(27) Kroženje e^- v magnetnem polju

$$\vec{E} = 0 \,, \quad \vec{B} = (0, 0, B)$$

$$F_{12} = -F_{21} = -B$$

$$\dot{u}^0 = 0 \Rightarrow \gamma = \text{konst.}$$

- $\dot{u}^1 = \left(-\frac{eB}{m}\right)(-u^2) = \omega u^2$, $\quad \dot{u}^2 = \frac{eB}{m}(-u^1) = -\omega u^1$ $\Bigg\}$ $\ddot{u}^1 = -\omega^2 u^1$, $\quad \ddot{u}^2 = -\omega^2 u^2$

- robni pogoji $\quad u^1(0) \cdot u^2(0) = 0$

$$u^1(0) = \frac{p}{m} = \frac{\sqrt{T(T+2mc^2)}}{mc}$$

$$x_1(\tau) \propto \frac{u^1(0)}{\omega} \sin \omega\tau$$

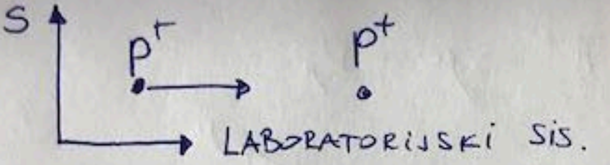
$$x_2(\tau) \propto \frac{u^1(0)}{\omega} \cos \omega\tau$$

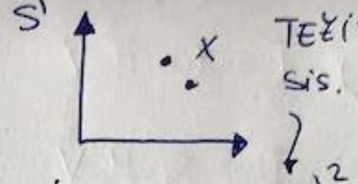
$$2r = \frac{2p}{eBc} = \frac{2\sqrt{T(T+2mc^2)}}{eBc} = 0{,}2\,\text{m}$$

(34)

$T = 6\,GeV$

$E_x = ?$





$$(\gamma mc^2 + mc^2, \gamma\beta mc^2)^2 = (2mc^2 + E_x, 0)^2$$

$$(\gamma+1)^2 - \underbrace{\gamma^2\beta^2}_{\gamma^2-1} = \left(2 + \frac{E_x}{mc^2}\right)^2$$

$$\gamma^2 + 2\gamma + 1 - \gamma^2 + 1 = 2(\gamma+1) = 2\left(\frac{T}{mc^2} + 1 + 1\right) = \left(2 + \frac{E_x}{mc^2}\right)^2$$

$T = (\gamma - 1)mc^2$

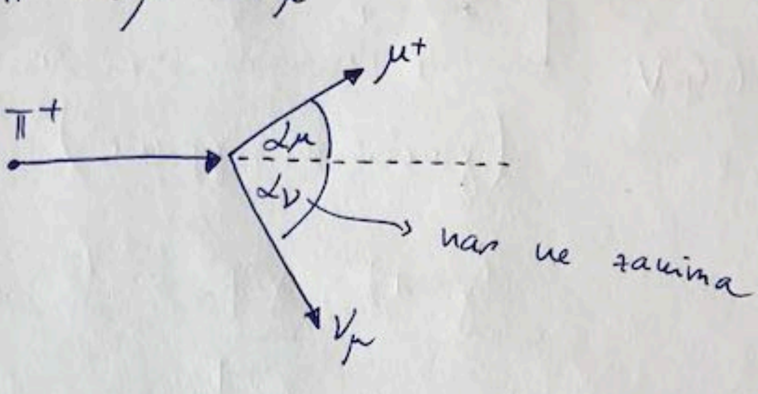
$$\frac{E_x}{mc^2} = 2\left(\sqrt{1 + \frac{T}{2mc^2}} - 1\right)$$

$$E_x = 2\,GeV\left(\sqrt{1 + \underset{\overset{\shortparallel}{3}}{\frac{6}{2}}} - 1\right) \simeq 2\,GeV$$

$$\frac{E_x}{T} \simeq \frac{2\,GeV}{6\,GeV} \sim \frac{1}{3} = \underline{33\%}$$

(55) $T_{\pi^+} = 100\,MeV$ $\quad \pi^+ \to \mu^+ + \nu_\mu$

$T_{\mu^+} = 80\,MeV$



$\alpha_\mu = ?$

$\alpha_\nu = ?$

$E_\nu = ?$

NA ZAČETKU : $(E_\pi,\ cp_\pi,\ 0)$

NA KONCU $(E_\mu + E_\nu,\ cp_\mu \cos\alpha_\mu + cp_\nu \cos\alpha_\nu,\ cp_\mu \sin\alpha_\mu - cp_\nu \sin\alpha_\nu)$

0 : $E_\pi = E_\mu + E_\nu$; $E_\nu = cp_\nu$; [POZNAMO] ⇓ ; $E_\nu = T_\pi + m_\pi c^2 - T_\mu - m_\mu c^2 \cong 55\,MeV$

$E_\pi = T_\pi + m_\pi c^2$, $E_\mu = T_\mu + m_\mu c^2$; $cp_\pi = \sqrt{T_\pi (T_\pi + 2m_\pi c^2)} = 195\,MeV$ ✓

$cp_\mu = \sqrt{T_\mu (T_\mu + 2m_\mu c^2)} = 152\,MeV$ ✓

x: $cp_\mu \cos\alpha_\mu - cp_\pi = -cp_\nu \cos\alpha_\nu \quad |^2$

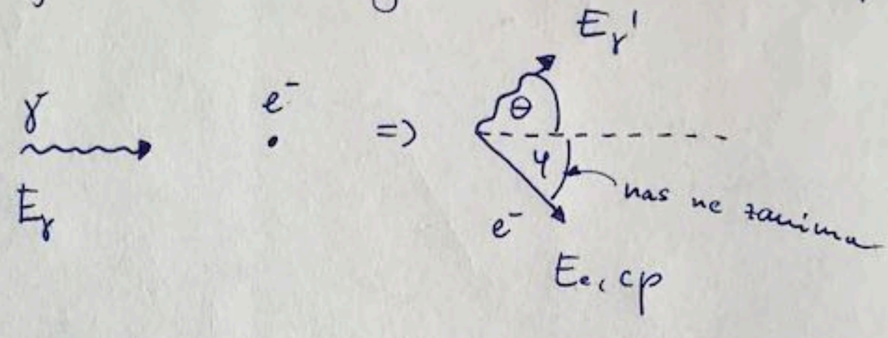
y: $cp_\mu \sin\alpha_\mu = E_\nu \sin\alpha_\nu \quad |^2$) +

$$(cp_\mu)^2 (\cos^2\alpha_\mu + \sin^2\alpha_\mu) + 2 cp_\mu cp_\pi \cos\alpha_\mu + (cp_\pi)^2 = E_\nu^2$$

$$\cos\alpha_\mu = \frac{E_\nu^2 - (cp_\mu)^2 - (cp_\pi)^2}{2 cp_\mu cp_\pi} \Rightarrow \underline{\alpha_\mu = 11{,}1^\circ}$$

$$\sin\alpha_\nu = \frac{cp_\mu}{E_\nu} \sin\alpha_\mu \Rightarrow \underline{\alpha_\nu = 33{,}3^\circ}$$

(35) Sipanje fotona na mirujočem e^- (Comptonov pojav)



$$0:\quad E_\gamma + mc^2 = E_\gamma' + E_e$$

$$x:\quad E_\gamma = E_\gamma'\cos\theta + cp\cos\varphi$$

$$y:\quad 0 = E_\gamma'\sin\theta - cp\sin\varphi$$

$$\Big\}\ (E_\gamma - E_\gamma'\cos\theta)^2 - (E_\gamma'\sin\theta)^2 = (cp)^2 = E_e^2 - m_e^2c^4$$

$$\Rightarrow\ \cancel{E_\gamma^2} - 2E_\gamma E_\gamma'\cos\theta + \cancel{E_\gamma'^2} = \cancel{E_\gamma^2} + 2E_\gamma mc^2 + \cancel{m^2c^4} - 2E_\gamma'(E_\gamma + mc^2) + \cancel{E_\gamma'^2} - \cancel{m^2c^4}$$

$$\Rightarrow\quad E_\gamma E_\gamma'\cos\theta = E_\gamma'(E_\gamma + mc^2) - E_\gamma mc^2$$

$$E_\gamma E_\gamma'(1-\cos\theta) = (E_\gamma - E_\gamma')\,mc^2\ ,\quad E_\gamma = \frac{hc}{\lambda}$$

$$\frac{(hc)^{\cancel{2}}}{\lambda\lambda'}(1-\cos\theta) = \cancel{(hc)}(mc^2)\left(\frac{1}{\lambda} - \frac{1}{\lambda'}\right)\quad /\lambda\lambda'$$

$$\underbrace{\frac{hc}{mc^2}}_{\lambda_c}(1-\cos\theta) = \lambda' - \lambda\ \Rightarrow\ \boxed{\lambda' - \lambda = \lambda_c\,\underbrace{(1-\cos\theta)}_{\text{MAX}\ 2\lambda_c}}$$

$$T_e = E_e - mc^2 = E_\gamma - E_\gamma'\ ,\quad T_e^{max} \rightarrow E_{\gamma\,min}' \rightarrow \lambda_{max}' = \lambda + 2\lambda_c$$

$$= E_\gamma - \frac{1}{\frac{1}{E_\gamma} + \frac{2}{mc^2}} = E_\gamma\left(1 - \frac{1}{1+\frac{2E_\gamma}{mc^2}}\right) = \frac{E_\gamma}{1+\frac{mc^2}{2E_\gamma}}\quad \searrow E_\gamma \qquad \frac{hc}{E_\gamma'} = \frac{hc}{E_\gamma} + \frac{2hc}{mc^2}$$