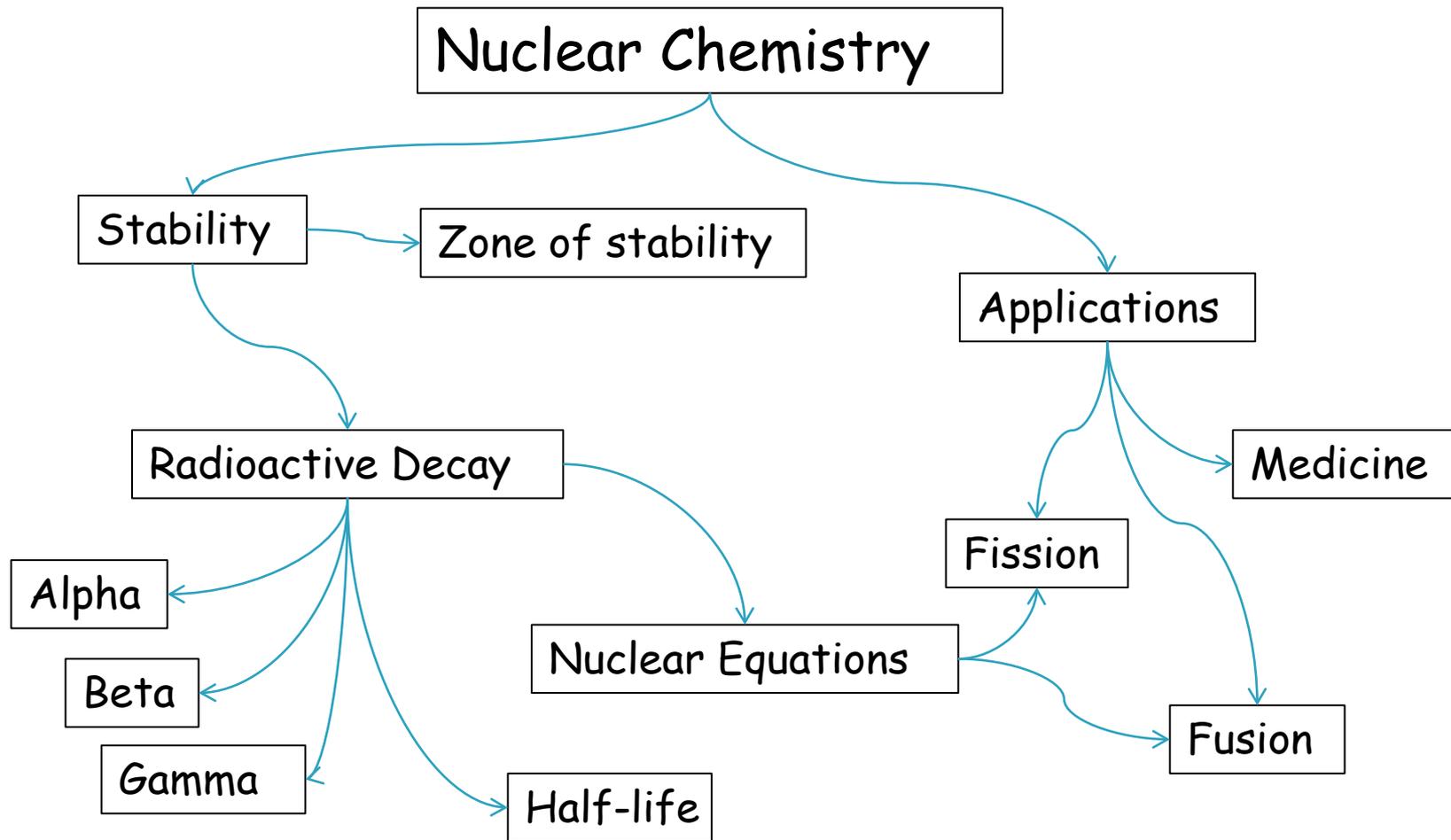
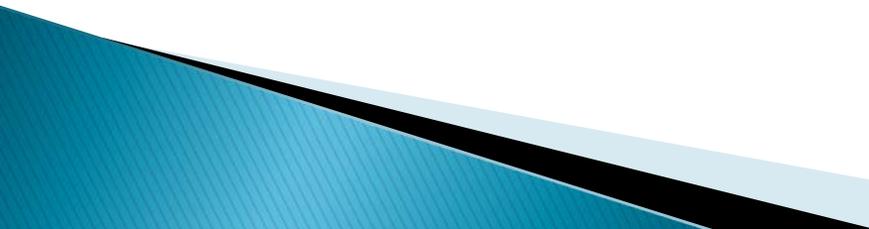


Nuclear Chemistry

Emissions in Nuclear Decay
Balancing Nuclear Equations



Total Radiation Exposure

- ▶ How does your total radiation exposure compare to the average exposure (360 mrems per year)?
 - ▶ What human-made sources of ionizing radiation and what natural sources of ionizing radiation were you exposed to?
 - ▶ Which source was the largest part of your exposure?
 - ▶ Why does elevation affect your exposure to ionizing radiation?
- 

Unstable Nuclei

- ▶ Most atoms have stable nuclei.
 - ▶ All elements with atomic number ≥ 84 are unstable.
 - ▶ Unstable nuclei (i.e., “radioactive” nuclei) undergo spontaneous change, giving off energy or particles when they change.
- 

Nuclear Reactions

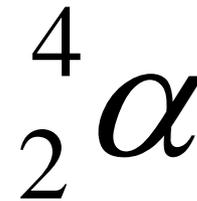
Transmutation

- nucleus of one element is transformed into nucleus of different element
 - Aka radioactive decay or nuclear decay
 - Nuclear reactions affect the nucleus of an atom
 - May occur naturally or be initiated artificially

Emissions in Nuclear Decay

▶ Alpha particles

- 2 protons, 2 neutrons—a helium nucleus
- +2 nuclear charge
- Discovered by Rutherford



Emissions in Nuclear Decay

- ▶ Alpha particles
 - Cannot penetrate skin; dangerous if ingested
 - Can be stopped by a piece of paper

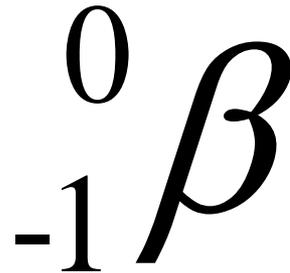


Emissions in nuclear decay

Beta particles

- Discovered by Rutherford
 - An electron emitted from the nucleus
 - -1 charge

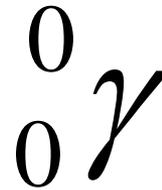
- Fast moving, can penetrate into skin
- Can be stopped by lead or glass



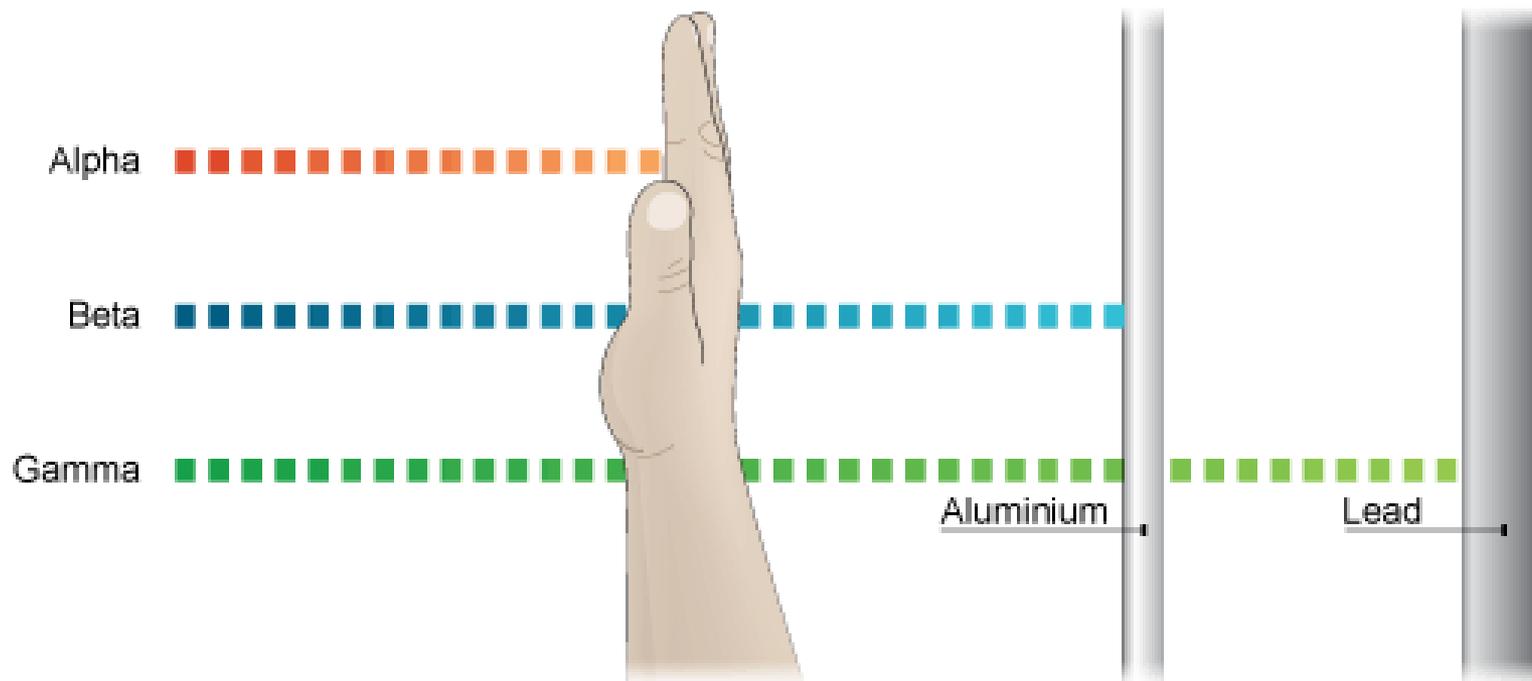
Emissions in nuclear decay

Gamma rays

- High energy electromagnetic waves emitted from nucleus
- No mass, no charge
- Very penetrating; may not be stopped by several feet of concrete



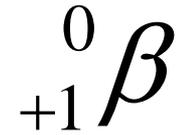
Penetrating Power



More Nuclear Particles

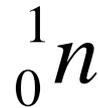
▶ Positrons

- Mass of electron, positive charge



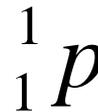
▶ Neutrons

- 1 amu, no charge

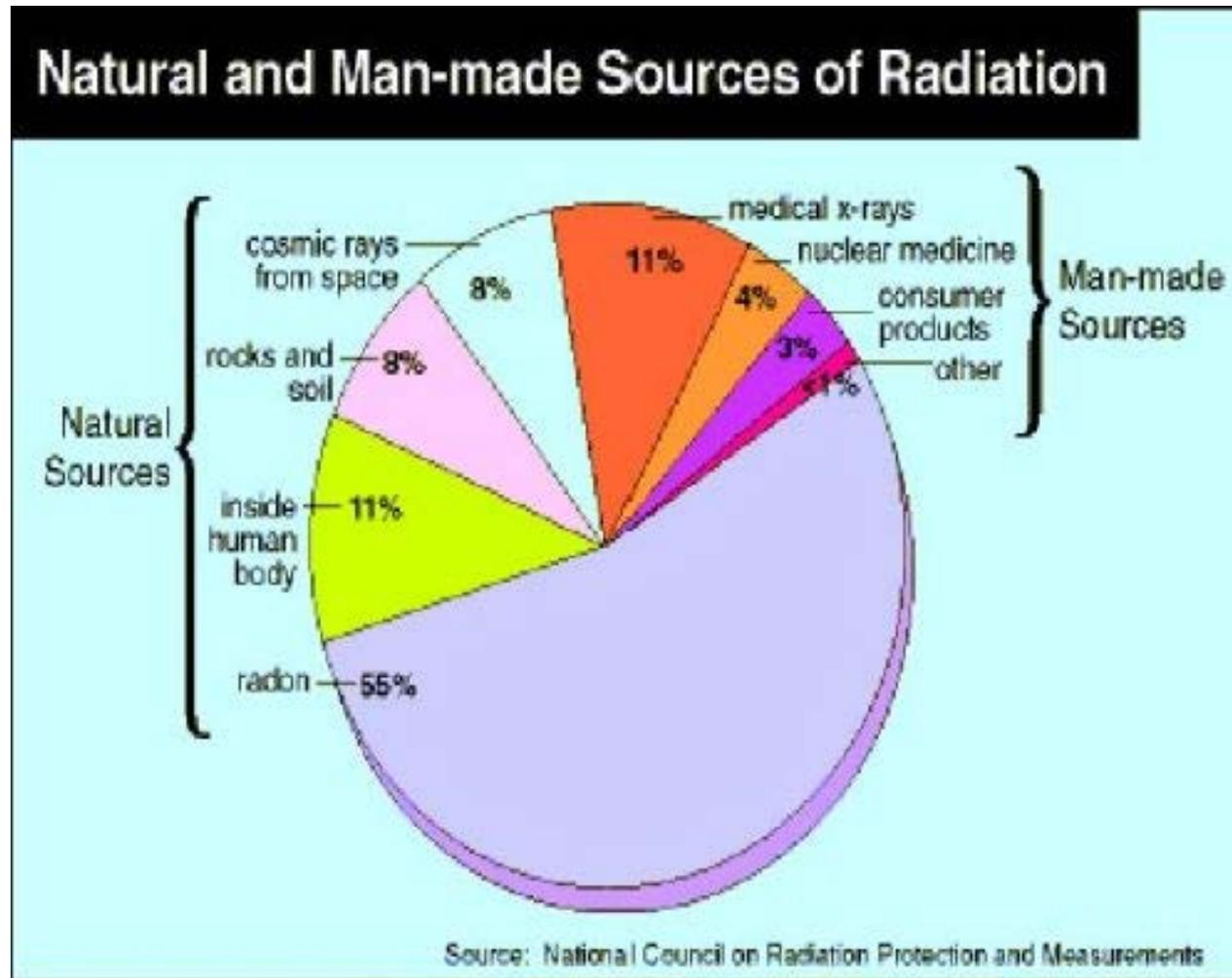


▶ Protons

- 1 amu, +1 charge



Sources of Exposure



What Happens When Radiation Impacts Human Body?

Exposure (rem)	Health Effect	Time to Onset (without treatment)
5-10	Changes in blood chemistry	Within hours
50	Nausea	Within hours
55	Fatigue	Within hours
70	Vomiting	Within hours
75	Hair loss	2-3 weeks
90	Diarrhoea	
100	Haemorrhage	
400	Possible death	Within 2 months
1,000	Destruction of intestinal lining internal bleeding and death	1-2 weeks
2,000	Damage to central nervous system loss of consciousness; and death	Minutes Hours to days

Source: US EPA

Videos

- ▶ [Nuclear Reactor Meltdown](#)
 - ▶ [Nuclear Blast Footage](#)
 - ▶ [Plutonium](#)
- 