electron (-): Electron (-) – Repulsion
Proton (+): Electron (-) - Attraction

Attraction pulls subatomic particles towards each other, while **repulsion** pushes subatomic particles apart in the atomic structure



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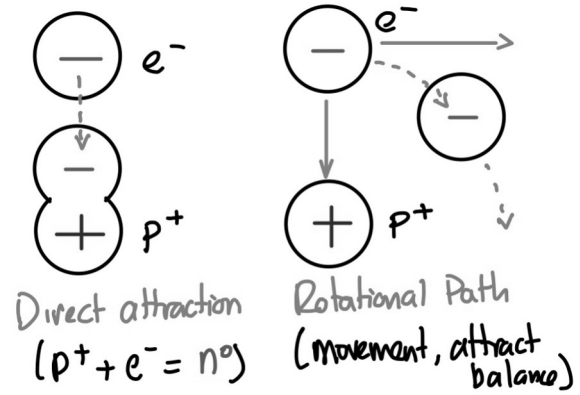
Subatomic Particles

Results of Interactions

Attracting particles will combine together when directly interacting

Proton (p^+) + Electron (e^-) = Neutron (n^o)

Within atoms, when subatomic particles attract the negative electron (e^-) will travel opposite that of the pull of the proton (p^+). This interaction leads to **circular e^- paths**



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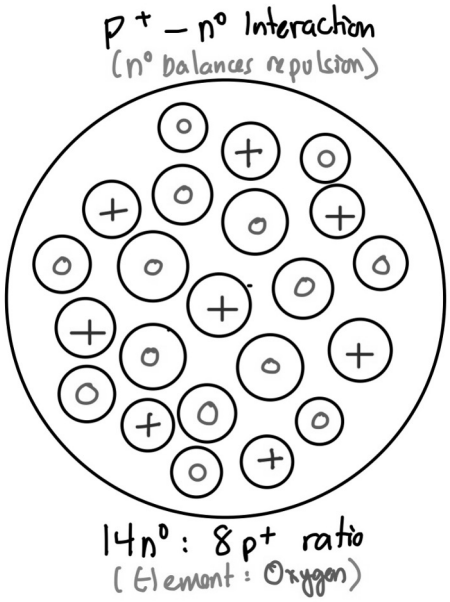
Subatomic Particles

Nucleus Interactions

The protons (p^+) within an atom repel other protons. To keep protons in the atom, neutrons (n^o) reduce the repulsion by sitting between the protons (p^+). This interaction is called *proton* (p^+) *– neutron* (n^o) *shielding*

Shielding also affects the attraction between the protons (p^+) and electrons (e^-) within the atom



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Role of Subatomic Particles

The modern atomic model contains protons, electrons, and neutrons *(+, -, and neutral*)

Protons

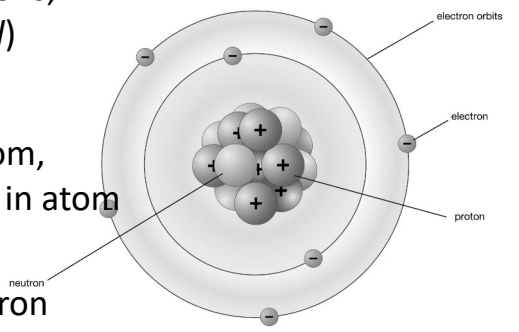
In nucleus (*center of atom*), identifies atom, provides attraction interaction holding e^- in atom

Electrons

Interactions between atoms due to electron transfer (*bonding*), absorbs extra atomic energy

Neutrons

Provides proton shielding, keep atom stable



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Atomic Stability – Z-Ratio (n^o:p^+ Ratio)

The Stability of an isotope of an atom is based on the relationship between protons (p^+) and neutrons (n^o) in an atom. Atoms with too many or too new n^o will become unstable.

Z-Ratio

Ratio between the protons (p^+) and neutrons (n^o) in the atom.

$$\text{Z-Ratio} = \frac{\#n^o\ (\textit{neutrons})}{\#p^+\ (\textit{protons})}$$

Most stable isotopes of elements have the following ratios:

Small (1 – 20): 1.0 – 1.2	Large (55 – 82): 1.4 – 1.5
Medium (1 – 54): 1.2 – 1.3	No Stable Isotopes Above 82

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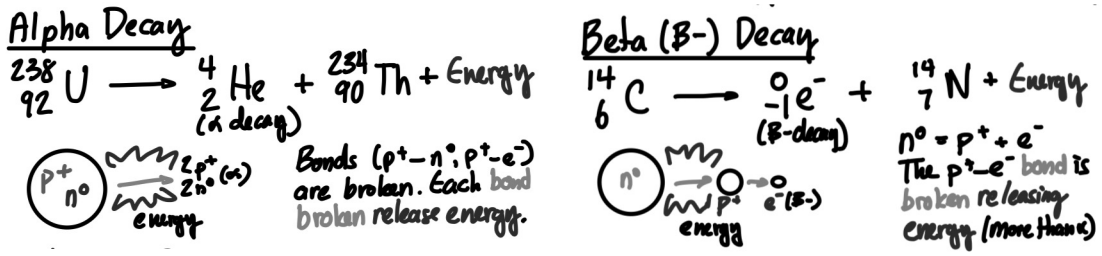
Nuclear Energy

Nuclear Energy is the *energy* (*heat or light*) produced through the decay (*breakup*) of **unstable isotopes** during the nuclear decay process.



Energy between Subatomic Particles is released with these particles decay (*break apart*). Alpha Decay break 4 subatomic particle bonds, while in Beta Decay, a neutron breaks apart into a proton and beta particle. More particle bonds broken = more energy produced.

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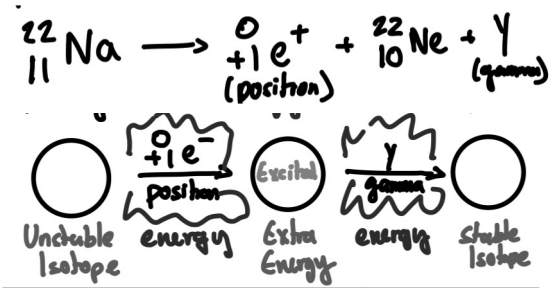
Gamma Radiation

Gamma Radiation is a byproduct of other nuclear decay processes (*such as alpha and beta decay*)

A **Gamma Ray** is a small high energy packet of light (*photon*) that is produced due to extra energy of an *excited atom*.

An *excited atom* when extra energy is added to an atom after a particle decays into a more stable isotope



The positron (e^{+}) decay above *excites* the new atom Ne-22, which then quickly releases the energy as a gamma ray particle

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Effects of Nuclear Radiation

The **energy of radiation** is based on the mass of the radiation particle and the energy of the particle itself.

Alpha Decay	**Beta Decay**	**Gamma Decay**
4 Subatomic Particles	Proton and Electron	Photon from Atom
High Energy, High Mass	Lower Energy, Low Mass	Low Energy, No Mass
Large Size	Small Size	Smallest Size
Lowest Penetration	Medium Penetration	High Penetration
Stopped by Paper	Stopped by Aluminum	Not Stopped

Penetration of nuclear decay is based on the relationship between the **particle energy** and the **size** of the particle itself.

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