8) Jaká bude energie rozpadu alfa jádra uranu 236? Jakou bude mít energii emitovaná alfa částice a jaká bude její rychlost a de Broglieho vlnová délka? [Q = 4,579 MeV, EK = 4,501 MeV, v = 0,0491 c, λ = 6,7 fm]

$^{236}_{92}U \rightarrow {}^{4}_{2}\alpha + {}^{232}_{90}Th$

$E_\alpha = 3727{,}4$ MeV

$E_{236} = 219\,829{,}5855$ MeV

$E_{232} = 216\,097{,}6$ MeV

$\hbar \cdot c = 197{,}3$ MeV·fm

Q: $E_{236} = E_\alpha + E_{232} + Q \rightarrow Q = 219\,829{,}5855 - 3727{,}4 - 216\,097{,}6$

$Q = 4{,}5855$ MeV

$E_{k\alpha}$:

ZZE: $E_{k232} + E_{k\alpha} = Q$

$\frac{1}{2} m_{232} \cdot v_{232}^2 + \frac{1}{2} m_\alpha v_\alpha^2 = Q$

ZZH: $p_{232} = p_\alpha$

$m_{232} \cdot v_{232} = m_\alpha \cdot v_\alpha \rightarrow v_{232} = \frac{m_\alpha}{m_{232}} \cdot v_\alpha$

Dosazení v_{232} do ZZE:

$\frac{1}{2} m_{232} \left(\frac{m_\alpha}{m_{232}} \cdot v_\alpha\right)^2 + \frac{1}{2} m_\alpha \cdot v_\alpha^2 = Q$

$\underbrace{\frac{1}{2} m_\alpha v_\alpha^2}_{E_{k\alpha}} \cdot \left(\frac{m_\alpha}{m_{232}} + 1\right) = Q$

$E_{k\alpha} = \frac{Q}{\frac{m_\alpha}{m_{232}} + 1} = \frac{4{,}5855}{\frac{3727{,}4}{216\,097{,}6} + 1} = 4{,}5077$ MeV

v: $E_{k\alpha} = \frac{1}{2} m_\alpha \cdot v_\alpha^2 \rightarrow v_\alpha = \sqrt{\frac{2 \cdot E_{k\alpha}}{m_\alpha}} = \sqrt{\frac{2 \cdot 4{,}5077}{3727{,}4}} = 0{,}0492\,c$

λ: $\lambda = \frac{h}{p} = 2\pi \frac{\hbar \cdot c}{m_\alpha \cdot v_\alpha \cdot c} = 2\pi \cdot \frac{197{,}3}{3727{,}4 \cdot 0{,}0492} = 6{,}76$ fm