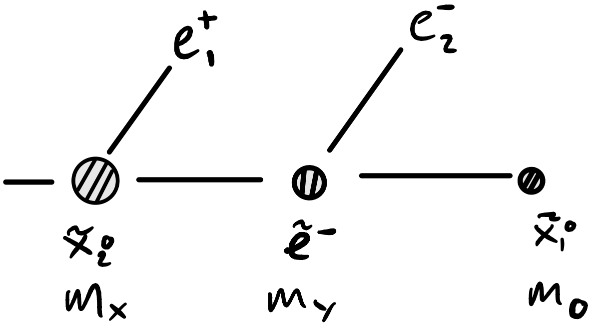
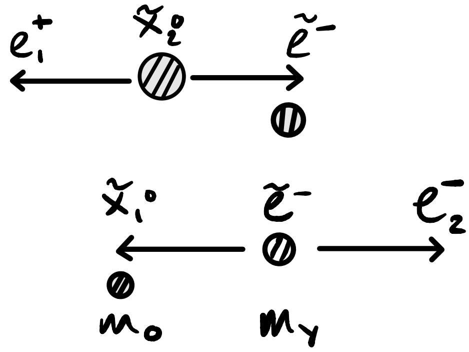
Luc Pape





$$m_{12}^2 = m_1^2 + m_2^2 + 2|\vec{p}_1||\vec{p}_2|(1-\cos\theta)$$

$$\max(m_{12}^2) = 4|\vec{p}_1||\vec{p}_2| \quad \text{για} \quad \vec{p}_1 // \vec{p}_2 // \hat{x}$$

$\tilde{\chi}_2^0 \to \ell_1^+ \tilde{e}^-$ στο σύστημα ηρεμίας του $\tilde{\chi}_2^0$

$$\underset{\tilde{\chi}_2^0}{\begin{pmatrix} m_x \\ 0 \end{pmatrix}} = \underset{\tilde{e}^-}{\begin{pmatrix} E_y \\ P_y \end{pmatrix}} + \underset{e_1^+}{\begin{pmatrix} P_1 \\ -P_1 \end{pmatrix}}$$

για $m_1 = 0$

$E_1 = \sqrt{m_1^2 + p_1^2} = P_1$

$p^\mu(\ell_1^+) \sim$ φωτοειδές

$$P_y = P_1$$
$$E_y + P_1 = m_x$$

$$\longrightarrow \quad \overbrace{P_y^2 + m_y^2}^{E_y^2} = m_x^2 + P_1^2 - 2m_x P_1$$

$$\boxed{P_1 = \frac{m_x^2 - m_y^2}{2m_x} = P_y}$$

$$E_y^2 = \frac{m_x^4 + m_y^4 - 2m_y^2 m_x^2}{4m_x^2} + m_y^2$$

$$\boxed{E_y = \frac{m_y^2 + m_x^2}{2m_x}}$$

$\tilde{e}^- \to e^- \tilde{\chi}_1^0$ στο σύστημα ηρεμίας του $\tilde{e}^-$

$$\begin{pmatrix} m_{\tilde{e}} \\ 0 \end{pmatrix} = \begin{pmatrix} E_0' \\ -P_0' \end{pmatrix} + \begin{pmatrix} P_2' \\ P_2' \end{pmatrix}$$

$$m_{\tilde{e}}^2 - 2m_{\tilde{e}} E_0' + m_0^2 = 0$$
$$(P_0')^2 = (E_0')^2 - m_0^2$$

ομοίως

$$\boxed{E_0' = \frac{m_{\tilde{e}}^2 + m_0^2}{2m_{\tilde{e}}}} \qquad \boxed{P_0' = \frac{m_{\tilde{e}}^2 - m_0^2}{2m_{\tilde{e}}} = P_2'}$$

$P_2^{\mu} = \begin{pmatrix} E_0' \\ P_0' \end{pmatrix}$ στο σύστημα ηρεμίας του $\tilde{e}^-$

$P_2^{\mu} = \Lambda(u) P_2'^{\mu}$ στο σύστημα ηρεμίας του $\tilde{\chi}_2^0$

με $u = -u_{\tilde{e}^-} = -P_{\tilde{e}}/E_{\tilde{e}}$ και $\gamma = E_{\tilde{e}}/m_{\tilde{e}}$

(το $\tilde{\chi}_2^0$ απομακρύνεται από το $\tilde{e}^-$ με ταχύτητα $u = -P_{\tilde{e}}/E_{\tilde{e}}$)

$$P_2^{\mu} = \begin{pmatrix} P_2 \\ P_2 \end{pmatrix} = \begin{pmatrix} \overset{\gamma}{E_{\tilde{e}}/m_{\tilde{e}}} & +\overset{-\gamma u}{P_{\tilde{e}}/m_{\tilde{e}}} \\ +\underset{-\gamma u}{P_{\tilde{e}}/m_{\tilde{e}}} & \underset{\gamma}{E_{\tilde{e}}/m_{\tilde{e}}} \end{pmatrix} \begin{pmatrix} P_2' \\ P_2' \end{pmatrix}$$

$$E_{\tilde{e}} = \frac{m_{\tilde{e}}^2 + m_x^2}{2m_x} \qquad P_2' = \frac{m_{\tilde{e}}^2 - m_0^2}{2m_{\tilde{e}}} \qquad -u = \frac{P_{\tilde{e}}}{E_{\tilde{e}}} = \frac{m_x^2 - m_{\tilde{e}}^2}{m_x^2 + m_{\tilde{e}}^2}$$

με

$$P_{\tilde{e}} = \frac{m_x^2 - m_{\tilde{e}}^2}{2m_x} \qquad \gamma = \frac{m_{\tilde{e}}^2 + m_x^2}{2m_x m_{\tilde{e}}} \qquad -\gamma u = +\frac{m_x^2 - m_{\tilde{e}}^2}{2m_x m_{\tilde{e}}}$$

$$P_2 = \gamma(P_2' - uP_2') = \underbrace{\frac{m_{\tilde{e}}^2 + m_x^2}{2m_x m_{\tilde{e}}}}_{\gamma} \underbrace{\frac{m_{\tilde{e}}^2 - m_0^2}{2m_{\tilde{e}}}}_{P_2'} \underbrace{\left(1 + \frac{m_x^2 - m_{\tilde{e}}^2}{m_x^2 + m_{\tilde{e}}^2}\right)}_{(1-u)}$$

$$p_2 = \frac{m_y^2 + m_x^2}{2m_x m_y} \, \frac{m_y^2 - m_0^2}{2m_y} \, \frac{2m_x^2}{m_x^2 + m_y^2} = \frac{m_y^2 - m_0^2}{2m_y^2} \, m_x$$

$$p_1 = \frac{m_x^2 - m_y^2}{2m_x}$$

$$\left[\begin{pmatrix} p_2 \\ p_2 \end{pmatrix} + \begin{pmatrix} p_1 \\ -p_1 \end{pmatrix}\right]^2 = (p_2 + p_1)^2 - (p_2 - p_1)^2 = 4p_1 p_2$$

$$m_{12}^2 = 4p_1 p_2 = 4 \, \frac{m_x^2 - m_y^2}{2m_x} \, \frac{m_y^2 - m_0^2}{2m_y^2} \, m_x$$

$$\boxed{m_{12}^2 = \frac{(m_x^2 - m_y^2)(m_y^2 - m_0^2)}{m_y^2}}$$