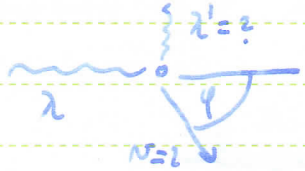
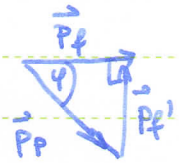
Foton nv. z val. dolžino 1,25 pm se sipa na mirujočem protonu. Sipan f. odleti pod kotom 90° glede na vpadni f. Kakšna je val. dolžina sipanega f., v kateri smeri in s kakšno hitrostjo odleti p.?

$\lambda = 1{,}25\ pm$

$m_p = 1{,}6 \cdot 10^{-27}\ kg$



Gib. k.:



$$\lambda' - \lambda = \frac{h}{m_e c}(1 - \cos\varphi)$$

$m_e \to m_p$, $\varphi = 90°$

$$\lambda' = \frac{h}{m_p c}(1 - \cos\varphi) + \lambda = \frac{6{,}62 \cdot 10^{-34}\ Js}{1{,}6 \cdot 10^{-27}\ kg \cdot 3 \cdot 10^{8}\ m} \cdot 1 + 1{,}25 \cdot 10^{-12}\ m =$$

$$= 1{,}25 \cdot 10^{-12}\ m = 1{,}25\ pm$$

$$p_f' = p_f = \frac{h}{\lambda} = \frac{6{,}62 \cdot 10^{-34}\ Js}{1{,}25 \cdot 10^{-12}\ m} = 5{,}3 \cdot 10^{-22}\ \frac{kg\,m}{s}$$

$\Downarrow$

$\varphi = 45°$

gib. k.: $p_p = \sqrt{2} \cdot p_f$ iz kvadrata $= \sqrt{2} \cdot 5{,}3 \cdot 10^{-22}\ \frac{kg\,m}{s} =$

$$= 7{,}5 \cdot 10^{-22}\ \frac{kg\,m}{s}$$

$p_p = m_p v_p$

$$v_p = \frac{p_p}{m_p} = \frac{7{,}5 \cdot 10^{-22}\ kg\,m}{s \cdot 1{,}6 \cdot 10^{-27}\ kg} = 4{,}68 \cdot 10^{5}\ m\,s^{-1}$$

W_k = RAČUNAJ $\frac{1}{2} m_p v_p^2$

Idealna pritlikavka ima največje sevanje sv. pri 650 nm. Kakšen je njen premer, če izseva enako količino E kot naše sonce? Sonce ima radij 695 500 km, gostota sv. toka na Zemlji je $1370 \frac{W}{m^2}$, oddaljenost od Sonca je 150 mio km. Na kateri oddaljenosti od rd. pritlikavke pride planet velikosti Zemlje enako veliko količine?

$\lambda_{RP} = 650$ nm

$R_S = 695\,500$ km

$R_{ZS} = 150 \cdot 10^6$ km

$j = 1370 \frac{W}{m^2}$

$$j = \frac{P_{moč}}{S} = \frac{P}{4\pi r^2}$$

$$P = j 4\pi r^2 = 1370 \frac{W}{m^2} \cdot 4\pi \cdot (150 \cdot 10^9 m)^2 = 3{,}87 \cdot 10^{26} W$$

$$j_{površ} = \frac{P}{4\pi R_S^2} = \frac{3{,}87 \cdot 10^{26} W}{4\pi (695\,500 \cdot 10^3)^2} = 6{,}37 \cdot 10^7 \frac{W}{m^2}$$

$$j = \sigma T^4$$

$$T = \sqrt[4]{\frac{j}{\sigma}} = \sqrt[4]{\frac{6{,}37 \cdot 10^7 W m^{-2} K^4}{5{,}67 \cdot 10^{-8} W m^{-2}}} = 5800 K$$

$$k_W = \lambda_{MAX} \cdot T$$

$$T_{RP} = \frac{k_W}{\lambda} = \frac{2{,}897 \cdot 10^{-3} mK}{650 \cdot 10^{-9} m} = 4457 K \qquad \lambda_{MAX} = \frac{2{,}897 \cdot 10^{-3} mK}{5800 K} = 500 nm - RUMENA$$

$$j_{RP} = \sigma \cdot T^4 = 5{,}67 \cdot 10^{-8} \frac{W}{m^2 K^4} \cdot (4457 K)^4 = 2{,}24 \cdot 10^7 \frac{W}{m^2}$$

$$R_{RP}^2 = \frac{P_{ZEM}}{4\pi j_{RP}} = \frac{3{,}87 \cdot 10^{26} W m^{-2}}{4\pi \cdot 2{,}24 \cdot 10^7 W} \Rightarrow 1{,}17 \cdot 10^6 km$$

Rdeča pritlikavka vol. II :

$P_{RP} = P_S$

$j = \frac{P}{4\pi r^2}$

$j_{površina\ S} = \frac{P_S}{4\pi R_S^2}$

$P_S = j_z \cdot 4\pi r_z^2$

Sonce se obnaša kot črno telo :

$j = \sigma T^4$

$k_w = T \cdot \lambda_{MAX\ RP}$

$T_{RP} = \frac{k_w}{\lambda_{MAX\ RP}}$

$j_{POVRŠINA\ RP} = \sigma \cdot T_{RP}^4$

$j_{RP} \cdot 4\pi R_{RP}^2 = P_S$

$R_{RP} = \sqrt{\frac{P_S}{j_{RP}\, 4\pi}} \Rightarrow$

$= 1{,}17 \cdot 10^6\ km$

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2. del RP :

$j_z = \frac{P_S}{4\pi r_z^2}$ — oddaljenost Sonca od Zemlje

$j_{P,RP} = \frac{P_{RP}}{4\pi r_P^2}$

$\frac{P_S}{4\pi r_z^2} = \frac{P_{RP}}{4\pi r_P^2}$

Na oddaljenosti (kot Sonce od Zemlje)

$150 \cdot 10^6$ km.

Tiger Woods udari golf žogico z maso 45,93 g z lesom 3. Žogica odleti s hitrostjo 174 milj/h. Hitrost je val. dolžina žogice in frekvenca? Udarec bi moral biti izvršen na rebl. mrežici, da bi z njo lahko naredili interferenco!

$1{,}6093\ km = 1\ milja$

$m_{GŽ} = 45{,}93\ g$

$v = 174\ mph$

$174\ mph = 174 \cdot \frac{1{,}6093 \cdot 10^3\ m}{3600\ s} = 77{,}78\ m\,s^{-1}$

$\lambda = \frac{h}{p} = \frac{h}{mv}$

$\lambda = \frac{6{,}62 \cdot 10^{-34}\ J\,s}{45{,}93 \cdot 10^{-3}\ kg \cdot 77{,}78\ m\,s^{-1}} = 1{,}853 \cdot 10^{-34}\ m$

$\nu = \frac{c}{\lambda} = \frac{3 \cdot 10^8\ m\,s^{-1}}{1{,}853 \cdot 10^{-34}\ m} =$

$E = h\nu$

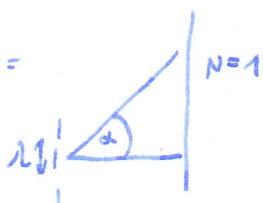
$\nu = \frac{E}{h}$

$E = W_k + E_0 = \frac{1}{2} m_{GŽ} \cdot v^2 + m_{GŽ} \cdot c^2 =$

$= 4{,}13 \cdot 10^{15}\ J$

$\nu = \frac{4{,}13 \cdot 10^{15}\ kg\,m^2\,s^{-2}}{6{,}62 \cdot 10^{-34}\ s^2\,kg\,m^2\,s} =$

$= 6{,}24 \cdot 10^{48}\ s^{-1}$



$N\lambda = d \sin\alpha$

$N = 1$

$\alpha = 90°$

$\lambda = d = 1{,}853 \cdot 10^{-34}\ m$

$m_{no} = 1{,}00866\ u$

$u = 1{,}66 \cdot 10^{-27}\ kg$

$m_{no} = u \cdot 1{,}00866\ u =$

$= 1{,}66 \cdot 10^{-27}\ kg \cdot 1{,}00866 =$

$= \underline{1{,}6744 \cdot 10^{-27}\ kg}$

$\lambda = \frac{h}{m_n \cdot v_n} = \frac{6{,}62 \cdot 10^{-34}\ Js / kg\,m^2\,s}{1{,}674756 \cdot 10^{-27}\ kg \cdot 77{,}78\ m\,s^{-1}} = \underline{5{,}1 \cdot 10^{-9}\ m} \Rightarrow$

pbl. mrežica mora biti velika $5{,}1 \cdot 10^{-9}\ m$

$\nu = \frac{E}{h} = \frac{\frac{1}{2}mv^2 + mc^2}{h} = \frac{1{,}674756 \cdot 10^{-27}\ kg \cdot 9 \cdot 10^{16}\ m^2 s}{s^2 \cdot 6{,}62 \cdot 10^{-34}\ kg\,m^2} =$

$= 2g \cdot 1{,}507 \cdot 10^{10} \cdot \underline{2{,}28 \cdot 10^{23}\ s^{-1}}$

Kolikšna je energija osnovnega stanja Be^{3+}? Na kakšni razdalji kroži e^- na 5. vzbujenem stanju? Kolikšna je val. dolžina prehoda iz 1. v 2. vzbujeno stanje?

$e_0 = 1{,}6 \cdot 10^{-19}\ As$

$m_e = 9{,}1 \cdot 10^{-31}\ kg$

$\hbar = 1{,}055 \cdot 10^{-34}\ Js$

$\varepsilon_0 = 8{,}85 \cdot 10^{-12}\ \frac{As}{Vm}$

Za Be^{3+} velja Bohrov model atoma:

$E_{Be^{3+}} = \frac{-z^2 e_0^4 m_e}{32\pi^2 \varepsilon_0^2 \hbar^2 n^2}$ $\quad n = 1$ ... osnovno stanje $\quad z = 4$

$E_{Be^{3+}} = \frac{-4^2 \cdot (1{,}6 \cdot 10^{-19}\ As)^4 \cdot 9{,}1 \cdot 10^{-31}\ kg}{32\pi^2 \cdot (8{,}85 \cdot 10^{-12}\ As\,V^{-1}m^{-1})^2 (1{,}055 \cdot 10^{-34}\ Js)^2 \cdot 1} =$

$= \ldots$

$E_{Be^{3+}} = \frac{-13{,}6\ eV \cdot z^2}{n^2} = \frac{-13{,}6\ eV \cdot 16}{1} = -217{,}6\ eV$

$\underline{-3{,}48 \cdot 10^{-17}\ J}$