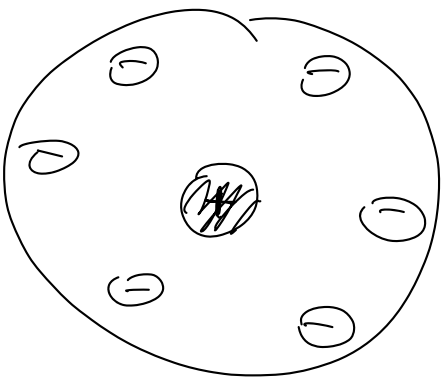
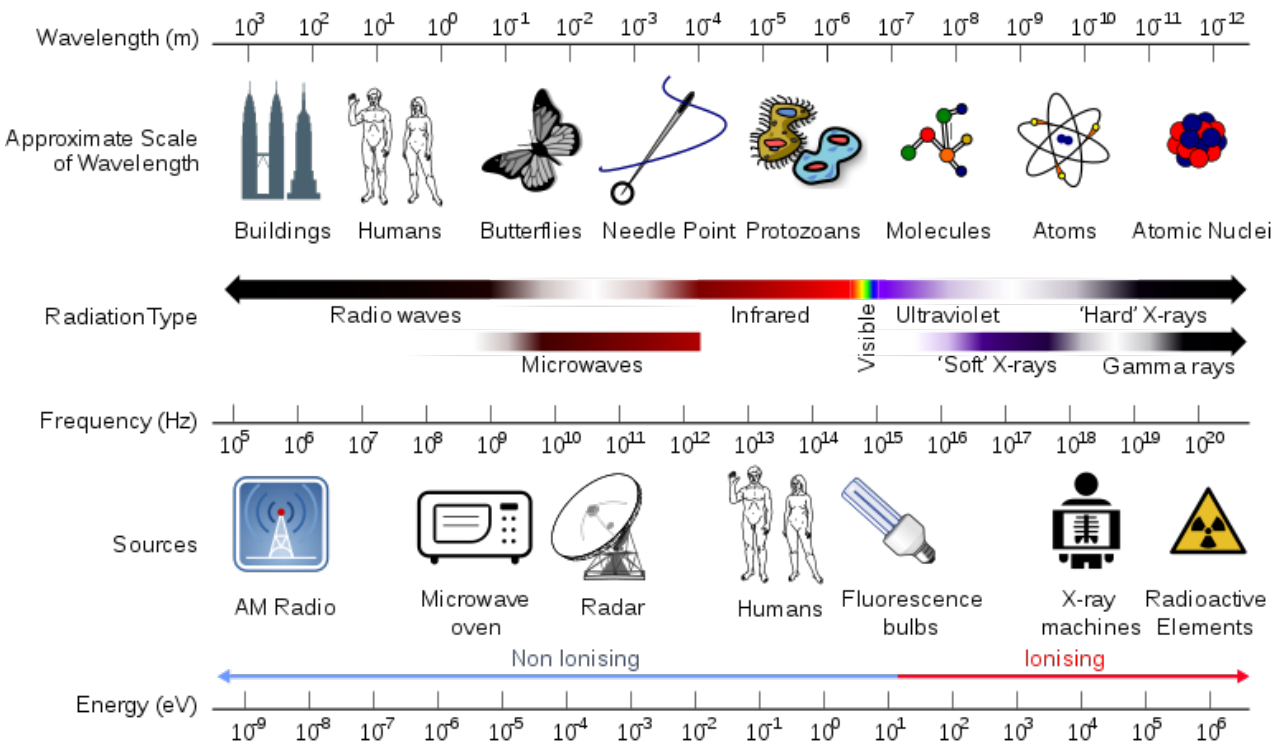
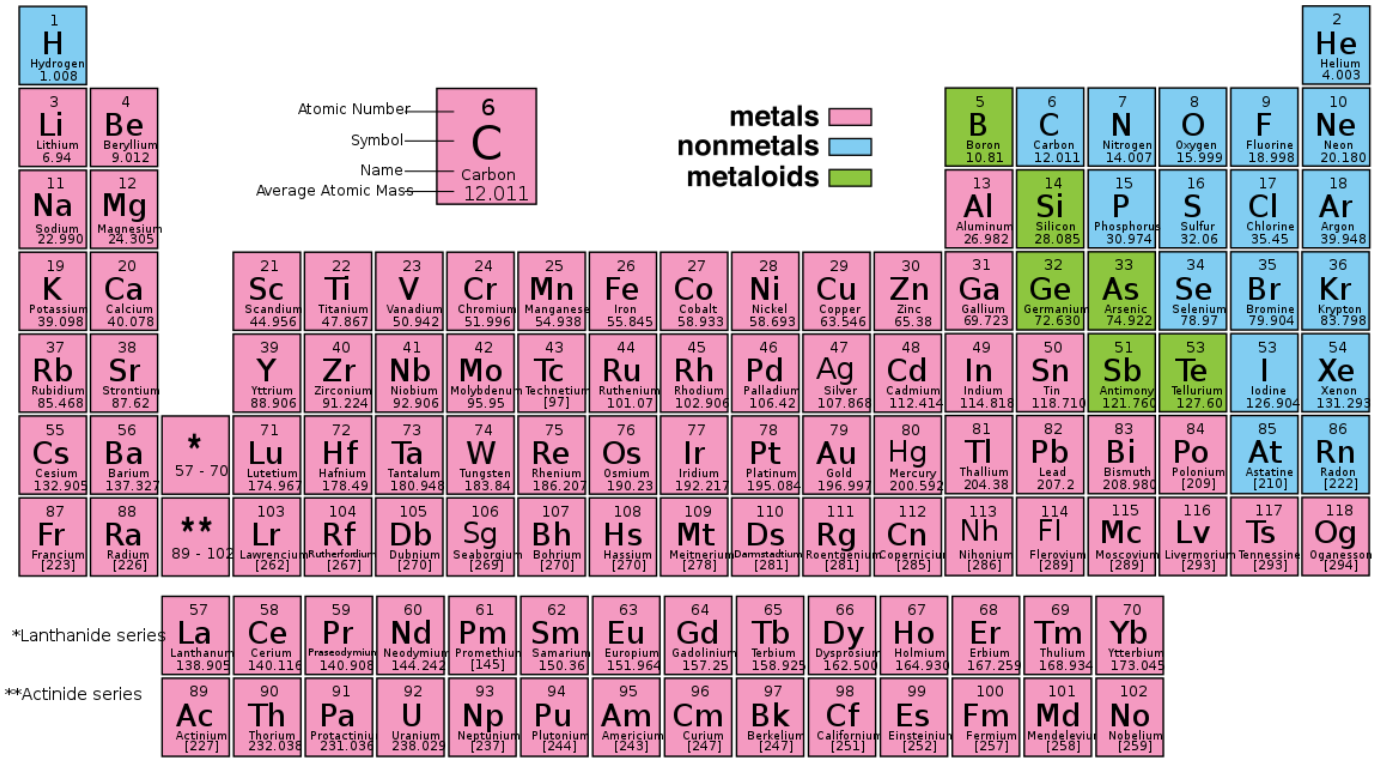
Token: 769 108

Rutherford $r_N \leq 30$ fm

γ, e^-, p(+) nuclei



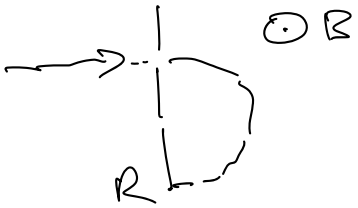




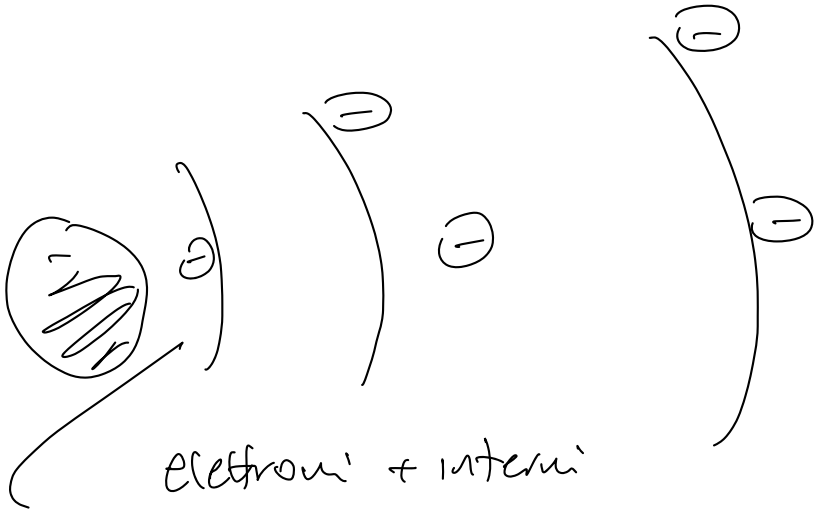
Z, A dei nuclei

nucleo: massa $\propto$ A

↳ spettroscopia di massa



Z: carica dei nuclei



legge di Moseley:

$$E_e = \frac{3}{4} R_y (Z-1)^2 \simeq 10\,eV\,(Z-1)^2$$

misura sperimentale di Z, A dei nuclei $^{A}_{Z}N$

nuclidi (Z, A)

isotopi: $^{12}_{6}C$ 0.989 abbondanze in natura

$^{13}_{6}C$ 0.011

isotopi: Z = cost. A variabile. (la stessa chimica lo stesso elemento)

$A = Z + N$

Z → #protoni

N → #neutroni

isobari: A = cost Z = diversi. sono elementi diversi nuclidi con la stessa massa.

nuclidi → stabili

→ instabili => studiare processi di decadimento.

$A \rightarrow B + C$

$E_i = E_f$ $\quad E = m + T$ → en. cinetica

p.f solidale con A: $M_A = E_B + E_C = m_B + m_C + T_C + T_B$

$Q = M_A - m_B - m_C = T_B + T_C = T_f$ en. cinetica nello stato finale.

Q valore del decadimento

$E_A = E_B + E_C$

Se $T_A \neq 0$ $\quad M_A + T_A = m_B + T_B' + m_C + T_C'$

$$Q = \underline{m_A + m_B - m_C} = T_B' + T_C' - T_A$$

Energia si conserva $\Rightarrow$ $Q \geq 0$ nei decadimenti

$$\Gamma(i \to f) = 2\pi |A|^2 \rho(E)\Big|_{E_R = E_i}$$

$$Q = M_{in} - \sum_f^N m_f$$

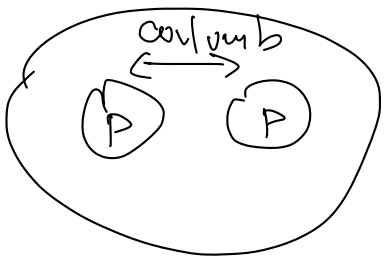
$A \longrightarrow \underbrace{B + C + D \cdots + Z}_{N}$

nuclide (A, Z) $\quad M(Z, A)$ massa del nuclide.

$$M(Z,A) = Z \cdot m_p + (A - Z)\, m_n$$

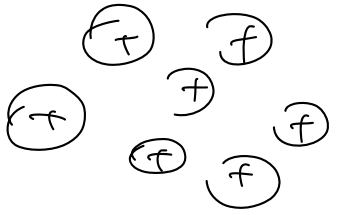
Esperimenti di diffusione sui nuclei
- distrib. continua di massa e carica.
- distrib. sferica uniforme (buona approssim.)
- $q = Ze \quad Z \in \mathbb{N}$
  - ↳ la stessa carica elettrica di e^-

$Z = 2$



$$F = \alpha \frac{1}{r^2}$$

Z cariche positive



$$\frac{Z(Z-1)}{2}$$

termini di repulsione

$\Rightarrow$ esistere una forza più forte di Coulomb

$\Rightarrow$ forza nucleare

sperimentalmente ↙

$$m(Z,A) < Z m_p + (A-Z) m_N$$

Definizione

$$m(Z,A) = Z m_p + (A-Z) m_N - B(Z,A) \qquad B \geq 0$$

$B(Z,A)$: energia di legame nucleare

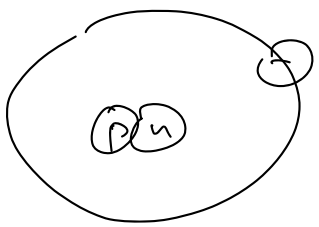
$$m\left({}^{1}_{1}H\right) = m_p + m_e - 13.6\ eV$$

$$= 938.9\ MeV = 1.008\ UA$$

$$1\ UA = \frac{1}{12} m\left({}^{12}_{6}C\right) = 931.494\ MeV$$

H: $B(1,1) = 0$

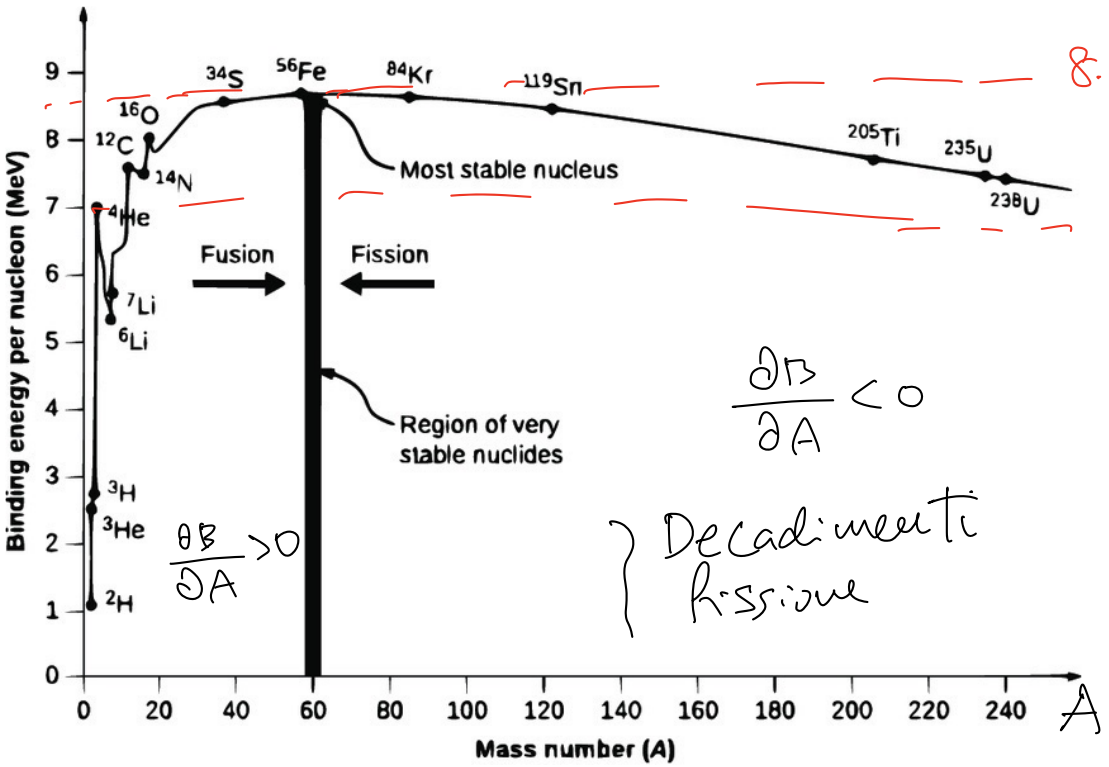
Deuterio: ${}^{2}_{1}H$



deutone: nucleo di Deuterio ${}^{2}_{1}H^{+}$

$$B(1,2) = m\left({}^{1}_{1}H\right) + m_N - m\left({}^{2}_{1}H\right) = 2.225\ MeV$$

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



nucleone: protone o neutrone

$B(^4He) = B(Z,A) = 7$ MeV particella α

$\Rightarrow$ uno dei nuclei più legati.

$\frac{\partial B}{\partial Z} > 0$ per $A \leq 60$ $\Rightarrow$ fissione favorita

Fissione $^{A}_{Z}N \longrightarrow {}^{A_1}_{Z_1}B + {}^{A_2}_{Z_2}C$

$A = A_1 + A_2$ tipicamente $Z_1 \simeq Z_2 \simeq \frac{Z}{2}$

$Z = Z_1 + Z_2$

α $^{A}_{Z}N \longrightarrow {}^{A-4}_{Z-2}B + {}^{4}_{2}He$

$^{A}_{Z}N^{*} \longrightarrow {}^{A}_{Z}N + \gamma$ Decadimento γ

$E_\gamma \simeq 1 - 10$ MeV

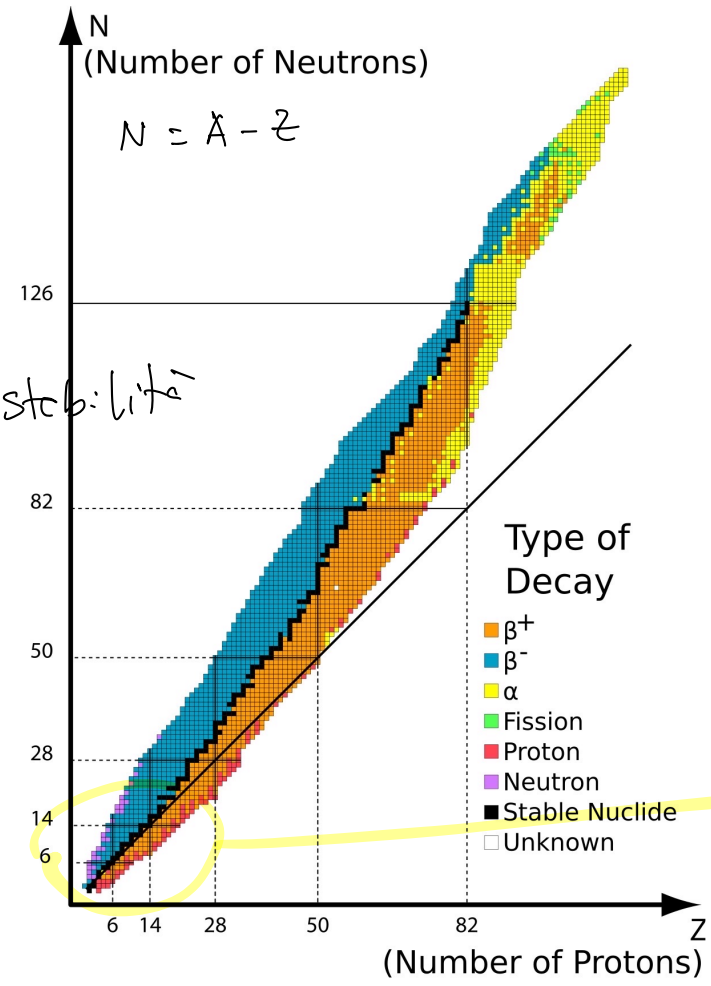
Conservazione # barionico

barioni ($q_1 q_2 q_3$) 3 quark.

protone (uud)

neutrone (udd)

Carta di Segrè



$N = A - Z$

Valle di stabilità

Z grandi

nuclei stabili hanno un eccesso di neutroni

$N \simeq Z$

$A \simeq 2Z$

$\frac{Z}{A} \simeq \frac{1}{2}$