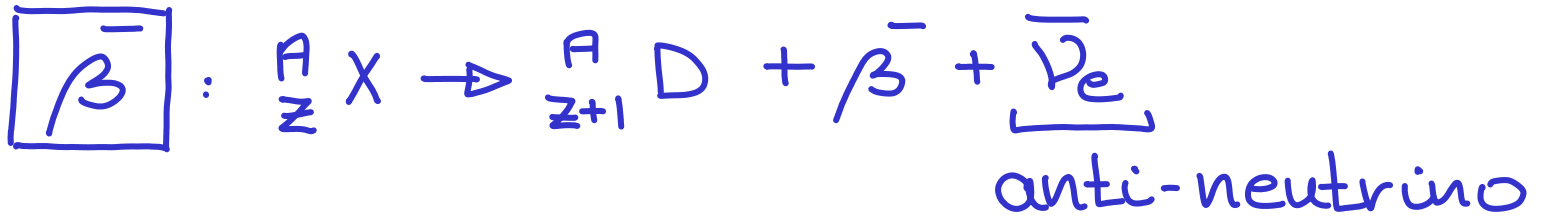
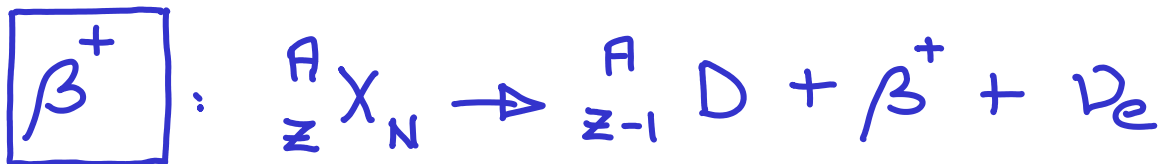
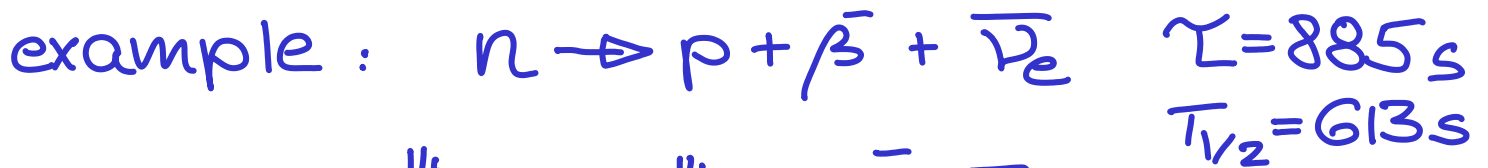


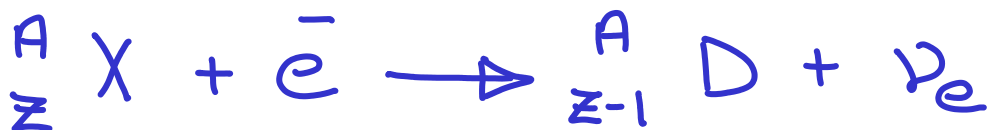
## Beta decay



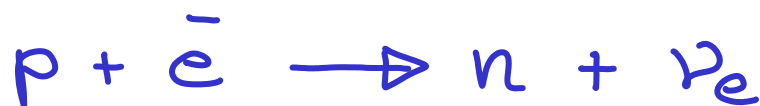
$$Q = [M({}^A_Z X) - M({}^A_{Z+1} D)] c^2$$



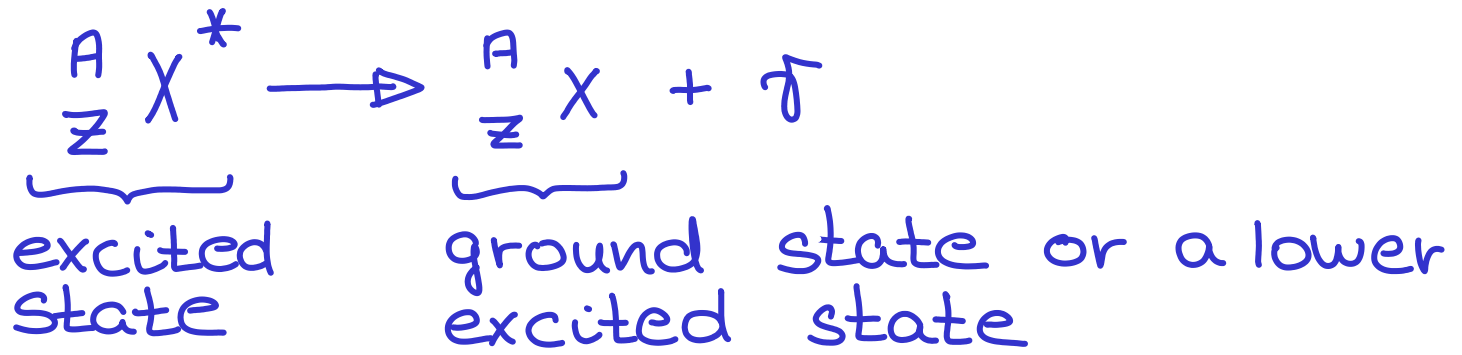
$$Q = [M({}^A_Z X_N) - M({}^A_{Z-1} D) - 2m_e] c^2$$



$$Q = [M({}^A_Z X) - M({}^A_{Z-1} D)] c^2$$

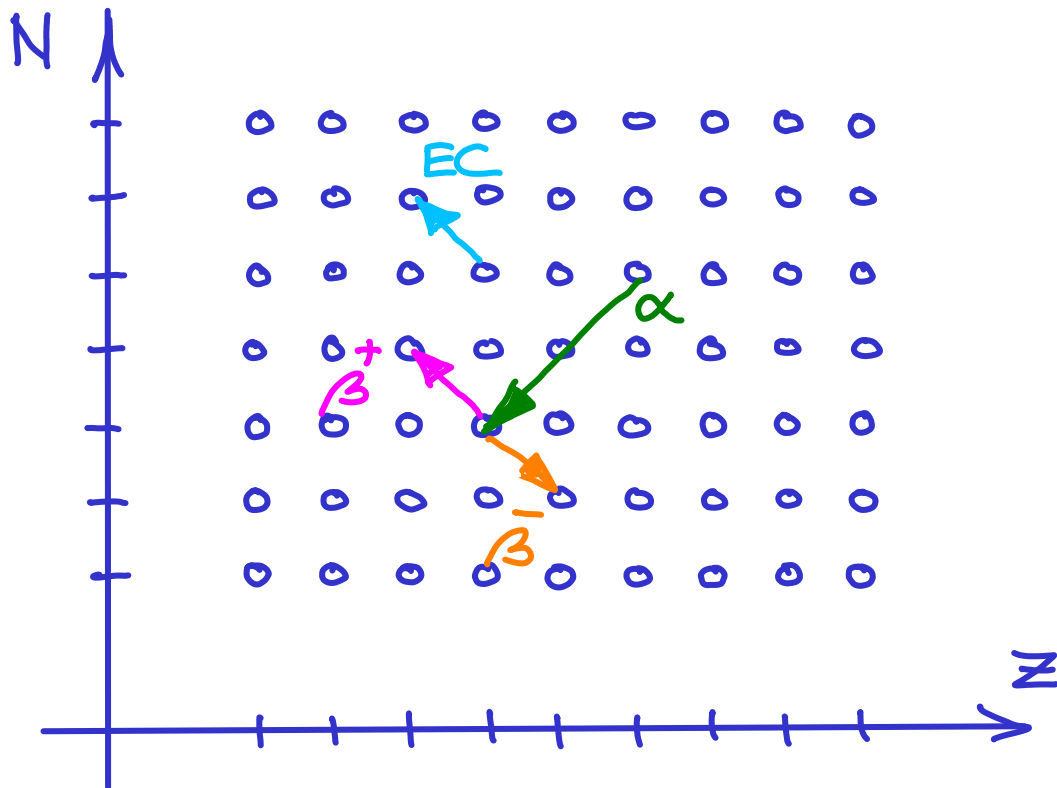


# Gamma decay

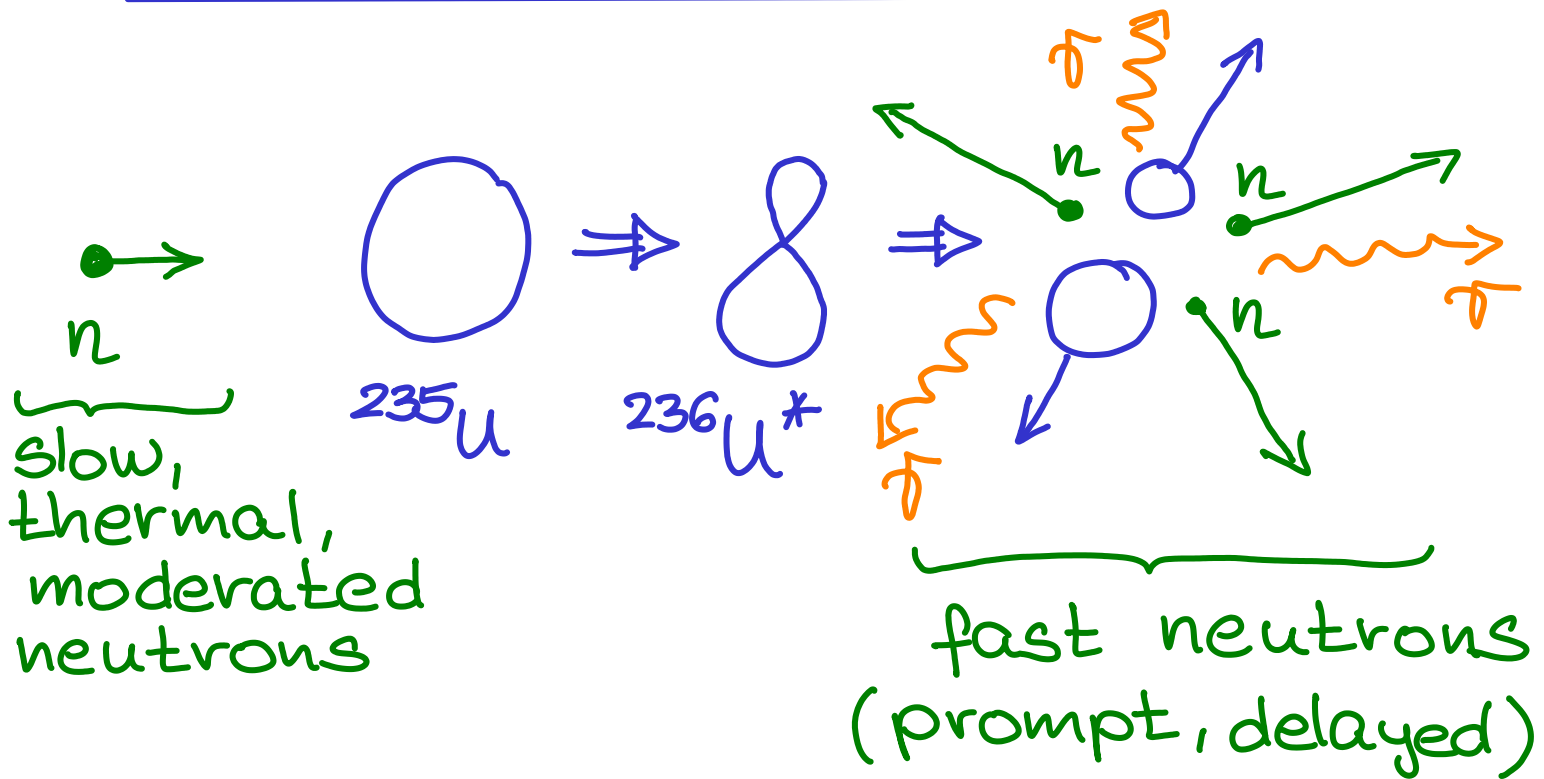


spin of  $\gamma$ :  $1 \Rightarrow$  there are meta-stable states called isomers or isomeric states with half lives of several years.

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# Fission and chain reaction



Average energy released:

$\approx 200 \text{ MeV}$  in fission

$\approx 20\text{-}30 \text{ MeV}$  in later decay

$\approx 1\%$  of the rest energy

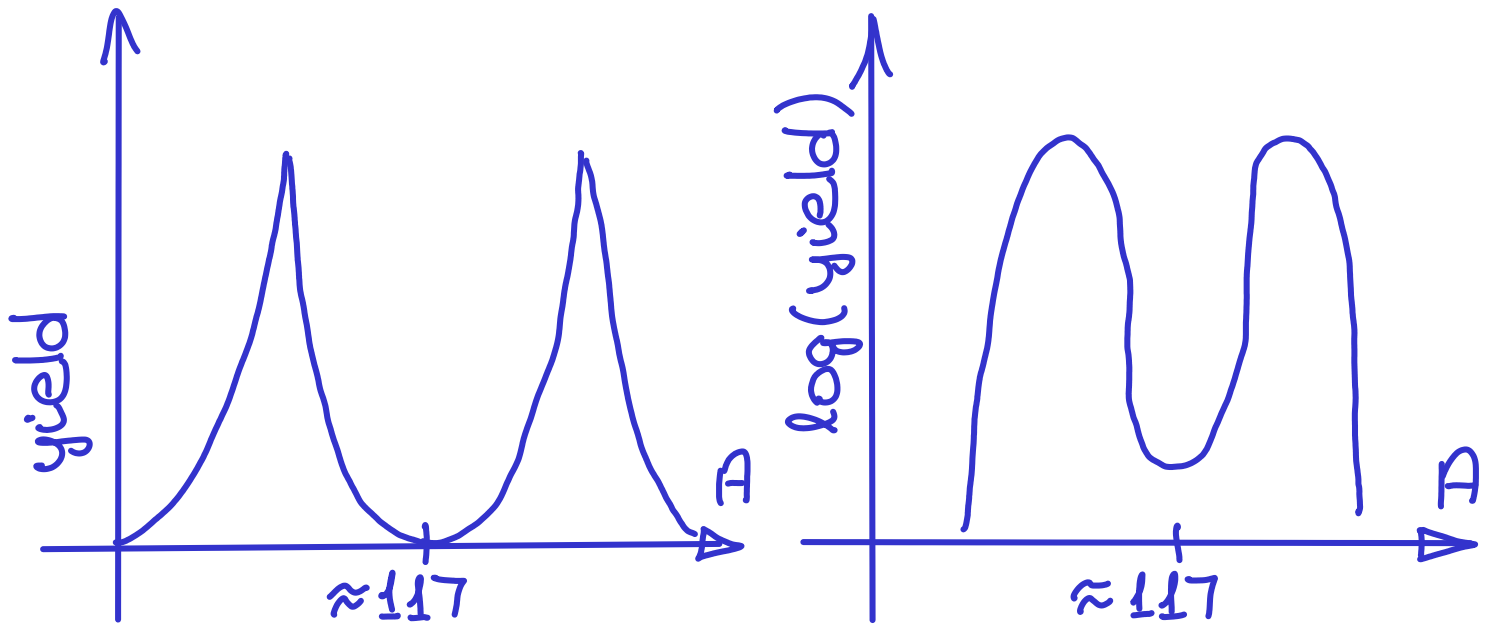
( $\text{C} + \text{O}_2 \rightarrow \text{CO}_2 : 4 \text{ eV} \approx \frac{1}{10,000}$  of rest en.)

Average number of neutrons released :  $2.45 \Rightarrow$  chain reaction

Fission: Otto Hahn (1944, Nobel), Fritz Strassman, Lise Meitner, Otto Frisch.

Chain reaction: Leo Szilárd

# Fission fragment distribution



# Fission cross section

Cross section

