Jumpstart #14

How many atoms of each element in the compound? Try your best! You can figure this out!

1) H_2O → **How many Hydrogens? How many Oxygens?**

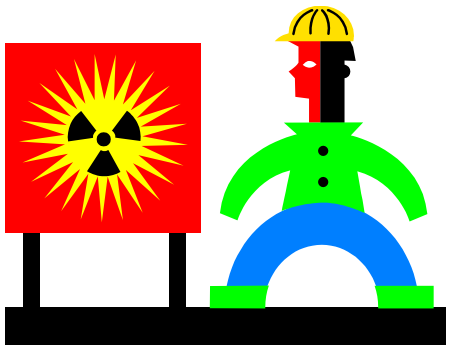
2) $2Al_2S_3$ → **How many Aluminums? How many Sulfurs?**

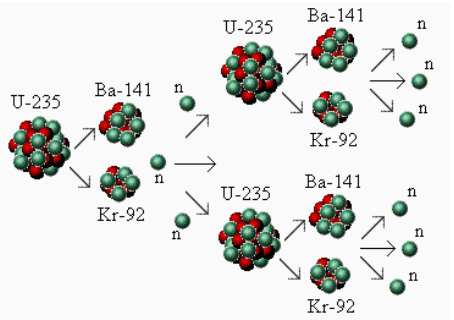
3) $3Mg_2(SO_4)_2$ → **How many Mg? How many S? How many O?**

Nuclear Chemistry!

Nuclear Fission

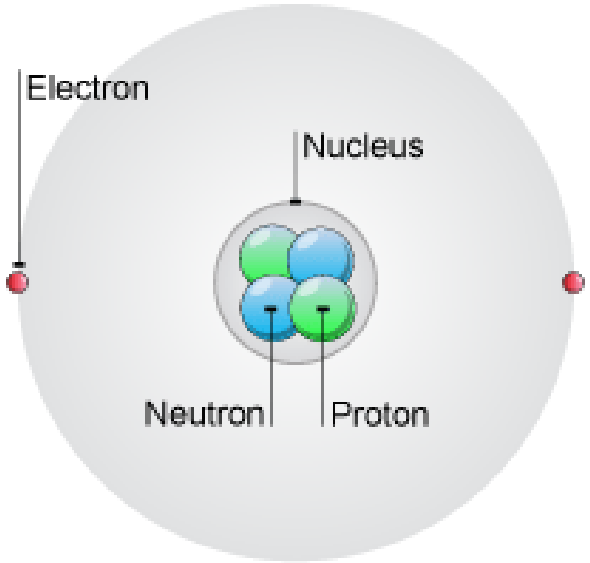
- Carbon-14 Dating
- Atomic Fission (the bomb, nuclear power)
- Radon
- Chain Reactions





Background

Protons → in the nucleus , +1 charge
Neutrons → in the nucleus, no charge
Electrons → outside of the nucleus, -1 charge



Mass # (p+n) → A

Atomic # (p) → Z

Sy

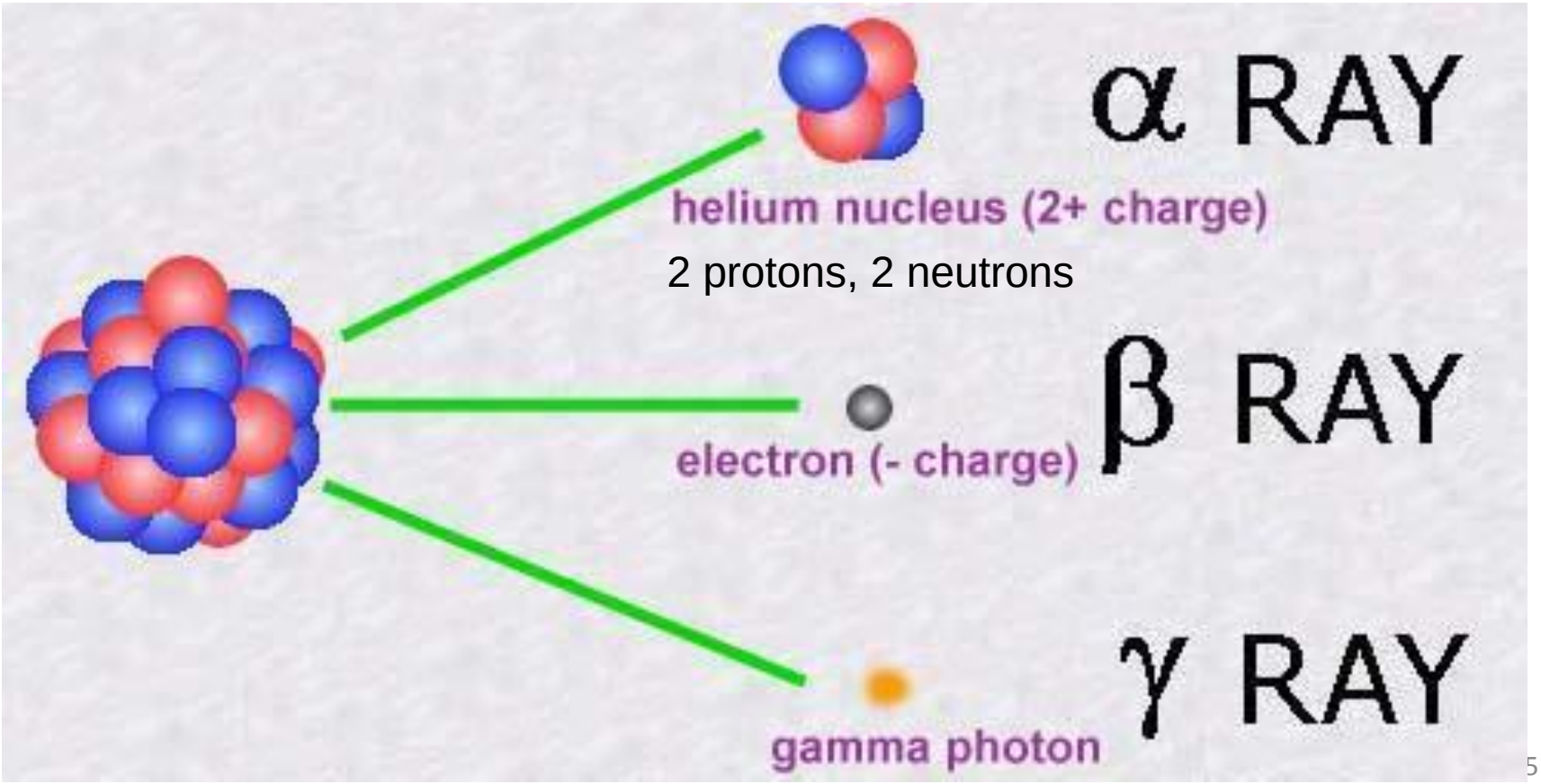
Strong Force

- Normally particles with similar forces (both + or both -) would repel each other
  - So why doesn't the nucleus totally fly apart from protons repelling each other?!
    - Strong Force

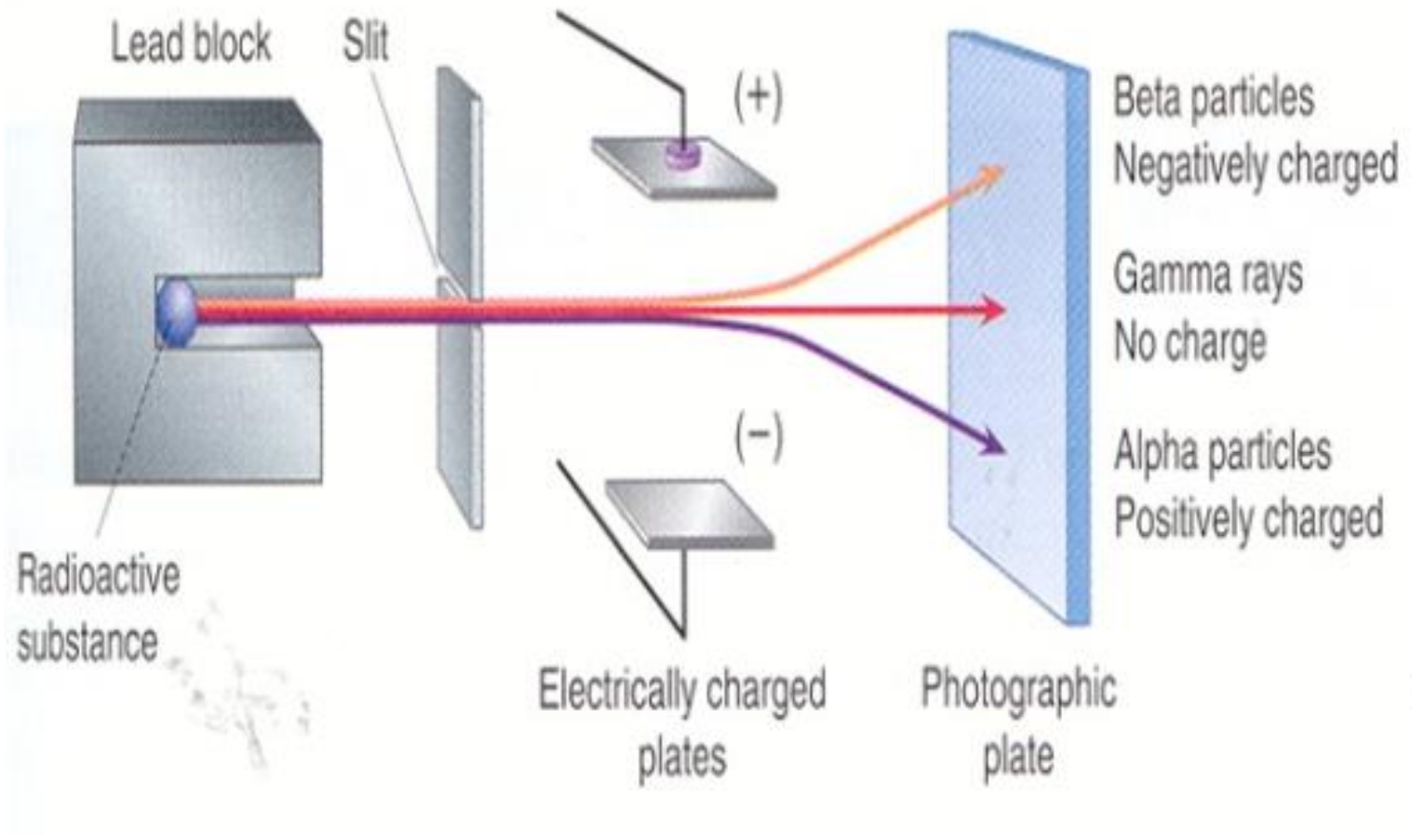
- Sometimes there are too many neutrons, and it makes the atom unstable

Radiation

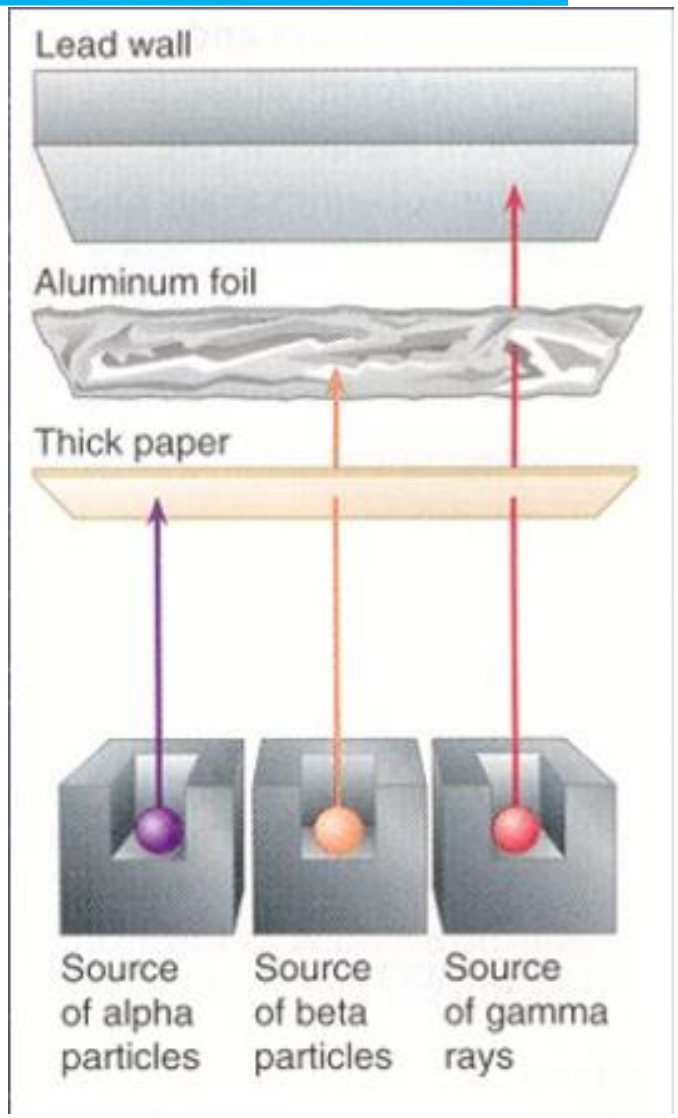
- **Radiation comes from the nucleus of an atom.**
- **Unstable nucleus emits (spits out) a particle or energy**

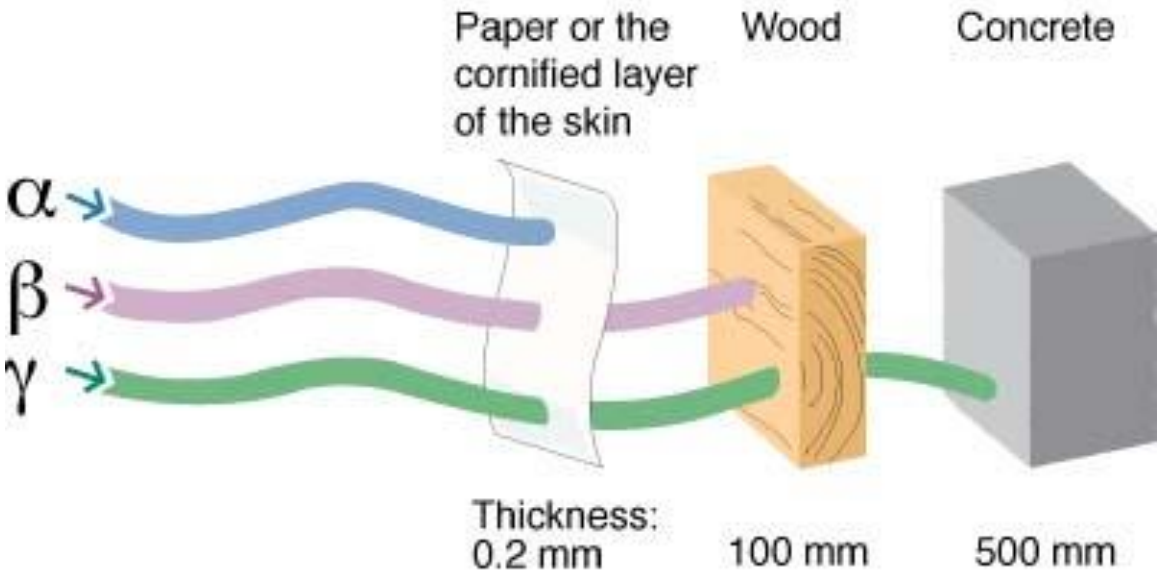


Charge of Nuclear Particles



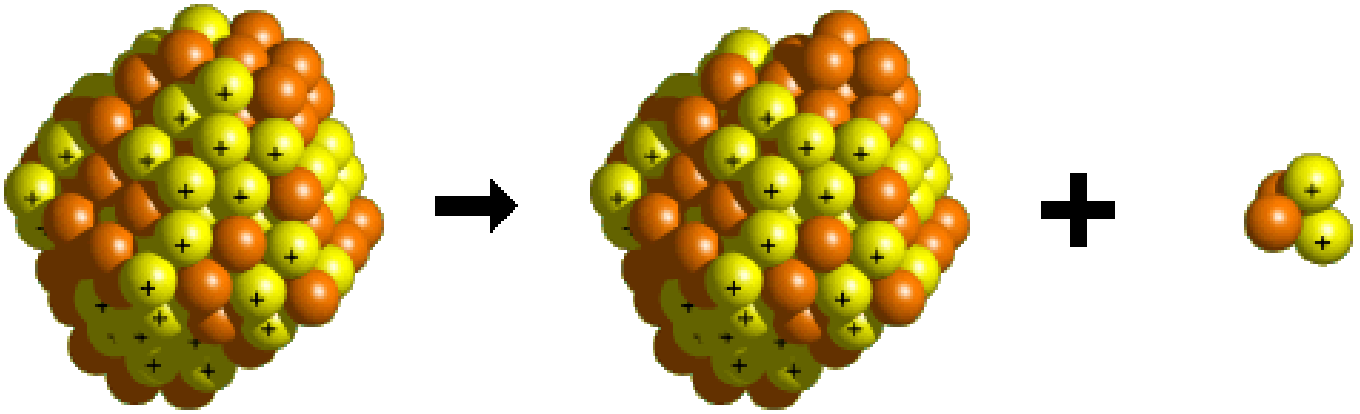
Penetrating Power of Radiation





Type	What is it?	Symbol	Charge	What Stops It
Alpha Particle	Helium Nucleus (2 protons 2 neutrons)	${}_{2}^{4}\mathrm{He}$ ${}_{2}^{4}\alpha$	2+	Paper
Beta Particle	An electron	${}_{-1}^{0}\beta$ $\mathbf{0}_{-1}\mathbf{e}^{-}$	1-	Aluminum, wood, clothes
Gamma Ray	High speed energy waves	γ ${}_{0}^{0}\gamma$	0	Thick lead or concrete

Alpha Decay



Large, unstable nucleus → Smaller, more stable nucleus + Alpha particle $^{4}_{2}He$

2 protons, 2 neutrons

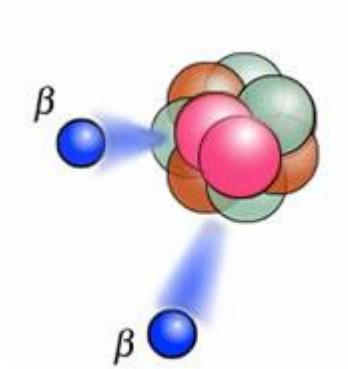
Example:

$$^{238}_{92}U \longrightarrow {}^{4}_{2}He + {}^{234}_{90}Th$$

uranium — helium — thorium

Beta Emission:

Neutron breaks into a proton and an e^-



$$^{1}_{0}\mathbf{n} \rightarrow {}^{0}_{-1}\beta + {}^{1}_{1}\mathbf{p}$$

Example:

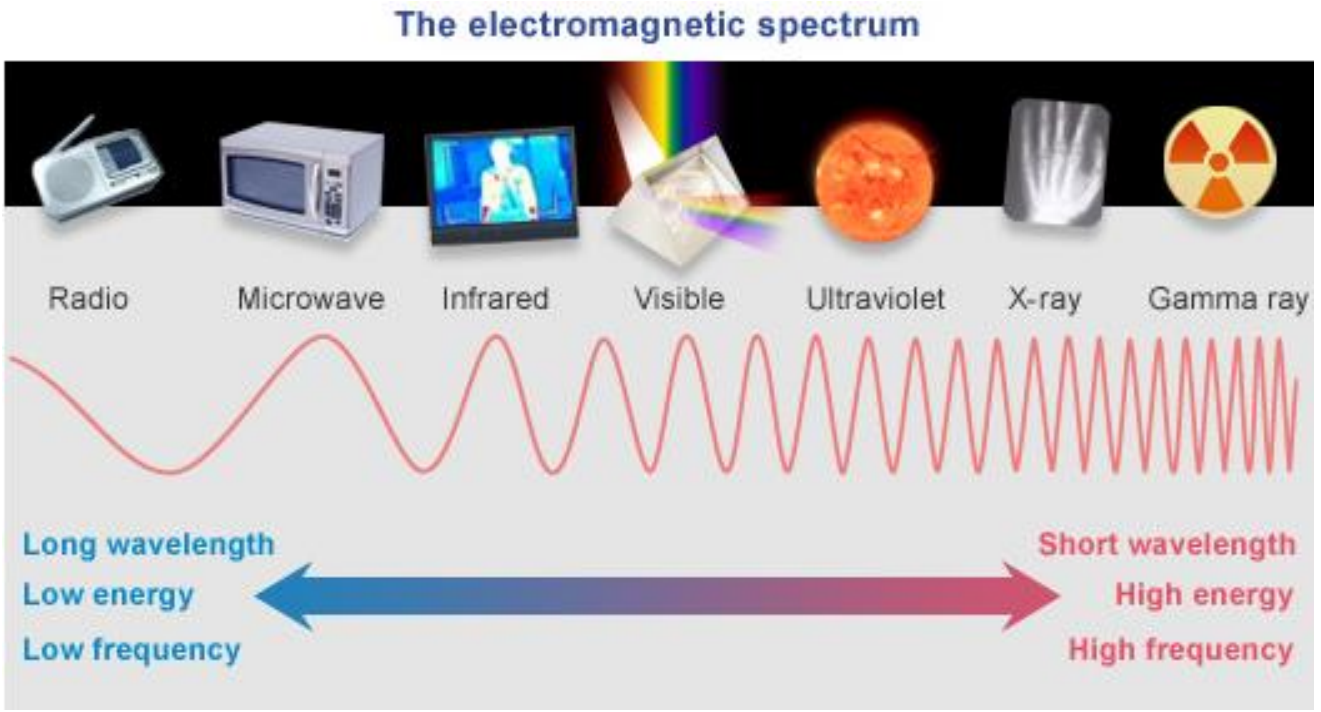
$$^{234}_{90}\mathrm{Th} \rightarrow {}^{0}_{-1}\beta + {}^{234}_{91}\mathrm{Pa}$$

beta particle acts like an e^-

Gamma rays:

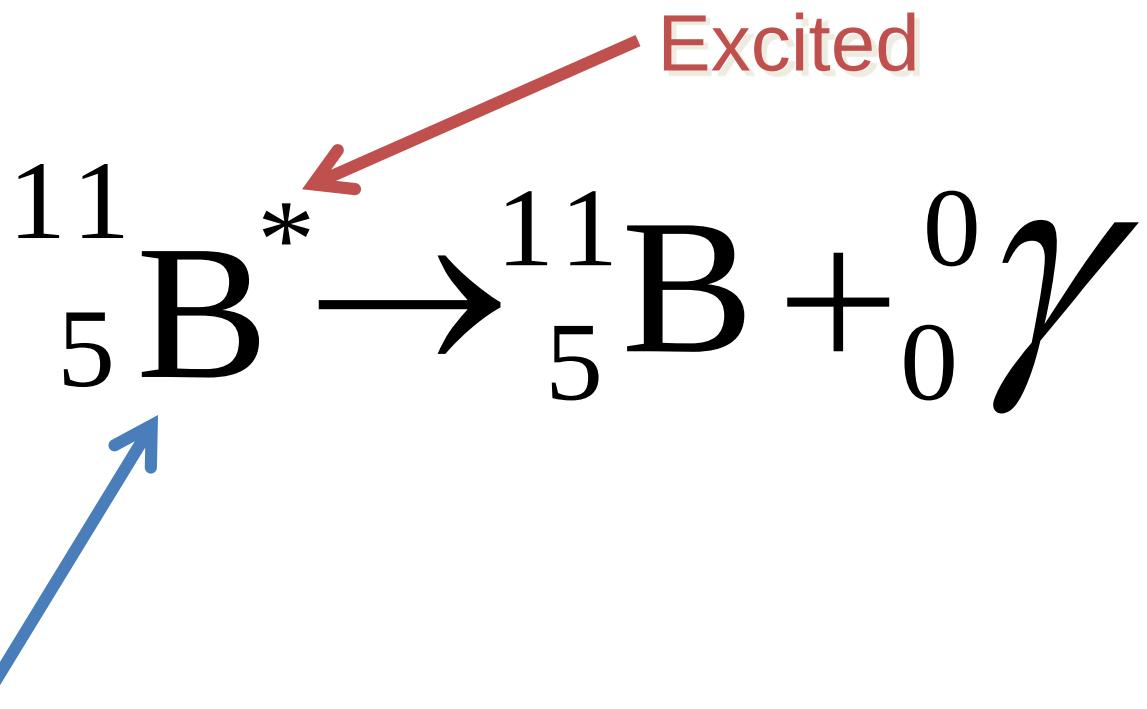
These are dangerous EMR waves with no significant mass that are usually emitted with other types of radiation. They penetrate very deeply.

The Symbol: $^{0}_{0}\gamma$



Gamma Radiation:

No change in atomic or mass number



Balancing Nuclear Equations

Alpha emission $\quad {}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$

Beta emission $\quad {}^{A}_{Z}X \longrightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}e$

Positron emission $\quad {}^{A}_{Z}X \longrightarrow {}^{A}_{Z-1}Y + {}^{0}_{+1}e$

Gamma emission $\quad {}^{A}_{Z}X^{*} \longrightarrow {}^{A}_{Z}X + {}^{0}_{0}\gamma$

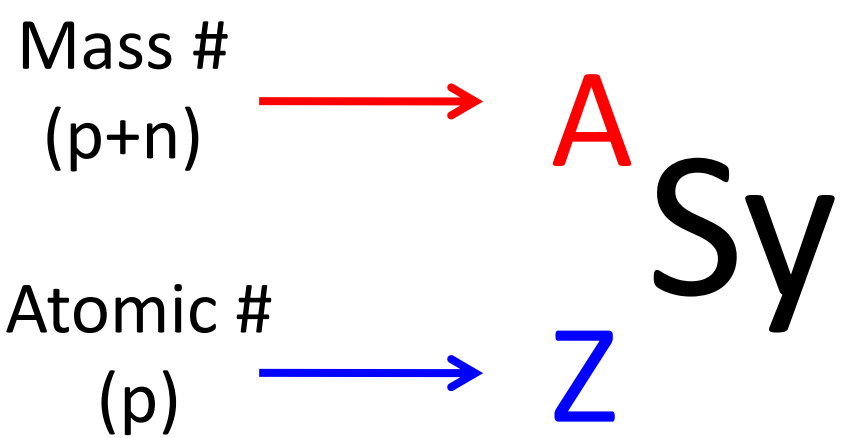
Writing Nuclear Equations

In the reactants and products

Atomic numbers must balance

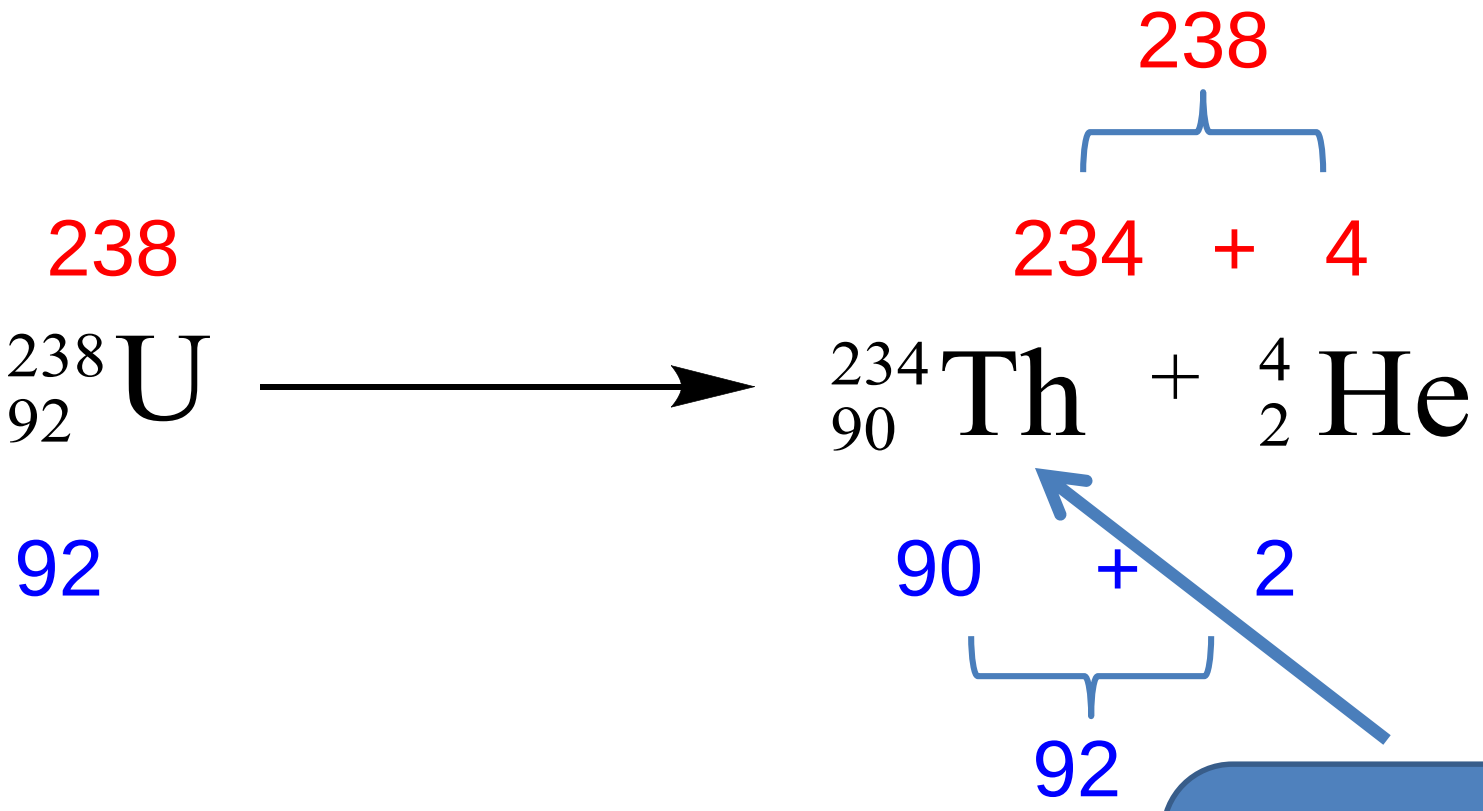
and

Mass numbers must balance



REMEMBER THE CONSERVATION OF MASS/MATTER LAW???

Balancing Nuclear Equations



Remember that the # of PROTONS determines which ELEMENT it is!!!

Practice Alpha Emission Problem

239 – 4 = 235

$$^{239}_{94}\mathbf{Pu} \rightarrow {}^{4}_{2}\alpha + \boxed{?}$$

94 – 2 = 92

235
92 Sy

Practice Problems

$$^{40}_{19}\mathrm{K} \rightarrow {}^{40}_{20}\mathrm{Ca} + \boxed{?}$$

$$^{241}_{95}\mathrm{Am} \rightarrow {}^{237}_{93}\mathrm{Np} + \boxed{?}$$