

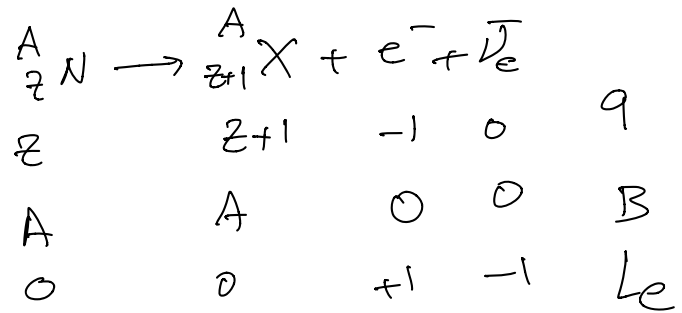
Carta di segregazione

nuclidi $\begin{cases} \text{stabili} \\ \text{instabili} \end{cases}$

\hookrightarrow decadono

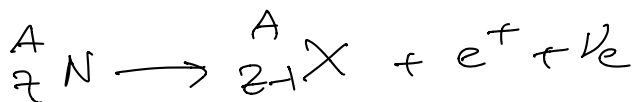
(3) nuclide ${}^A_Z N$

β^- decadimento.



nuclidi con eccesso di neutroni decadono β^-

Decadimento β^+



Sembra $p \rightarrow n + e^+ + \nu_e$

decadimento del protone?

} non è possibile

$|P|^2$ invariante.

$$E_i = E_f$$

$$E_i = m_p$$

$$E_f = m_n + K_n + m_e + K_e + m_\nu + K_\nu$$

$$m_p = m_n + m_e + m_\nu + (K_e + K_\nu + K_n)$$

939 940 0.5 0

MeV

al limite $\sum_i K_i = 0$. non è possibile

$$m_p < m_n + m_e$$

Q-value:

$$E_i = \underbrace{\sum_j m_j}_{\text{masse iniziali}} + \underbrace{\sum_j K_j}_{\text{en. cin. iniziali}}$$

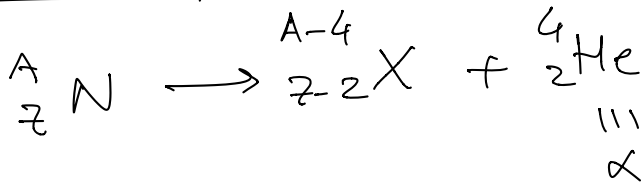
$$E_f = \sum_l m_l + \sum_l K_l$$

$$E_i = E_f \Rightarrow \sum_{\text{in.}} m_{\text{in}} - \sum_{\text{fin.}} m_{\text{fin}} = \sum_{\text{fin.}} K_{\text{fin}} - \sum_{\text{in.}} K_{\text{in}}$$

al limite in cui $K \equiv 0$. $Q \rightarrow$ diff. di massa.

$$Q = \sum_{\text{in}} m_{\text{in}} - \sum_{\text{fin}} m_{\text{fin}} \geq 0$$

Decadimento α

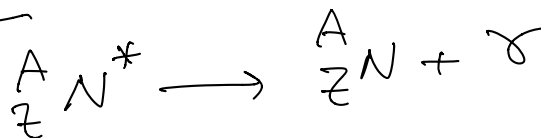


osservazione:

$$K_\alpha \simeq 4-7 \text{ MeV}$$

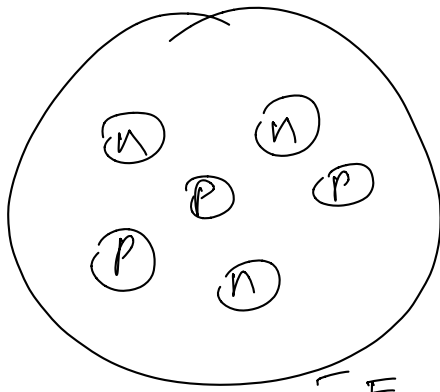
B
9

Decadimento γ



EM

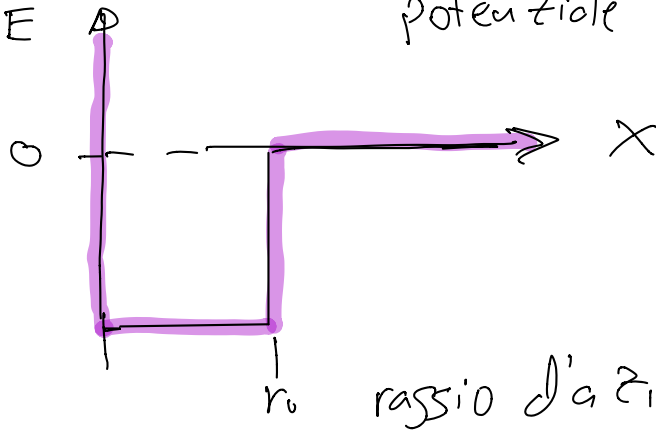
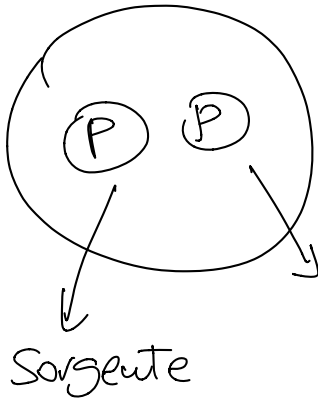
$$E_\gamma \simeq \text{MeV}$$



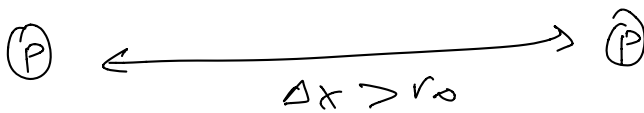
$$F_{\text{forte}} \gg F_{\text{EM}}$$

si osserva solo a corti rassi.

potenziale forte.



raggio d'azione.



nessuna forza forte.



$$F_{\text{forte}} \gg F_{\text{EM}}$$

Profondità della buca di potenziale V_0

V_0 = energia di legame del nucleone.

$$\frac{B(Z, A)}{A}$$

nucleoni non fermi nel nucleo:

$$P_F = 240 \text{ MeV}$$

impulso di Fermi

$$m_p = 1000 \text{ MeV}$$

$$E = \sqrt{m^2 c^4 + p^2 c^2}$$

$$\approx mc^2 + \frac{p^2}{2m}$$

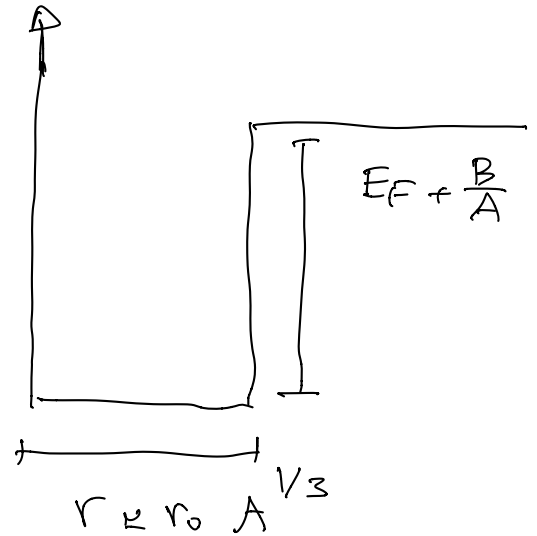
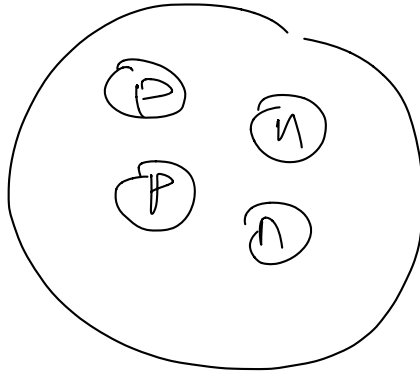
$$K \approx E - mc^2 = \frac{p^2}{2m}$$

$$E \approx \frac{p^2}{2m} \Rightarrow$$

$$E = \frac{(2 \times 10^8)^2}{2 \times 10^3} = \frac{4 \times 10^{16}}{2 \times 10^3} = 20 \text{ MeV}$$

Energia di Fermi: $E_F \approx 20 \text{ MeV}$

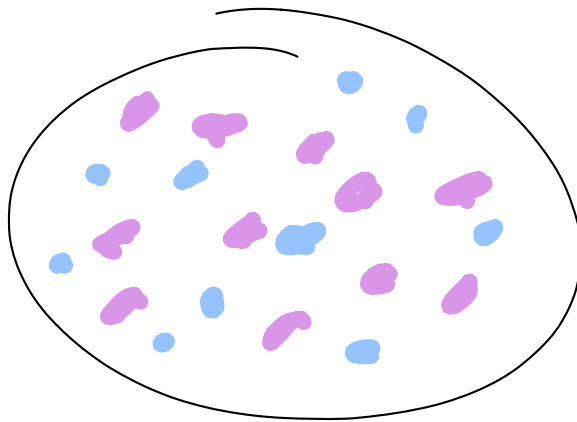
en. cinetica
media dei nucleoni.



$V_0 \approx 40 \text{ MeV}$ ordine
di grandezza.

$r_0 \approx 1.1 \text{ fm}$

A
 Z N

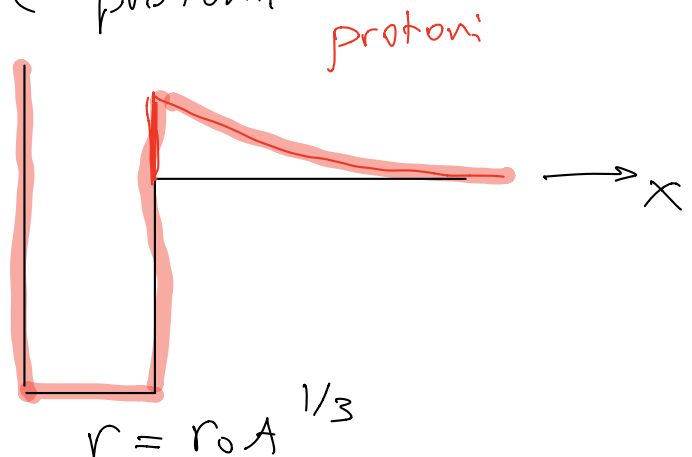
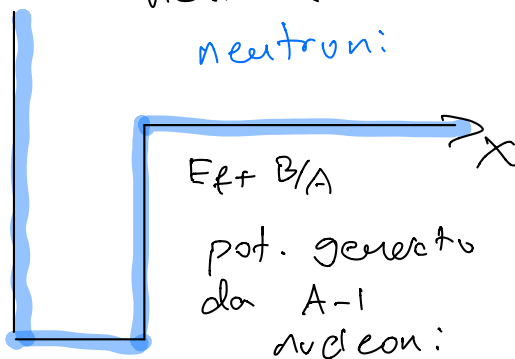


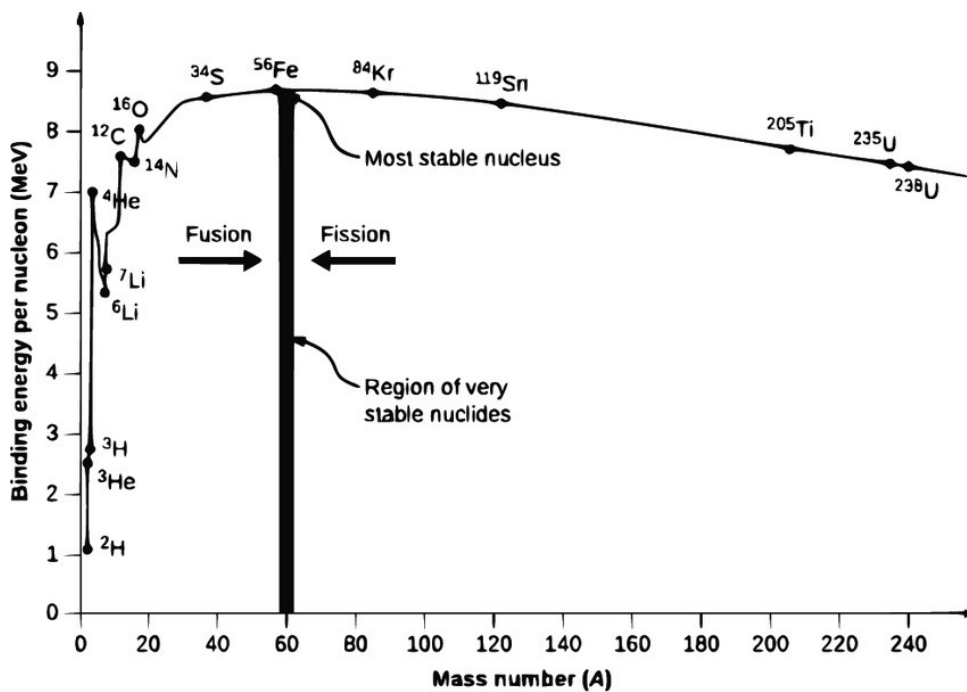
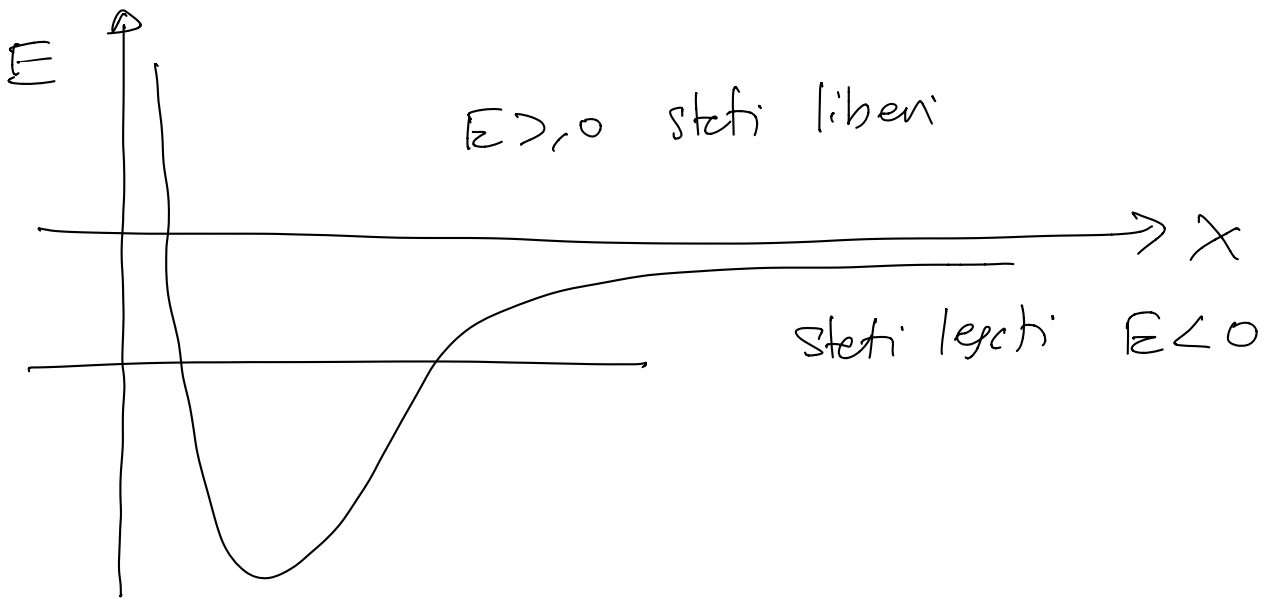
protoni
neutroni

prendo nucleone i -esimo.
sente potenziale generato da $A-1$ nucleoni.

sorgente di $A-1$ nucleoni.

1 nucleone vede il potenziale.
correzione tra neutroni e protoni.

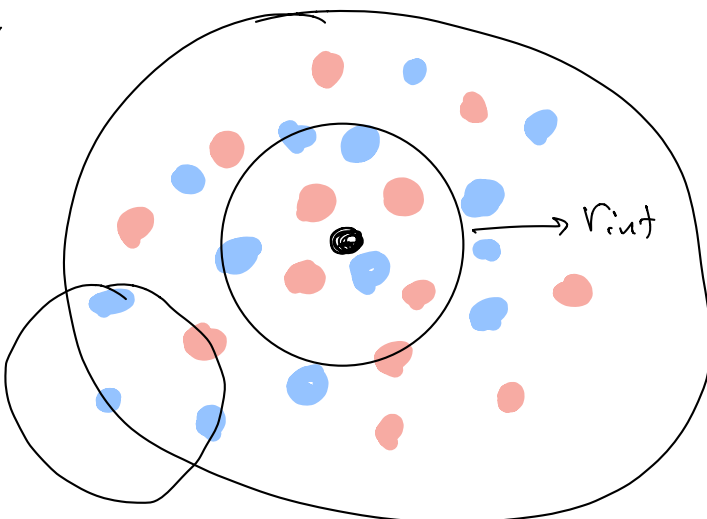




$$\frac{B(Z, A)}{A}$$

Modello a goccia

${}^A_Z X$



$r_{nucleare}$

$$r_N \approx r_0 A^{1/3}$$

oss. sperimentale.

nucleoni interagiscono
con nucl. entro $r < r_{int}$
entro volume V_{int}

A nucleon: se bñe alle Coulomb.

$$B \propto \frac{A \cdot (A-1)}{2} \propto \frac{A^2}{2} \text{ termini di interazione.}$$

contribuenti all'energia di legame $B(Z, A)$

Ipotesi: del modello a goccia.

Interazione per ciascun nucleone $r < r_{int}$

Dalle misure sperimentali: $\frac{B}{A} = \text{cost.} = 7.5 \text{ MeV.}$

Se

$$B \propto A^2$$

↙
ipotesi:
inter. tutti con
tutti

$$\frac{B}{A} = \text{cost}$$

↘
oss.
sperimentale.

possibile?

$\frac{B}{A} \propto A$. non è quel cm si vede.

\Rightarrow ipotesi solo nucleon.
con $r < r_{int}$ interagiscono.

$$B(Z, A) = \sum_i \frac{A(A-1)}{2} \frac{V_{int}}{V_{nucleare}} < U >$$

Termine di Volume.

$< U >$ en. media di legame.

< 1

V: volume.

$$V_{nucleare} = \frac{4\pi}{3} r_N^3$$

$$B(Z, A) \propto A^2 \frac{V_{int}}{r_N^3} \propto A$$

$$\Rightarrow r_N \propto A^{-1/3}$$

$$\frac{B_v(Z, A)}{A} \propto \frac{A}{r^3}$$

$B_V(Z, A) \propto A$ aumenta con A .

Termine di superficie $B_S(Z, A)$

Ridurre termine di volume

$$S_N \simeq 4\pi R^2 = 4\pi r_0^2 A^{2/3}$$

nucleoni
sulla
sup. $N_S \propto S \propto A^{2/3}$

$$B(Z, A) = \underbrace{\alpha_V A}_{\text{termine di volume}} - \underbrace{\alpha_S A^{2/3}}_{\text{termine di superficie}} + \dots$$