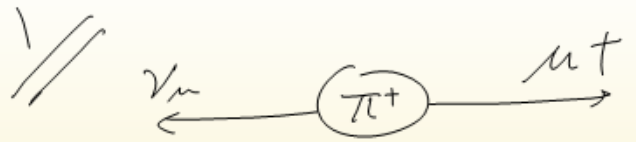


Assignment 1



$$m_\nu^2 = m_\pi^2 + m_\mu^2 - 2m_\pi E_\mu$$

$$1\text{eV}^2$$

$$100\text{MeV}$$

$$\Delta(m_\nu^2) \sim 2m_\pi \Delta E_\mu$$

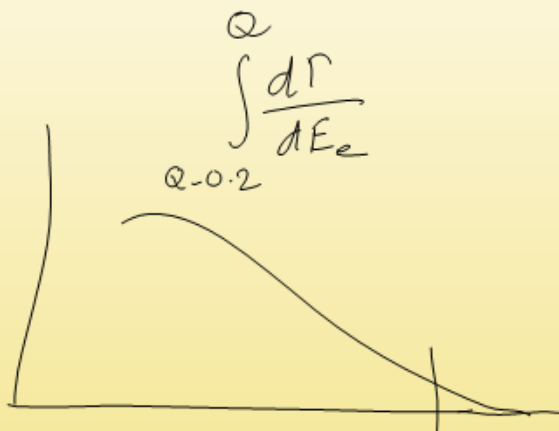
$$\downarrow$$

$$10^{-9}\text{eV}$$

2//

$$\frac{d\Gamma}{dE_e} \sim P_e E_e P_\nu E_\nu \sim \sqrt{E_e^2 - m_e^2} E_e (Q - E_e)^2$$

$$E_e \sim m_e + T_e$$

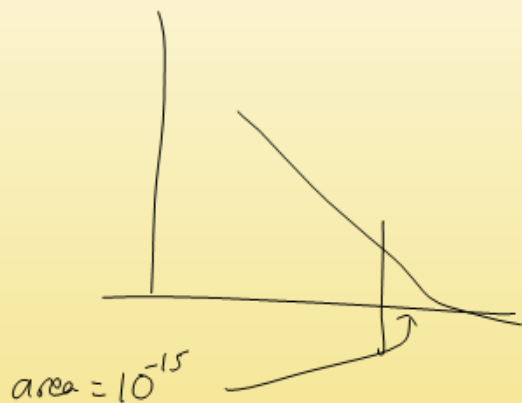


$$N = \int_{Q-DE}^Q n(E) dE \sim C \Delta E \left[ \cancel{n(Q)} + \cancel{n'(Q) \Delta E} + \frac{n''(Q) (\Delta E)^2}{2!} + \dots \right]$$

$\swarrow$                        $\swarrow$   
 $0$                        $0$

$$N = \int_{Q-DE}^Q n(E) dE = \frac{n''(Q)}{2} (\Delta E)^3$$

$$N(\Delta E) = a (\Delta E)^3$$



$$\begin{array}{ccc} \text{3} // & (E, E, 0, 0) & (M_N, 0, 0, 0) \\ & \textcircled{E} \longrightarrow \textcircled{N} & \\ & (E) & M_N \end{array}$$

$$\sigma \sim G_F^2 S$$

$$E \ll M_N: \sigma \sim E$$

$$E_{CM}^2 = (E + M_N)^2 - E^2$$

$$S = 2M_N E + M_N^2 \checkmark$$

~~$$E \ll M_N: \sqrt{S} (E \ll M_N): M_N \left(1 + \frac{2E}{M_N}\right)^{1/2} \sim M_N + E$$~~

$$\sqrt{S} (E \gg M_N) \sim \sqrt{2M_N} \sqrt{E} \left(1 + \frac{M_N}{2E}\right)^{1/2}$$

4

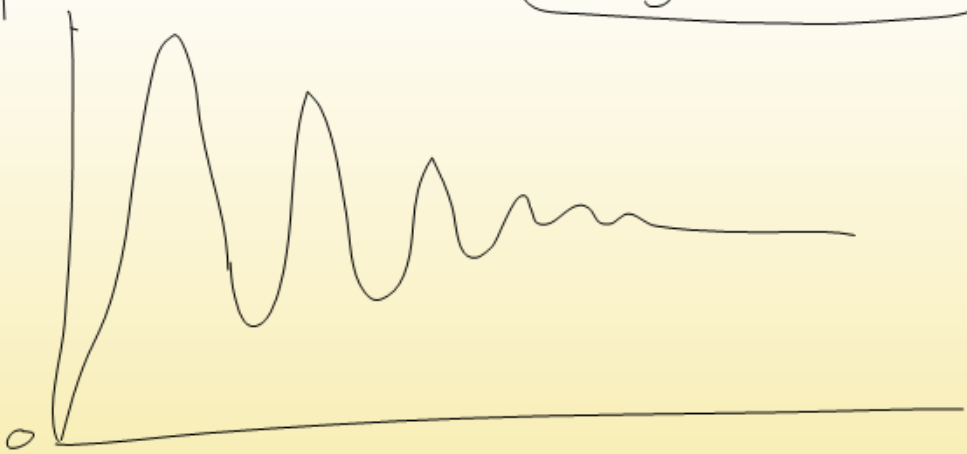
10 MeV  $\rightarrow$  nucleus as a whole

GeV  $\rightarrow$  protons and neutrons

TeV  $\rightarrow$  u and d quarks

Assignment 2

1  
1  
1



$$\cancel{2} \quad E \uparrow : \quad \sin^2 2\theta_m \rightarrow \frac{\Delta \sin 2\theta}{\left( \Delta \cos 2\theta + \frac{G_F n_n}{2\sqrt{2}} \right)^2 + (\Delta \sin 2\theta)^2}$$

$$\sin^2 2\theta_m = \frac{\Delta^2 \sin^2 2\theta}{\left( \Delta^2 \cos^2 2\theta + G_F n_n E \sqrt{2} \right)^2 + (\Delta^2 \sin^2 2\theta)^2}$$

$$\Delta m^2 \sin 2\theta = \Delta m_m^2 \sin 2\theta_m$$

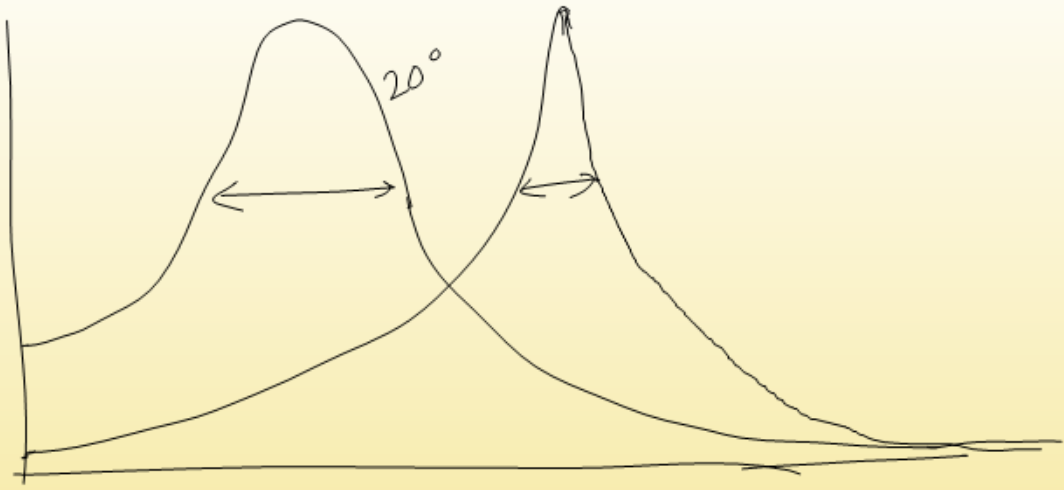


$$\int d\theta \text{ Flux}(\theta) \quad \times$$

$$\int d\cos\theta$$

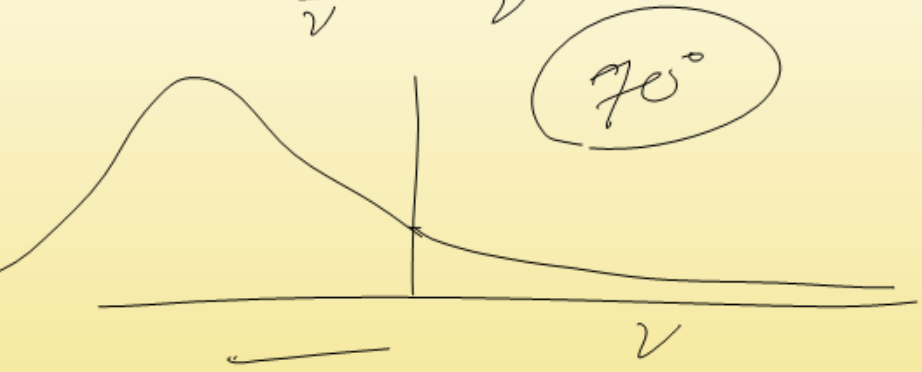
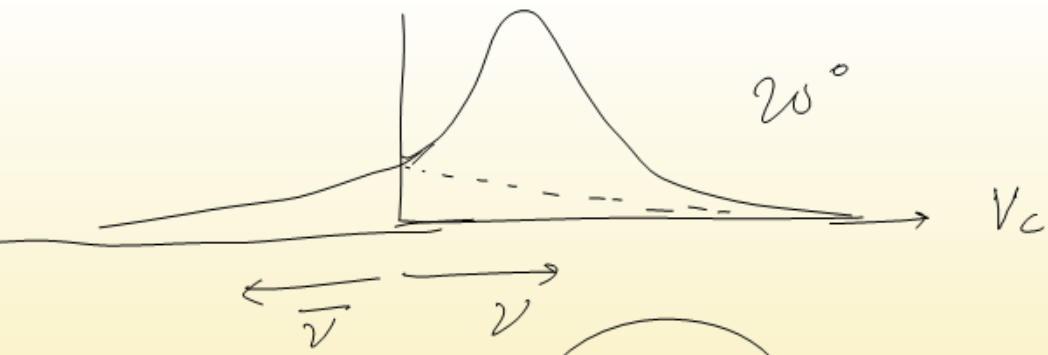
$$\int d\theta \cdot \sin\theta$$

3  
sin<sup>2</sup> 20m



Small  $\theta \rightarrow$  Small resonance region  $\rightarrow$  non-adiabatic.

$$\gamma \sim \frac{Dm^2}{2E} \frac{\sin^2 \theta}{\cos 2\theta} \frac{1}{|v_c'/v_c|}$$

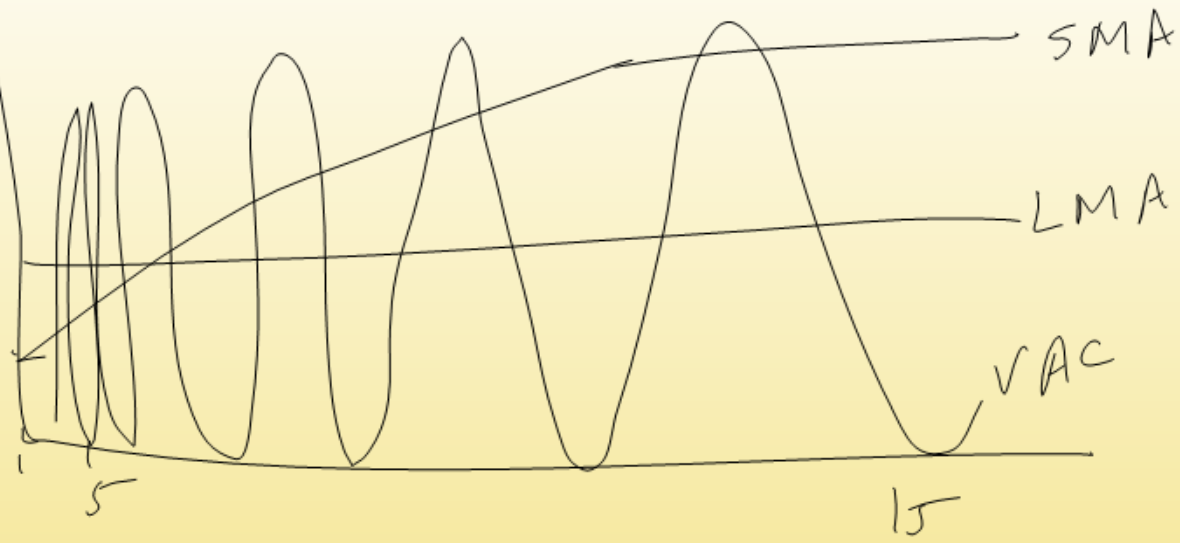


$$\tan 20^\circ = \frac{\Delta \sin 20^\circ}{\left(\Delta \cos 20^\circ - \frac{V_d}{2}\right)}$$

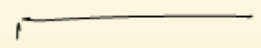
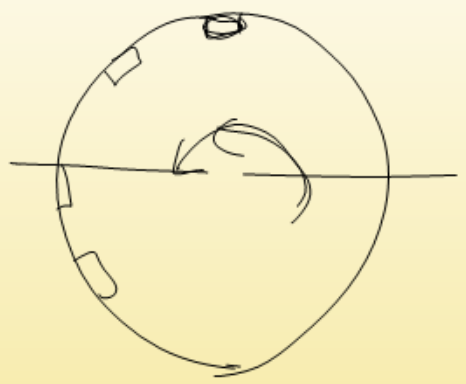
$$\Delta \rightarrow -\Delta$$

$$\theta \rightarrow \frac{\pi}{2} - \theta$$

~~25~~



S



$$P_{ee}(L) \rightarrow P_{ee}(\varphi)$$

$$\int_0^{\pi} d\varphi P_{ee}(\varphi)$$