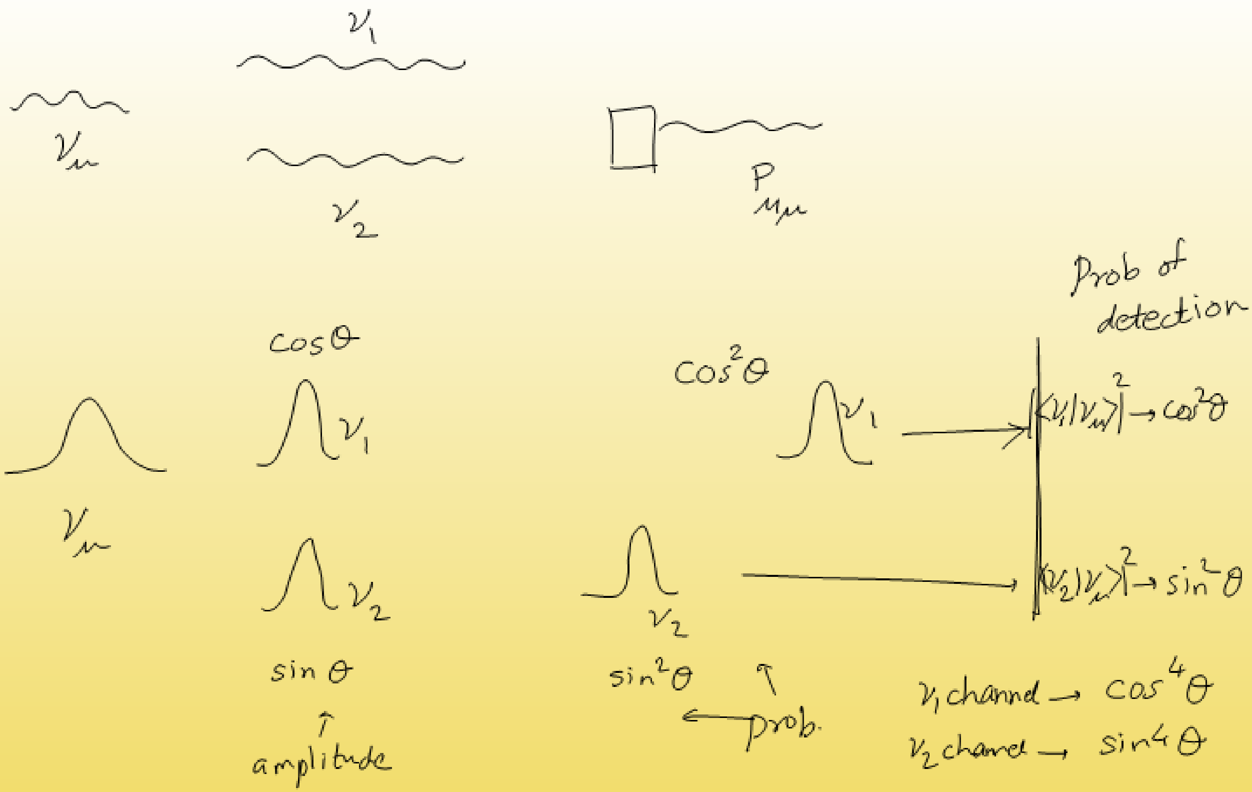
3/2/2010 14:39



$\nu_1$
$\nu_\mu$
$\nu_2$
$P_{\mu\mu}$
Prob of detection
$\cos\theta$
$\cos^2\theta$
$\nu_1$
$|\langle\nu_1|\nu_\mu\rangle|^2 \to \cos^2\theta$
$\nu_\mu$
$\nu_2$
$|\langle\nu_2|\nu_\mu\rangle|^2 \to \sin^2\theta$
$\sin\theta$
$\sin^2\theta$
amplitude
prob.
$\nu_1$ channel $\to$ $\cos^4\theta$
$\nu_2$ channel $\to$ $\sin^4\theta$

Wavepacket separation:

$$P_{\mu\mu} = \cos^4\theta + \sin^4\theta$$

$$= (\cos^4\theta + \sin^4\theta + 2\sin^2\theta\cos^2\theta) - 2\sin^2\theta\cos^2\theta$$

$$= 1 - \frac{1}{2}\sin^2 2\theta$$

oscillation:

$$P_{\mu\mu} = 1 - \sin^2 2\theta \sin^2\left(\frac{\Delta m^2 L}{4E}\right)$$

3/2/2010 14:56

$$\phi = \frac{\Delta m^2 L}{2E}$$

Production point uncertainty: $\Delta L$

Phase uncertainty: $\Delta\phi = \frac{\Delta m^2}{2E} \Delta L$

$\Delta\phi > 2\pi \Rightarrow$ complete decoherence

$$\Delta\phi = \underbrace{\frac{\Delta m^2 L}{2E}}_{\pi} \cdot \underbrace{\left(\frac{\Delta L}{L}\right)}_{0.01} \sim 0.01\,\pi$$

atm: $\rightarrow$

3/2/2010 15:06

# Energy resolution

$$\phi = \frac{\Delta m^2 L}{2E} \Rightarrow \quad \Delta\phi = \frac{\Delta m^2 L}{2E^2}\Delta E$$

$$= \frac{\Delta m^2 L}{2E} \cdot \left(\frac{\Delta E}{E}\right)$$

For observing osc:

$$\Delta\phi << 2\pi \qquad \frac{\Delta m^2 L}{2E}\left(\frac{\Delta E}{E}\right) << 2\pi$$

$$\pi [ \quad ] << 2\pi$$

atmospheric

3/2/2010 15:30

$$\boxed{\Delta\phi} = \left(\frac{\Delta m^2 L}{2E}\right)\left(\frac{\Delta E}{E}\right)$$

| | | |
|---|---|---|
| $\pi$ | 102 | 0.7 |
| $3\pi$ | | 0.9 |
| $5\pi$ | | 1.5 |
| $7\pi$ | | |

3/2/2010 15:35

$$\varphi_1 \sim \frac{\Delta m_1^2}{2E} L$$

$$\varphi_2 \sim \frac{\Delta m_2^2}{2E} L$$

$$\varphi_2 - \varphi_1 = \frac{\Delta m^2}{2E} L$$