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fisika modern

1. $x_1 = 0$ hingga $x_2' = l_0$

$l = x_2 - x_1$

$x' = \gamma (x - ut)$

$t' = \gamma \left(t - \frac{ux}{c^2}\right)$

$\gamma = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}$

• Waktu sama ($t_1 = t_2$)

$x_1' = \gamma (x_1 - ut)$

$x_2' = \gamma (x_2 - ut)$

$l_0 = x_2' - x_1'$

$l_0 = \gamma (x_2 - ut) - \gamma (x_1 - ut)$

$l_0 = \gamma (x_2 - 1)$ atau

$l = \frac{l_0}{\gamma} \rightarrow \gamma = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}$

$l = l_0 \sqrt{1 - \frac{u^2}{c^2}}$

2. Diketahui :

$E = 25\ 6\ eV$

$d = 3000\ m$

$m_0 = 0{,}511\ MeV/c^2$

$c = 3 \times 10^8\ m/s$

Ditanya :

a. Kecepatan elektron yang energinya 25 6eV ?

b. Waktu yang diperlukan untuk menempuh jarak 300 m?

c. Panjang avs elevator dalam kerangka acuan elektron ?

d. Waktu tempuh elektron dalam kerangka acuan laboratorium sendiri ?

Jawab :

a) $E = \gamma m_0 c^2$

$\gamma = \frac{E}{m_0 l^2}$

Date :

$= \frac{2.5 \times 10^9 \text{ eV}}{0.511 \times 10^6 \text{ eV}}$

$= 4.89 \times 10^4$

$1 - \frac{v^2}{c^2} = \frac{1}{\gamma^2}$

$\frac{v^2}{c^2} = 1 - \frac{1}{(4.89 \times 10^4)^2}$

$v = c\sqrt{1 - \frac{1}{(4.89 \times 10^4)^2}}$

$v \approx c(1 - 1.05 \times 10^{-10})$

$v \approx 2.99999 \times 10^8$ m/s

sama dengan kecepatan cahaya

$(-v \approx 0.031$ m/s

Jadi elektron hampir bergerak dengan kecepatan cahaya.

b) $t = \frac{d}{v}$

$t = \frac{3000 \text{ m}}{2.99999 \times 10^8 \text{ m/s}}$

$t \approx 1.00000000001 \times 10^{-5}$ s

≈ 10 Ms

c) $l' = l\sqrt{1 - \frac{v^2}{c^2}}$

karena $\gamma \approx 4.89 \times 10^4$, maka

$l' = \frac{3000}{4.89 \times 10^4}$

$l' \approx 0.061$ m $= 6.1$ cm

d) $t' = \frac{t}{\gamma}$

$t' = \frac{10^{-5}}{4.89 \times 10^4}$

$t' \approx 2.04 \times 10^{-4}$ s $= 0.204$ ms

3. Diketahui : $\lambda_0 = 122$ nm

$\lambda_1 = 366$ nm

$c = 3 \times 10^8$ m/s

Ditanya = a) kecepatan galaksi v jika spektrum bergeser dari λ_0 menjadi λ'?

b) panjang gelombang baru λ jika galaksi menjauhi bumi dengan kecepatan yang sama

a) $\frac{\lambda}{\lambda_0} = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$

$\frac{366 \text{ nm}}{122 \text{ nm}} = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$

No.

Date:

8 nm $= \sqrt{\frac{1+\frac{v}{c}}{1-\frac{v}{c}}}$

$g = \frac{1+\frac{v}{c}}{1-\frac{v}{c}}$

$g = (1-\frac{v}{c} = 1+\frac{v}{c}$

$g - g\frac{v}{c} = 1+\frac{v}{c}$

$8 = 10\frac{v}{c}$

$v = \frac{8}{10} c = 0,8c$

$V = 0,8(3\times10^8 \text{ m/s})$

$= 2,4 \times 10^8 \text{ m/s}$

b. $\frac{\lambda''}{\lambda_0} = \sqrt{\frac{1-\frac{v}{c}}{1-\frac{v}{c}}}$

$\lambda'' = \lambda_0 \times \sqrt{\frac{1-0,8}{1+0,8}}$

$= \lambda_0 + \sqrt{\frac{0,2}{1,8}}$

$= 122 \times \sqrt{0,1111}$

$= 122 \times 0,3123$

$\lambda'' \simeq 40,167 \text{ nm}$

4. Diketahui :

E perotom = 200 mev

muranium :

A = 235

1 mev $= 1,602 \times 10^{-13}$ J

($= 3 \times 10^8$ m/s

m atom $\frac{235g}{6,022 \times 10^{23}}$

Ditanya : perubahan massa dan aktivasi reaksi 1 kg uranium ?

Jawab :

E = 200 mev $\times 1,602 \times 10^{-13}$ J/mev

$= 3,204 \times 10^{-11}$ J

Jumlah atom dalam uranium 1kg :

$N = \frac{1000\ g}{m \text{ atom}}$

$= \frac{1000\ g}{\frac{235}{6,022 \times 10^{23}}} \cdot 2,56 \times 10^{24}$ atom

E total : $(3,204 \times 10^{-11}$ J (atom) $(2,56 \times 10^{24})$

$= 8,20 \times 10^{13}$ J

$E = mc^2 \rightarrow m = E / c^2$

$m = (8{,}20 \times 10^{10}\ J) / (3 \times 10^8\ m/s)^2$

$= 9{,}11 \times 10^{-4}\ kg$

5. Diketahui :

$m_p = 1{,}007276\ u$ $\quad$ $1u = 1{,}66059 \times 10^{-23}\ kg$

$m_n = 1{,}008665\ u$ $\quad$ $1u c^2 = 931{,}5\ MeV$

$m\ helium = 4{,}001506\ u$

Ditanya :

a) energi kuat inti helium E_b

b) benda massa inti helium dengan fotal massa partikel

Jawab :

a) massa total $= 2\ m_p + 2 m_n$

$= 2(1{,}007276) + 2(1{,}008665)$

$= 4{,}03188\ u$

$\Delta m = m\ total - m\ helium$

$= 4{,}03188\ u - 4{,}00506$

$= 0{,}030376\ u$

$E = \Delta m c^2$

$= (3{,}0444 \times 10^{-29}\ kg)(2{,}9979 \times 10^8\ m/s)^2$

$= 4{,}533 \times 10^{-12}\ J = 28{,}6\ MeV$

b) $\Delta m\ kg = (0{,}030376\ u) \times (1{,}66059 \times 10^{-27}\ kg)$

$= 3{,}04 \times 10^{-29}\ kg$

6. Diketahui :

$V_A = 0{,}8\ c$

$V_B = 0{,}6\ c$

Ditanya : kecepatan pesawat di bulan (V') ?

Jawab :

$$V' = \frac{V_A + V_B}{1 + \frac{V_A V_B}{c^2}} = \frac{0{,}8 + 0{,}6\ c}{1 + (0{,}8)(0{,}6)} = \frac{1{,}4\ c}{1 + 0{,}48} = \frac{1{,}4}{1{,}48} = 0{,}946\ c$$

7. Diketahui :

$P = 20$ W

$\lambda = 589$ nm $= 589 \times 10^{-9}$ m

$h = 6{,}626 \times 10^{-34}$ Js

$c = 3 \times 10^{8}$ m/s

Ditanya : Jumlah foton yang dipancarkan ?

Jawab :

$$E = \frac{hc}{\lambda} = \frac{(6{,}626 \times 10^{-34})(3 \times 10^{8})}{589 \times 10^{-9}}$$

$$= \frac{1{,}9878 \times 10^{-25}}{589 \times 10^{-9}} \approx 3{,}37 \times 10^{-19} \text{ J}$$

$$N = \frac{20}{3{,}37 \times 10^{-19}} = 5{,}93 \times 10^{19} \text{ foton / detik.}$$

8. Diketahui :

$W = 2{,}2$ eV

$\lambda = 3500$ Å $= 3500 \times 10^{-10}$ m $= 3{,}5 \times 10^{-7}$ m

$c = 3 \times 10^{8}$ m/s

1 eV $= 1{,}6 \times 10^{-19}$ J

Ditanya : Energi kinetik maksimum foto elektron (h) dalam eV ?

Jawab :

$$E = \frac{hc}{\lambda} = \frac{(6{,}626 \times 10^{-34})(3 \times 10^{8})}{3{,}5 \times 10^{-7}} = \frac{1{,}9878 \times 10^{-25}}{3{,}5 \times 10^{-7}}$$

$$\approx 5{,}68 \times 10^{-19} \text{ J}.$$

$$E = \frac{5{,}68 \times 10^{-19}}{1{,}6 \times 10^{-19}} = 3{,}53 \text{ eV}$$

$$K = E - W$$

$$= 3{,}53 - 2{,}2 = 1{,}35 \text{ eV}$$