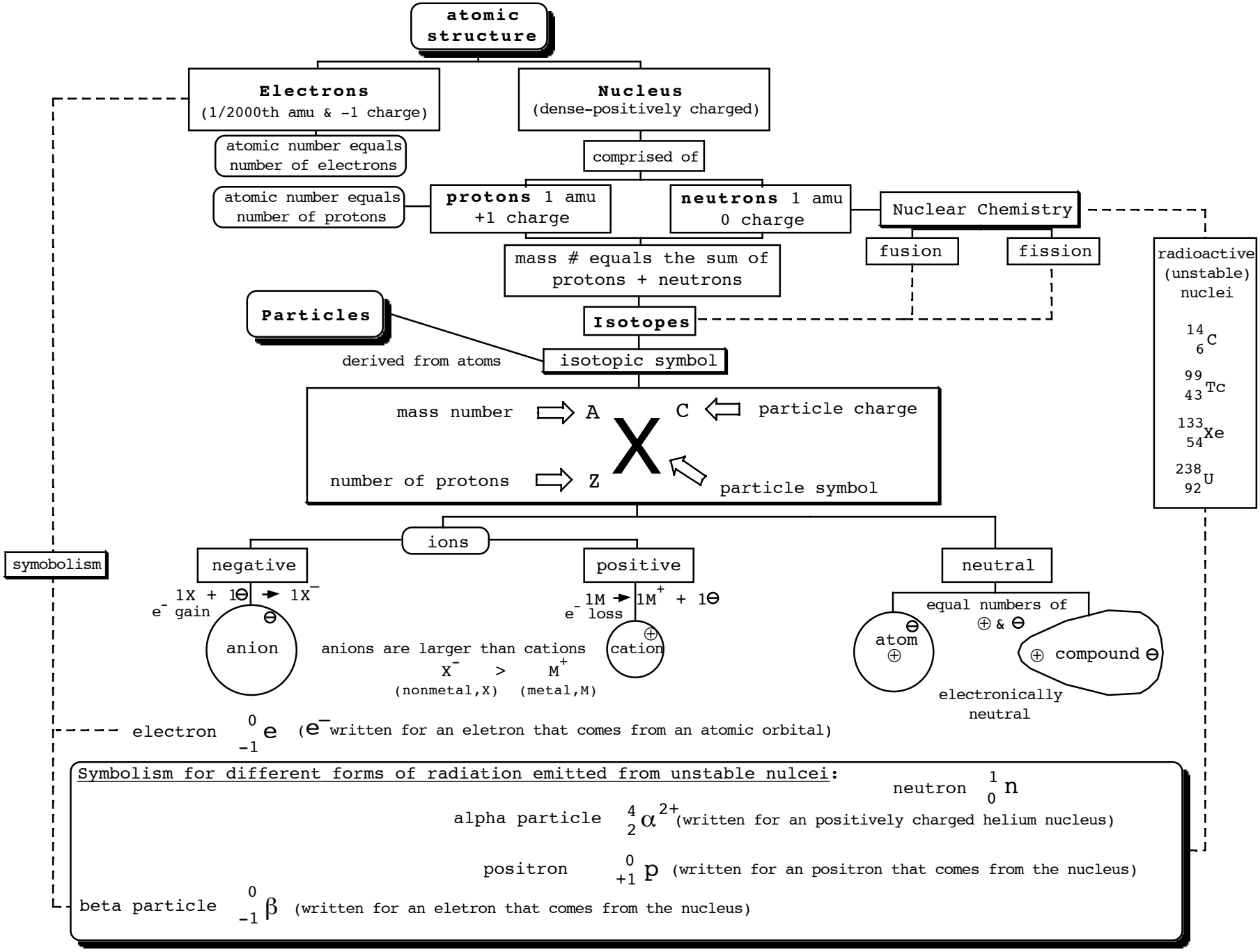

NUCLEAR CHEMISTRY

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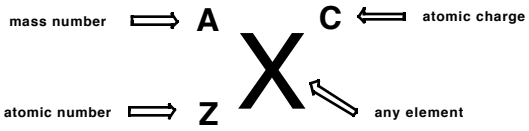

Number of protons = Z Number of neutrons = A - Z

3 Types of Radiation

Name and Symbol	Identity	Charge	Mass (amu)	Penetration
Alpha (α)	Helium nucleus	2+	4	Low
Beta (β)	Electron	1-	1/1820	Medium
Gamma (γ)	Radiant energy	0	0	High

Characteristics of Radioactive Isotopes

Binding energy - the energy that holds the protons, neutrons, and other particles together in the nucleus.

List the four factors responsible for nuclear stability

1. Nuclear stability correlates with the ratio of neutrons to protons in the isotope. A ratio of 1:1 is preferred
2. Nuclei with large numbers of protons (Z = 84 or greater) tend to be unstable.
3. Isotopes containing the "magic numbers" 2, 8, 20, 50, 82 or 126 protons or neutrons are stable.
4. Isotopes with even numbers of protons or neutrons are generally more stable than those with odd numbers.

The following hypothetical nuclear reactions are correctly balanced:

$$^{210}_{84}Po \longrightarrow {}^{4}_{2}\alpha + {}^{206}_{82}Pb$$

$$^{222}_{86}Rn \longrightarrow {}^{4}_{2}\alpha + {}^{218}_{84}Po$$

$$^{40}_{20}Ca \longrightarrow {}^{0}_{-1}\beta + {}^{40}_{21}Sc$$

$$^{238}_{92}U \longrightarrow {}^{0}_{-1}\beta + {}^{238}_{93}Np$$

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

$$^{247}_{97}Bk \longrightarrow {}^{4}_{2}\alpha + {}^{243}_{95}Am$$

Balance these Nuclear Reactions

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α (alpha) decay

$$^{241}_{95}\mathrm{Am} \longrightarrow \square + {}^{4}_{2}\mathrm{He}$$

americium-241

fill in missing isotope

(click here for answers)

β (beta) decay

$$^{60}_{27}\mathrm{Co} \longrightarrow \square + {}^{0}_{-1}\beta$$

cobalt-60

fill in missing isotope

$$^{14}_{6}\mathrm{C} \xrightarrow[5730\ \mathrm{yrs}]{t_{1/2}} \square + {}^{0}_{-1}\mathrm{e}$$

carbon-14

fill in missing isotope

γ (gammma) emission, diagnostics

$$^{99m}_{43}\mathrm{Tc} \longrightarrow \square + {}^{0}_{0}\gamma$$

technecium-99m metastable

fill in missing isotope

carbon-14 synthesis in our atmosphere

$$^{14}_{7}\mathrm{N} + {}^{1}_{0}\mathrm{n} \longrightarrow \square + {}^{1}_{1}\mathrm{H}$$

nitrogen-14 cosmic ray

fill in missing isotope

tritium synthesis in the laboratory

$$^{6}_{3}\mathrm{Li} + {}^{1}_{0}\mathrm{n} \longrightarrow \square + {}^{3}_{1}\mathrm{H}$$

lithium-6 cosmic ray

fill in missing isotope

tritium (hydrogen-3)

Nuclear Reactions
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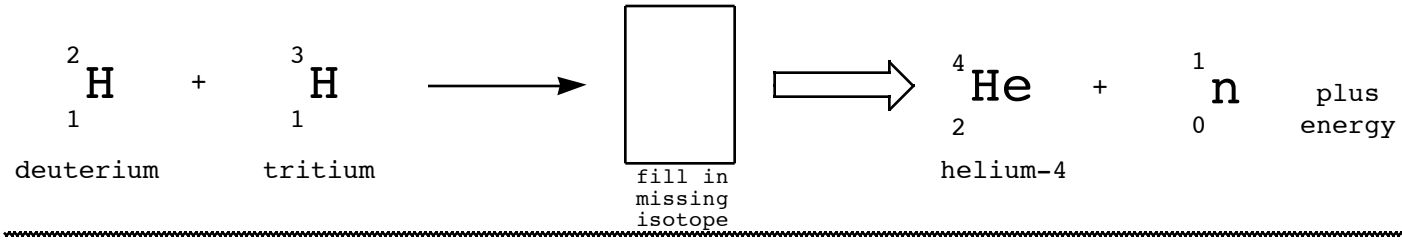
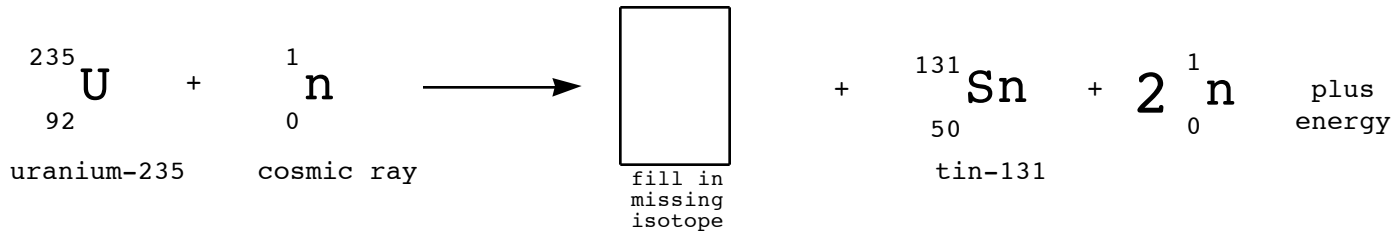
Fusion Nuclear D-T Reaction, General Atomics in Sorrento Valley San Diego



Fission Nuclear, San Onofre Reaction



Nuclear Reactions
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α (alpha) decay

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americium-241

fill in missing isotope

β (beta) decay

$$^{60}_{27}\mathrm{Co} \longrightarrow \boxed{^{60}_{28}\mathrm{Ni}} + {}^{0}_{-1}\beta$$

cobalt-60

fill in missing isotope

$$^{14}_{6}\mathrm{C} \xrightarrow[5730\ \mathrm{yrs}]{t_{1/2}} \boxed{^{14}_{7}\mathrm{N}} + {}^{0}_{-1}\mathrm{e}$$

carbon-14

fill in missing isotope

γ (gamma) emission, diagnostics

$$^{99m}_{43}\mathrm{Tc} \longrightarrow \boxed{^{99}_{43}\mathrm{Tc}} + {}^{0}_{0}\gamma$$

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lithium-6 cosmic ray

fill in missing isotope

tritium (hydrogen-3)

Nuclear Reactions
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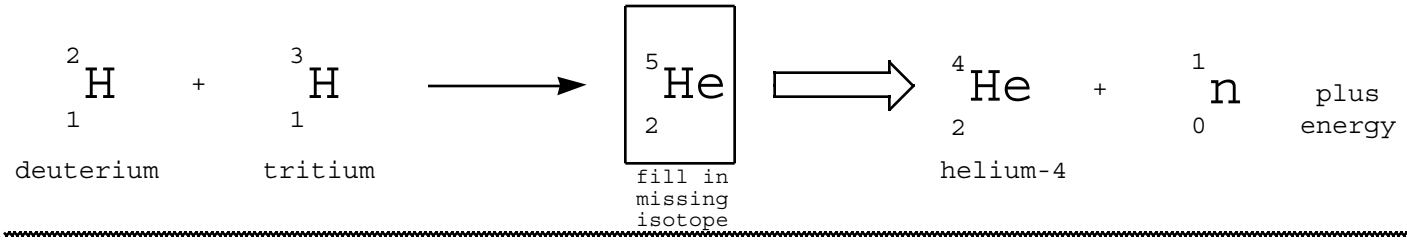
Fusion Nuclear D-T Reaction, General Atomics Sorrento Valley San Diego



Fission Nuclear San Onofre Reaction