Nuclear Terms

The atom: Nucleons (Protons, Neutrons) Electrons

	Protons	Neutrons	Electrons
charge	+	N	−
location	in nucleus	in nucleus	orbit nucleus
mass (kg)	$1.672\,622 \times 10^{-27}$	$1.674\,927 \times 10^{-27}$	$9.109\,383 \times 10^{-31}$
(u)	1.007	1.008	~0

Atomic mass unit → $\frac{1}{12}$ of the mass of a C-12 atom

Atomic Number, Z → # of protons → tells us what element

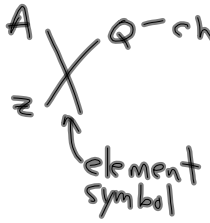
Mass Number, A → p + n (# of nucleons) → tells us what isotope it is (# of neutrons)

Isotopes

examples → C-12 p=6, n=6
C-14 p=6, n=8

H-1 (protium) → H_2O 8 n, 10 p
H-2 (deuterium)
H-3 (tritium) → 10 n, 10 p

Standard Atomic Notation:



$^{12}_{6}C$

Isotopes & Nuclear Energy / Stability

Strong nuclear force keeps nucleus intact.

Gravity keep mass on Earth "intact"

- ↓ E ↓ ∴ more stable } Also true for nuclear energy

When a nucleus goes from one isotope to a more stable isotope it undergoes nuclear decay (nuclear fission) or nuclear fusion.

The difference in nuclear energy is given off as kinetic energy of the "daughter" particle or light.

Types of Nuclear Decay

1) Alpha decay

α - particle $\rightarrow {}_{2}^{4}He^{+2}$

General equation:

$${}_{Z}^{A}X \longrightarrow {}_{2}^{4}He + {}_{Z-2}^{A-4}A$$

$${}_{92}^{235}U \longrightarrow {}_{2}^{4}He + {}_{90}^{231}Th$$

2) Beta decay (2 types)

β^- → electron β^+ → positron

$${}_{Z}^{A}X \longrightarrow {}_{-1}^{0}e^{-} + {}_{Z+1}^{A}A + \bar{\nu}$$

$${}_{6}^{14}C \longrightarrow {}_{-1}^{0}e^{-} + {}_{7}^{14}N + \bar{\nu}$$

$${}_{Z}^{A}X \longrightarrow {}_{1}^{0}e^{+} + {}_{Z-1}^{A}A + \nu$$

$${}_{11}^{22}Na \longrightarrow {}_{1}^{0}e^{+} + {}_{10}^{22}Ne + \nu$$

3) Gamma decay

γ-ray $\Rightarrow$ light beam

$$ {}^{A}_{Z}X \rightarrow {}^{0}_{0}\gamma + {}^{A}_{Z}X^{*} $$

$$ {}^{7}_{4}Be \rightarrow {}^{0}_{0}\gamma + {}^{7}_{4}Be^{*} $$