Семинар 6.

1.398.

$u = \frac{c}{2}$

$l = 1\,м$

$\theta = 45°$

$l_0 - ?$

$l_y^к = l\sin\theta \qquad l_y' = l\sin\theta$

$l_x^к = l\cos\theta \qquad l_x' = \frac{l\cos\theta}{\sqrt{1-\beta^2}}$

$l_0 = l\sqrt{\sin^2\theta \cdot \frac{\cos^2\theta}{1-\beta^2}} = l\frac{\sqrt{1-\beta^2\sin^2\theta}}{\sqrt{1-\beta^2}} = 1{,}08\,м$

1.415

$u_1 = 0{,}5c$

$u_2 = 0{,}75c$

$u_0, u_{отн} - ?$

$u_1' = \frac{u_x - u}{1 - \frac{u_x u}{c^2}}$

$u_{сб} = u_1 + u_2$

$u_{сб} = \frac{ds}{dt} = u_1 + u_2 = 1{,}25c$

$u_{отн} = \frac{u_1 + u_2}{1 + \frac{u_1 u_2}{c_2}} = 0{,}91c$

1.428

$m, u_1 = 0{,}6c$

$u_2 = 0{,}8c$

$I - ?$

$t_{кр} - ?$

$T = c^2 m\left(\frac{1}{\sqrt{1-\frac{u_2^2}{c^2}}} - \frac{1}{\sqrt{1-\frac{u_1^2}{c^2}}}\right) = mc^2(\gamma_2 - \gamma_1) = 0{,}41mc^2$

$T_{кр} = \frac{mu_2^2}{2} - \frac{mu_1^2}{2} = \frac{mc^2}{2}(\beta_2^2 - \beta_1^2) = 0{,}41mc^2$

1.443

m, K

$m' - ?$

$u' - ?$

$c \cdot p_{30} = \sqrt{E^2 - m^2c^4} = \sqrt{(mc^2+K)^2 - m^2c^4} = \sqrt{K^2 + 2mc^2 K}$

$$\begin{cases} \frac{\sqrt{K^2+2mc^2K}}{c} = \frac{m'u'}{\sqrt{1-\frac{u'^2}{c^2}}} \\ K + 2mc^2 = \frac{m'c^2}{\sqrt{1-\frac{u'^2}{c^2}}} \end{cases}$$

$$M' = \frac{(K+2mc^2)}{c^2} + \sqrt{1 - \frac{K}{K+2mc^2}} = \frac{(K+2mc^2)}{c^2} + \sqrt{\frac{2mc^2}{K+2mc^2}} = \sqrt{\frac{2m(K+2mc^2)}{c}}$$

$$u'^2 = \frac{K^2+2mc^2 \cdot K}{(K^2+4mc^2K+4m^2c^4)} \cdot \frac{c^4}{c^2} = \frac{K(K+2mc^2)\cdot c^2}{(K+2mc^2)^2} = \frac{Kc^2}{K+2mc^2}$$

$$u' = c\sqrt{\frac{K}{K+2mc^2}}$$

Домашняя работа в семинар.

1.396.

u; $\eta = 0{,}5\%$

v - ?

$$c_0\sqrt{1-\frac{u^2}{c^2}} = (1-\eta)c_0$$

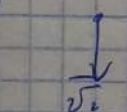
$$1 - \frac{v^2}{c^2} = 1 - 2\eta + \eta^2$$

$$v = c\sqrt{\eta(2-\eta)} = 0{,}1c$$

1.417

v_1, v_2

$v_{отн}$ - ?



$$v'_{2x} = \frac{0 - v_1}{1} = -v_1$$

$$v'_{2y} = \frac{v_2\sqrt{1-\frac{v_1^2}{c^2}}}{1} = v_2\sqrt{1-\frac{v_1^2}{c_0^2}}$$

$$v_{отн} = \sqrt{v_1^2 + v_2^2\left(1-\frac{v_1^2}{c^2}\right)} = \sqrt{v_1^2 + v_2^2 - \frac{v_1^2 v_2^2}{c^2}}$$

5.9

$$v = \frac{v_1 + v_2}{1 + \frac{v_1 v_2}{c^2}}$$

$v_1 \ll c$

$$\lim_{v_0 \to 0}\left(\frac{v_1 v_2}{c^2}\right) = 0 \Rightarrow \boxed{v = \frac{v_1 + v_0}{1+0} = v_1 + v_2}$$

5.30

m_p, m_e

$T = 1$ ГэВ

$\frac{m_p}{m_e}$ - ?

$$T = mc^2 - m_0c^2$$

$$m_e c^2 = m_{e0}c^2 + T$$

$$m_p c^2 = m_{p0}c^2 + T$$

$$\boxed{\frac{m_p}{m_e} = \frac{m_{p0}c^2 + T}{m_{e0}c^2 + T} = 1{,}937}$$