

Today

- Refresher on isotopes
- Start nuclear decay

	#p <sup>+</sup>	#n <sup>0</sup>	Naturally Occurring	If we have 1,000,000 atoms how many do we expect?
Helium-3 ${}^3_2\text{He}$	2	3-2=1	Yes	1

$$\begin{aligned}
 \text{predicted \#} &= \frac{\text{\# of atoms} \times \%}{100} \\
 &= \frac{1,000,000 \times 0.000137\%}{100} \\
 &= 1.37
 \end{aligned}$$

Remember this?

A natural sample of chlorine contains 800 atoms. What different isotopes would you expect to find and how many of each?

$${}^{35}\text{Cl} - 75.77\% \quad \# = \frac{\# \text{ atoms} \times \%}{100} = \frac{800 \times 75.77\%}{100} = 606$$

$${}^{37}\text{Cl} - 24.23\% \quad \frac{800 \times 24.23}{100} = \frac{194}{800}$$

We've been working with naturally occurring isotopes. These are generally **stable**.

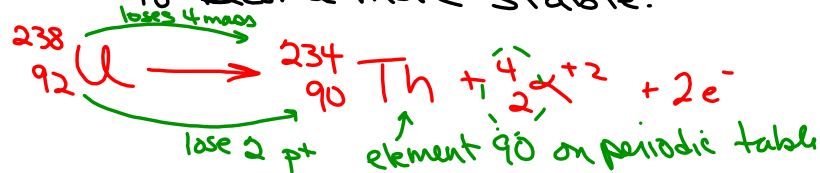
Many isotopes are **not stable!** They will eventually **decay**.

(nuclear decay)

**Decay** causes the nucleus to change into a different nucleus (and often times a different element altogether) by emitting a particle.

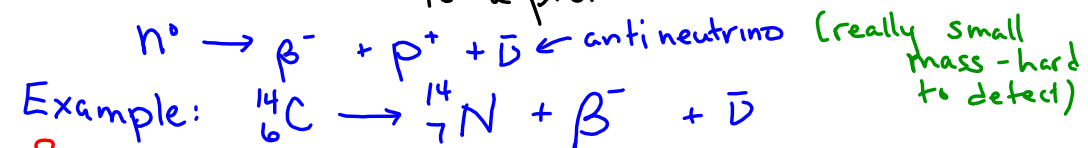
## Types of Decays

Alpha Decay:  $\alpha^{+2}$  A nucleus (usually a large one) emits a helium nucleus ( ${}^4_2\text{He}^{+2} = \alpha$ ) to become more stable.



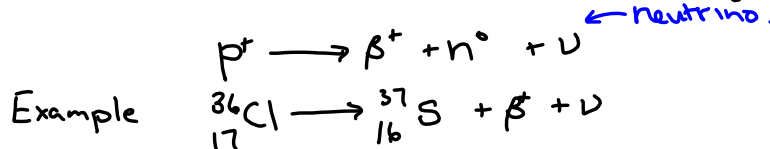
Least dangerous of the particles, unless it's internal. They can be stopped by a sheet of paper.

Beta Negative Decay: Can happen with both small and large nuclei. In general, there are too many neutrons for the number of protons. An electron is "kicked" out of the nucleus and a neutron changes to a proton.

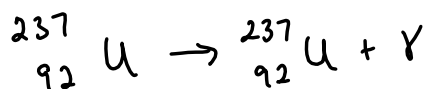


fast moving electrons, similar energy to X-rays, can be stopped by a thin sheet of lead.

Beta Positive Decay: Can occur with both large and small nuclei - too many protons for number of neutrons. A  $\beta^+$  particle is a positron - an anti-electron (same mass but opposite charge)



Gamma radiation: Any size nucleus - becomes more stable by giving off high energy light ( $\gamma$ )



The most penetrating. Requires 6 ft (2m) of concrete or several centimeters of lead to stop it.

[https://phet.colorado.edu/sims/html/build-a-nucleus/latest/build-a-nucleus\\_all.html](https://phet.colorado.edu/sims/html/build-a-nucleus/latest/build-a-nucleus_all.html)



Or Google: [Build a nucleus pHet](#)

Example:      Decay of Carbon 14

Using the pHet simulation, for each of the following, give the decay type and the resulting atom after the decay.



note: there are two for this one!



