

$$E_{\pi} = E_{\mu} + E_0 \quad \vec{P}_{\pi} = 0 = \vec{P}_{\mu} + \vec{P}_0 \quad \Rightarrow \vec{P}_{\mu} = -\vec{P}_0 = \vec{P}$$

$$m_{\pi} c^2 = \sqrt{m_{\mu}^2 c^4 + P^2 c^2} + \sqrt{m_0^2 c^4 + P^2 c^2}$$

(DROP FACTORS OF c)

$$m_{\pi} = \sqrt{m_{\mu}^2 + P^2} + \sqrt{m_0^2 + P^2}$$

$$m_{\pi}^2 + m_0^2 + P^2 - 2m_{\pi} \sqrt{m_0^2 + P^2} = m_{\mu}^2 + P^2$$

$$\frac{m_{\pi}^2 + m_0^2 - m_{\mu}^2}{2m_{\pi}} = \sqrt{m_0^2 + P^2}$$

$$\Rightarrow P = \left[\left(\frac{m_{\pi}^2 + m_0^2 - m_{\mu}^2}{2m_{\pi}} \right)^2 - m_0^2 \right]^{1/2}$$

a) $m_0 = 0$

$$P = 29.7899 \text{ MeV}/c \quad E_{\mu} = 109.778 \text{ MeV}$$

$$E_0 = 29.7899 \text{ MeV}$$

b) $m_0 \neq 0$

$$P = 29.7894 \text{ MeV}/c \quad E_{\mu} = 109.778 \text{ MeV}$$

$$E_0 = 29.790 \text{ MeV}$$