NUCLEAR REACTIONS

Radioactive Decay

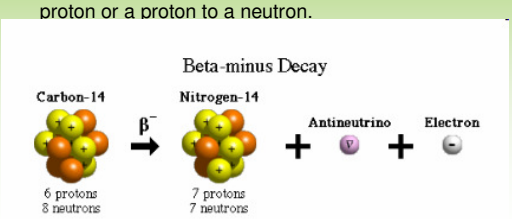
- **Alpha Decay**
  - **Alpha decay** is a type of radioactive decay in which an atomic nucleus emits an alpha particle (two protons and two neutrons) and thereby transforms (or 'decays') into an atom with a mass number 4 less and atomic number 2 less.

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

Alpha Particle

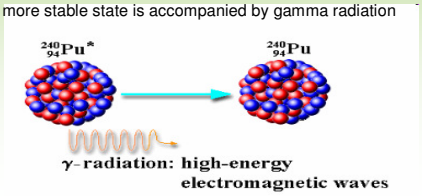
Radioactive Decay

- **Beta Decay** Beta Decay ???
  - Beta decay occurs when an unstable atom converts to a more stable state by changing a neutron to a proton or a proton to a neutron.



Radioactive Decay

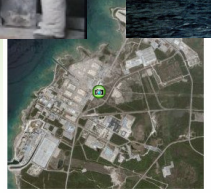
- **Gamma Radiation**
  - Gamma radiation is high energy electromagnetic radiation. Since gamma radiation has neither mass, nor charge, it is represented as "y".
  - When nuclei undergo radioactive decay, they are left at an unstable, high-energy state. The "relaxation" of the nucleus to a more stable state is accompanied by gamma radiation



Radiation Poisoning

- Radioactive waste from nuclear reactions can lead to health problems. For example, ions of the radioactive isotope strontium-90, an alkali metal, exhibit chemical behavior similar to calcium ions. This leads to incorporation of ions into bone tissue, sending ionizing radiation into the bone marrow, possible causing leukemia.

Nuclear Fission and Fusion



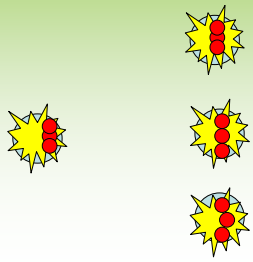
Nuclear Fission and Fusion

- **Nuclear Fission**
  - Nuclear fission occurs when a highly unstable isotope splits into smaller particles. Nuclear fission usually has to be induced in a particle accelerator.

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{87}_{35}Br + ^{146}_{57}La + 3^{1}_{0}n$$

Nuclear Fission and Fusion

- **Nuclear Fission (A Chain Reaction)**

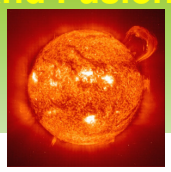


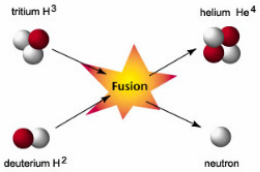
Nuclear Fission and Fusion

- **Nuclear Fission**
  - You can control a fission reaction in a laboratory setting by limiting the number of collisions with various controls. However, if you allow the reaction to proceed uncontrolled …

Nuclear Fission and Fusion

- **Nuclear Fusion**
  - Nuclear fusion occurs when a target nucleus absorbs an accelerated particle. The reaction that takes place inside the Sun, or in a hydrogen bomb is a fusion reaction. Fusion reactions require extremely high temperatures but produce an enormous amount of energy.





Nuclear Fission and Fusion

- Nuclear Fusion
  - Unfortunately, to date, we have not yet been able to harness the energy in a fusion reaction to produce a huge amount of clean energy. However, there is hope to accomplishing this goal in the near future …

```
ERROR: undefined
OFFENDING COMMAND: =frF*

STACK:
```