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Mata kuliah : fisika modern

Tugas Pertemuan 7!!!

1) $x'_1 = 0$ hingga $x'_2 = L_0$

$$L = x_2 - x_1$$

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

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

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

$$L_0 = x'_2 - x'_1$$

$$L_0 = \gamma (x_2 - vt) - \gamma (x_1 - vt)$$

$$L_0 = \gamma (x_2 - x_1)$$

$$L = \frac{L_0}{\gamma} \rightarrow \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$t_1 = t_2$$

$$x'_1 = \gamma (x_1 - vt)$$

$$x'_2 = \gamma (x_2 - vt)$$

$$L = L_0 \sqrt{1 - \frac{v^2}{c^2}}$$

2) Dik : $E = 25 \text{ GeV} = 25 \cdot 10^9 \text{ eV}$

$$d = 3000 \text{ m}$$

$$m_0 = 0.511 \text{ MeV}/c^2$$

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

Dit : a) $c-v$?

c) L' ?

b) t ?

d) t' ?

Jawaban:

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

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

$$= \frac{25 \cdot 10^9 \text{ eV}}{0.511 \cdot 10^6 \text{ eV}}$$

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

$$\frac{v^2}{c^2} = 1 - \frac{1}{(4.09 \cdot 10^4)^2}$$

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

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

$$v \approx 2.9999 \times 10^8 \text{ m/s}$$

$$\text{Growth: } c - v$$

$$= (3 - 2.9999) \cdot 10^8 \text{ m/s}$$

$$= 0.0001 \text{ m/s}$$

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

$$t = \frac{3000 \text{ m}}{2.9999 \cdot 10^8 \text{ m/s}}$$

$$t \approx 1.000000000 \cdot 10^{-3} \text{ s}$$

$$t \approx 10 \text{ ns}$$

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

$$L' = \frac{L}{\gamma}$$

$$L' = \frac{3000}{4.89 \cdot 10^4}$$

$$L \approx 0.061 \text{ m}$$

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

$$t' = \frac{10^{-3}}{4.89 \cdot 10^4}$$

$$t' \approx 2.04 \cdot 10^{-4} \text{ s}$$

$$= 0.204 \text{ ns}$$

3. Dik : $\lambda_0 = 122 \text{ nm}$
 $\lambda' = 366 \text{ nm}$
 $c = 3 \cdot 10^8 \text{ m/s}$

Dit : a). $v \dots ?$

b) $\lambda'' \dots ?$

Jawaban:

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

$$\beta = 10^4 / c$$

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

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

$$v = 0.8 c$$

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

$$= 0.8 (3 \cdot 10^8 \text{ m/s})$$

$$= 2.4 \cdot 10^8 \text{ m/s}$$

$$\beta = \frac{1 + v/c}{1 - v/c}$$

$$\beta \left(1 - \frac{v}{c}\right) = 1 + \frac{v}{c}$$

$$\beta - \beta v/c = 1 + v/c$$

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

$$\lambda'' = \lambda_0 \sqrt{\frac{1 - 0.8}{1 + 0.8}}$$

$$= \lambda_0 \sqrt{\frac{0.2}{1.8}}$$

$$= 122 \sqrt{0.111}$$

$$= 122 \cdot 0.3323$$

$$\lambda'' \approx 40.67 \text{ nm}$$

A. Diketahui : E per atom : 200 MeV
 M Uranium : 1 kg = 1000 gr
 n : 235
 $1 \text{ MeV} : 1.602 \cdot 10^{-13} \text{ J}$

$C : 3 \cdot 10^8 \text{ m/s}$
 $M_{\text{atom}} : \frac{22595}{6.022 \cdot 10^{23}}$

Ditanya : Δm ?

Jawaban: $E = 200 \text{ MeV} \cdot 1.602 \cdot 10^{-13} \text{ J/MeV}$
 $= 3.204 \cdot 10^{-11} \text{ J}$

$N = \frac{1000 \text{ gr}}{M_{\text{atom}}}$

$= \frac{1000 \text{ gr}}{235}$

$6.022 \cdot 10^{23}$

$= 2.56 \cdot 10^{24} \text{ atom}$

$E_{\text{total}} : (3.204 \cdot 10^{-11} \text{ J/atom}) (2.56 \cdot 10^{24})$
 $= 8.20 \cdot 10^{13} \text{ J}$

$E = mc^2$

$m = \frac{E}{c^2}$

$= \frac{8.2 \cdot 10^{13} \text{ J}}{(3 \cdot 10^8 \text{ m/s})^2}$

$= 9.11 \cdot 10^{-4} \text{ kg}$

5.) Dik : $m_p = 1,007276 \text{ u}$

$m_n = 1,008665 \text{ u}$

$m_{\text{helium}} = 4,001506 \text{ u}$

$1 \text{ u} = 1,66054 \cdot 10^{-27} \text{ kg}$

$1 \text{ MeV} = 931,5 \text{ MeV}$

Ditanya: a) energi ikat ?

b) Δm_{kg} ?

Jawab:

a. $m_{\text{total}} = 2m_p + 2m_n$

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

$= 4,031802 \text{ u}$

$\Delta m = m_{\text{total}} - m_{\text{helium}}$

$= 4,031802 - 4,001506$

$= 0,030296 \text{ u}$

$E = \Delta mc^2$

$= (5,044 \cdot 10^{-29}) (2,9979 \cdot 10^8)^2$

$= 4,533 \cdot 10^{-12}$

$= 28,3 \text{ MeV}$

b. $\Delta m_{\text{kg}} = (0,030296 \text{ u}) \cdot (1,66054 \cdot 10^{-27})$

$= 5,04 \cdot 10^{-29} \text{ kg}$

6.) Dik : $v_A = 0,8c$

$v_B = 0,6c$

Ditanya: $v_{\dots}$?

Jawaban: $v' = \frac{v_A + v_B}{1 + \frac{v_A v_B}{c^2}} = \frac{0,8 + 0,6c}{1 + \frac{(0,8)(0,6)}{c^2}} = \frac{1,4c}{1 + 0,48} = \frac{1,4}{1,48}$

$= 0,946c$

7. Diketahui : $P = 20W$
 $\lambda = 589 \text{ nm} = 589 \times 10^{-9} \text{ m}$
 $h = 6.6 \cdot 10^{-34} \text{ Js}$
 $c = 3 \cdot 10^8 \text{ m/s}$

Ditanya : N ?

Jawaban: $E = \frac{hc}{\lambda}$

$$= \frac{(6.6 \cdot 10^{-34})(3 \cdot 10^8)}{589 \cdot 10^{-9}}$$

$$= \frac{1.978 \cdot 10^{-21}}{589 \cdot 10^{-9}}$$

$$= 3.37 \cdot 10^{-19} \text{ J}$$

$N = \frac{20}{3.17 \cdot 10^{-19}}$
 $= 5.94 \cdot 10^{19} \text{ foton/s}$

8.1 Dik : $W = 2.2 \text{ eV}$
 $\lambda = 3500 \text{ \AA} = 3.5 \cdot 10^{-7} \text{ m}$
 $h = 6.6 \cdot 10^{-34} \text{ Js}$
 $c = 3 \cdot 10^8 \text{ m/s}$
 $I_w = 1.6 \times 10^{-19} \text{ J}$

Ditanya : E_k ?

Jawaban

$$E = \frac{hc}{\lambda} = \frac{(6.6 \cdot 10^{-34})(3 \cdot 10^8)}{3.5 \cdot 10^{-7}}$$

$$= \frac{1.978 \times 10^{-21}}{3.5 \times 10^{-7}}$$

$$= 5.68 \times 10^{-19}$$

$$E = \frac{5.68 \times 10^{-19}}{1.6 \times 10^{-19}}$$

$$= 3.55 \text{ eV}$$

$$E_k = E - W$$

$$= 3.55 \text{ eV} - 2.2 \text{ eV}$$

$$= 1.35 \text{ eV}$$