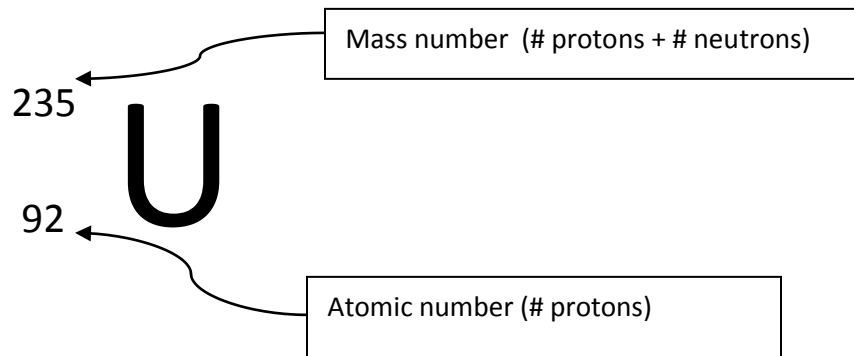


Radioactive Decay

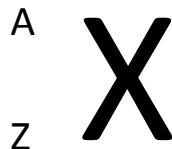
Radioactivity – a process by which the nucleus of an atom spontaneously disintegrates.

Nuclear fission – the decomposition of large, unstable nuclei into smaller, more stable nuclei.

This element is uranium



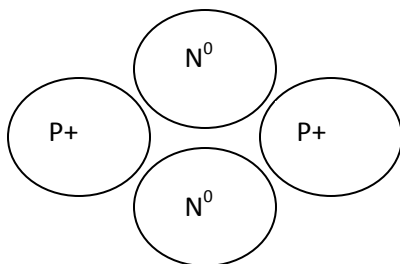
This is the **general form** of an element.



Why nuclear reactions?

Most of the chemistry you have learned so far has to do with bonding – making them and breaking them. This involves the electrons. Nuclear reactions involve changing the nucleus. This is harder to do. Usually we consider the nucleus stable.

Consider a helium nucleus.



Protons should repel from each other but they don't! Why?
There is a strong nuclear force that is attractive.

electrostatic repulsive force = strong nuclear attractive force

$$F_e = F_{sn}$$

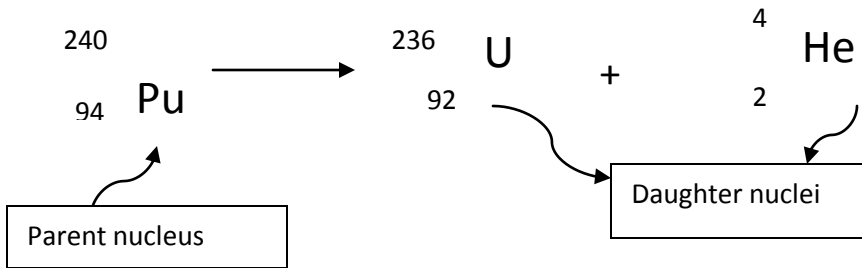
Balanced forces! And stable nucleus!

When $Z \neq Z_{\text{sn}}$, the nucleus is unstable. Then radioactive decay occurs to become stable.

Types of Radioactive Decay

1. **Alpha Decay (α)** - fairly common - emits alpha particle ($2p + 2n$)
 - speed of alpha particle slow ($0.1c$) - penetration weak (5 cm air)

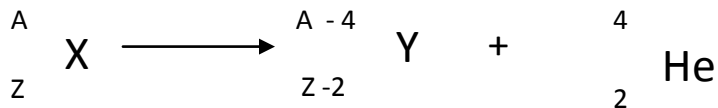
Specific Example



Transmutation = nuclear decay in which new elements are produced.

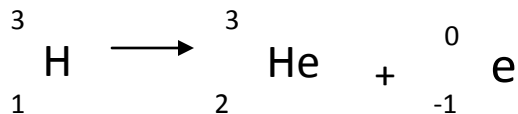
Alpha decay is a transmutation.

General equation (*put on formula sheet)

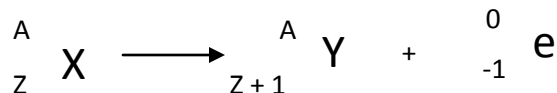


2. **Becay Negative Decay (β^-)** - emits 1 electron
 - speed of electron medium ($0.6c - 0.99c$) - medium penetration (30-50 cm air)
 - sometimes nucleus has too many neutrons so it gets rid of one. The neutron breaks into an electron which is emitted and a proton which it keeps. This is a transmutation.

Specific example



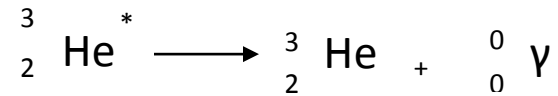
General equation (*put on formula sheet)



- 3. Gamma Decay (γ)** - speed of emission fast! (c) - high penetration (2km air)
 - used to treat cancer tumours.

Sometimes daughter nuclei are in an excited state (*). The nucleus therefore emits energy to return to its stable energy level. This energy is released as gamma radiation. (EMR) The packet of energy is called a 'photon'.

Specific example.



General example (*put on formula sheet)

