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Kelas : 23 B

1. $x'_1 = 0$ hingga $x'_2 = l_0$

$$l = x_2 - x_1$$

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

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

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

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

atau

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

Waktu sama ($t_1 - t_2$)

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

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

$$l_0 = x'_2 - x'_1$$

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

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

2. Diketahui :

$$E = 25 \text{ GeV}$$

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

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

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

Ditanya : a. Kecepatan elektron yang energinya 25 GeV ?

b. Waktu yg diperlukan untuk menempuh

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jarak 3000 m?

c. Panjang akselerator dalam kerangka
aluan elektron?

d. Waktu tempuh elektron dalam kerangka
aluan inertialnya sendiri?

jawab :

$$a). E = 8 \text{ MoI}^2$$

$$\gamma = \frac{E}{\text{MoI}^2}$$

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

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

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

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

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

$$V \approx c (1 - 1,05 \times 10^{-10})$$

$$V \approx 2,99999 \times 10^8 \text{ m/s}$$

selisih kecepatan $|c - V| \approx 0,031 \text{ m/s}$

cahaya

jadi elektron ^{hampir} bergerak dengan kecepatan
cahaya.

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

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

$$t \approx 1,0000000001 \times 10^{-5} \text{ s}$$

$$= 10^{-4}$$

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

karena $\beta = 4,89 \times 10^9$, maka

$$l' = \frac{3000}{4,89 \times 10^9}$$

$$l' \approx 0,061 \text{ m} = 6,1 \text{ cm}$$

$$d). \quad f' = \frac{f}{\gamma}$$

$$f' = \frac{10^{-5}}{4,89 \times 10^9}$$

$$f' = 2,04 \times 10^{-4} = 0,204 \text{ ns.}$$

$$3. \quad \text{Diket} = \lambda_0 = 122 \text{ nm}$$

$$\lambda_1 = 366 \text{ nm}$$

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

jawab :

$$a. \quad \frac{\lambda_1}{\lambda_0} = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$$

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

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

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

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

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

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

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

$$v = 0,8 (3 \times 10^8 \text{ m/s})$$

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

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

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

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

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

$$= 122 \times 0,3323$$

$$\lambda'' = 40,67 \text{ nm}$$

4. Diketahui :

$$E_{\text{proton}} = 200 \text{ mev}$$

Muranium =

$$A = 235$$

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

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

$$M_{\text{atom}} = 235 \text{ g}$$

$$6,022 \times 10^{23}$$

Ditanya: Perubahan massa om akibat reaksi 1 kg Uranium?

Jawab :

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

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

Jumlah atom dalam Uranium 1 kg :

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

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

$$= 6,022 \times 10^{23} = 2,56 \times 10^{24} \text{ atom}$$

$$E_{\text{total}} = (3,204 \times 10^{-11} \text{ J/atom}) (2,56 \times 10^{24})$$

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

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

$$m = (8,20 \times 10^{13} \text{ J}) / (3 \times 10^8 \text{ m/s})^2$$

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

☐ 5. Diketahui: $m_p = 1,007276 \text{ u}$ $1 \text{ u} = 1,66054 \times 10^{-27} \text{ kg}$
☐ $m_n = 1,008665 \text{ u}$ $1 \text{ u}^2 = 931,5 \text{ MeV}$
☐ $m_{\text{helium}} = 4,001506 \text{ u}$

☐ Ditanya: a). Energiikat inti helium E_b
☐ b). beda massa inti helium dengan
☐ total massa partikel penyusunannya
☐ dalam kg

☐ Jawab :

☐ a). Massa total = $2m_p + 2m_n$
☐ $= 2(1,007276 + 1,008665)$
☐ $= 4,031882 \text{ u}$

☐ $\Delta m = m_{\text{total}} - m_{\text{helium}}$
☐ $= 4,031882 \text{ u} - 4,001506$
☐ $= 0,030376 \text{ u}$

☐ $E = \Delta m c^2$
☐ $= (3,044 \times 10^{-29} \text{ kg}) (2,9979 \times 10^8 \text{ m/s})^2$
☐ $= 2,733 \times 10^{-12} \text{ J} = 20,3 \text{ MeV}$

☐ b). $\Delta m_{\text{kg}} = (0,030376 \text{ u}) \times (1,66054 \times 10^{-27} \text{ kg})$
☐ $= 5,04 \times 10^{-29} \text{ kg}$

SiDU

6.

Diketahui:

$$V_A = 0,8c$$

$$V_B = 0,6c$$

Ditanya: kecepatan pesawat A menurut Pengamat dibulan (V')?

Jawab:

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

$$= \frac{1,4c}{1 + 0,48}$$

$$= \frac{1,4}{1,48} = 0,94$$

7.

Diketahui: $P = 20 \text{ W}$

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

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

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

Ditanya: jumlah atom yg dipancarkan?

Jawab:

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

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

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

SIDU

8- Diketahui: $W = 2,2 \text{ eV}$

$$\lambda = 3500 \text{ \AA} = 3300 \times 10^{-10} \text{ m} = 3,5 \times 10^{-7} \text{ m}$$

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

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

Ditanya: energi kinetik maksimum foton elektron (h) dalam eV?

Jawab:

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

$$= \frac{1,9178 \times 10^{-25}}{3,5 \times 10^{-7}} \approx 5,68 \times 10^{-19} \text{ J}$$

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

$$K = E - W$$

$$= 3,53 - 2,2 = 1,33 \text{ eV}$$