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mk : Fisika Modern

1). $x'| = 0$ hingga $x_2' = l_0$

$l = x_2 - x_1$

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

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

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

• Waktu sama ($t_1 = t_2$)

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

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

$l_0 = x_2' - x_1'$

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

$\rightarrow l_0 = \gamma(x_2 - x_1)$ atau $l = \frac{l_0}{\gamma} \rightarrow \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$

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

2). Diketahui : $E = 25$ GeV

$d = 3000$ m

$m_0 = 0{,}5118$ mev/c^2

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

ditanya : a). Kecepatan elektron yang energinya 25 GeV?

b). Waktu yang diperlukan untuk menempuh jarak 3000 m?

c). panjang akselerator dalam kerangka alnah elektron?

d). Waktu tempuh elektron dalam kerangka alnah inersianya sendiri?

jawab.

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

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

$= \frac{25 \times 10^9 \text{ eV}}{0{,}511 \times 10^6 \text{ eV}}$

$= 4{,}89 \times 10^4$

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

$\frac{v^2}{c^2} = 1 - \frac{1}{(4{,}89 \times 10^4)^2}$

$V = c\sqrt{1 - \frac{1}{(4{,}89 \times 10^4)^2}}$

$V \approx c(1 - 1{,}05 \times 10^{-10}) \rightarrow V \approx 2{,}99999 \times 10^8$ m/s

Selisih dengan kecepatan cahaya $c - V = 0{,}031$ m/s jadi elektron hampir bergerak dgn kecepatan cahay

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

$t = \frac{3000\ m}{2,99999 \times 10^8\ m/s}$

$t \simeq 1,0000000001 \times 10^{-3}$

$= 10\ M_1$ 4

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

karna $\gamma = 4,89 \times 10^4$ maka

$l' = \frac{3000}{4,89 \times 10^4}$

$l' \simeq 0,061\ m = 6,1\ cm$ //.

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

$t' = \frac{10^{-5}}{4,89 \times 10^4}$

$t' \simeq 2,04 \times 10^{-4}\ s = 0,204\ ns$

3). diketahui : $\lambda_0 = 122\ nm$

$\lambda' = 366\ nm$

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

ditanya : a). Kecepatan gravitasi V jika spektrum bergeser dari λ_0 menjadi λ_1

b). panjang gelombang baru jika λ' jika digalaksi mendekati dengan kecepatan yang sama?

jawab:

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

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

$3\ nm = \sqrt{\frac{1+\frac{v}{c}}{1-\frac{v}{c}}}$

$9 = \frac{1-\frac{v}{c}}{1-\frac{v}{c}}$

$9(1-\frac{v}{c} = 1-\frac{v}{c}$

$9 - 9\frac{v}{c} = 1 + \frac{v}{c}$

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

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

$V = 0,8\,(3 \times 10^8\ m/s)$

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

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

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

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

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

$= 122 \times 0,3323$

$\lambda'' \simeq 40,67\ nm$ //.

4). Diketahui : E perorom = 200 mev

Muranium

A = 235

1 mev = 1,602 x 10^{-12} J

C = 3 x 10^{8} m/s

marom = $\frac{235g}{6,022 \times 10^{23}}$

Dit : Perubahan massa Dm akibat reaksi 1 kg uranium ?

jawab.

E = 200 mev x 1,602 x 10^{-13} J/mev

= 3,204 x 10^{-11} J

jumlah atom dalam uranium 1kg =

N = $\frac{1000g}{marom}$

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

Etotal = 3,204 x 10^{-11} J / atom (2,56 x 10^{24})

= 8,20 x 10^{13} J.

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

m = (8,20 x 10^{13} J) / (1 x 10^{8} m/s)^2

≃ 9,11 x 10^{-4} kg //.

5). Dik : mp : 1,007276 V lu = 1,66054 x 10^{-23} kg

mn = 1,008665 V lu.c^2 = 9,31 J mev

Mhelium = 4,001506 V

Dit : a). energi luar inti helium Eb

b). Beda massa inti helium dengan total massa partikel penyusun dalam kg...

a). massa total = 2mp + 2mn

= 2(1,007776) + 2(1,008665)

= 4,0318824

Δm = mtotal - mhelium

= 4,031882 V − 4,00506

= 0,0303764

$E = \Delta mc^2$

= (3,044 x 10^{-29} kg)(2,9979 x 10 m/s)^2

= 4,533 x 10^{-12} = 28,3 mev

6). Diket : V_A = 0,8c

V_B = 0,6 c

Dit : Kecepatan pesawat A menurut pengamat dibulan (V') ?

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

7). Dik : $p = 20$

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

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

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

Dit : jumlah atom yang dipancarkan?

jawab :

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

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

$$N = \frac{20}{3,37 \times 10^{-19}} = 5,94 \times 10^{19}\ \text{foton / detik.}$$

8). Dik : $W = 2,2\ eV$

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

$h = 6,626 \times 10^{-34}\ J/s$

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

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

Dit : Energi kinetik maksimum fotoelektron (k) dalam eV.

jawab :

$$E = \frac{hc}{\lambda} = \frac{(6,626 \times 10^{-34})(3 \times 10^{8})}{3,5 \times 10^{-7}} = \frac{1,9878 \times 10^{-35}}{3,5 \times 10^{-7}} \approx 5,68 \times 10^{-19}\ J.$$

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

$$K = E - W$$

$$= 3,53 - 2,2 = 1,35\ eV.$$