2) a) $\varepsilon_x = C_\gamma \gamma^2 \frac{1}{RL} \int_0^L H(s)\,ds$ mit $H(s) = \gamma(s) \cdot D^2(s) + 2\alpha(s) D(s) D'(s) + \beta(s) D'^2(s)$

mit $D(s) \approx s^2/2R$; $D'(s) = s/R$

mit $\beta(s) = \beta(0) - 2\alpha(0) s + \gamma(0) s^2$; $\alpha(s) = \alpha(0) - \gamma(0) s$

$\gamma(s) = \gamma(0)$

$H(s)$ vereinfacht sich zu: $H(s) = \frac{1}{R^2} (\gamma(0) \frac{s^4}{4} - \alpha(0) s^3 + \beta(0) s^2)$

$$\Rightarrow \varepsilon_x = C_\gamma \gamma^2 \frac{L^3}{R^3} \cdot [\frac{1}{20} L \gamma(0) - \frac{1}{4} \alpha(0) + \frac{1}{3} \beta(0) \frac{1}{L}]$$

mit $\gamma = \frac{1+\alpha^2}{\beta} \Rightarrow \gamma_0 = \frac{1+\alpha(0)^2}{\beta(0)}$

b) $\Rightarrow \varepsilon_x = C_\gamma \gamma^2 \frac{L^3}{R^3} [\frac{1}{20} L \frac{1}{\beta(0)} + \frac{1}{20} L \frac{\alpha(0)^2}{\beta(0)} - \frac{1}{4}\alpha(0) + \frac{1}{3}\beta(0)\frac{1}{L}]$

$$\frac{d\varepsilon_x}{d\alpha(0)} = \frac{1}{20} L\, 2 \frac{\alpha(0)}{\beta(0)} - \frac{1}{4} = 0$$

$$\Leftrightarrow \frac{1}{4} = \frac{1}{10} L \frac{\alpha(0)}{\beta(0)}$$

$$\Leftrightarrow \frac{10}{4} = L \frac{\alpha(0)}{\beta(0)} \Rightarrow \frac{5}{2} \frac{\beta(0)}{L} = \alpha(0)$$

$$\frac{d\varepsilon_x}{d\beta(0)} = -\frac{1}{20} L \frac{1}{\beta(0)^2} - \frac{1}{20} L \frac{\alpha(0)^2}{\beta(0)^2} + \frac{1}{3}\frac{1}{L}]$$

$$= -\frac{1}{20} L \frac{1}{\beta(0)^2} \cdot (1 + \alpha(0)^2) + \frac{1}{3}\frac{1}{L} = 0$$

$$\Leftrightarrow -\frac{1}{20} L \frac{1}{\beta(0)^2} \cdot (1 + \frac{25}{4} \frac{\beta(0)^2}{L^2}) + \frac{1}{3}\frac{1}{L} = 0 \quad | \cdot \beta(0)^2$$

$$\Leftrightarrow -\frac{1}{20} L (1 + \frac{25}{4} \cdot \frac{\beta(0)^2}{L^2}) + \beta(0)^2 \frac{1}{3}\frac{1}{L} = 0$$

$$\Leftrightarrow -\frac{25}{80} \frac{\cancel{L}}{L^{\cancel{2}}} \beta(0)^2 + \frac{1}{3}\frac{1}{L} \cdot \beta(0)^2 - \frac{1}{20} L = 0$$

$$\Leftrightarrow -\frac{5}{16}\frac{1}{L}\beta(0)^2 + \frac{1}{3}\frac{1}{L}\beta(0)^2 = \frac{1}{20} L$$

$$\Leftrightarrow \frac{1}{48}\frac{1}{L}\beta(0)^2 = \frac{1}{20} L \quad | \cdot L \,| \cdot 48 \,| \sqrt{\;}$$

$$\Leftrightarrow \beta(0) = \sqrt{\frac{48}{20} L^2} = \sqrt{\frac{12}{5}} L = 2\sqrt{\frac{3}{5}} L \approx 1{,}55 \cdot L$$

$\beta(0)$ in $\alpha(0)$: $\alpha(0) = \frac{5}{\cancel{2}} \cancel{2} \sqrt{\frac{3}{5}} \frac{\cancel{L}}{\cancel{L}} = 5\sqrt{\frac{3}{5}} = \sqrt{15} \approx 3{,}87$

$\beta(0)$ und $\alpha(0)$ in $\gamma(0)$: $\gamma(0) = \frac{1+(\sqrt{15})^2}{2\sqrt{\frac{3}{5}} L} = \frac{10{,}33}{L}$

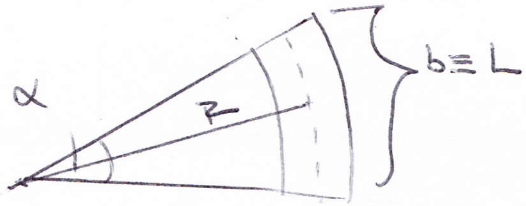
geg.: $E = 1{,}5\ \text{GeV} = 1{,}5 \cdot 10^9\ \text{eV}$

$R = 3{,}33\ \text{m}$

$\alpha = 20^\circ$

$C_\gamma = 3{,}83 \cdot 10^{-13}\ \text{m}$

$\gamma = ?\ ,\ L = ?$



$$\gamma = \frac{E_e}{E_{\text{Ruhe}}} = \frac{1{,}5 \cdot 10^9\ \text{eV}}{511 \cdot 10^3\ \text{eV}} \approx 2935{,}4$$

$$L = \pi \cdot R \cdot \frac{\alpha}{180^\circ} = \pi \cdot 3{,}33\ \text{m} \cdot \frac{20^\circ}{180^\circ} \approx$$

$$\Rightarrow \varepsilon_x \approx 7{,}79 \cdot 10^{-9}\ \frac{1}{\text{m}}$$