Jan 24, 2018

→ $\Psi(x,t) = \Psi(x)\, e^{-iEt/\hbar}$

→ $\nu_e \; \nu_\mu \; \nu_\tau$ are weak (flavour) eigenstates
(interact with W/Z boson & their charged lepton partner)

→ $\nu_1 \; \nu_2 \; \nu_3$ are <u>mass</u> eigenstates
⇒ determine kinematics of propagation

→ $P_{Beam} = $ constant ⇒ $E_1 \neq E_2$
since $m_1 \neq m_2$.

$$P(|\nu_\mu\rangle \to |\nu_e\rangle) = |\langle \nu_\mu | \nu_e \rangle|^2$$

$$= \left| \sin\theta_{12} \; e^{i(E_2 - E_1)t/\hbar} \right|^2$$

$E_i \gg m_i \Rightarrow E^2 = p^2 + m^2$

$E_2^2 = p_E^2 + m_2^2 \qquad E_1^2 = p^2 + m_1^2$

$$E_2 - E_1 = \sqrt{p^2 + m_2^2} - \sqrt{p^2 + m_1^2} \simeq p\left(1 + m_2^2/p^2\right) - \left(1 + \frac{m_1^2}{2p^2}\right) = \frac{m_2^2 - m_1^2}{2p} \simeq \frac{m_2^2 - m_1^2}{2E}.$$