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fisika modern

1. diket :

- Panjang meteran dalam kerangka : L_0
- kecepatan relatif pengamat O terhadap O' : u
- panjang yang di ukur : L

Transformasi lorentz ?

Jawab :

- transformasi lorentz :

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

Jadi, Panjang meteran L yang diukur dalam kerangka O lebih pendek daripada L_0, tergantung kecepatan u.

2. diket :

- $L_0 = 3000$ m.
- $m_0 = 0.511$ MeV/c^2
- E = 25 GeV
- c = 3×10^8 m/s

a.) diket : dit. Hitung kecepatan elektron yang energi 25 GeV?

- E = 25 GeV
- $m_0c^2 = 0.511$ MeV
- c = 3×10^8 m/s

Jawab :

- $\gamma = \frac{E}{m_0c^2} = \frac{25\times10^9 \text{ eV}}{0.511\times10^6 \text{ eV}}$

$\gamma \simeq 4.89\times10^4$.

- kecepatan elektron :

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

$$v = (3\times10^8)\times\sqrt{1-\frac{1}{(4.89\times10^4)^2}}$$

$v = 2.999\times10^8$ m/s.

selisih kecepatan dengan kecepatan cahaya : 0.31 m/s.

b.) menghitung waktu yang diperlukan elektron untuk menempuh jarak 3000 m

Jawab :

$$t = \frac{L_0}{v} = \frac{3000}{2.9999\times10^8}$$

$t \simeq 1.000000001\times10^{-5}$ s = 10 mikrodetik.

c.) panjang akselerator dalam kerangka elektron

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

karena $\gamma \simeq 4.89\times10^4$, maka:

$$L = \frac{L_0}{\gamma} = \frac{3000}{4.89\times10^4}$$

L = 0.0613 m = 6.13 cm //

d.) waktu tempuh elektron dalam kerangka inersialnya.

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

$$t' = \frac{10 \times 10^{-6} \; s}{4.89 \times 10^{9}}$$

$$t \approx 2.04 \times 10^{-10} s = 0.204 \; ns \; //$$

3. Diket :

- $\lambda_0 = 122 \; nm$
- $\lambda = 366 \; nm$

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

a.) kecepatan galaksi

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

$$\left(\frac{366}{122}\right)^2 = \frac{1+v/c}{1-v/c}$$

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

Dengan v/c

$$g(1-v/c) = 1+v/c$$

$$g - gv/c = 1+v/c$$

$$8 = 10 \; v/c$$

$$v/c = 0.8$$

$$v = 0.8c = 2.4 \times 10^{8} \; m/s \; //$$

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

$$\lambda' = 122 \times \sqrt{\frac{1-0.8}{1+0.8}}$$

$$\lambda' = 122 \times \sqrt{0.111}$$

$$\lambda' = 122 \times 0.333$$

$$\lambda' = 40.6 \; nm \; //$$

4. Diket :

- Energi yang dilepas per atom uranium : 200 Mev
- massa uranium : 1kg
- massa 1 atom : 235 u
- $1 \; u = 1.6605 \times 10^{-27} \; kg$

a.) $N = \frac{1 kg}{massa \; atom}$. $N = \frac{1}{235 \times 1.6605 \times 10^{-27}} = 2.56 \times 10^{24}$ Atom.

b.) $E_{total} = N \times 200 \; Mev$

$$E_{total} = (2.56 \times 10^{24}) \times (200 \times 10^{6} \times 1.6 \times 10^{-13})$$

$$E_{total} = 8.2 \times 10^{13} \; J$$

c.) $\Delta m = \frac{E}{c^2}$

$$\Delta m = \frac{8.2 \times 10^{13}}{(3 \times 10^{8})^2} \; . \; \Delta m = 9.1 \times 10^{-4} \; kg.$$

5. Diket :

- $m_{He} = 4.001506\ u$
- $m_p = 1.007276\ u$
- $m_n = 1.008665\ u$
- $1\ u = 931.5\ MeV$

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

$m_{total} = 2(1.007276) + 2(1.008665)$

$m_{total} = 2.014552 + 2.01733$

$m_{total} = 4.031882\ u.$

- Defisit massa :

$\Delta m = m_{total} - m_{He}$

$\Delta m = 4.031082 - 4.001506$

$\Delta m = 0.030376\ u.$

- Energi ikat

$E_{ikat} = \Delta m \times 931.5$

$= 0.030376 \times 931.5$

$= 28.3\ MeV //$

b.) $\Delta m \times 1.6605 \times 10^{-27}\ kg$

$= 0.030376 \times 1.6605 \times 10^{-27}$

$= 5.04 \times 10^{-29}\ kg //$

6. Diket :

- $V_{AB} = 0.8c$
- $V_B = 0.6c$
- $V_A = ?$

Jawab :

$$V_A = \frac{0.8c + 0.6c}{1 + \frac{(0.8c)(0.6c)}{c^2}}$$

$$= \frac{1.4c}{1 + 0.48}$$

$$= \frac{1.4c}{1.48}$$

$V_A = 0.946c //$ atau $2.84 \times 10^8\ m/s //$

7. Diket :

- Daya lampu : 20 W
- Panjang $\lambda = 589\ nm = 589 \times 10^{-9}\ m.$
- $h = 6.626 \times 10^{-34}\ Js$
- $c = 3.0 \times 10^8\ m/s$

- $E = hc/\lambda$

$$E = \frac{(6.626 \times 10^{-34})(3.0 \times 10^8)}{589 \times 10^{-9}}$$

$$= \frac{1.9878 \times 10^{-25}}{5.89 \times 10^{-7}}$$

$E = 3.37 \times 10^{-19}\ J$

Jumlah foton perdetik :

$$N = \frac{Daya}{E}$$

$$N = \frac{20}{3.37 \times 10^{-19}}$$

$N = 5.93 \times 10^{19}$ foton/detik.

8. Diket :

- $\lambda = 3500\ \text{Å} = 350 \times 10^{-9}\ m$
- $W = 2.2\ eV$

Energi foton :

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

$$E = \frac{(6.626 \times 10^{-34})(3.0 \times 10^{8})}{350 \times 10^{-9}}$$

$$= \frac{1.9878 \times 10^{-25}}{3.5 \times 10^{-7}}$$

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

konversi ke eV.

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

$$= 3.55\ eV$$

Energi kinetik fotoelektron :

$$K = E - W$$

$$= 3.55 - 2.2$$

$$= 1.35\ eV\ //$$