Opgave 6

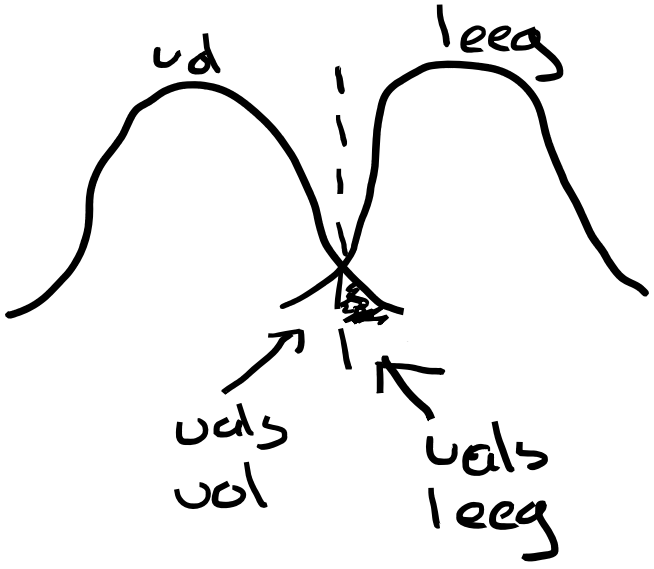
^{83}Kr: 10 GBq

blik ϕ 48 mm

detectierendement $1{,}6 \cdot 10^{-4}$

$\mu/\rho)_{\text{lucht en bier}} = 0{,}0097\ m^2/kg$

$\rho_{bier} = 1008\ kg/m^3$



a) leeg blikje: $\dot{N} = A \cdot f_\gamma \cdot f_{geom} \cdot f_{det} \cdot f_{abs}$

$f_\gamma = 0{,}043$, $f_{geom} \cdot f_{det} = 1{,}6 \cdot 10^{-4}$, $f_{abs} = 1$

$\dot{N}_L = 10 \cdot 10^9\ Bq \cdot 0{,}043 \cdot 1{,}6 \cdot 10^{-4} \cdot 1 = 6{,}89 \cdot 10^3\ cps$

b) $I = I_0 e^{-\mu d}$ $\quad e^{-\mu d} = e^{-\frac{\mu}{\rho} \rho d}$

$= e^{-0{,}0097\,m^2/kg \cdot 1008\,kg/m^3 \cdot 48 \cdot 10^{-3}\,m}$

$= 0{,}625$

Oolblikje: $\dot{N}_v = 6{,}89 \cdot 10^3\,cps \cdot 0{,}625 = 4{,}31 \cdot 10^3\,cps$

c) Aantal counts in 20 ms: $4{,}31 \cdot 10^3 \cdot 20 \cdot 10^{-3} = 86$ counts

$\sigma = \sqrt{N} = \sqrt{86} = 9$ counts

$\sigma_{\dot{N}_v} = \frac{9}{20 \cdot 10^{-3}\,s} = 460$ counts/s $= 0{,}5 \cdot 10^3\,cps$

d) Selectredrempel $\frac{1}{2}(N_L + N_v) = \frac{1}{2}(6{,}89 + 4{,}31) \cdot 10^3$

$= 560 \cdot 10^3\,cps$

Verschil met leeg blikje: $(6{,}89 - 5{,}60) \cdot 10^3 = 1{,}29 \cdot 10^3\,cps$

" " vol "

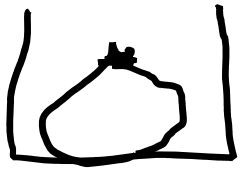
$\sigma_{N_v} = 0{,}5\ 10^3$ cps

Aantal standaarddeviaties: $k = \frac{1{,}29}{0{,}5} = 2{,}58$

Bijbehorende kansen zijn dan: 0,006 en 0,0013

e)

Opgave 10



^{131}I uitgavegrens 100 Bq/g

achtergrond: 1398 tps in 10 min

a) $\dot{N} = A \cdot f_\gamma \cdot f_{geom} \cdot f_{det} \cdot f_{abs}$

$E_\gamma = 365\,keV \quad f_\gamma = 0{,}812 \quad f_{det} = 0{,}11$ ← f_{det} figuur

$\Rightarrow f_\gamma \cdot f_{det} = 0{,}812 \cdot 0{,}11 = 8{,}9 \cdot 10^{-2}$ tps/Bq

E_γ	Y	η
365	0.812 ± 0.11	$= 8{,}9 \cdot 10^{-2}$
284	0061 ± 0.10	$6{,}1 \cdot 10^{-3}$
80	0026 ± 0045	$1{,}2 \cdot 10^{-3}$
	0,899	$9{,}6 \cdot 10^{-2}$

b) $A = 20\,kg \cdot 1\,Bq/g \cdot 10^3\,g/kg = 20\,kBq$

$N = 8{,}9\,10^{-2}\,tps/Bq \cdot 20 \cdot 10^3\,Bq = 1780\,tps$

$T_{bruto} = T_{netto} + T_{achtergrond} = 1780 + 1398 = 3178 = 3{,}2\,10^3\,tps$

c) Geen activiteit, alleen nuleffect

↳ in $t = 10s$ worden $1398 \cdot 10 = 1{,}4 \cdot 10^4$ pulsen

d) $\sigma = \sqrt{N} = \sqrt{1{,}4 \cdot 10^4} = 118$ pulsen

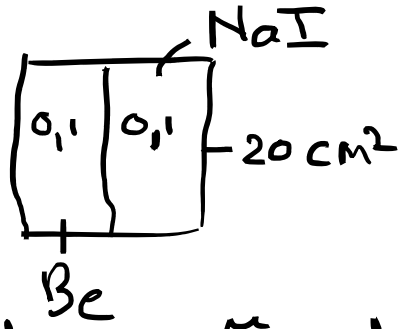
e) Minimaal detecteerbare activiteit $3\sigma = 3 \cdot 118 = 355$ pulsen

$N = A \cdot \varepsilon \Rightarrow A = \frac{N}{\varepsilon} = \frac{355/10\,tps}{8{,}9\,10^{-2}\,tps/Bq} = 399\,Bq$

f) $\frac{399\,Bq}{20\,kg} = 19{,}9\,Bq/kg = 0{,}020\,Bq/g \ll 100\,Bq/g.$

Opgave 12

^{55}Fe



K_α 6 keV 0,250

a) $T = e^{-\mu d} = e^{-\frac{\mu}{\rho}\cdot\rho d} = e^{-2{,}07\,cm^2/g \cdot 1{,}85\,g/cm^3 \cdot 0{,}01\,cm}$

$= 0{,}962$

b) $T = e^{-\mu d} = e^{-\frac{\mu}{\rho}\cdot\rho\cdot d} = e^{-450\,cm^2/g \cdot 3{,}67\,g/cm^3 \cdot 0{,}01\,cm}$

$= 6{,}72 \cdot 10^{-8}$

c) $N = A \cdot f_x \cdot f_{geom} \cdot f_{det} \cdot f_{abs}$

$f_x = 0{,}250$

$f_{geom} = 0{,}5$

$f_{det} = 1 - T = 1 - 6{,}72 \cdot 10^{-8} \approx 1 \cdot 0{,}962$

$f_{abs} = 1$

$N = A \cdot 0{,}250 \cdot 0{,}5 \cdot 0{,}962 = 0{,}120\,A$

$A = 1\,Bq/cm^2 \cdot 20\,cm^2 = 20\,Bq$

$N = 0{,}120 \cdot 20 = 2{,}4\,tps$ per $1\,Bq/cm^2$

dj $2000\,Bq/cm^2 \longrightarrow 5000\,tps$

dus glufactor: $\frac{5000\,tps}{2000\,Bq/cm^2} = 2{,}5\,tps$ per Bq/cm^2