

Lösn. anv. till tentamen Fysik för E del II (2000-12-11)

① Bragg: $2 \frac{a}{\sqrt{h^2+k^2+l^2}} \sin \theta = \lambda \Rightarrow \frac{\sin^2 \theta}{h^2+k^2+l^2} = \frac{\lambda^2}{4a^2}$

Si: diamantstruktur: $h^2+k^2+l^2 = 3, 8, 11, 16, \dots$
 och $a = 5,43 \text{ \AA}$

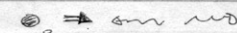
$\therefore \frac{\lambda^2}{4a^2} = \frac{\sin^2 15^\circ}{3} = \frac{\sin^2 24,5^\circ}{8} = \frac{\sin^2 29^\circ}{11} = \frac{\sin^2 36^\circ}{16} = 0,022$

$\Rightarrow \lambda = \sqrt{0,022} \cdot 2 \cdot a = 1,61 \text{ \AA}$; neutroner våglängd $= \lambda = \frac{h}{m_n v}$

a) $\Rightarrow v = \frac{h}{m_n \lambda} = \frac{6,63 \cdot 10^{-34}}{1,67 \cdot 10^{-27} \cdot 1,61 \cdot 10^{-10}} \text{ m/s} = 2464 \text{ m/s} \approx 2,5 \cdot 10^3 \text{ m/s}$

b) 4:de reflexen för $h^2+k^2+l^2 = 16$ skall komma vid $\theta = 80^\circ$

$\therefore 2 \cdot \frac{5,43 \text{ \AA}}{\sqrt{16}} \cdot \sin 80^\circ = \lambda \Rightarrow \lambda = 2,67 \text{ \AA} \Rightarrow v = \frac{h}{m_n \lambda} = 1485 \text{ m/s} \approx 1,5 \cdot 10^3 \text{ m/s}$

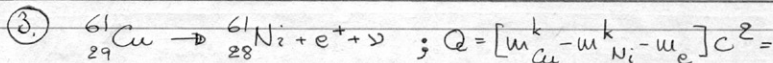
② π^- -meson: i vila \Rightarrow 
 sönderfaller: $m_0 c^2 = 67,5 + 67,5 \text{ MeV} = 135 \text{ MeV} = E_0$

π^- -meson: i rörelse \Rightarrow 
 sönderfaller: $v = ?$

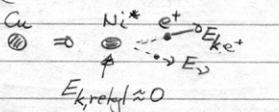
Energi: $E_1, E_2, E_3 = 99 \text{ MeV}$; $E_1 = E_2 + E_3 \dots$ ①
 Rörelsemängd: $\frac{1}{2} \sqrt{E_1^2 - E_0^2}, \frac{E_2}{c}, \frac{E_3}{c}$; $\sqrt{E_1^2 - E_0^2} = E_3 - E_2 \dots$ ②

Kvadrera ① och ② och subtrahera: $E_0^2 = 4E_2 E_3 \Rightarrow E_2 = \frac{E_0^2}{4E_3} = 46 \text{ MeV}$

Ekv. ①: $E_1 = E_2 + E_3 = 46 \text{ MeV} + 99 \text{ MeV} = 145 \text{ MeV}$
 men $E_1 = \frac{E_0}{\sqrt{1-v^2/c^2}} \Rightarrow 1 - \frac{v^2}{c^2} = \left(\frac{E_0}{E_1}\right)^2 = \left(\frac{135}{145}\right)^2 \Rightarrow v = 0,36c$



$= [(60,933462 u - 29 m_e) - (60,931057 u - 28 m_e) - m_e] c^2 = 0,001307 u \cdot c^2 = 1,217 \text{ MeV}$

$\text{Cu} \Rightarrow \text{Ni}^* + e^+ + \nu$

 E_{k,e^+}^{max} då $E_\nu \approx 0$; Vidare: $E_{k,\text{Ni}}^{\text{reky}} \approx 0$
 $\therefore E_{k,e^+}^{\text{max}} \approx Q = 1,217 \text{ MeV}$ om Ni i grundtillst.
 eller $m_e \ll m_{\text{Ni}}$
 $E_{k,\text{reky}} \approx 0$

Svar: $E_{k,e^+}^{\text{max}} = 1,217 - 0,66 = 0,56 \text{ MeV}$ då Ni i exc. tillst.