

Flavor sector: Masses and Mixing

Fig. I.2

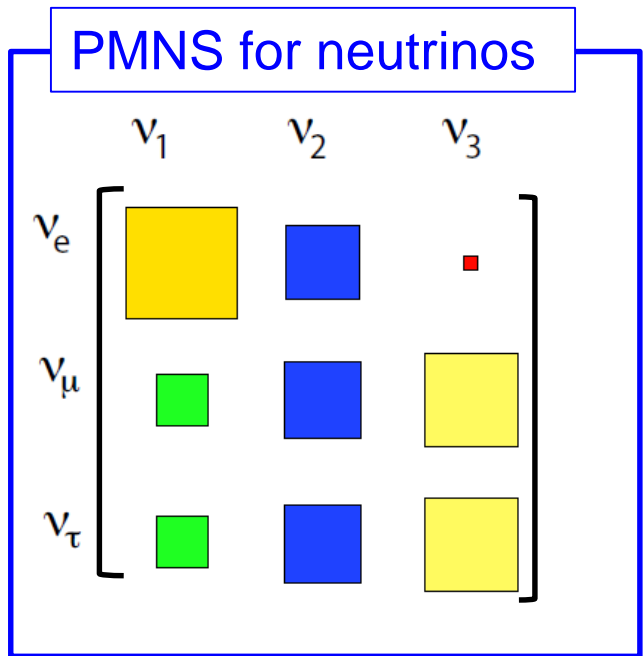
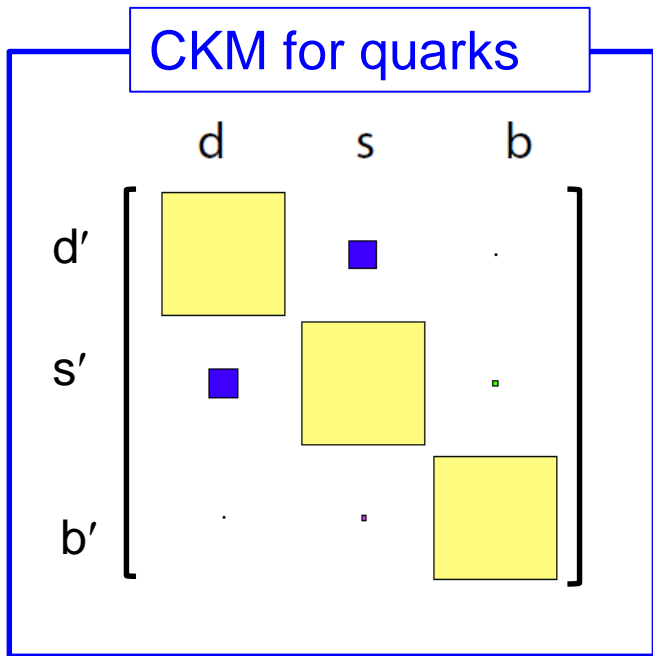
Flavor parameters:

- 6 quark masses
- 3 quark mixing angles + 1 phase: CKM matrix
- 3 + 3 lepton masses
- 3 lepton mixing angles + 1 phase : PMNS matrix

} 20 parameters

Mixing:

Area $\sim V^2$



Pontecorvo–Maki–Nakagawa–Sakata

Why these values? Are the two related? Are they related to masses?

Light neutrino generations

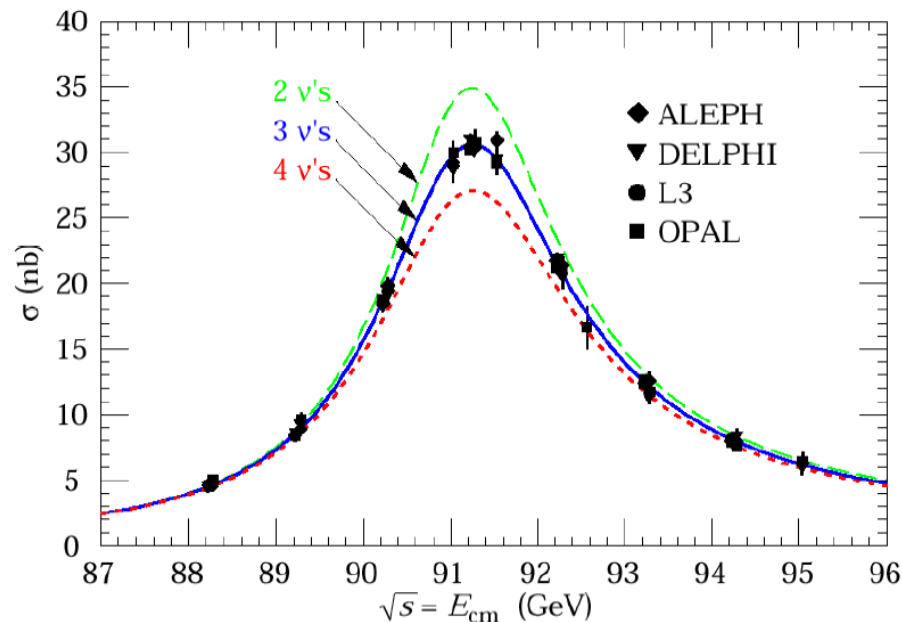
Fig. I.4

$$\Gamma_Z = \Gamma_{had} + 3 \cdot \Gamma_\ell + \underbrace{N_\nu \cdot \Gamma_\nu}_{\text{invisible: } \Gamma_{inv}} \rightarrow \left\{ \begin{array}{l} e^+ e^- \rightarrow Z \rightarrow \nu_e \bar{\nu}_e \\ e^+ e^- \rightarrow Z \rightarrow \nu_\mu \bar{\nu}_\mu \\ e^+ e^- \rightarrow Z \rightarrow \nu_\tau \bar{\nu}_\tau \end{array} \right.$$

$$\Gamma_{inv} = 0.4990 \pm 0.0015 \text{ GeV}$$

$$N_\nu = \frac{\Gamma_{inv}}{\Gamma_{\nu, SM}} = \underbrace{\left(\frac{\Gamma_{inv}}{\Gamma_\ell} \right)_{exp}}_{5.9431 \pm 0.0163} \cdot \underbrace{\left(\frac{\Gamma_\ell}{\Gamma_\nu} \right)_{SM}}_{=1/1.991 \pm 0.001}$$

(small theo. uncertainties from m_{top} M_H)



$$N_\nu = 2.9840 \pm 0.0082$$