

Today

- Refresher on isotopes
- Start nuclear decay

Helium-3	# p ⁺	# n ⁰	Naturally occurring	If 1,000,000 atoms how many?
${}^3_2\text{He}$	2	3-2=1	Yes	1

$$\begin{aligned} \text{predicted \#} &= \frac{\text{\# atoms} \times \%}{100} \\ &= \frac{1000000 \times 0.000137\%}{100} \\ &= 1.37 \end{aligned}$$

Remember this?

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

$$\begin{array}{l} {}^{35}\text{Cl} - 75.77\% \quad \# = \frac{\# \text{ atoms} \times \%}{100} = \frac{800 \times 75.77\%}{100} = 606 \\ {}^{37}\text{Cl} \quad 24.23\% \quad \# = \frac{800 \times 24.23\%}{100} = 194 \\ \hline 800 \end{array}$$

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: Occurs when a large nucleus kicks out an α -particle ($2p^+$, $2n^0 \rightarrow$ same as a helium nucleus) to become more stable.

α ← Greek letter alpha.

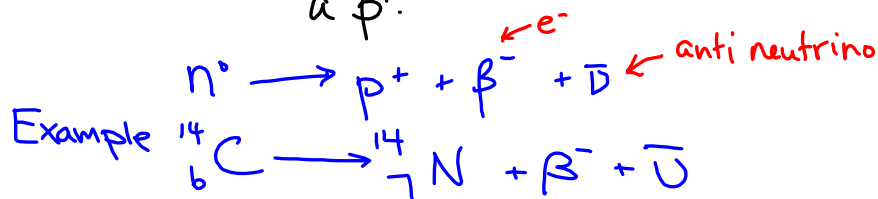
Example: ${}_{92}^{238}\text{U} \rightarrow {}_{90}^{234}\text{Th} + {}_{2}^{4}\alpha$

loses 4 mass
loses 2 p^+

α radiation is the least dangerous to humans unless it is ingested or inhaled.
- a piece of paper or skin will stop α -particles

Beta Negative Decay: Can happen with small or large nuclei. This occurs when the nucleus has too many neutrons compared to protons. The nucleus "kicks out" an e^- (β^- particle) and a n^0 becomes a p^+ .

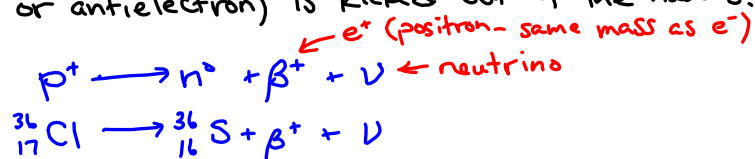
β^- ← Greek letter beta



β^- particles have similar energies as X-rays and can be stopped with a thin piece of lead.

Beta Positive Decay: Similar to β^- except there are too many p^+ s for the # of neutrons. A proton becomes a n^0 and a β^+ (a positron, or antielectron) is kicked out of the nucleus.

β^+



Gamma radiation: An unstable nucleus emits high energy light to become more stable, without changing the # of p^+ or e^-

γ ← Greek letter gamma



This is the most penetrating of radiation. It takes about 6 feet (2m) of concrete or several cm of lead to stop γ -rays.

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!

