Quark-lepton complementarity, neutrino and standard model data predict $\theta_{13}^{PMNS} = 9^{+1}_{-2}$ deg

Paris, Planck '06

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Quark-Lepton complementarity

- Neutrino experiments confirm that the PMNS lepton mixing matrix contains large mixing angles:

  atmospheric mixing θ_{23}^{PMNS} is compatible with 45 deg;

  the solar mixing θ_{12}^{PMNS} is approx 34 deg.
- To be compared with θ_{13}^{PMNS} and the mixing angles in the CKM matrix.
- The disparity between quark and lepton mixing angles has been viewed in terms of a 'quark-lepton complementarity' (QLC) which can be expressed in the relations

$$\theta_{12}^{PMNS} + \theta_{12}^{CKM} \simeq 45 \text{ deg}$$
$$\theta_{23}^{PMNS} + \theta_{23}^{CKM} \simeq 45 \text{ deg}$$

Correlation matrix Definition

- Possible consequences of QLC have been investigated in the literature and in particular a simple correspondence between the PMNS and CKM matrices has been proposed and analyzed in terms of a correlation matrix.
- The correlation matrix is simply defined as the product of the CKM with the PMNS matrices
- There are unknown phases

Correlation matrix
Zero order approximation

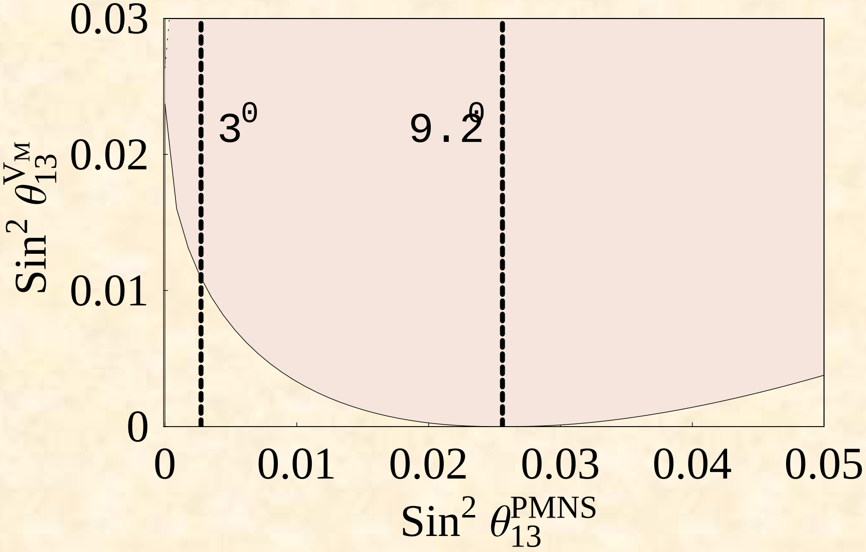
- For central values of the experimental data the (1,3) entry of the correlation matrix is not zero.
- To include particular correlation matrix
  - bimaximal (two angles of 45 deg and a vanishing one)
  - tribimaximal (one angle of 45 deg, one with $\tan^2 \theta = 0.5$ and a third vanishing one)

one needs models with renormalization effects

(relevant only for large $\tan \beta$ and quasi degenerate ν)

Correlation matrix
First order approximation

- Owing to the uncertainty in the value for θ_{13}^{PMNS}, the (1,3) entry of correlation matrix may or may not include zero.

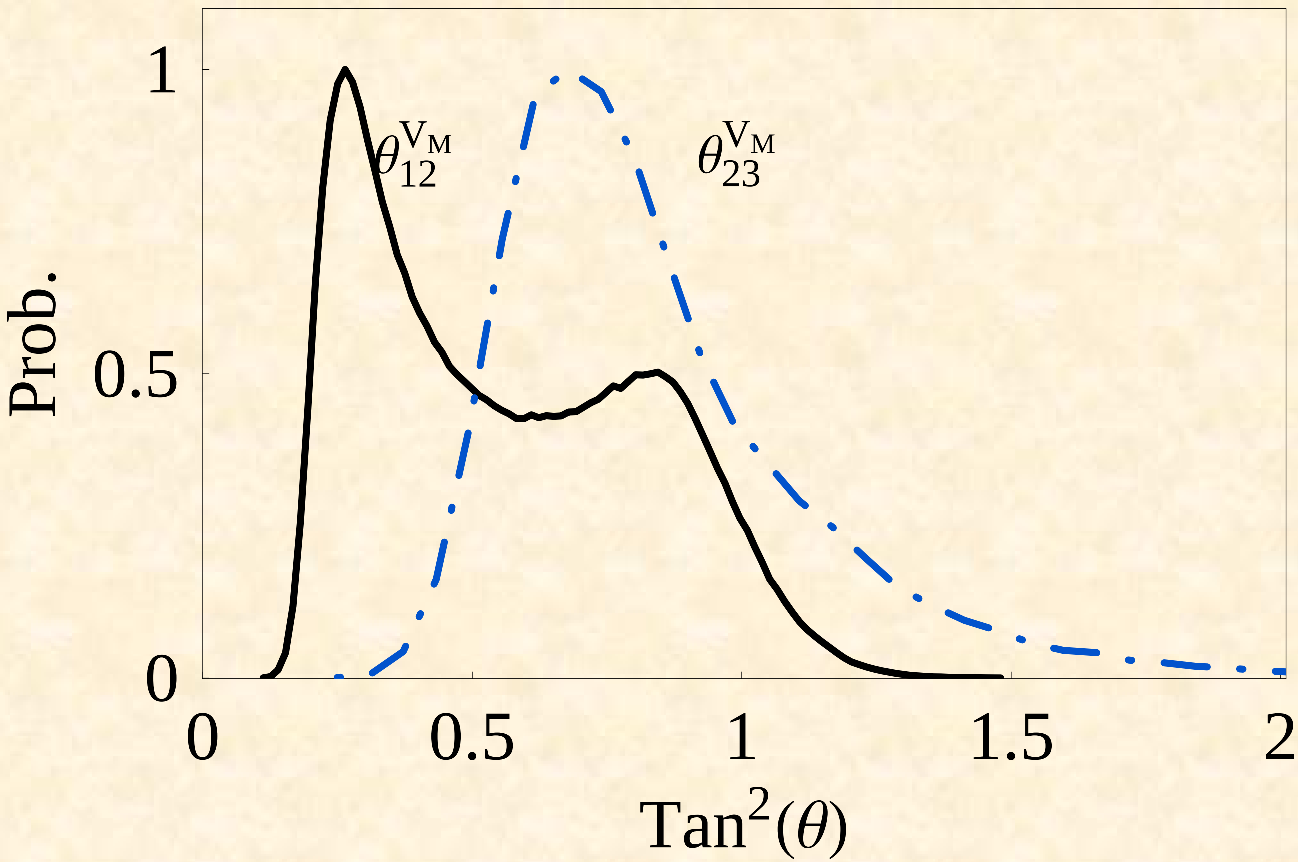


All the other CKM and PMNS mixing parameters are fixed at their best fit points.

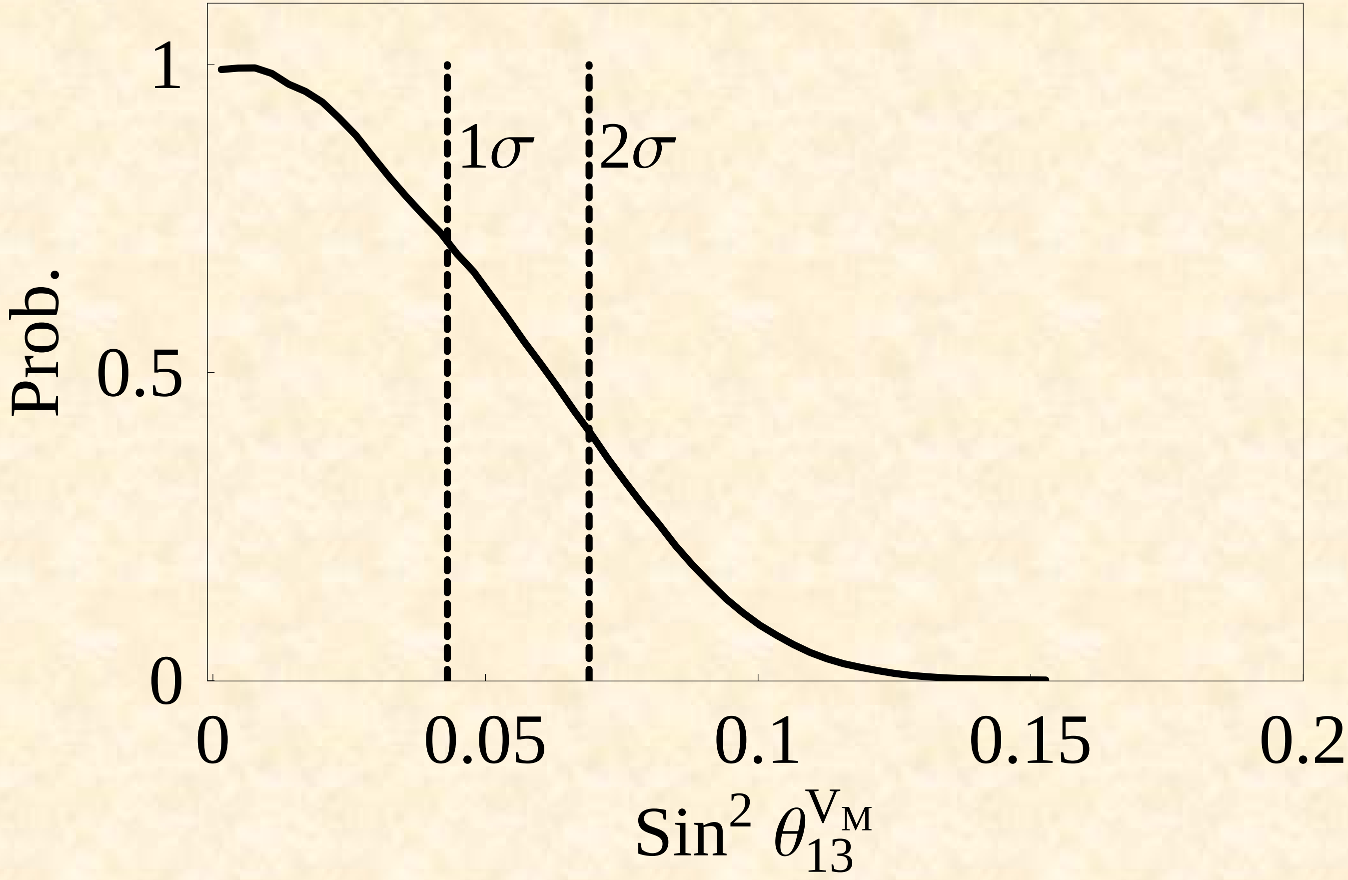
Bottom up approach

- We use all the experimental data with their incertitude in a Monte Carlo simulation to convolute them
- The correlation matrix CKM * PMNS has:
  - $0.3 < \tan^2 \theta_{12} < 1.$
  - $0.5 < \tan^2 \theta_{23} < 1.4$
  - $\sin^2 \theta_{13} < 0.1$

Correlation matrix: θ_{12} and θ_{23}



Correlation matrix: θ_{13}

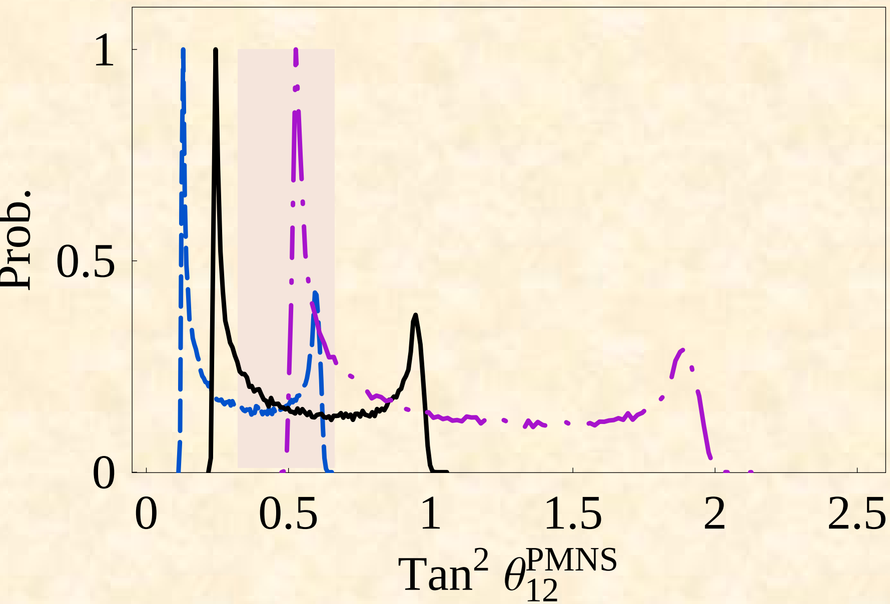


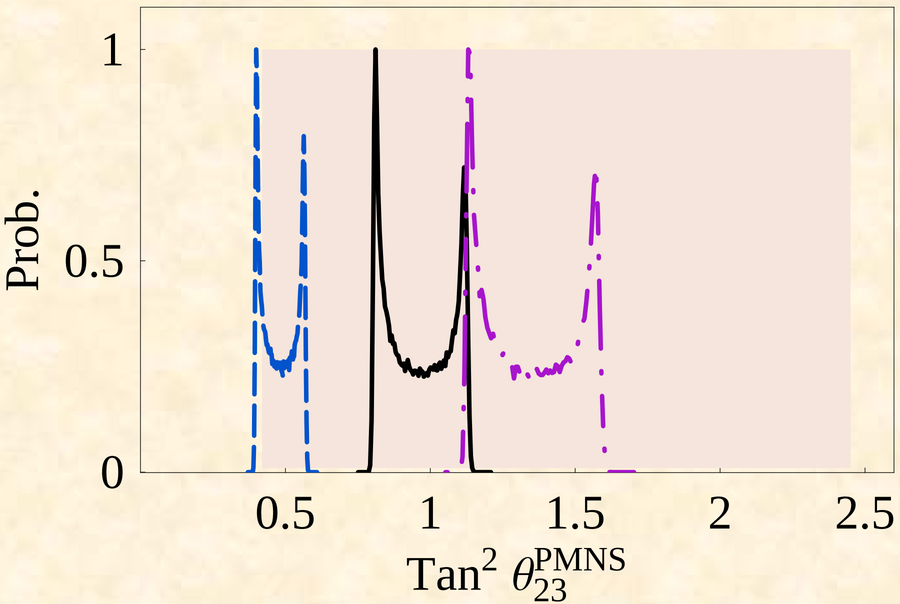
Top down approach

- If we assume that the correlation matrix has:
  - $0.3 < \tan^2 \theta_{12} < 1.$
  - $0.5 < \tan^2 \theta_{23} < 1.4$
  - $\sin^2 \theta_{13} = 0$ <--------- Hypotesis

then we get that the unknow mixing lepton angle θ_{13}^{PMNS} is 9^{+1}_{-2} deg.

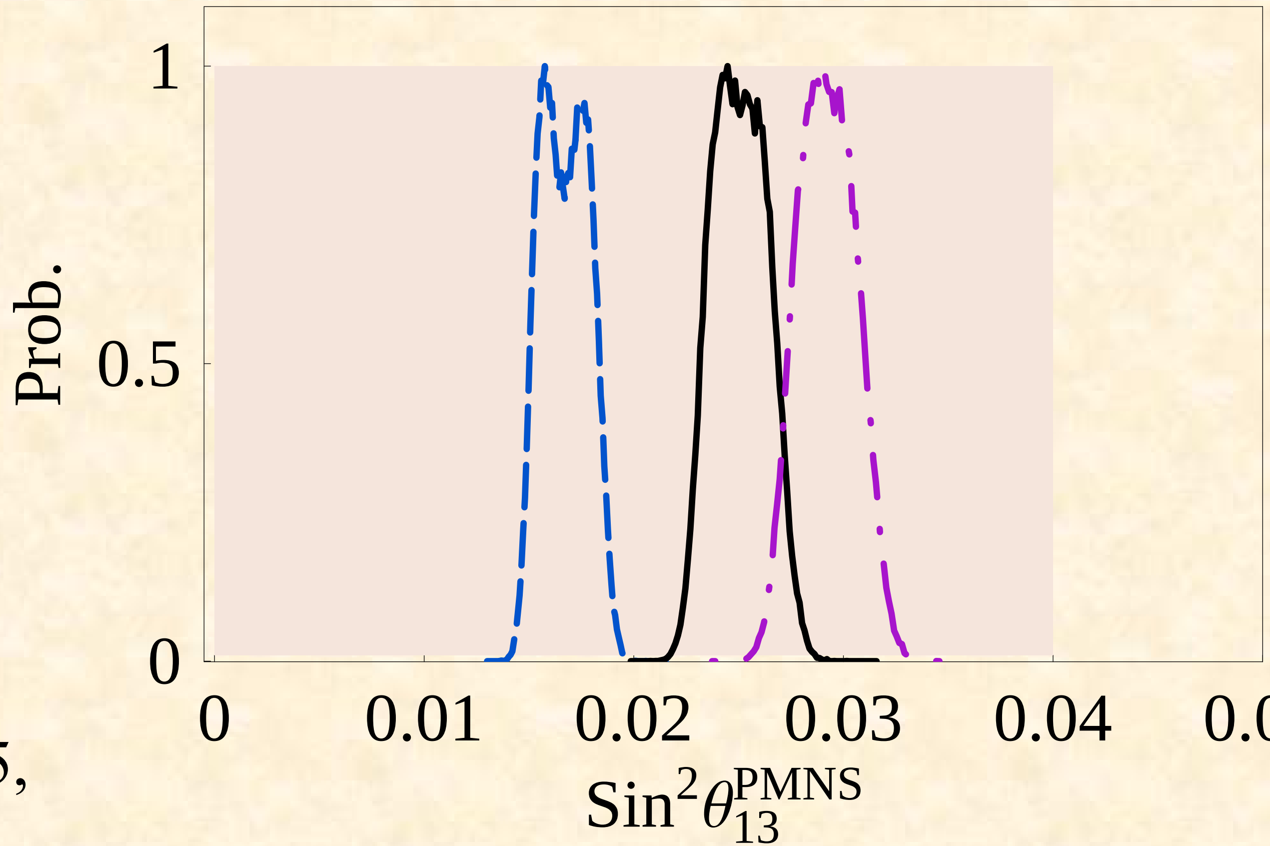
PMNS matrix: θ_{12}^{PMNS} and θ_{23}^{PMNS}





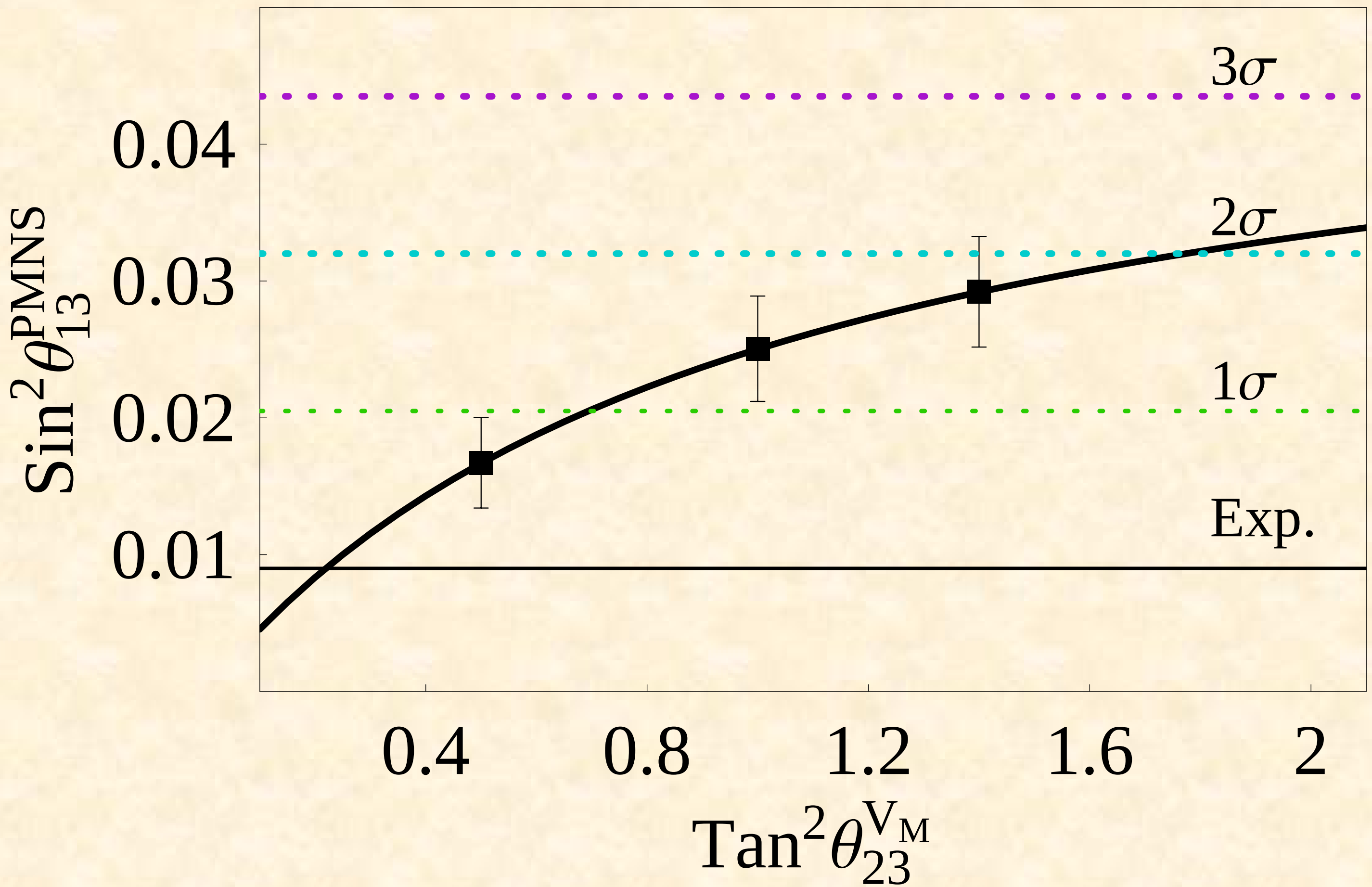
(left) $\tan^2\theta_{23} = 1.0$, $\sin^2\theta_{13} = 0$,
$\tan^2\theta_{12} = 0.3$ (dashed), 0.5 (continuos), 1.0 (dot-dashed)
(right) $\tan^2\theta_{12} = 0.5$, $\sin^2\theta_{13} = 0$,
$\tan^2\theta_{23} = 0.5$ (dashed), 1.0 (continuos), 1.4 (dot-dashed)

PMNS matrix: θ_{13}^{PMNS}



$\tan^2\theta_{12} = 0.5$,
$\sin^2\theta_{13} = 0$,
$\tan^2\theta_{23} = 0.5$ (dashed), 1.0 (continuos), 1.4 (dot-dashed)

$\sin^2 \theta_{13}^{PMNS}$ as a function of $\tan^2 \theta_{23}$



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