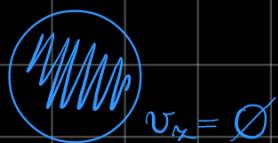


... od radnje

c) kolikšnu delž celote E predstavlja odrivna E ? Na produžkovu u procesu

Odrivna E

taksonomski sistem



$$1) E_{\infty} = m_{\infty} c^2$$

$$2) E_R = m_1 c^2 + T_1 + m_2 c^2 + T_2$$

↓
odrivna energija

V našem primjeru c) kako računati $\frac{T_{Fe}}{E_F} = ?$ - odrivna E (alt. matiču)

$$T_{Fe} = \frac{p^2}{2m_{Fe}} = \frac{(pc)^2}{2m_{Fe}c^2} \Rightarrow E_{odrivena} = \frac{E_F^2}{2m_{Fe}c^2 E_F} \approx 10^{-9}$$

Topič VI / 15

β^- razpad



$$m_n c^2 = 939'56 \text{ MeV}$$

$$m_p c^2 = 938'27 \text{ MeV}$$

$$m_e c^2 = 0'51 \text{ MeV}$$

$$m_{\bar{\nu}_e} = \emptyset$$

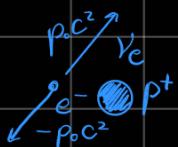
Priuverajmo 2 scenario

a) proton miruje

začetak:



konec



b) el. neutrino mirige



a) Observator E și p

$$p_\infty^\mu c = (m_m c^2, 0)$$

$$\left. \begin{array}{l} p_{e^-}^\mu c = (E_{e^-}, -p_o c) \\ p_{p^+}^\mu c = (m_p c^2, \emptyset) \text{ mirige} \\ p_{\bar{\nu}_e}^\mu c = (E_{\bar{\nu}_e}, p_o c) \end{array} \right\} p_R^\mu c = (E_{e^-} + m_p c^2 + E_{\bar{\nu}_e}, 0)$$

Observator către o galaxie locală

$$m_m c^2 = E_{e^-} + m_p c^2 + E_{\bar{\nu}_e}, \text{ presupunem } E = \sqrt{(mc^2)^2 + (pc)^2}$$

$$m_m c^2 = \underbrace{\sqrt{(m_e c^2)^2 + (p_o c)^2}}_{\text{xenonului neutrino maso}} + m_p c^2 + p_o c / 2$$

$$(m_m c^2)^2 + (m_p c^2)^2 + (p_o c)^2 - 2m_m c^2 p_o c - 2m_m c^2 m_p c^2 +$$

$$2m_p c^2 p_o c = (m_e c^2)^2 + (p_o c)^2$$

$$p_o c = \frac{(m_e c^2)^2 - (m_m c^2)^2 - (m_p c^2)^2 + 2m_m c^2 m_p c^2}{2(m_p c^2 - m_m c^2)} = 0.54 \text{ GeV}$$

Op.: Vzeli mo ultrarelativisticu limită în s tem xenonul neutrino E. To nu bătăi aproape, sau $m_e c^2 \ll E_{\text{kin}}$
 $\frac{p_o c}{m_e c^2}$

$$\left. \begin{array}{l} pc = m_0 v c \\ E = m_0 c^2 \end{array} \right\} \quad \frac{pc}{E} = \frac{v}{c}, \quad E = \sqrt{(m_0 c^2)^2 + (p_0 c)^2}$$

$$\Rightarrow \frac{v}{c} = 0.730 \Rightarrow v_c = 0.730c$$

b) Podolno, samo s kvadratnim enacbo

Dinamika jedrskeh razpadov

$A \rightarrow B$ razpad je makljucni proces

Po sledici teh trditev je razpadui zakon:

(ne vemo, kdaj jedro razpade, poznamo le verjetnost za to)

$$\frac{dN_A}{dt} = -\frac{N_A}{\tau}, \quad \tau \text{ -- razpadui cas}$$

$$\int_{N_{A_0}}^{N_A(t)} \frac{dN_A}{N_A} = \int_0^t \frac{dt}{\tau} \quad (\text{izracun z Egger-Nuttalovo enacbo})$$

razpadov \propto # jedr (ekponenten proces)

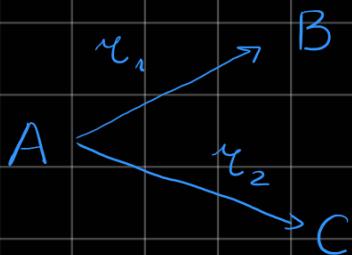
$$\ln \frac{N_A(t)}{N_A(t=0)} = -\frac{t}{\tau} \Rightarrow N_A(t) = N_{A_0} e^{-\frac{t}{\tau}}$$

Za razpolovni cas

$$\ln \frac{N_A(t)}{N_{A_0}} = \log_2 \frac{N_A(t)}{N_{A_0}} \ln 2 \Rightarrow N_A(t) = N_{A_0} 2^{-\frac{t}{\tau_{1/2}}}$$

$t_{1/2} = \gamma \ln 2$... maxpolovni čas

Vec razpadnih produktov



Razpadni zakon $\frac{dN_A}{dt} = -\frac{N_A(t)}{\gamma_1} - \frac{N_A(t)}{\gamma_2}$

Razpadna veriga



Razpadni zakon $\frac{dN_A}{dt} = -\frac{N_A(t)}{\gamma_2} + \frac{N_A(t)}{\gamma_1}$

Opozri, da računamo za A, zato +, ko gre $C \rightarrow A$

A_A ... aktivnost

$$A_A(t) = \left| \frac{dN_A}{dt} \right| = \frac{N_A(t)}{\gamma} \quad [Bg = \text{S}^{-1}]$$

Zorko 5/13



$$\gamma_2 = 87 \text{ dm}$$

$$A_x = 3.5 \cdot 10^9 \text{ Bg} \quad \text{in } A_x = \text{konst.}$$

neaviden počoj

$$A_{sb}(t=0) = 1'2 \cdot 10^9 \text{ Bq}$$

$$A_{sb}(t=t_0) = 2'5 \cdot 10^9 \text{ Bq}$$

$$A_{sb}(t=\max) = \max$$

$$t_0, t_{\max} = ?$$

Treba določimo $A_{sb}(t)$, lahko odgovorimo na obe vprašanji.

$$A_{sb}(t) = \frac{N_{sb}(t)}{\tau_2} \quad ; \quad \frac{dN_{sb}}{dt} = -\frac{N_{sb}}{\tau_2} + \underbrace{\frac{N_x}{\tau_1}}_{A_x}$$

$$\frac{dN_{sb}}{dt} + \frac{N_{sb}}{\tau_2} = A_x \quad // \text{ množimo DE} \quad y' + Ay = f(x)$$

• homogeni del

$$y' + Ay = \emptyset \Rightarrow y_H(x)$$

• partikularni del $y_p(x)$
(ali variacija konst.)

$$\text{Rešitev: } y(x) = y_H + y_p$$

$$\text{Homogeni rešitev} \quad \frac{dN_{sb}}{dt} + \frac{N_{sb}}{\tau_2} = \emptyset$$

$$\Rightarrow N_{sb}^H(t) = K_1 e^{-\frac{t}{\tau_2}}$$

$$\text{Partikularna rešitev} \quad N_{sb}^p = K_2 \neq N_{sb}^p(t) \quad \text{nihomogenost je konst.}$$

$$\Rightarrow N_{sb}(t) = K_1 e^{-\frac{t}{\tau_2}} + K_2$$

$$\frac{dN_{sb}}{dt} = K_1 \left(-\frac{1}{\tau_2} \right) e^{-\frac{t}{\tau_2}}$$

Vntaveniu ~ DE

$$-\cancel{\frac{K_1}{\tau_2} e^{-\frac{t}{\tau_2}}} + \cancel{\frac{K_2}{\tau_2} e^{\cancel{-\frac{t}{\tau_2}}}} + \frac{K_2}{\tau_2} = A_x$$

$$K_2 = A_x \tau_2$$

K_1 dobiuo v_x IC

$$A_{sb}(t) = \frac{N_{sb}(t)}{\tau_2} = \frac{K_1 e^{-\frac{t}{\tau_2}} + K_2}{\tau_2}$$

$$A_{sb}(t=\emptyset) = \frac{K_1 + A_x \tau_2}{\tau_2} \Rightarrow K_1 = (A_{sb}(t=\emptyset) - A_x) \tau_2$$

$$A_{sb}(t) = \frac{1}{\tau_2} \left[(A_{sb}(t=\emptyset) - A_x) \tau_2 e^{-\frac{t}{\tau_2}} + A_x \tau_2 \right]$$

$$= (A_{sb}(t=\emptyset) - A_x) e^{-\frac{t}{\tau_2}} + A_x$$

$$A_{sb}(t_0) = (A_{sb}(t=\emptyset) - A_x) e^{-\frac{t_0}{\tau_2}} + A_x$$

$$t_0 = (-\tau_2) \ln \left[\frac{A_{sb}(t_0) - A_x}{A_{sb}(t=\emptyset) - A_x} \right] = 72 \text{ dni}$$

b) $A_{sb}(t_{max}) = \max ?$

$$\frac{dA_{sb}}{dt} = (A_{sb}(t=\emptyset) - A_x) \left(-\frac{1}{\tau_2} \right) e^{-\frac{t}{\tau_2}}$$

Odwod mina miel \rightarrow maks. w minu. ta dozvina ma robu

definičného obdobia

\Rightarrow funkcia je meraťažnosťa \rightarrow maks. vo dospelosti, keď $t \rightarrow \infty$

$$\text{vii } A_{\text{sb}}(t \rightarrow \infty) = A_x$$

Zorisko 5/14

$$m_0(\text{Ca}) = 5 \text{ mg}$$

$$\gamma = \frac{t_{\frac{1}{2}}}{\ln 2}$$

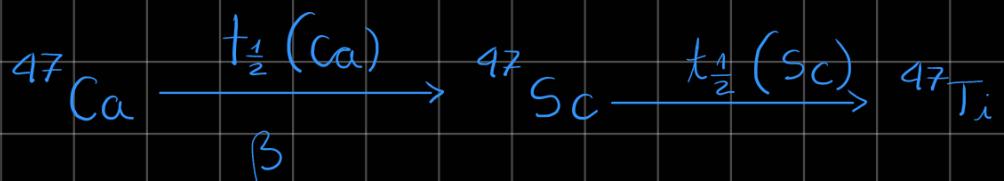
$$t_{\frac{1}{2}}(\text{Ca}) = 4'8 \text{ dneva}$$

$$\gamma_1 = 6'92 \text{ dneva}$$

$$t_{\frac{1}{2}}(\text{Sc}) = 3'43 \text{ dneva}$$

$$\gamma_2 = 4'95 \text{ dneva}$$

$$M(\text{Ca}) = 47 \text{ g/mol}$$



Záčiatková aktívlosť pri $t=0$ súvisí s Ca

$$A(t=0) = \frac{N_{\text{Ca}}(0)}{\gamma_1} = \frac{m_0(\text{Ca}) N_A}{\gamma_1 M(\text{Ca})} = 1'07 \cdot 10^{19} \text{ Bq}$$

$$\bullet A_{t_{\max}} = \max ?$$

Potrebujeme A_t v odvajom: