

... od zadania

$$A(t) = A_{ca}(t) + A_{sc}(t)$$

$$\hookrightarrow \frac{N_{ca}(t)}{\tau_1} \quad \hookrightarrow \frac{N_{sc}}{\tau_2}$$

$$\text{Za Ca: } N_{ca}(t) = N_0 e^{-\frac{t}{\tau_1}}$$

$$sc: \frac{dN_{sc}}{dt} = \frac{N_{ca}}{\tau_1} - \frac{N_{sc}}{\tau_2}$$

Riešenie s maticovou metódou:

$$\bullet \text{ homogéna reakcia } N_{sc}^R(t) = B e^{-\frac{t}{\tau_2}}$$

$$\bullet \text{ partikularna reakcia } N_{sc}^P(t) = C e^{-\frac{t}{\tau_1}}$$

Določenie C

$$\frac{dN_{sc}^P}{dt} = \left(-\frac{1}{\tau_1}\right) C e^{-\frac{t}{\tau_1}}$$

$$\Rightarrow \left(-\frac{1}{\tau_1}\right) C e^{-\frac{t}{\tau_1}} = \frac{1}{\tau_1} N_0 e^{-\frac{t}{\tau_1}} - \frac{1}{\tau_2} C e^{-\frac{t}{\tau_1}}$$

$$C = \frac{\frac{N_0}{\tau_1}}{\frac{1}{\tau_2} - \frac{1}{\tau_1}} = \frac{N_0 \tau_2}{\tau_1 - \tau_2}$$

$$IC: N_{sc}(t=0) = 0$$

$$\left[B e^{-\frac{t}{\tau_2}} + C e^{-\frac{t}{\tau_1}} \right] \Big|_{t=0} = 0 \Rightarrow B = -C = -\frac{N_0 \tau_2}{\tau_1 - \tau_2}$$

Celotua aktívnost

$$A(t) = \underbrace{\frac{N_0}{\tau_1} e^{-\frac{t}{\tau_1}}}_{Ca} + \underbrace{\frac{N_0 \tau_2}{(\tau_1 - \tau_2) \tau_2} \left[e^{-\frac{t}{\tau_1}} - e^{-\frac{t}{\tau_2}} \right]}_{Sc}$$

lôžimo ekstreum (máximum)

$$\frac{dA(t)}{dt} = \left(-\frac{1}{\tau_1} \right) \frac{N_0}{\tau_1} e^{-\frac{t}{\tau_1}} + \frac{N_0}{\tau_1 - \tau_2} \left[\left(-\frac{1}{\tau_1} \right) e^{-\frac{t}{\tau_1}} - \left(-\frac{1}{\tau_2} \right) e^{-\frac{t}{\tau_2}} \right] \Big/ \cdot e^{\frac{t}{\tau_1} \tau_1 \tau_2} (-1)$$

už $\frac{dA}{dt} \Big|_{t_{\max}} = \emptyset$

$$\Rightarrow \frac{N_0 \tau_2}{\tau_1} + \frac{N_0}{\tau_1 - \tau_2} \left[\tau_2 - \tau_1 e^{-t_{\max} \left(\frac{1}{\tau_2} - \frac{1}{\tau_1} \right)} \right] = 0$$

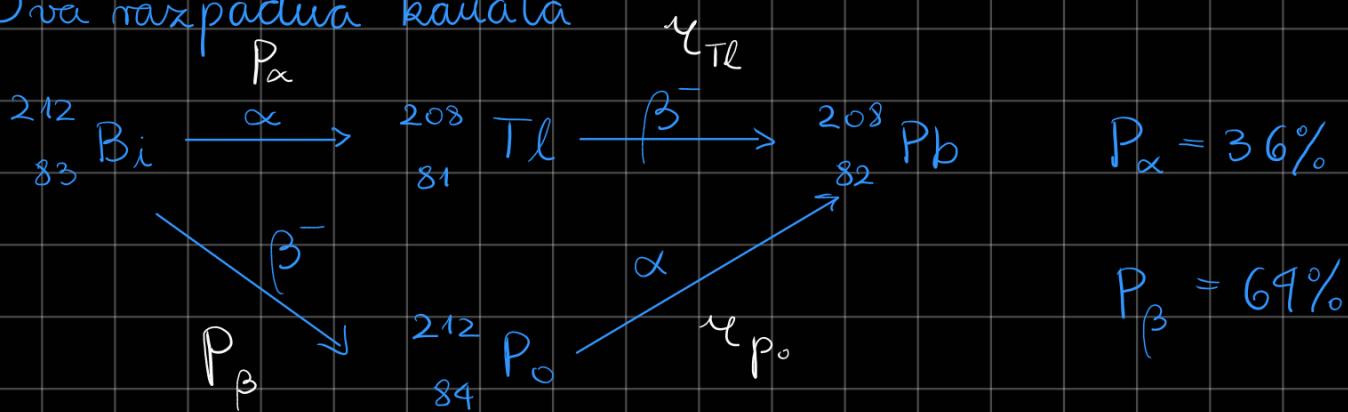
$$t_{\max} = \ln \left(\frac{-\frac{N_0 \tau_2}{\tau_1}}{\frac{N_0}{\tau_1 - \tau_2} - \tau_2} \right) \frac{(-1)}{\frac{1}{\tau_2} - \frac{1}{\tau_1}}$$

$$= -\frac{\tau_2 \tau_1}{\tau_1 - \tau_2} \ln \left(-\frac{\tau_2 (2\tau_1 - \tau_2)}{\tau_1^2} \right) \approx 1'47 \text{ dneva}$$

$$A(t_{\max}) = 1'11 \cdot 10^{14} \text{ Bq}$$

Zorko 5/16

Dva razpadua kauala



$\tau_{Bi} = 87,3$ min celotne razpadui čas bixunta v
vsiac po obch kaualih

$$m_0 = 1 \mu g$$

$$M_{Bi} = 208,9809 \text{ g/mol}$$

↪ mi ok, naj viame mi že ${}^{212}_{83} Bi \rightarrow$ nieskor M nahrávame
o pomocjo SEMF

$$A(t=1h) = \zeta$$

$$\frac{A_\alpha(t=1h)}{A(t=1h)} = \zeta$$

$$N_{Bi} = N_0 e^{-\frac{t}{\tau_B}}$$

$$N_0 = \frac{m_0}{M_{Bi}} N_A$$

$$A(t) = A_{Bi}(t) + A_{Tl}(t) + A_{Po}(t)$$
$$\stackrel{\Gamma}{\rightarrow} \frac{N_{Tl}(t)}{\tau_{Tl}} \quad \stackrel{\Gamma}{\rightarrow} \frac{N_{Po}(t)}{\tau_{Po}}$$

$$\hookrightarrow \frac{N_0}{\tau_B} e^{-\frac{t}{\tau_B}}$$

Talij: \rightarrow verjetnost za razpad

$$\frac{dN_{Te}}{dt} = P^\alpha \frac{N_B}{\tau_B} - \frac{N_{Te}}{\tau_{Te}}$$

Nastavek:

- homogen $B e^{-\frac{t}{\tau_{Te}}}$

- partikularna $C e^{-\frac{t}{\tau_B}}$

$$\Rightarrow C \left(-\frac{1}{\tau_B} \right) e^{-\frac{t}{\tau_B}} = P^\alpha \frac{1}{\tau_B} N_0 e^{-\frac{t}{\tau_B}} - \frac{1}{\tau_T} e^{-\frac{t}{\tau_B}}$$

$$C = \frac{P^\alpha N_0 \tau_{Te}}{\tau_{Bi} - \tau_{Te}}$$

IC: $N_{Te}(t=0) = 0$

$$B = -C = -\frac{P^\alpha N_0 \tau_{Te}}{\tau_{Bi} - \tau_{Te}}$$

Enako velja za polonij

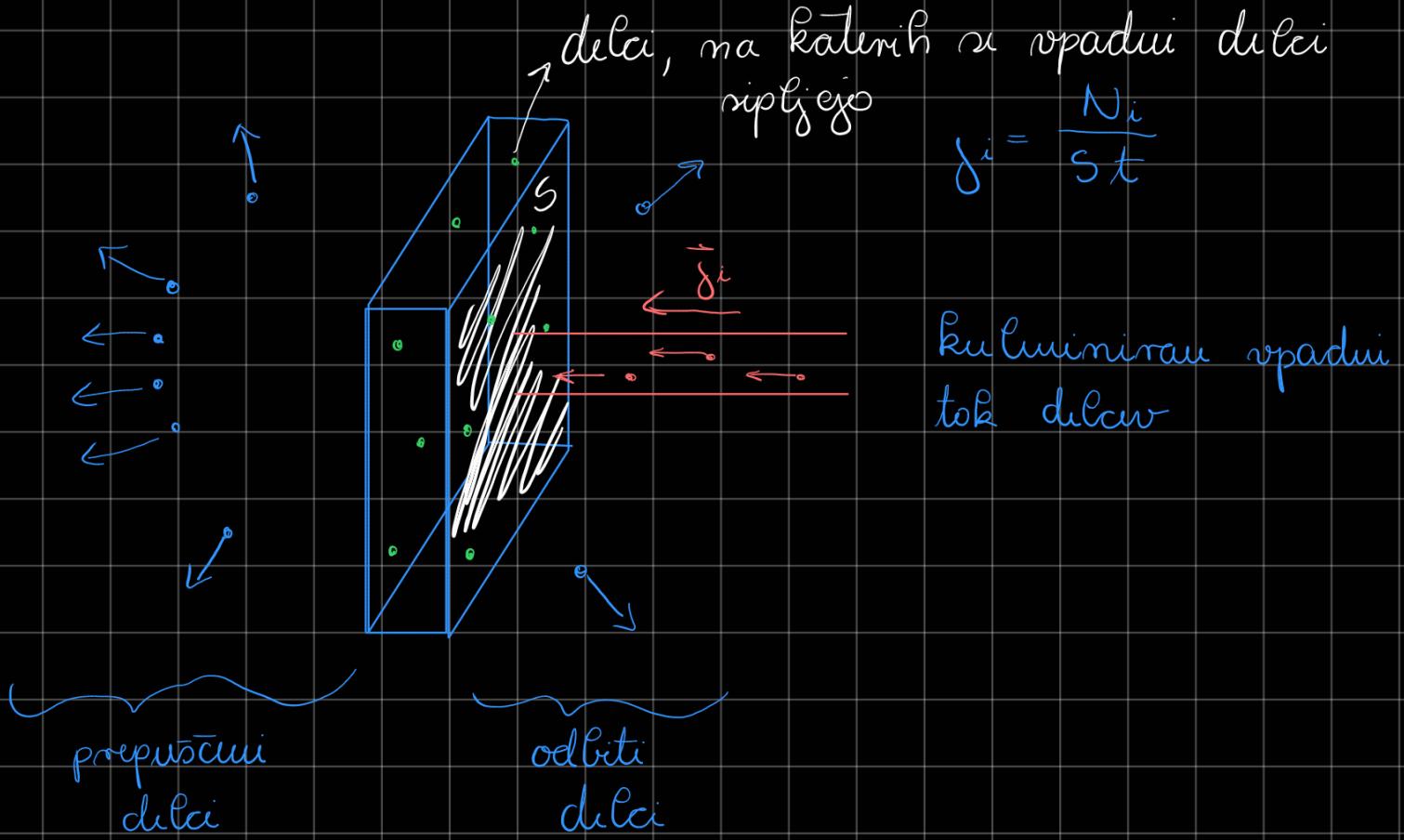
skupaj: $A(t) = \underbrace{\frac{N_0}{\tau_B} e^{-\frac{t}{\tau_B}}}_{A_B} + \underbrace{\frac{P^\alpha N_0}{\tau_B - \tau_{Te}} \left[e^{-\frac{t}{\tau_B}} - e^{-\frac{t}{\tau_T}} \right]}_{A_{Te}} + \underbrace{\frac{P^\beta N_0}{\tau_B - \tau_P} \left[e^{-\frac{t}{\tau_B}} - e^{-\frac{t}{\tau_P}} \right]}_{A_P}$

$$A(t=60\text{ min}) = 5'43 \cdot 10^{11} \text{ Bq}$$

$$A_\alpha(t) = \frac{P_\alpha N_0}{\tau_B} e^{-\frac{t}{\tau_B}} + A_P$$

$$A_\alpha(t=1h) = 2'68 \cdot 10^{11} \text{ Bq} \Rightarrow \frac{A_\alpha(t)}{A(t)} \Big|_{t=1h} = 49\%$$

Sipalui procesi



\rightarrow # interakcij \rightarrow # (gostota) delcov v tarci

$$N_{int} = N_i \frac{N_j}{S} \delta$$

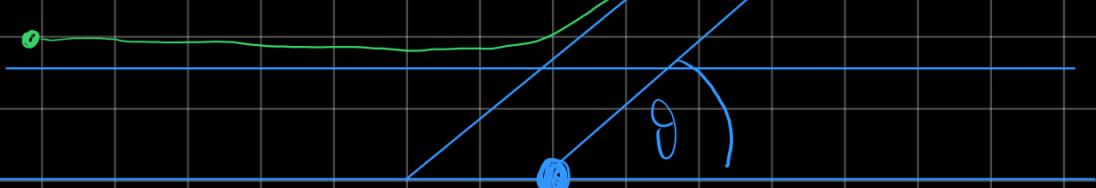
\hookrightarrow sipalui presk
 \rightarrow # vpaduhi delcov

? ... kakma je vreyctvost na sypavje v nekem prostorniku kot?

Te me xamina, koliko delcov se sypa v določnu prostorski kot:

$$N_{sip} (\theta \in (\theta_1, \theta_2)) \propto \delta (\theta \in (\theta_1, \theta_2))$$

Sypavje na Coulombskim potencialu



$$\frac{d\beta}{d\cos\theta} = 2\pi \left(\frac{\chi_1 \chi_2 C_0^2}{16\pi \epsilon_0 T} \right)^2 \frac{1}{\sin^2 \frac{\theta}{2}}$$

$$\frac{C_0^2}{4\pi \epsilon_0} = \alpha \hbar c, \quad \alpha = \frac{1}{137}, \quad \hbar c = 197 \text{ MeV fm}$$

Elastično sijanje. Pri neelastičem sijanju je možnost notranje razgradbe sijalca ali tare (tvorba novih delcev)

Zorko 5/22

$$T = 3 \text{ MeV}$$

$$P_{p\pi} = 99.97\% \Rightarrow P_{OD} = 0.03\%$$



$$S_{Am} = 19.3 \text{ g/cm}^3$$

$$M_{Am} = 196.967 \text{ g/mol}$$

"S.d"

$$P_{OD} = \frac{N_{OD}}{N_i} = \frac{N_{Am}}{S} \cdot \beta_{OD}; \quad N_{Am} = \frac{m_{Am}}{M_{Am}} \cdot N_A = \frac{S_{Am} V}{M_{Am}} N_A$$

$$P_{OD} = \frac{S d \beta_{OD} N_{Am}}{M_{Am}} \Rightarrow d = \frac{P_{OD} M_{Am}}{S_{Am} \beta_{OD} N_A}, \quad \beta_{OD} = ?$$

$$\beta_{OD} = \int_{-1}^0 \frac{d\beta}{d\cos\theta} d\cos\theta \quad \text{pri odložji velja } \theta \in \left(\frac{\pi}{2}, \pi\right) \\ \Rightarrow \cos\theta \in (-1, 0)$$

$$\beta_{OD} = \int_{-1}^0 2\pi \left(\frac{\chi_1 \chi_2 C_0^2}{16\pi \epsilon_0 T} \right)^2 \frac{1}{\sin^2 \left(\frac{\theta}{2}\right)} d\cos\theta$$

Upostavimo $\chi_\alpha = 2, \chi_{Am} = 79$

$$\mathcal{Z}_{\text{OD}} = 2\pi \left(\frac{\gamma g \hbar c \alpha}{2\pi} \right)^2 \int_{-1}^1 \frac{d\cos\theta}{\sin^4(\frac{\theta}{2})}$$

$$\sin\left(\frac{\theta}{2}\right) = \pm \sqrt{\frac{1 - \cos\theta}{2}} \quad \sin^4\left(\frac{\theta}{2}\right) = \frac{(1 - \cos\theta)^2}{4}$$

$$\int_{-1}^1 \frac{d\cos\theta}{(1 - \cos\theta)^2} = \int_{-1}^1 \frac{dx}{(1 - x)^2} = - \int_2^1 \frac{dt}{t^2} = \frac{1}{t} \Big|_2^1 = \frac{1}{2}$$

$$t = 1 - x$$

$$dt = dx$$

$$\mathcal{Z}_{\text{OD}} = \pi \left(\frac{\gamma g \alpha \hbar c}{\pi} \right)^2 = 4'52 \cdot 10^3 \text{ fm}^2$$

Zorko 6/13

$$p_m = 350 \text{ MeV}/c$$

R = 1.5 fm // parameter potencijala jekave

m_{int} = ? // masa nosilca interakcije

$$\frac{P(\theta = 80^\circ \pm 5^\circ)}{P(\theta = 30^\circ \pm 3^\circ)} = 2$$

$$V(r) = -\frac{\alpha^2}{r} e^{-\frac{r}{R}} \quad // \text{doseg moči interakcije}$$

V tej teoriji imamo virtualne prenosače interakcije, ki skrbijo

za propagacijo te interakcije.

- interakcija \propto doseg, nosilci so brezmasni (npr. pri EM interakciji, virtualni fotoni)
- interakcije so končne, nosilci imajo maso (npr. pri močni jekrski interakciji, virtualni pioni)

Zapleteniji formalizem je potreben, saj se delci gibajo s tako velikimi hitrostmi, da α potencial v okolini delca ne spreminja več dovolj hitro, da bi lahko obravnavali hitre spremembe.

Močna interakcija deluje med kvarki \rightarrow nosilci gluoni in tudi med gluoni \rightarrow nosilci pioni

$$R = \frac{\hbar c}{mc^2} \rightarrow m_{int} = \frac{\hbar c}{Rc^2} \quad m_{int}c^2 = \frac{\hbar c}{R} = 130 \text{ MeV}$$

$$\frac{d\mathcal{Z}}{d\Omega} \propto |M|^2$$