$$U = R_{23}(\theta_{23})\, R_{13}(\theta_{13})\, R_{12}(\theta_{12})$$

$P_{\mu\mu}$

$\theta_{23} \approx \theta_{atm}$

$\theta_{23} \approx \theta_{atm} + \theta(\theta_{13})$

P_{ee}

≈ 0

reactor

$\theta_{reactor}$

$P_{ee} \sim \sin^2\theta_{\odot}$

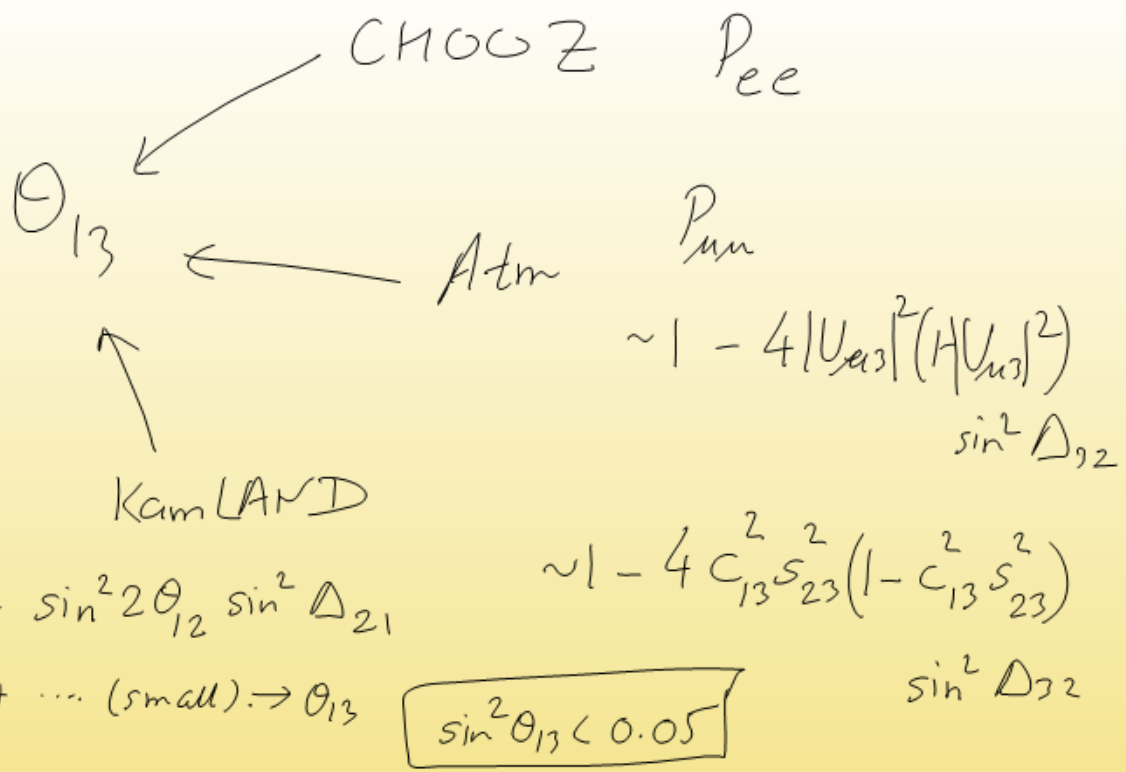
$\nu_e \to \nu_e$

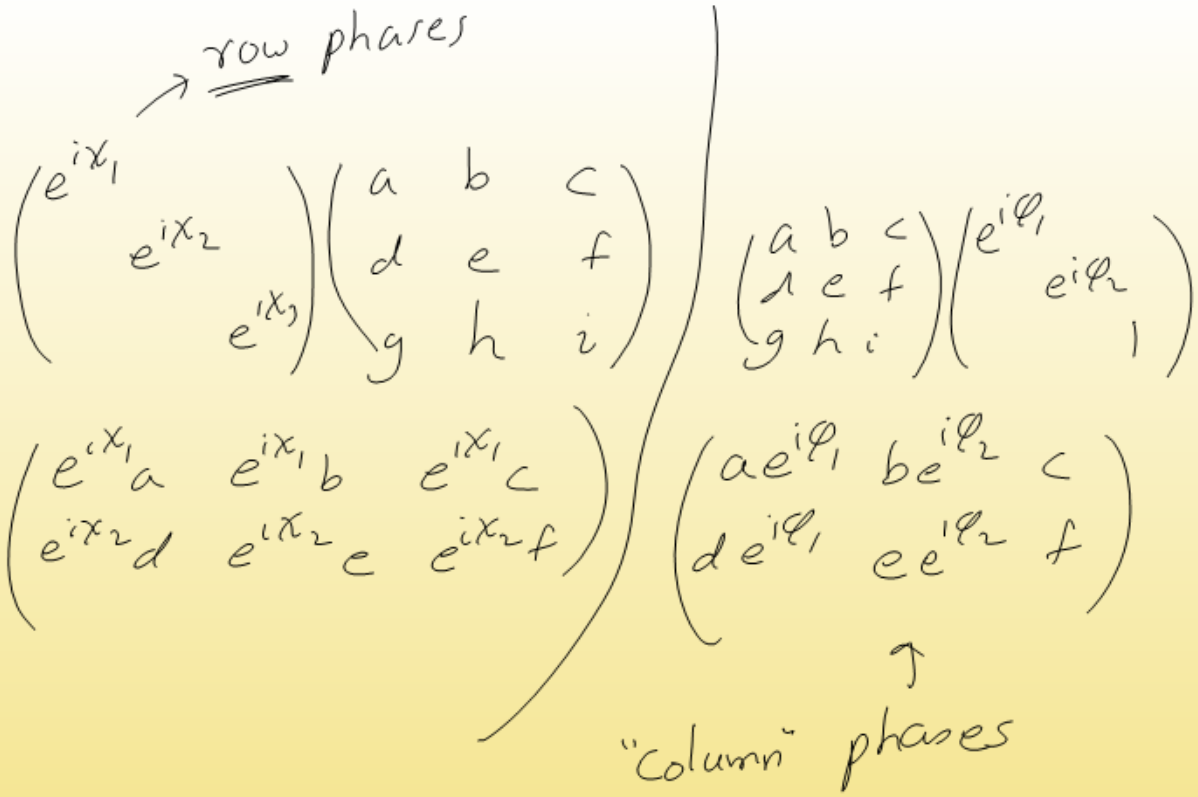
$\nu_\mu \to \nu_x$

$\nu_\tau \to \nu_y$

$\theta_{12} \approx \theta_{\odot}$

$$\begin{pmatrix} \nu_e \\ \nu_x \end{pmatrix} = \begin{pmatrix} c_{12} & s_{12} \\ -s_{12} & c_{12} \end{pmatrix} \begin{pmatrix} \nu_1 \\ \nu_2 \end{pmatrix}$$


CHOOZ
P_{ee}
θ_{13}
Atm
$P_{\mu\mu}$
$\sim 1 - 4|U_{e3}|^2(1-|U_{e3}|^2)$
$\sin^2\Delta_{32}$
KamLAND
$P_{ee} \sim 1 - \sin^2 2\theta_{12} \sin^2\Delta_{21}$
$+ \cdots$ (small) $\to \theta_{13}$
$\sim 1 - 4 c_{13}^2 s_{23}^2 (1 - c_{13}^2 s_{23}^2)$
$\sin^2\Delta_{32}$
$\sin^2\theta_{13} < 0.05$


row phases
"column" phases

$$\nu_\alpha \longrightarrow e^{i\lambda} \nu_\alpha$$

$$\nu_\alpha = U_{\alpha i} \nu_i \qquad U_{\alpha i} \longrightarrow e^{+i\lambda} U_{\alpha i}$$

$$U^*_{\beta j} \longrightarrow e^{-i\lambda} U^*_{\alpha j}$$

$$U_{\alpha i} U^*_{\alpha j} \longrightarrow U_{\alpha i} U^*_{\alpha j}$$

N_2 Plaquette

$$\begin{pmatrix} \nu_e \\ \nu_\mu \\ \nu_\tau \end{pmatrix} = \begin{pmatrix} \bigcirc & \square \\ \square & \bigcirc \end{pmatrix} \begin{pmatrix} \nu_1 \\ \nu_2 \\ \nu_3 \end{pmatrix}$$

$$D_{\alpha\beta ij} = U_{\alpha i} U_{\beta j} U^*_{\alpha j} U^*_{\beta i}$$