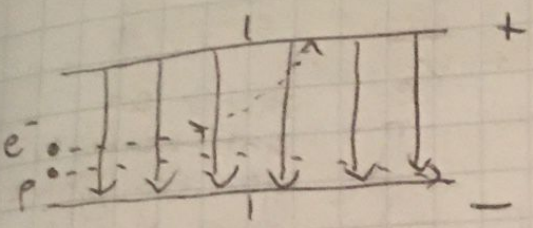
Quick Review of the atom / particles / Electromagnetism

Electric Field points from positive to negative



- Electrons = negative → will accelerate to the positive end
- Protons = positive → will accelerate to negative end.

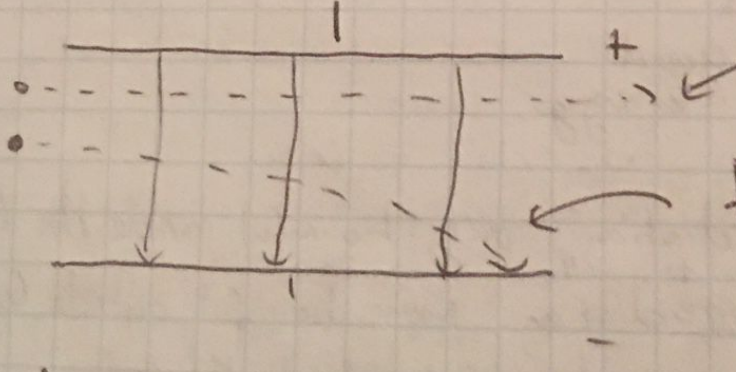
As protons are heavier, they move more slowly!

Three types of Radiation:

- Alpha (α) — a Helium nucleus (^4_2He)
- Beta (β) — an electron (e^-)
- Gamma (γ) — a gamma ray (high-energy EM radiation)

number of protons and neutrons

number of protons



Must be γ-ray as it is neutral.

this must be an α particle as it is positive

α: big, heavy, positive, produced from decay of large nuclei:

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

e.g. $^{237}_{93}Np \rightarrow {}^{?}_{?}Pa + {}^{4}_{2}He \longrightarrow {}^{233}_{91}Pa$

β: small, negative, formed from small nuclei

A neutron becomes a proton and an electron

$$^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + e^{-} + \overline{\nu_e}$$

this is an anti-neutrino, you can ignore why this is produced, but it is always produced!

e.g: $^{14}_{6}C \rightarrow {}^{14}_{7}N + e^{-} \; (+\overline{\nu_e})$

6 protons, 8 neutrons

7 protons, 7 neutrons

γ: high-energy EM wave, no charge or mass

Releases energy with no change in the nuclei

$$^{A}_{Z}X \rightarrow {}^{A}_{Z}X + \gamma$$

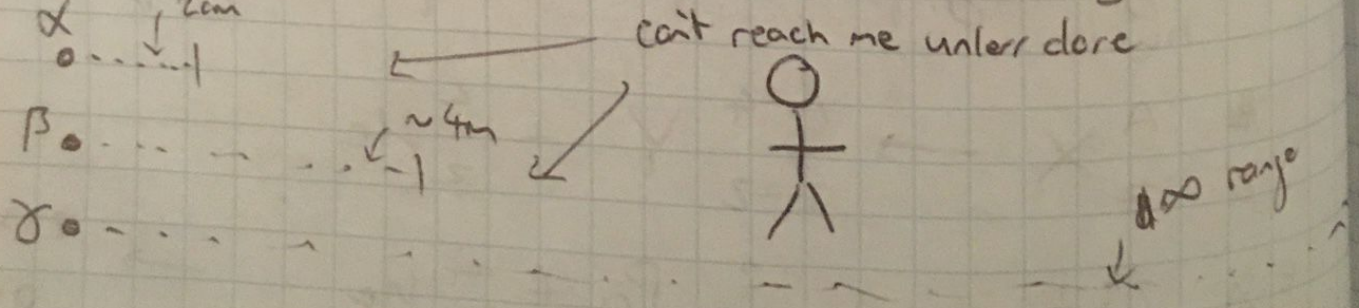
too-much energy

good energy

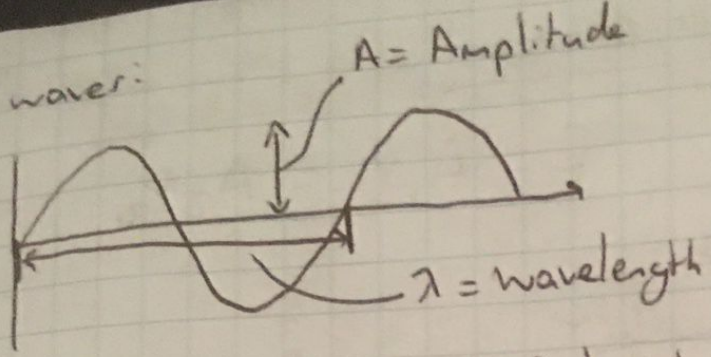
α: short-range radiation, only harmful inside the body

β: medium-range radiation, more harmful outside body

γ: long-range, very harmful outside the body.



EM waves:



transverse waves

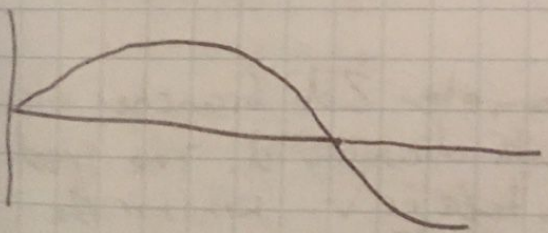
- Travel at the speed of light

$$c = f\lambda$$

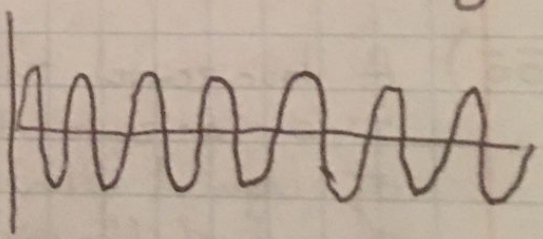
radio waves | Microwaves | IR | Visible | UV | X-rays | Gamma Rays

low f, high λ ← → high f, low λ

radio



gamma rays



If $c = 3\times10^{8}\ ms^{-1}$ and $\lambda = 5m$, what is f?

$f = 60{,}000{,}000\ Hz$

or $60MHz$

this is large ⇒ radio

For reference, red light is $\lambda = 800nm = \underline{8\times10^{-7}\ m}$