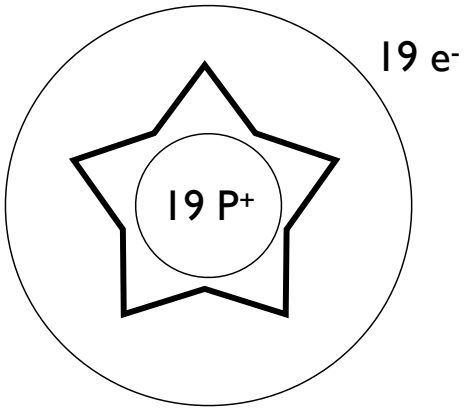
Nuclear Decay and Radioactivity

The "Problem" of the Nucleus

Strong Nuclear Force - the force of attraction that holds the nucleus together against the repulsion of the protons



$E = mc^2$

Fission, Fusion & Decay

Overview

- 2 types of nuclear changes
  - High Energy
    - Fission
    - Fusion
  - Low Energy
    - Radioactive Decay
      - Alpha
      - Beta
      - Gamma

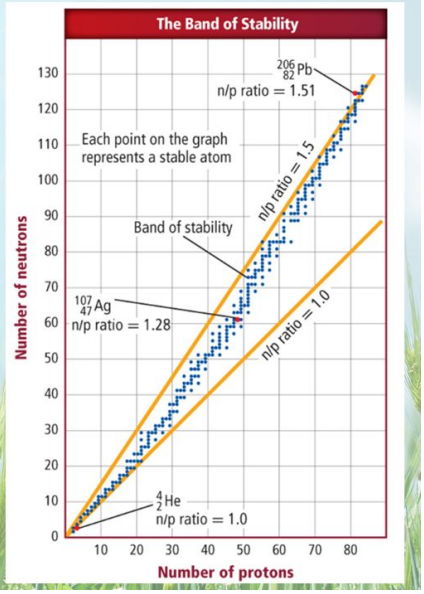
Fission, Fusion & Decay

Low Energy Nuclear Changes - Radioactive Decay Processes

- Decay - break down
- Unstable nuclei undergo radioactive decay to become stable

Nuclear Stability

The *Band of Stability* is the area on the graph where all stable nuclei fall. Anything outside of this band is considered radioactive and will decay to achieve stability.



Fission, Fusion & Decay

Low Energy Nuclear Changes - Radioactive Decay Processes

- Alpha decay (α or $^{4}_{2}He$)
  - Involves the release of a helium nucleus
    - 2 protons and 2 neutrons
  - Big, slow, and low energy
  - ROT - Z decreases by 2 / A decreases by 4
- What happens to Radium-226 when it experiences alpha decay?

$$^{226}_{88}Ra \Rightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$$

88 P^+ 138 N^0 | 86 P^+ 136 N^0 | 2 P^+ 2 N^0

Fission, Fusion & Decay

Low Energy Nuclear Changes - Radioactive Decay Processes

- Beta decay (β or $_{-1}e$)
  - Electron originating in the nucleus when a neutron becomes a proton
  - Small, high energy
  - ROT - Z increases by 1 / A remains constant
- What happens to Iodine-127 when it undergoes beta decay?

$$^{127}_{53}I \Rightarrow {}^{127}_{54}Xe + {}_{-1}e$$

53 P^+ 74 N^0 | 54 P^+ 73 N^0 | electron

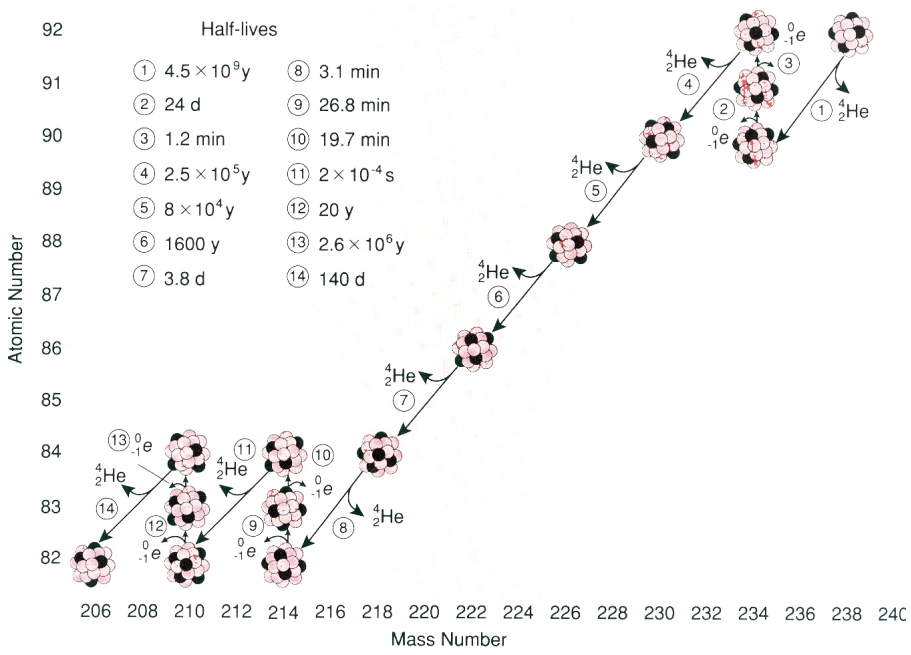
Fission, Fusion & Decay

Low Energy Nuclear Changes - Radioactive Decay Processes

- Gamma decay (γ)
  - Not a particle, just energy
  - High energy waves similar to light
  - Doesn't change Z or A

Half Life

Half Life & Radioactive Decay



Fission, Fusion & Decay

Low Energy Nuclear Changes - Radioactive Decay Processes

	Type
$^{131}_{54}Xe \Rightarrow {}^{131}_{55}Cs + {}^{}_{-1}e$	beta (β)
$^{209}_{84}Po \Rightarrow {}^{4}_{2}He + {}^{205}_{82}Pb$	alpha (α)
$^{238}_{92}U \Rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$	alpha (α)

Fission, Fusion & Decay

Decay Processes

Alpha decay of Radon-222

$$^{222}_{86}Rn \Rightarrow {}^{4}_{2}He + {}^{218}_{84}Po$$

Beta decay of Bismuth-214

$$^{214}_{83}Bi \Rightarrow {}^{}_{-1}e + {}^{214}_{84}Po$$