Radioaktivni raspad

A = aktivnost - broj raspada u jednoj sekundi. $1Bq = 1/s$

$1Ci = 3{,}7 \cdot 10^{10}\,Bq$

$$dN = -\lambda N dt$$

$$A = -\frac{dN}{dt} = \lambda N$$

$$\int_{N_0}^{N} \frac{dN}{N} = -\int_0^t \lambda dt$$

$$\ln N - \ln N_0 = \ln \frac{N}{N_0} = -\lambda t$$

$$\frac{N}{N_0} = e^{-\lambda t}$$

$$\boxed{N = N_0 e^{-\lambda t}}$$

znači da i aktivnost pada kao $A = A_0 e^{-\lambda t}$

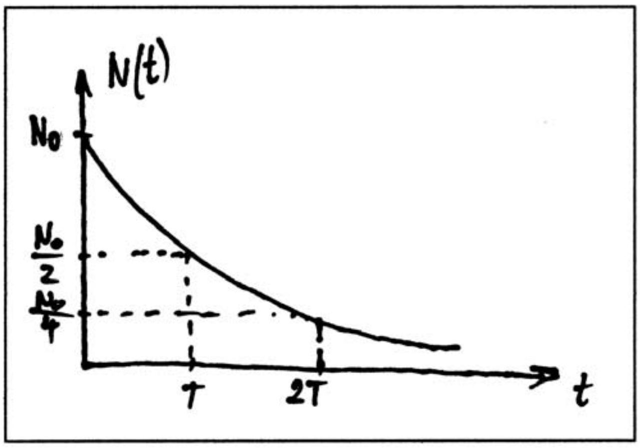
vrijeme poluraspada $T_{1/2} = T$

$$\frac{N_0}{2} = N_0 e^{-\lambda T}$$

$$2 = e^{\lambda T}$$

$$\ln 2 = \lambda T$$

$$T = \frac{\ln 2}{\lambda} = \frac{0{,}693}{\lambda}$$



srednje vrijeme života

$$\tau = \frac{\int_0^\infty t dN}{\int_{N_0}^0 dN} = \frac{\int_0^\infty t d\left(N_0 e^{-\lambda t}\right)}{(-1) N_0}$$

$$\tau = -\int_0^\infty t d\left(e^{-\lambda t}\right) = -\left[t e^{-\lambda t}\right]_0^\infty + \int_0^\infty dt e^{-\lambda t} = 0$$

$$\tau = -\frac{1}{\lambda}\left[e^{-\lambda t}\right]_0^\infty = 0 + \frac{1}{\lambda}$$

$$\boxed{\tau = \frac{1}{\lambda} = \frac{T}{0{,}693}}$$

Radioaktivni nizovi

1) dugoživući roditelji (1), kratkoživući potomak (2), tako da možemo smatrati da je $A_1 = konst.$

$$\frac{dN_2}{dt} = A_1 - \lambda_2 N_2$$

$$\frac{dN_2}{A_1 - \lambda_2 N_2} = dt$$

nova varijabla $u = A_1 - \lambda_2 N_2$ $\quad du = -\lambda_2 dN_2$

$$dN_2 = -\frac{du}{\lambda_2}$$

$$\frac{-du}{\lambda_2(u)} = dt \Rightarrow \boxed{\frac{du}{u} = -\lambda_2 dt}$$

$$\ln(A_1 - \lambda_2 N_2) = -\lambda_2 t + C$$

ako je u $t = 0$ bilo $N_2 = N_{20}$, slijedi $C = \ln(A_1 - \lambda_2 N_{20})$

$$\ln\frac{A_1 - \lambda_2 N_2}{A_1 - \lambda_2 N_{20}} = -\lambda_2 t \text{ ili } A_1 - \lambda_2 N_2 = (A_1 - \lambda_2 N_{20})e^{-\lambda_2 t}$$

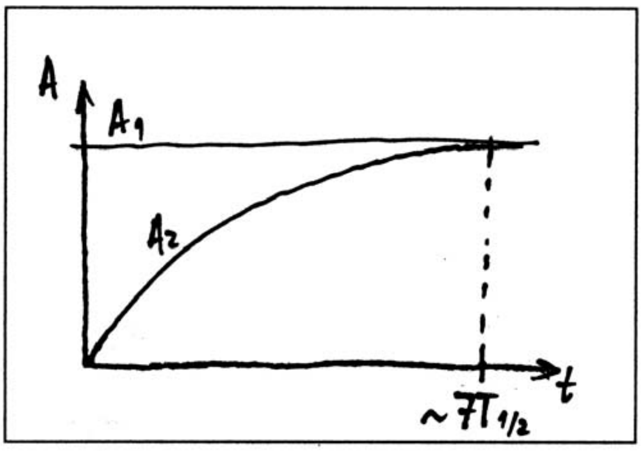
u praksi često počinjemo samo s nuklidom $(1) \Rightarrow N_{20} = 0$

$$\lambda_2 N_2 = \underline{A_2 = A_1\left(1 - e^{-\lambda_2 t}\right)}$$

$e^{-\lambda 2t}$ nakon približno $7T_{1/2}$ postaje zanemariv prema (1), pa imamo $A_1 \approx A_2$

<u>SEKULARNA RAVNOTEŽA</u> !

u tom slučaju ukupna aktivnost iznosi $2A_1$.



2) opći slučaj

Kad nema restrikcije na relativne $\lambda - de$ tada pišemo jednadžbu

$$\frac{dN_2}{dt} = \lambda_1 N_1 - \lambda_2 N_2$$

uz početni uvjet $N_{20} = 0$, rješenje je

$$N_2 = \frac{\lambda_1 N_{10}}{\lambda_2 - \lambda_1}\left(e^{-\lambda_1 t} - e^{-\lambda_2 t}\right)$$