6. SPECIJALNA TEORIJA RELATIVNOSTI

Elektron: (3)

$E = mc^2 + K = \gamma mc^2$

$v_0 = 0\ m/s$

ali vrijedi i: $E^2 = m^2c^4 + (pc)^2$

$U = 700\ kV$ — to je E_k!

$p_e = ?$ → izraziti sa keV/c — brzina nabijenih

kilo elektron volt

$E_{keV} = m_e c^2 = 511\ keV$

$U = 700 \times 10^3\ V$

$E^2 = (mc^2)^2 + 2E_J \cdot U + U^2$

$(mc^2)^2 + 2E_J U + U^2 = (mc^2)^2 = (pc)^2$

$p^2 = \frac{2E_J U + U^2}{c^2}$

$p = \frac{\sqrt{2E_J U + U^2}}{c} \cdot \frac{e}{e}$

$p = \frac{\sqrt{U(2E_J + U)}}{c} \cdot \frac{e}{e}$

treba sve pretvoriti u istu vrstu jedinica

$1eV = 1{,}602 \times 10^{-19} C$

$U \quad 700 \cdot 1000 \cdot e = 1{,}1214 \times 10^{-13}\ J$

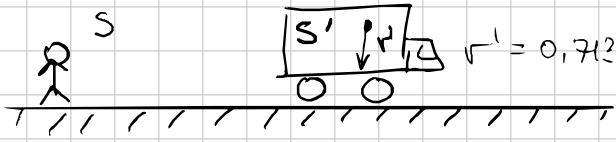
$E_J = 511 \times 10^3 \cdot e = 8{,}187 \times 10^{-14}\ J$

Zbog mješane jedinice

$p = 1096{,}857\ keV/c$

4. sustav S' se giba u odnosu na S brzinom 0,699c

$v = 0{,}699 \rightarrow v = 0{,}699c$



ne možemo usporediti v i v' jer nisu iz istog sustava!

$$u_y' = \frac{u_y}{\gamma\left(1 - \frac{v}{c^2}u_x\right)} = \frac{u_y}{\left(1 - \frac{v}{c^2}u_x\right)} \cdot \sqrt{1 - v^2/c^2}$$

$u_y' = v'$

$u_x = v$

znamo i TREBAMO u_y

$$u_y = \frac{u_y'\left(1 - \frac{v}{c^2}u_x\right)}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{0{,}713c\left(1 - \frac{0{,}699^2}{c^2}c^2\right)}{\sqrt{1 - 0{,}699}}$$

$u_y = 0{,}50988c$

$$\operatorname{tg}\alpha = \frac{u_y}{u_x} = \frac{0{,}50988}{0{,}699} \quad \boxed{\neq 0{,}72944}$$

Ankica:

(1.) CERN zadatak

- pioni ubrzani do $0,99975c$
- njihovim raspadom emitiraju se gama zrake, kolika je brzina tih fotona?

$\Rightarrow$ njihova brzina je c (fotoni se gibaju brzinom svjetlosti)

(2.) Prvi postulat spec. teorije rel.:

Zakoni fizike su isti za sve promatrače u svim inercijskim sustavima

(3.) $U = 820\,kV$ $\quad mc^2 = 511\,keV$

$v_e = ?$ $[c]$

$$E = mc^2 + E_k = \gamma mc^2 \rightarrow \gamma = \frac{mc^2 + E_k}{mc^2}$$

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

$$\hookrightarrow \sqrt{1-\left(\frac{v}{c}\right)^2} = \frac{mc^2}{mc^2 + E_k}\Big|^2$$

$$E_k = 820 \cdot 1000 \cdot e = 1,314 \times 10^{-13}\,J$$

$$mc^2 = 511 \cdot e \cdot 1000 = 8,187 \times 10^{-14}\,J$$

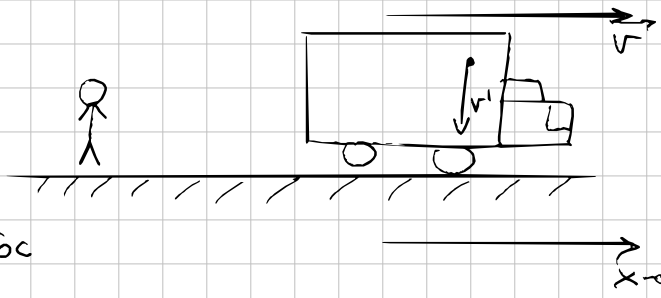
$$1-\left(\frac{v}{c}\right)^2 = \frac{(mc^2)^2}{(mc^2+E_k)^2}$$

$$\frac{v}{c} = \sqrt{1 - \frac{(mc^2)^2}{(mc^2+E_k)^2}} = 0,92338$$

$\hookrightarrow$ pomnožimo s c

$$\boxed{v = 0,923c}$$

4.



$v = 0{,}726c$

$v' = 0{,}811c$

$u_x = v \qquad u_y' = v'$

$u_y = ?$

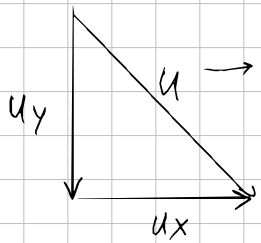
$$u_y' = \frac{u_y\sqrt{1-\left(\frac{v}{c}\right)^2}}{1-\frac{v u_x}{c^2}}$$

$$u_y = \frac{u_y'\left(1-\frac{v u_x}{c^2}\right)}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$$

— ovo je isto pa možemo pisati u_x^2 i/ili v^2

$$u_y = \frac{0{,}811c\,(1-0{,}726^2)}{\sqrt{1-0{,}726^2}}$$

$u_y = 0{,}5577\,c$



$u \rightarrow \sqrt{u_y + u_x} = 0{,}91548\,c$