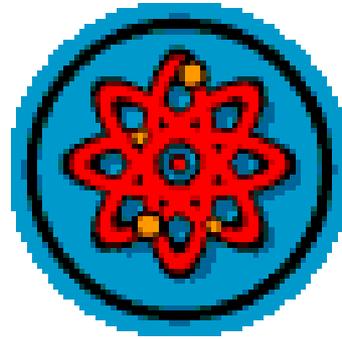


Nuclear Energy

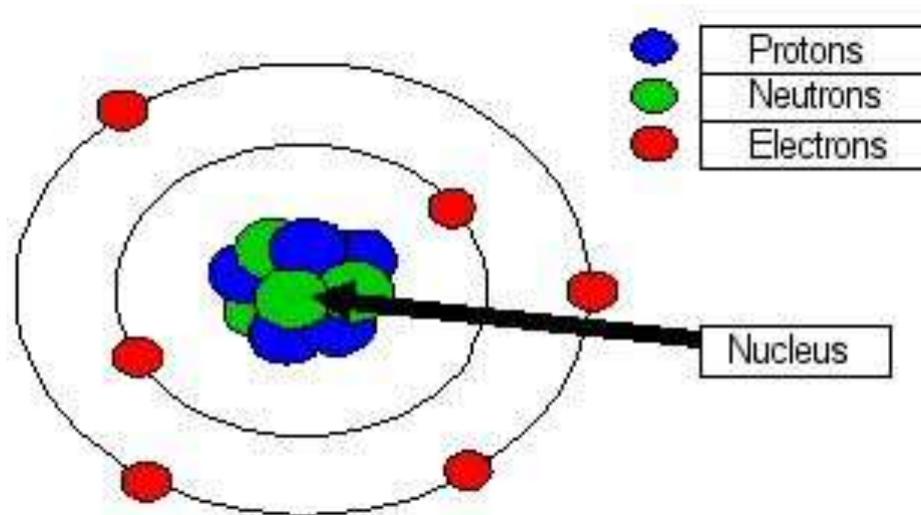


The Nuclear Structure

All matter is made up of atoms.

There are 3 particles that make up an atom

1. Positive parts (protons) are located in a tiny core in the centre of the atom.
2. Neutral parts (neutrons) are also in the core
3. Negative parts (electrons) moving quickly around the empty space surrounding the core



The number of protons and the number of electrons are represented by the **atomic number**.

The number of neutrons is calculated by
atomic mass – **atomic number**.
(Rounded)

Ex. Chlorine

$$35 - 17 = 18 \text{ neutrons}$$



An **isotope** is a form of an element having the same number of protons but a different number of neutrons.

That means for each isotope it has the same atomic number but a different atomic mass.

Chlorine has 2 isotopes

${}^{35}_{17}\text{Cl}$ has 17 protons
(35-17)=18 neutrons

${}^{37}_{17}\text{Cl}$ has 17 protons
(37-17)=20 neutrons

Hydrogen has 3 isotopes



has 1 proton
(1-1)=0 neutrons
called "protium"



has 1 proton
(2-1)=1 neutron
called "deuterium"



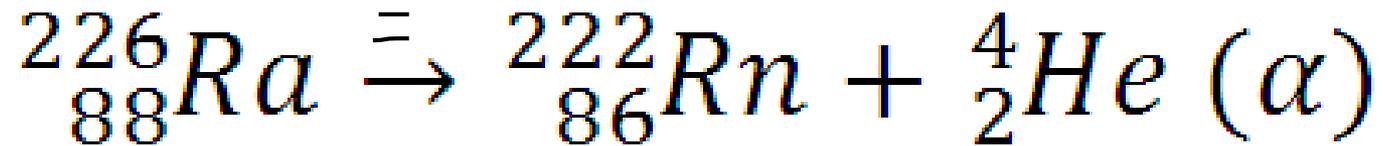
has 1 proton
(3-1)=2 neutrons
called "tritium"

- Isotopes have the **same physical** and **chemical properties**; however some isotopes can also be radioactive.
- Radioactive means that the nucleus has a tendency to split apart and release high energy particles.
- The nucleus splits because there is not enough nuclear force of attraction in the nucleus and is trying to become stable.

Alpha Decay

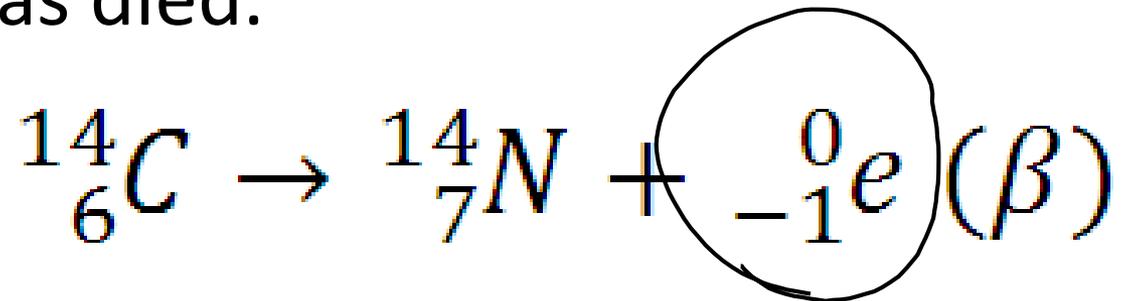
- Alpha particles (α) are the most common emission for an atom to stabilize.
- An alpha particle is the nucleus of a helium atom (2 protons, 2 neutrons)
- This form of radiation is mostly emitted by heavy elements
- Alpha particles are the least harmful of radioactive materials and can be blocked by aluminum foil.

- Alpha particles were discovered by Marie Curie in radium decay.



Beta Decay

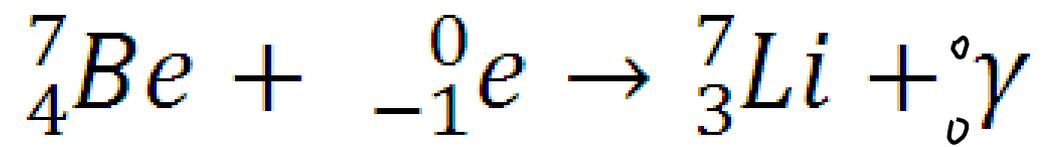
- Beta particles (β) are high energy electrons
- Beta decay usually occurs in organic matter that has died.



- Beta particles can penetrate further than an alpha particle but could be blocked by several millimeters of aluminum foil.

Gamma Decay

- Another way for a nucleus to become stable is to gain an electron.
- By adding an electron the atom becomes excited and emits a high-frequency electromagnetic wave known as a gamma ray.
- Gamma rays (γ) are high energy electromagnetic radiation that can be blocked by 30 cm of lead or 2 km of air.



Radioisotopes can be very helpful

- Counting the number of gamma rays can check for flaws in aircraft, automobiles, and ski lift cables
- Americium is used in smoke detectors
- Uranium is used to make power for Ontario
- Technetium is used to detect tumors
- Iodine is used to treat thyroid cancer
- Cobalt is used to treat cancerous growths

Radioisotopes can also be very harmful.

Radiation can damage living tissues and can alter the DNA. This can cause serious diseases, including cancer and birth defects.