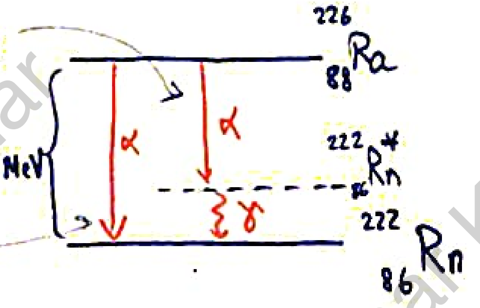
Alpha Decay $\;{}^{A}_{Z}X \to {}^{A-4}_{Z-4}Y + \alpha$

α emission occurs principally with nuclei that are too large to be stable.

As $N \to N-2$ and $Z \to Z-2$ they move closer to stable territory on Segrè chart.

Ex: ${}^{226}_{88}Ra \to {}^{222}_{86}Rn^{*} + \alpha \to {}^{222}_{86}Rn + \gamma + \alpha$

or ${}^{226}_{88}Ra \to {}^{222}_{86}Rn + \alpha$



α-decay is possible whenever the mass of the original neutral atom is greater than the sum of the masses of the final neutral atom and the neutral ${}^{4}He$ atom

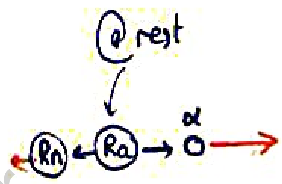
Let's see that this is the case for the above Radium α-decay.

The mass difference is:

$$226.025403\,u - (222.017571\,u + 4.002603\,u) = +0.005229\,u$$

$$E = \frac{0.005229\,u}{931.5\,MeV/u} = 4.871\ MeV$$

This is the total KE of Rn & α



Non-relativistic treatment can still be used at this energy.

Since Rn & α will have the same p (but opposite dir's), their velocity will be inversely prop. masses. Hence α gets $\frac{222}{222+4}$ of the total K.E $= 4.78$ MeV $\to v_\alpha = 0.05c$