

NuFact Summer Institute

Capri 2005

Physics of massive ν_s

Eligio Lisi, INFN, Bari, Italy

LECTURE III

2005 up-to-date global analysis
of 3-neutrino mass and mixing parameters

(G.L.Fogli, E.L., A. Marrone, A. Palazzo)

Invited by (and submitted to) P.P.N.P.

Finished just before leaving to this School

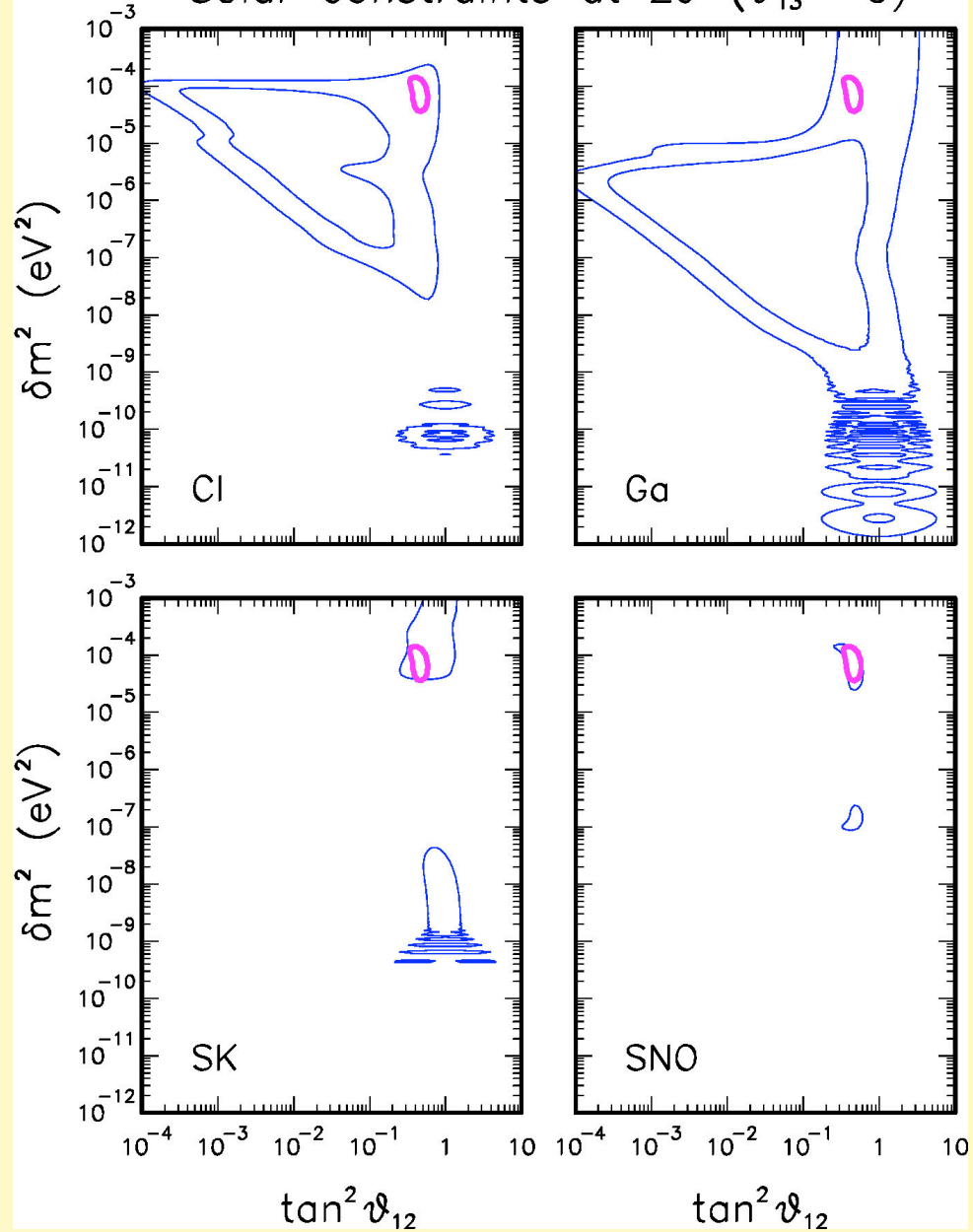
- I really had no time to insert any written comment -
Here, only verbal comments to the plots - Sorry!

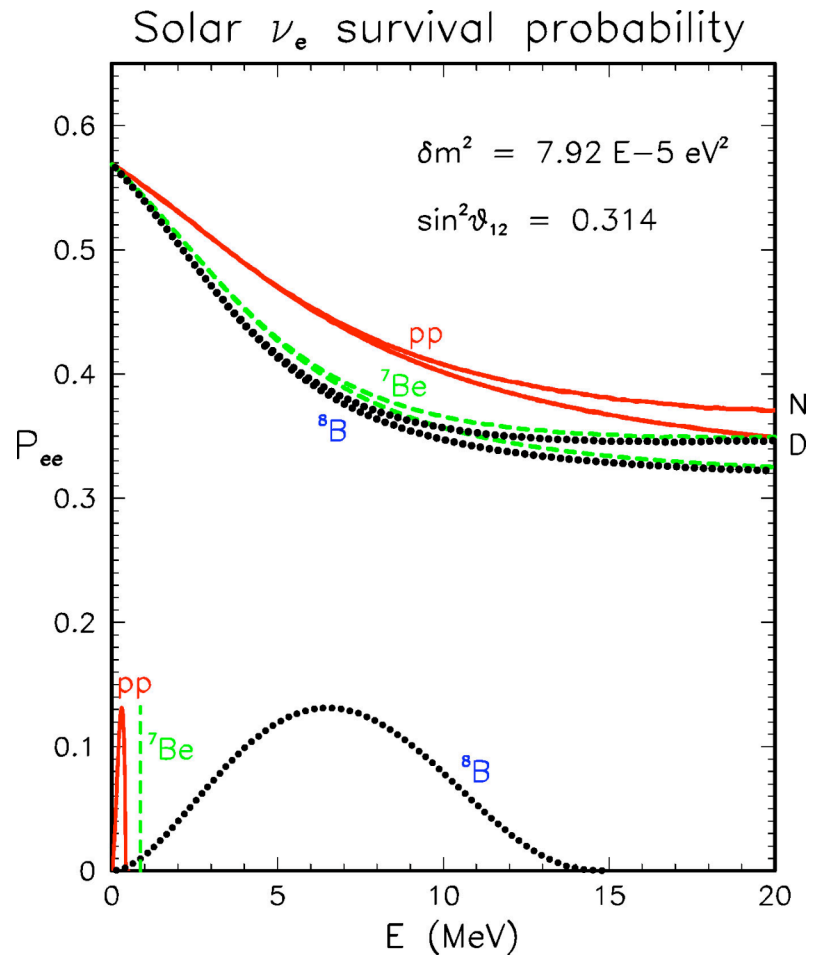
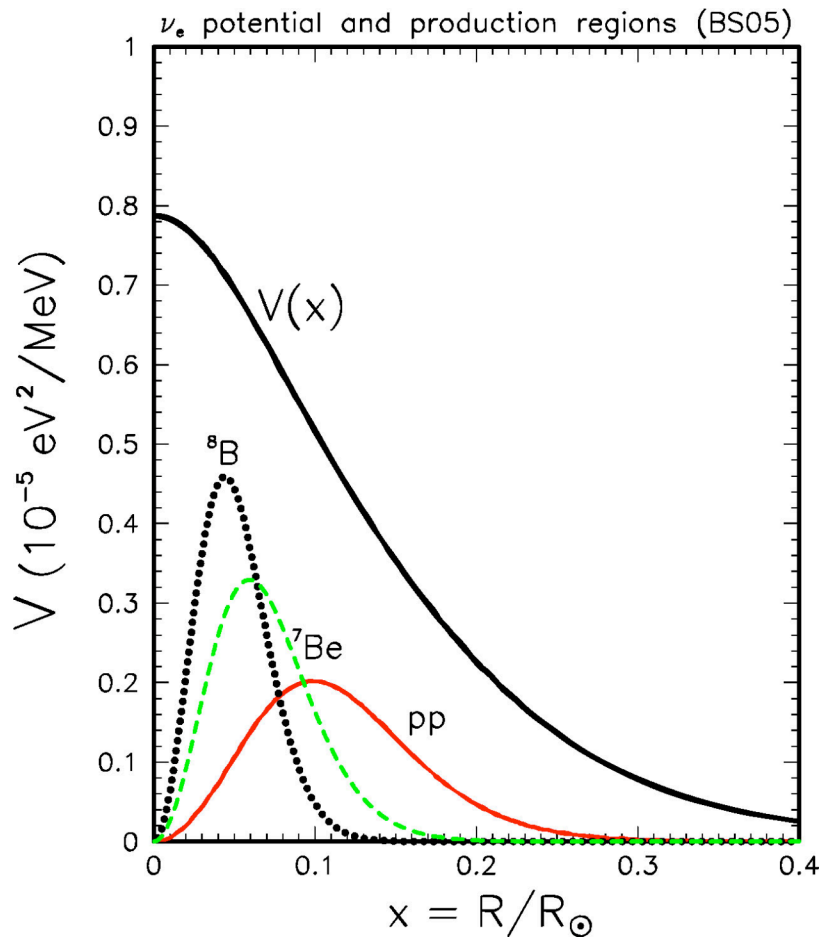
Many thanks to all our collaborators in neutrino papers

Outline:

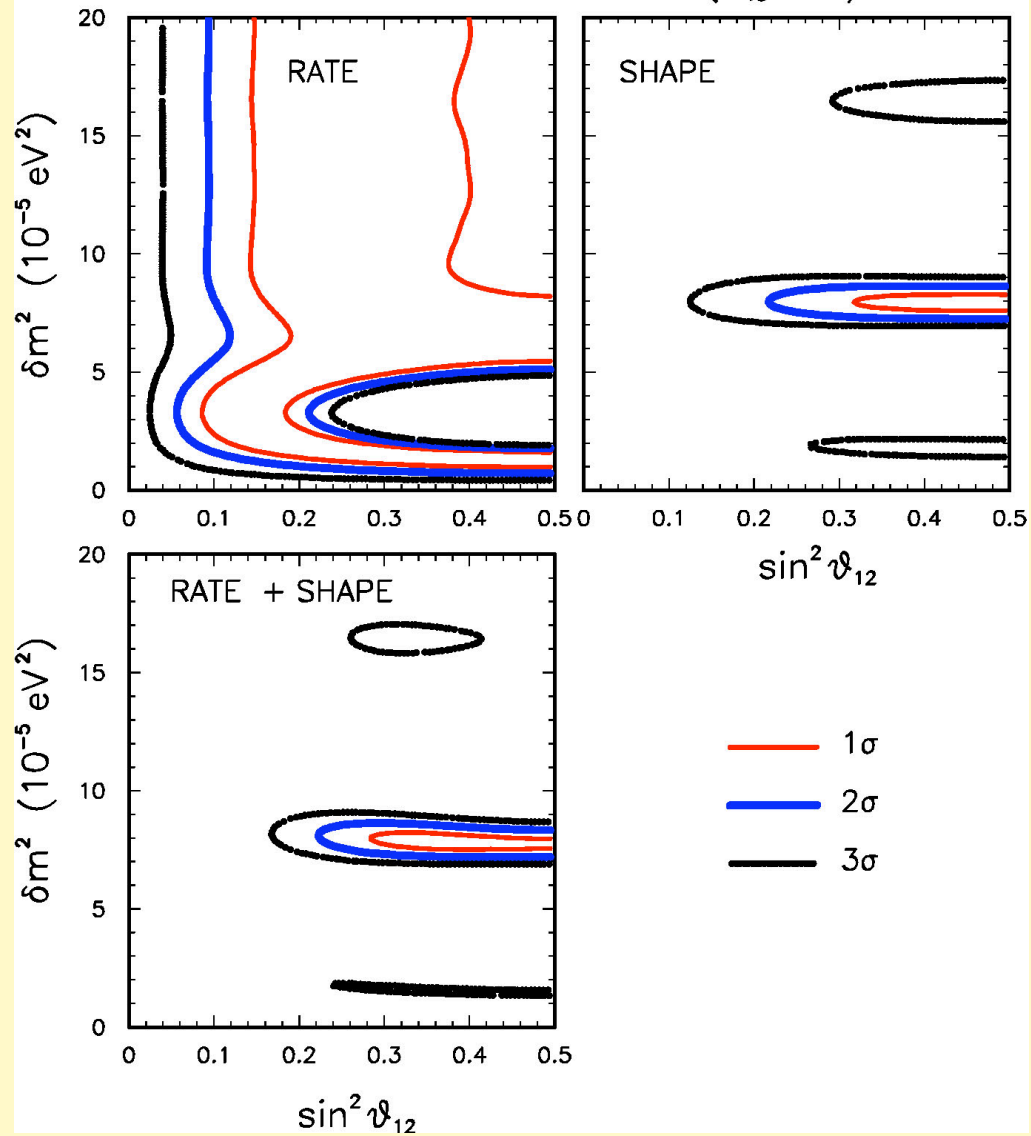
- Solar + KamLAND oscillations
- SK_{ATM} + K2K oscillations
- Constraints from all oscillation data
- Combination with non-oscillation data
- Conclusions

Solar constraints at 2σ ($\vartheta_{13} = 0$)

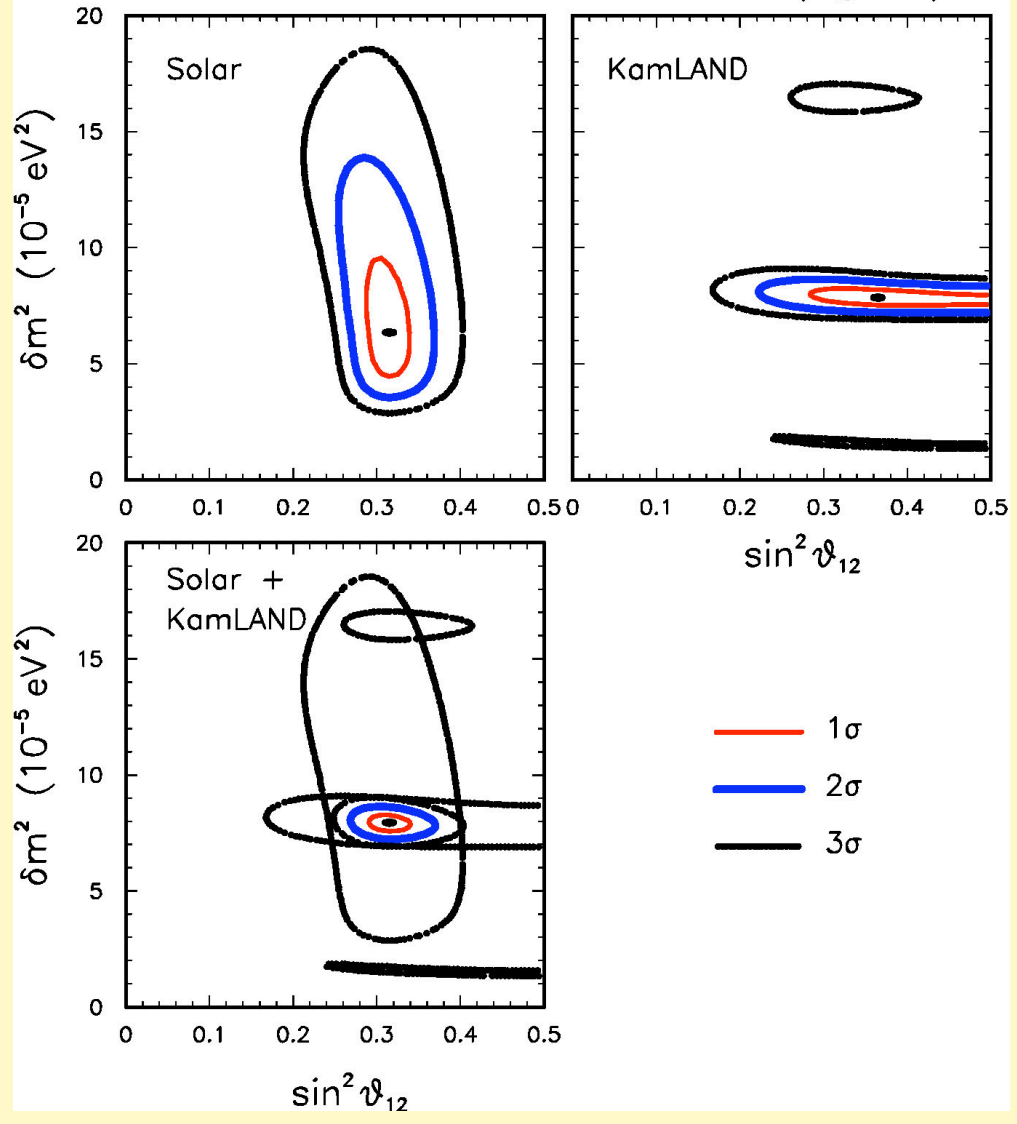


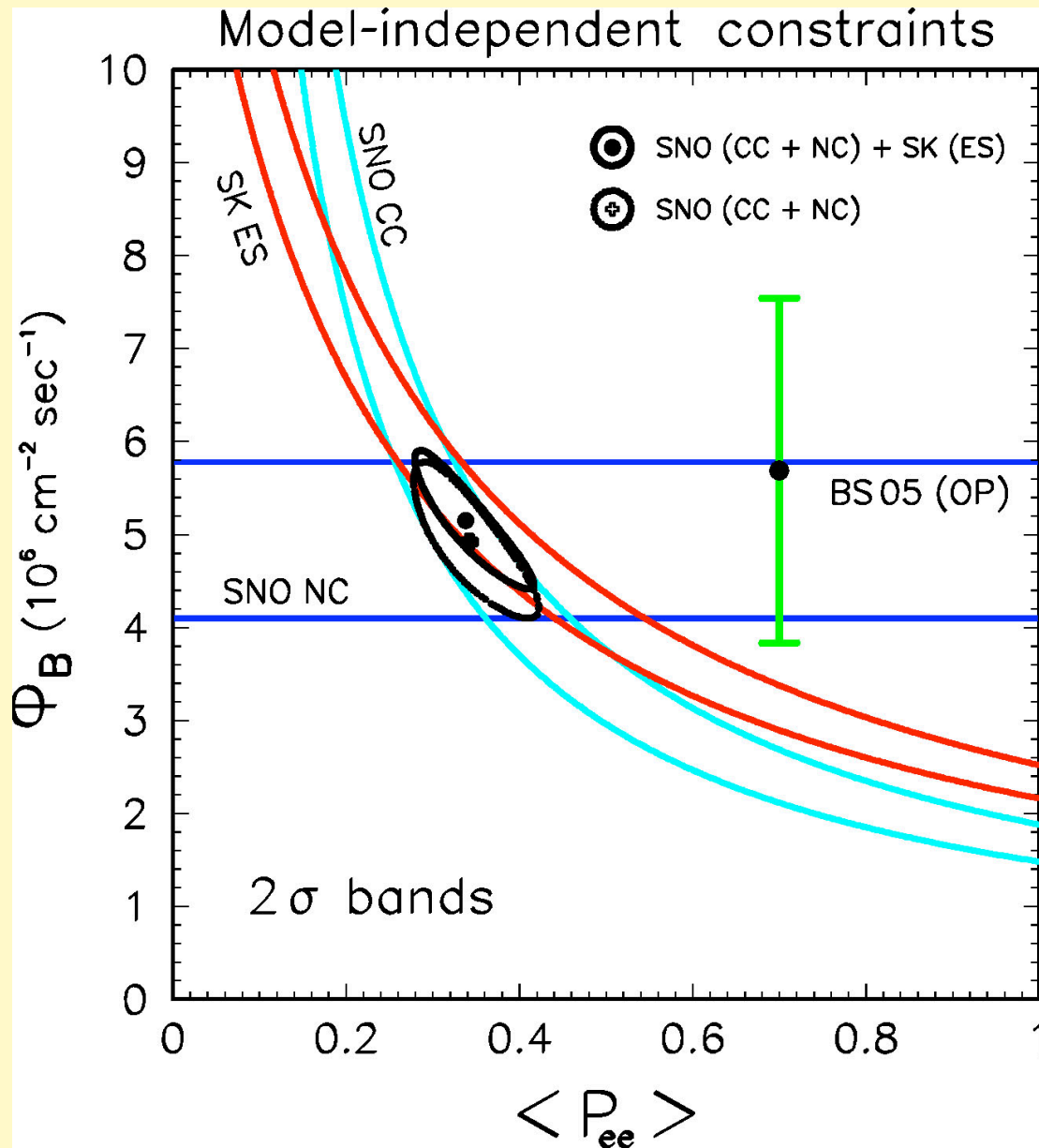
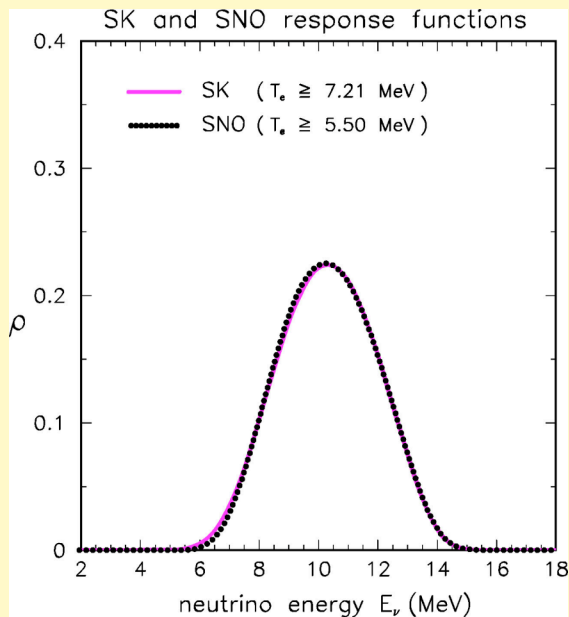


KamLAND constraints ($\vartheta_{13} = 0$)

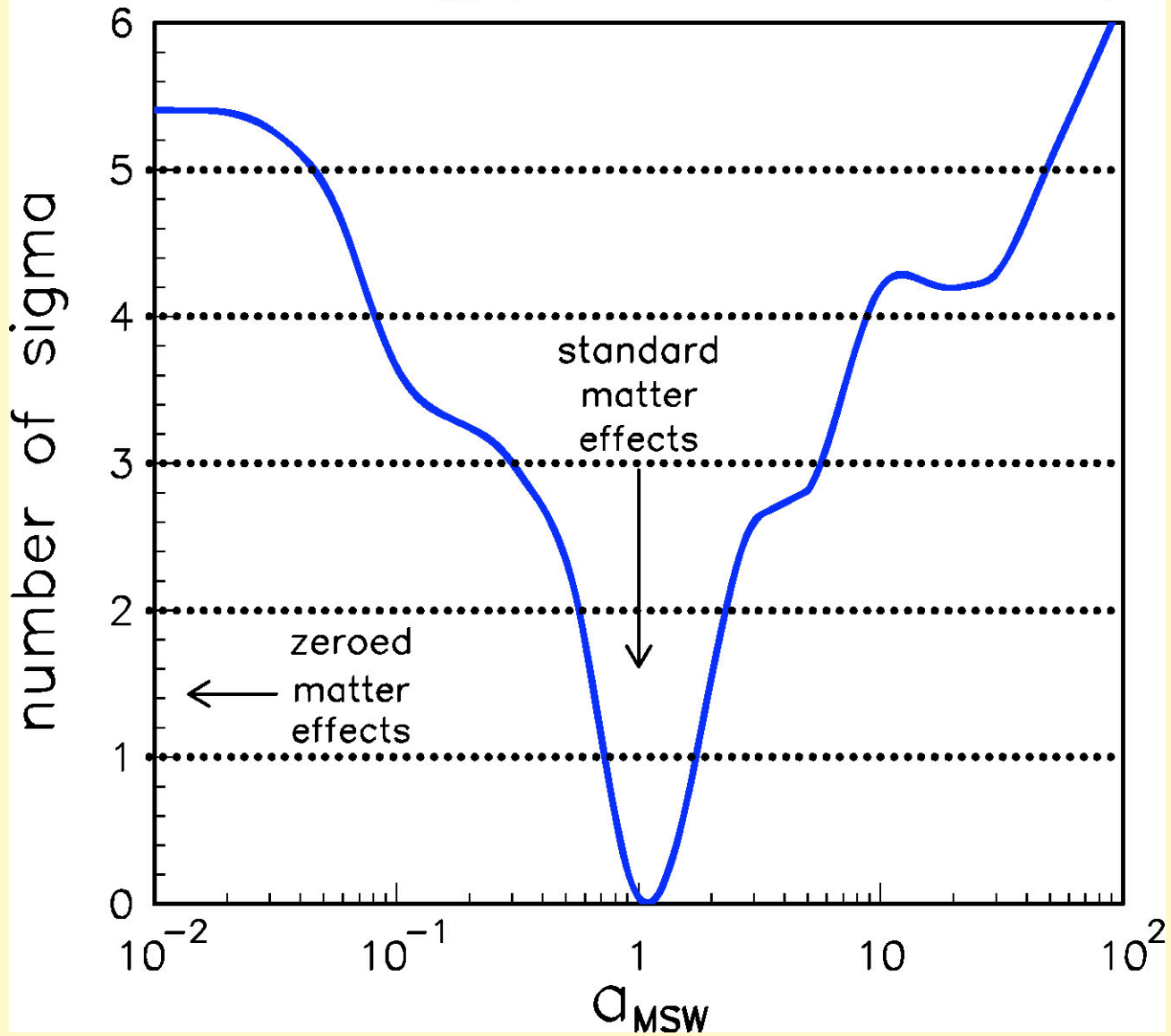


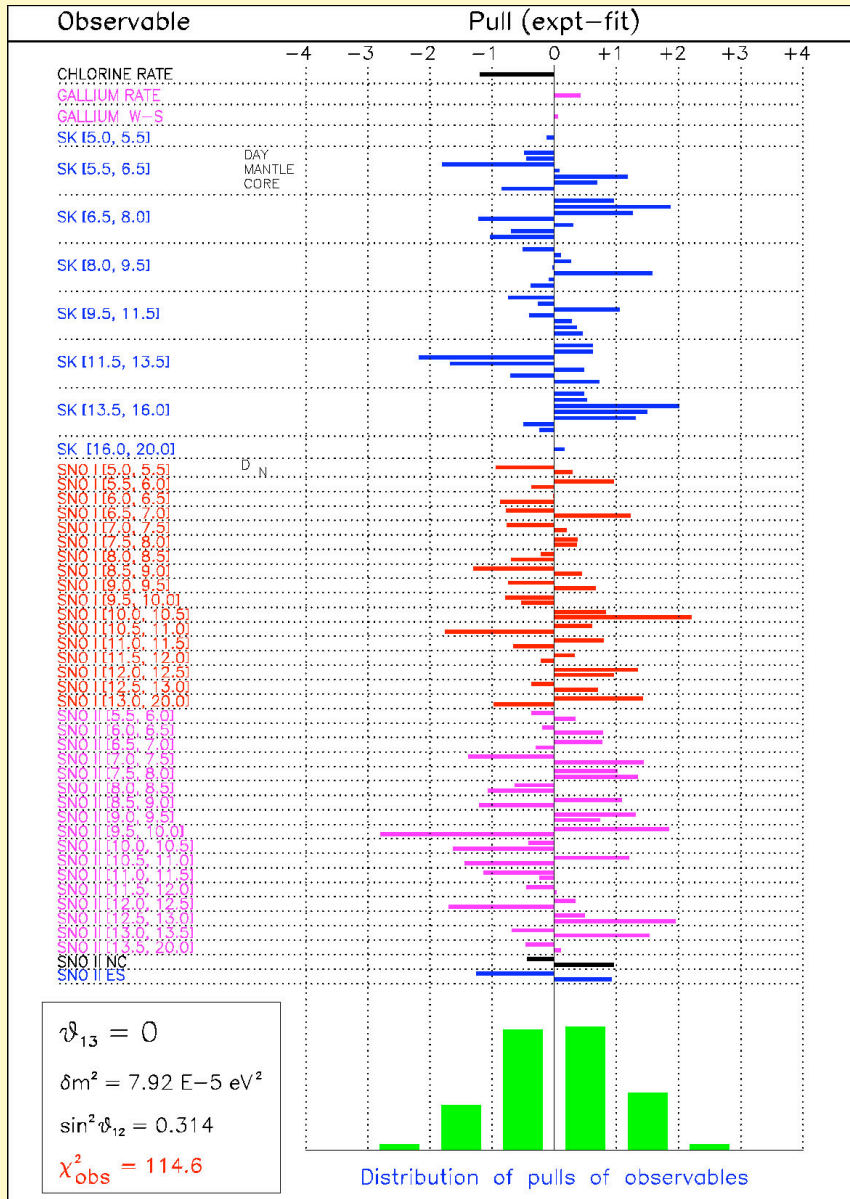
Solar and KamLAND constraints ($\vartheta_{13} = 0$)



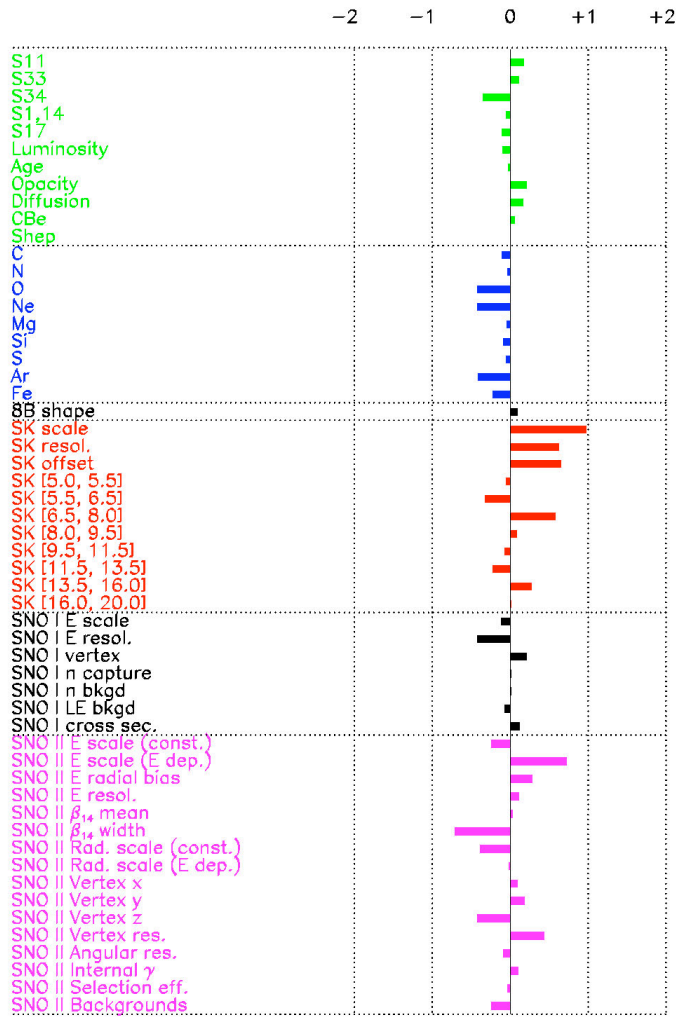


Bounds on a_{MSW} (Solar + CHOOZ + KamLAND)





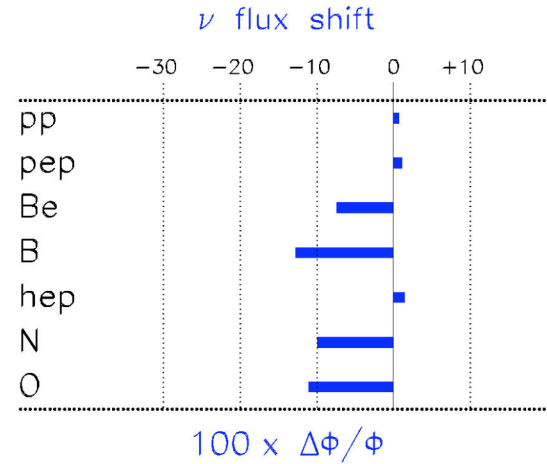
Systematic pulls (solar ν analysis)



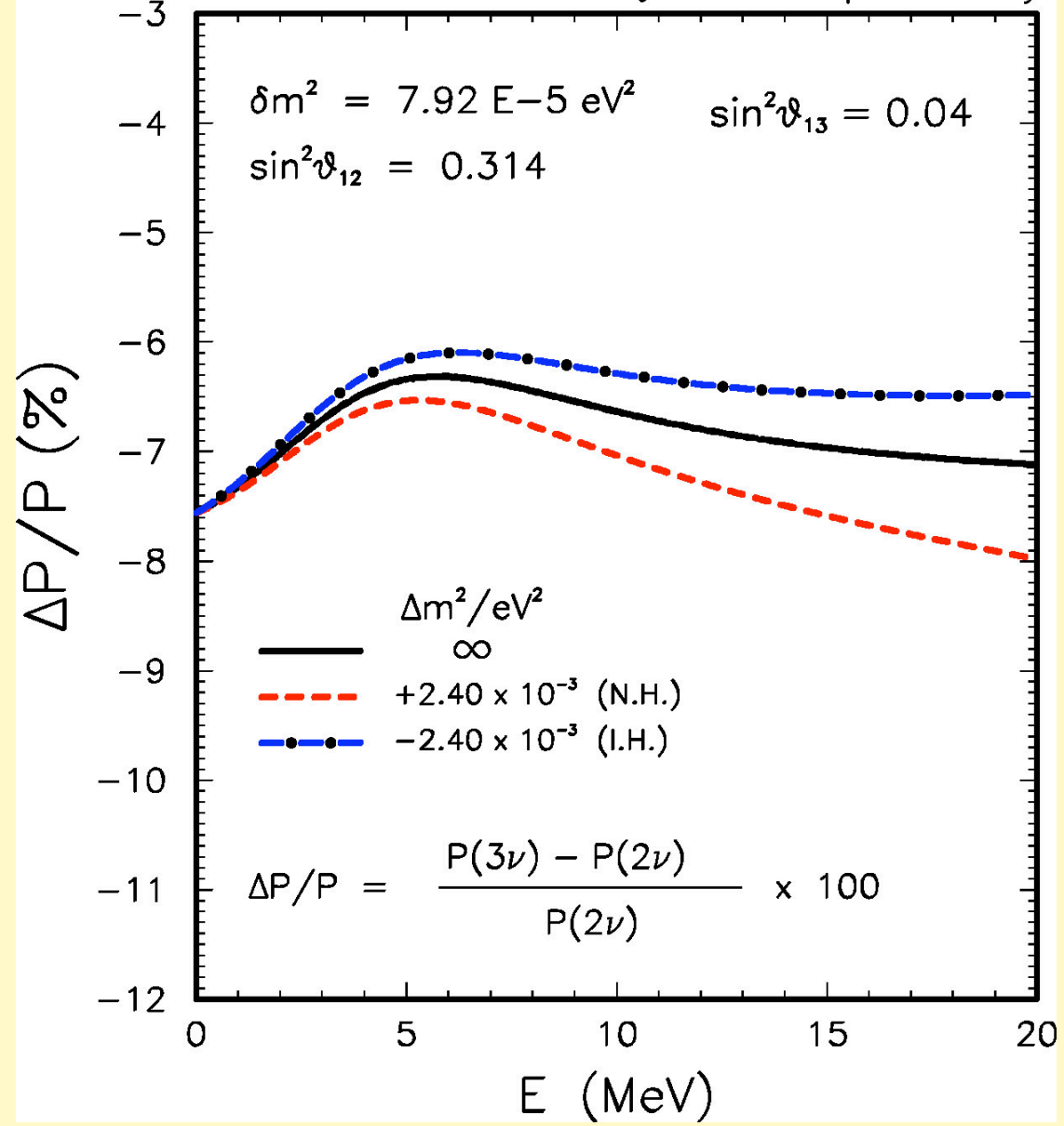
$\chi^2_{\text{sys}} = 4.9$

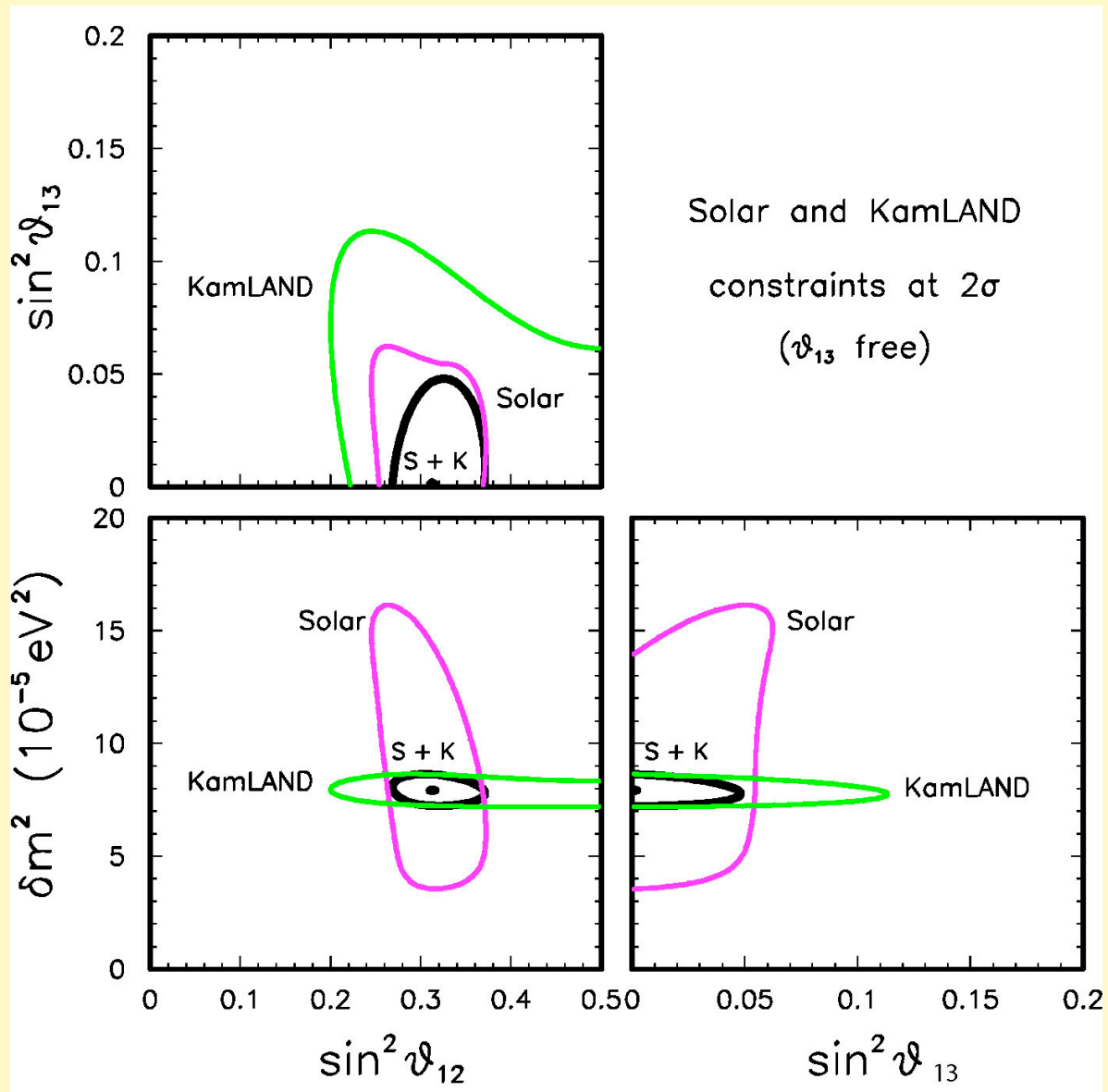
Shifts from SSM BS05(OP)

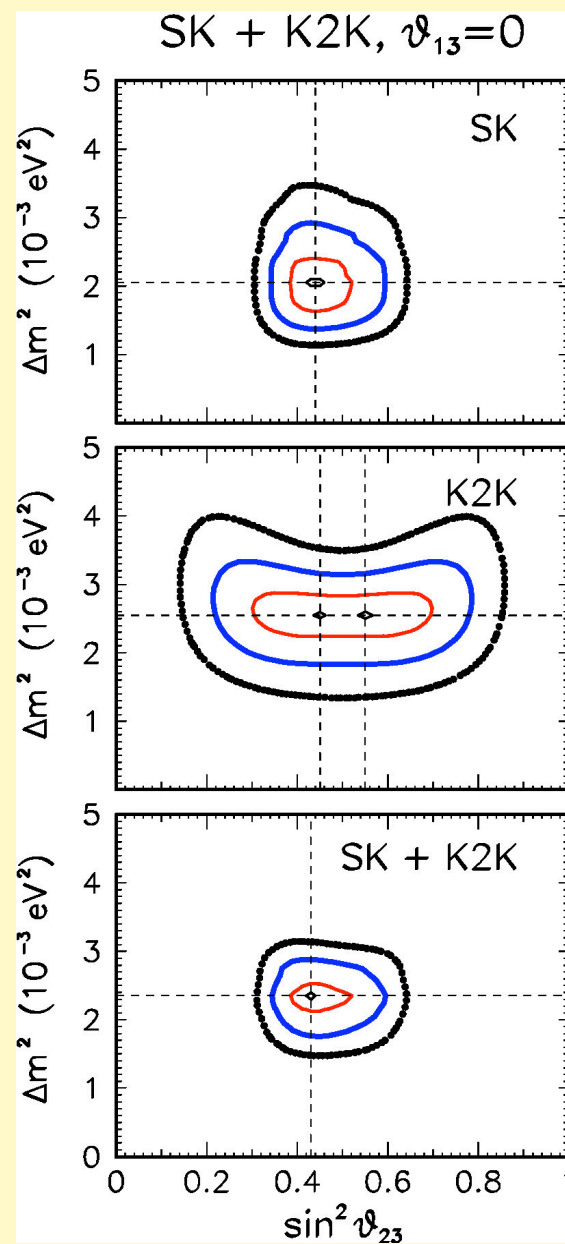
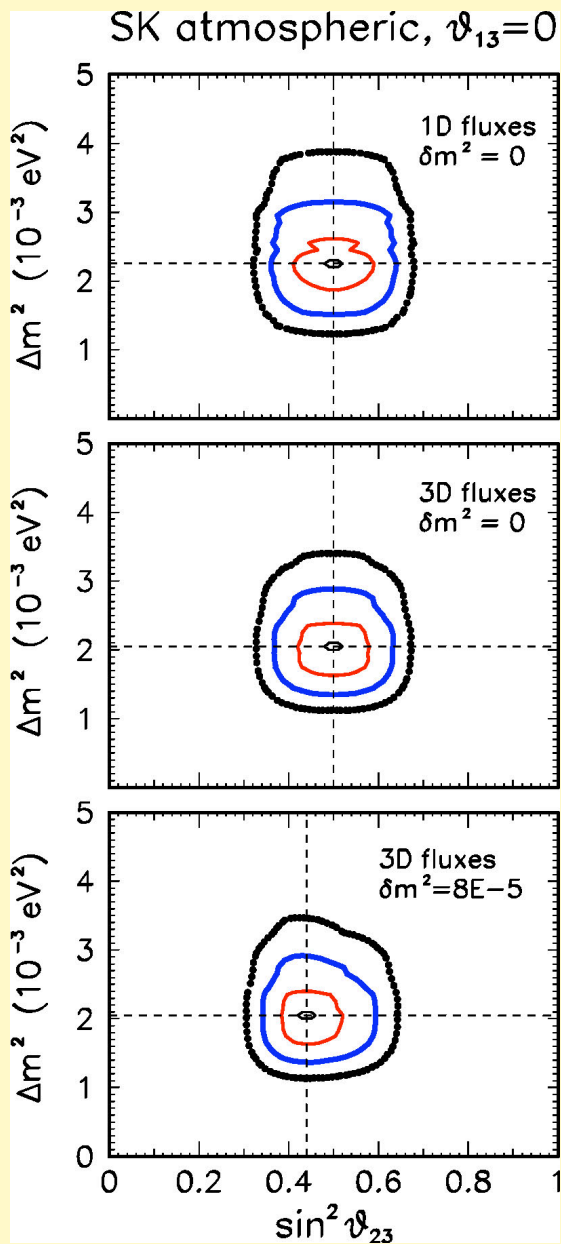
Solar + KamLAND best fit



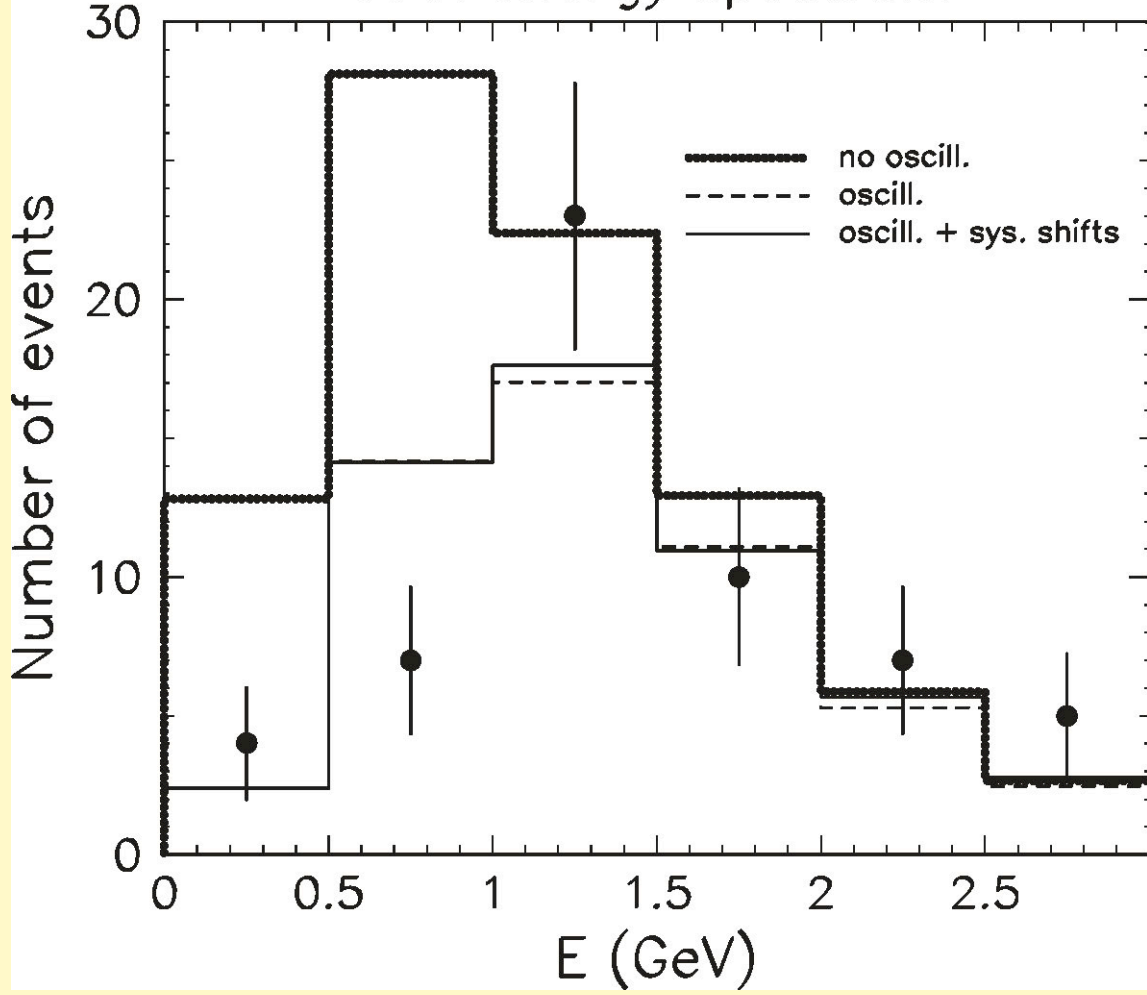
3ν effects on solar ν_e survival probability







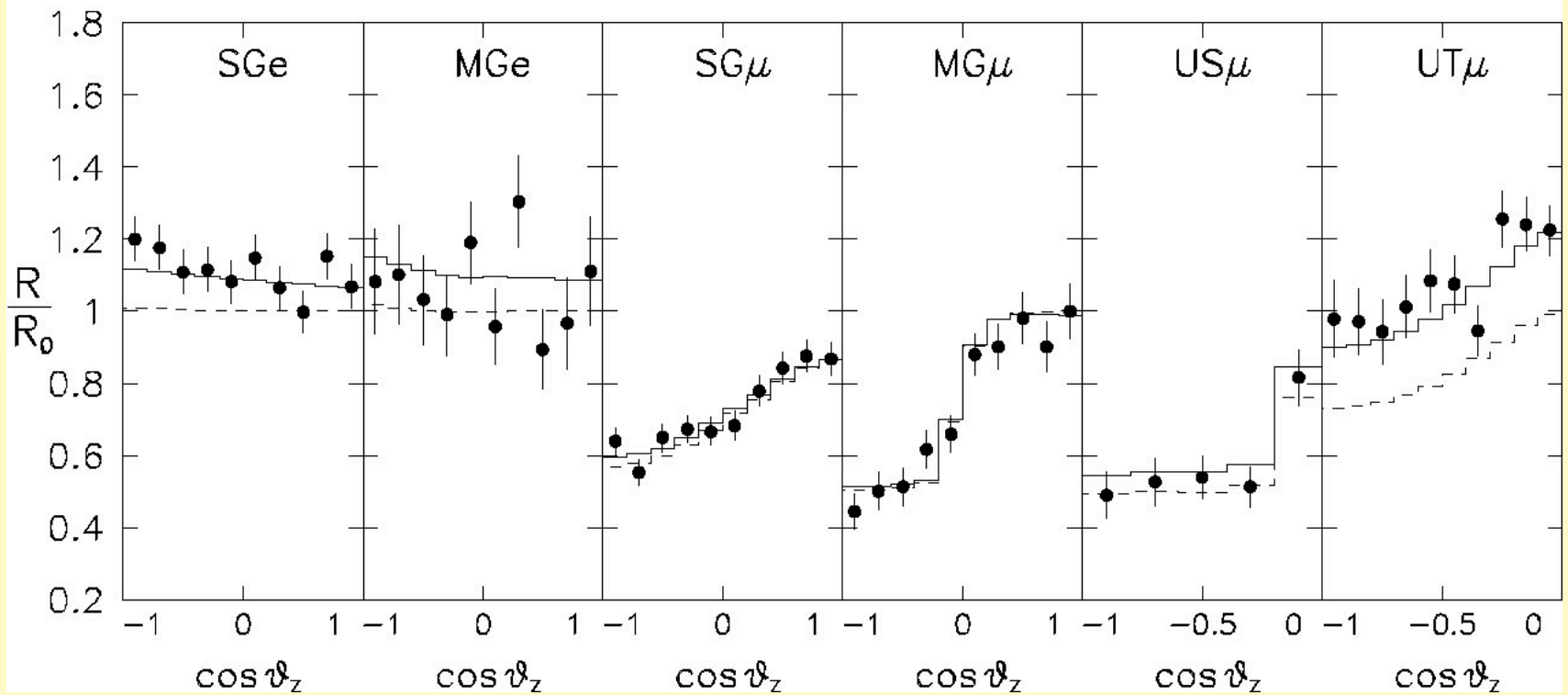
K2K energy spectrum

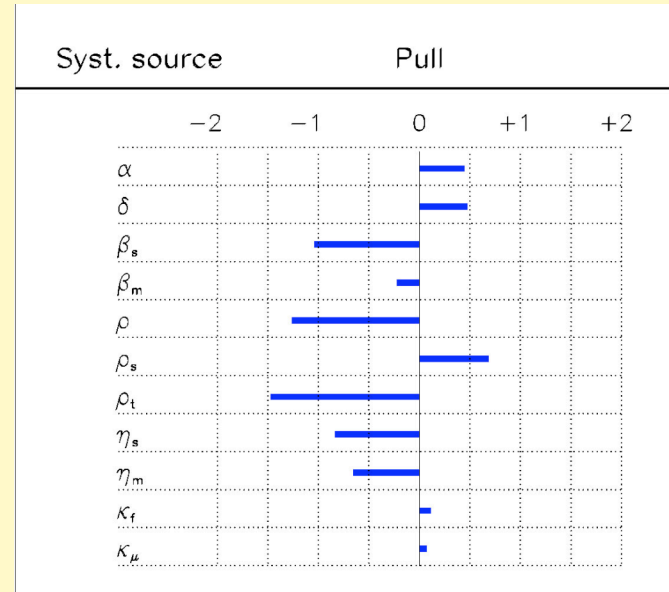
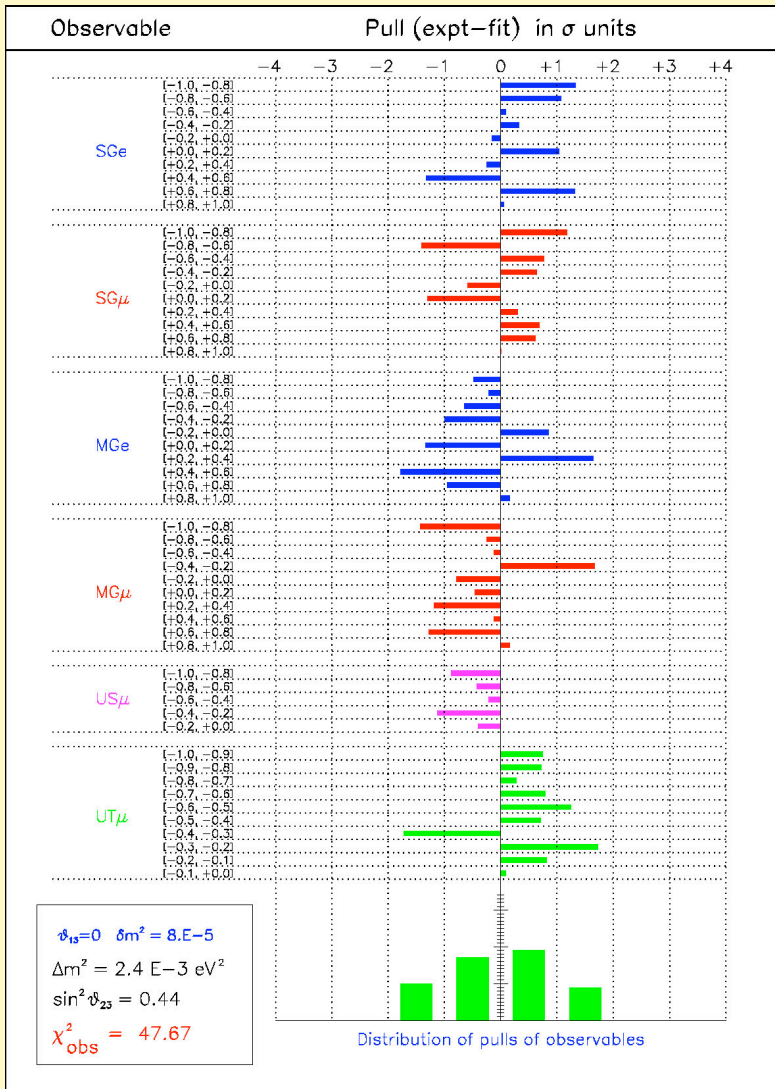


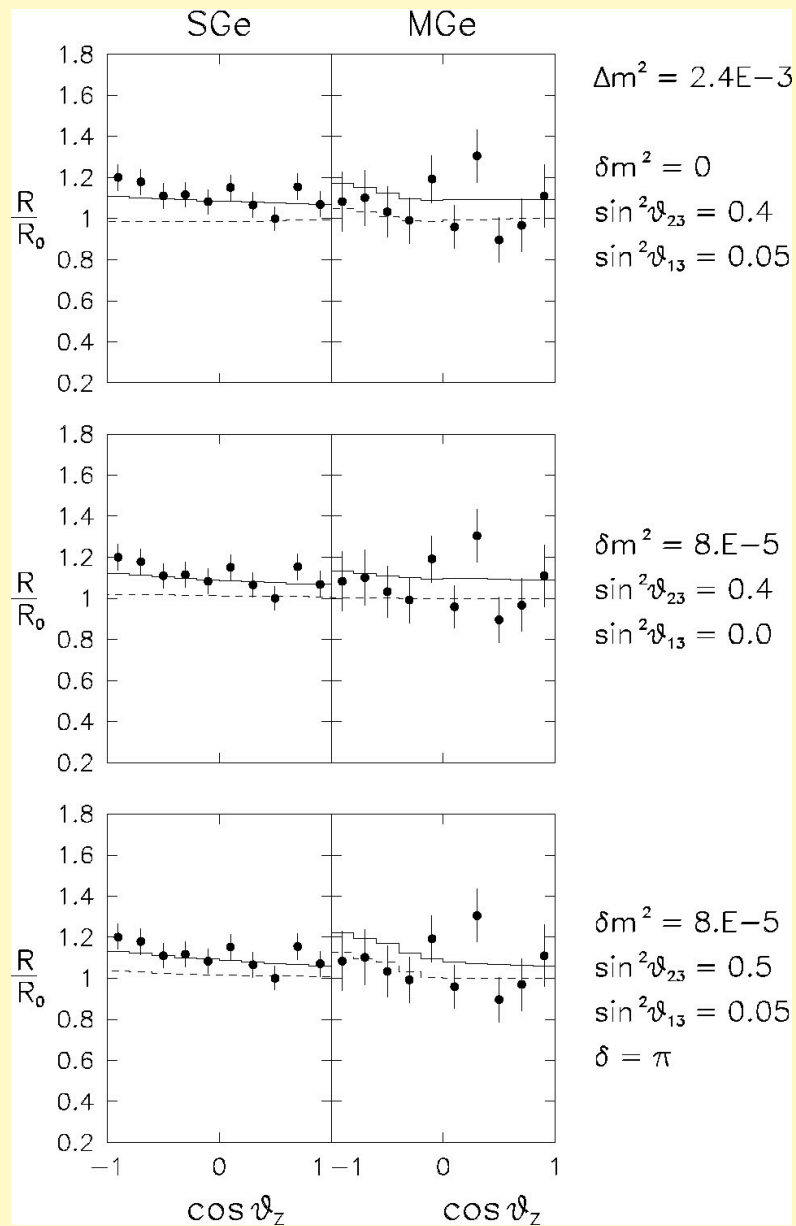
Super-Kamiokande (92 kTy)
 e, μ zenith distributions
 normalized to no oscillation

● SK data
 - - - - - theo. calc.
 — theo. + shifts

$\Delta m^2 = +2.4E-3$
 $\delta m^2 = 8.E-5$
 $\sin^2 \vartheta_{23} = 0.44$
 $\sin^2 \vartheta_{13} = 0$



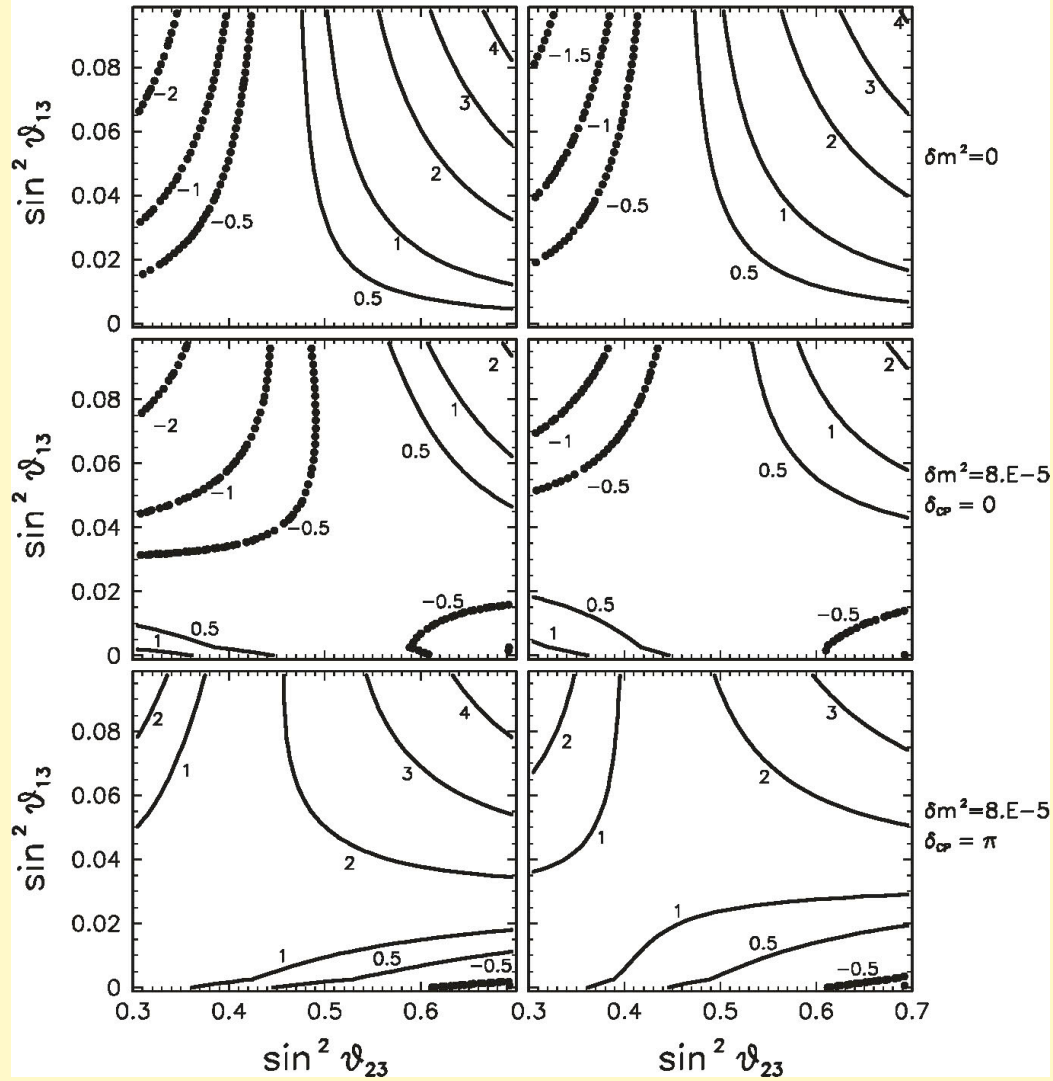




SGe asymmetry $[(U/D)/(U_0/D_0)-1] \times 100$

$\Delta m^2 = +2.4E-3 \text{ eV}^2$

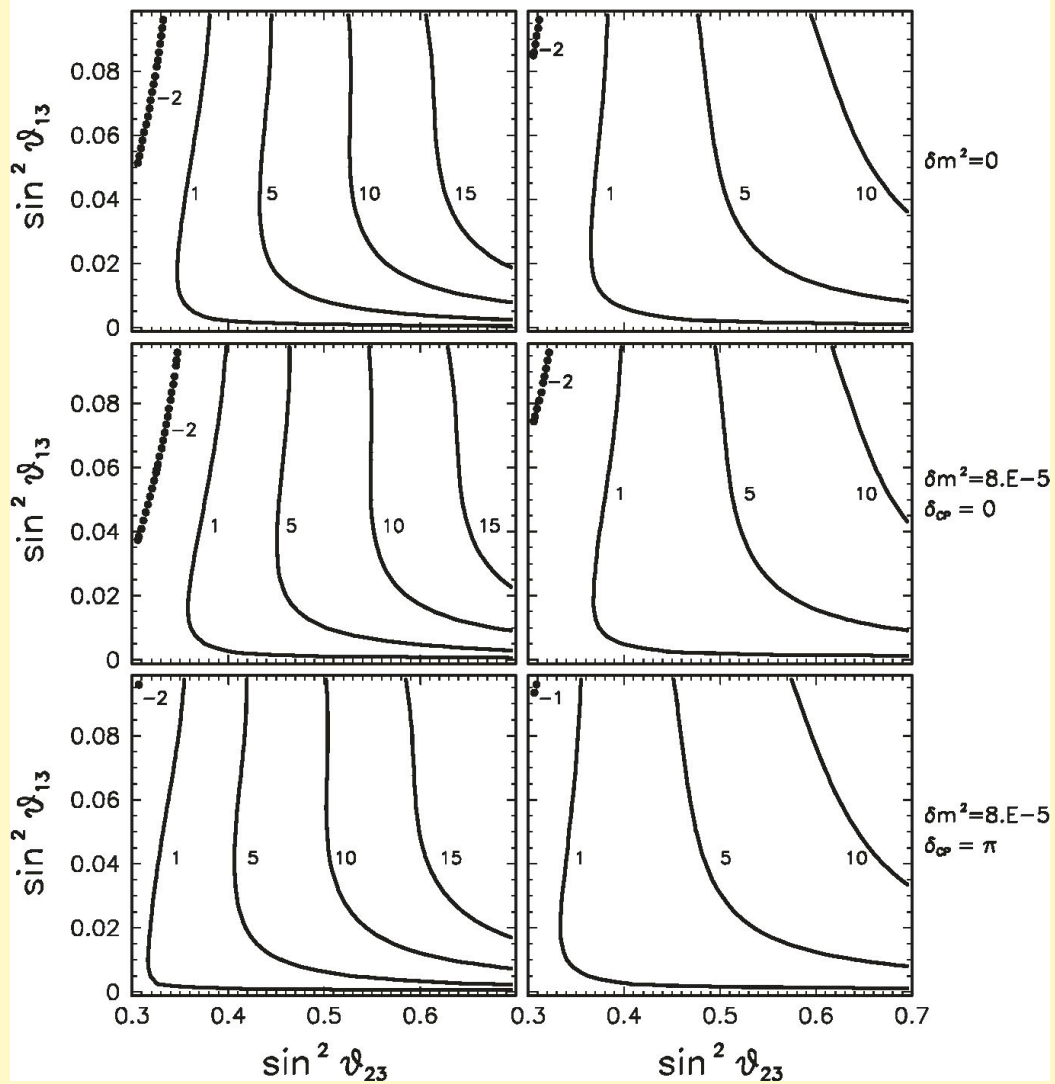
$\Delta m^2 = -2.4E-3 \text{ eV}^2$



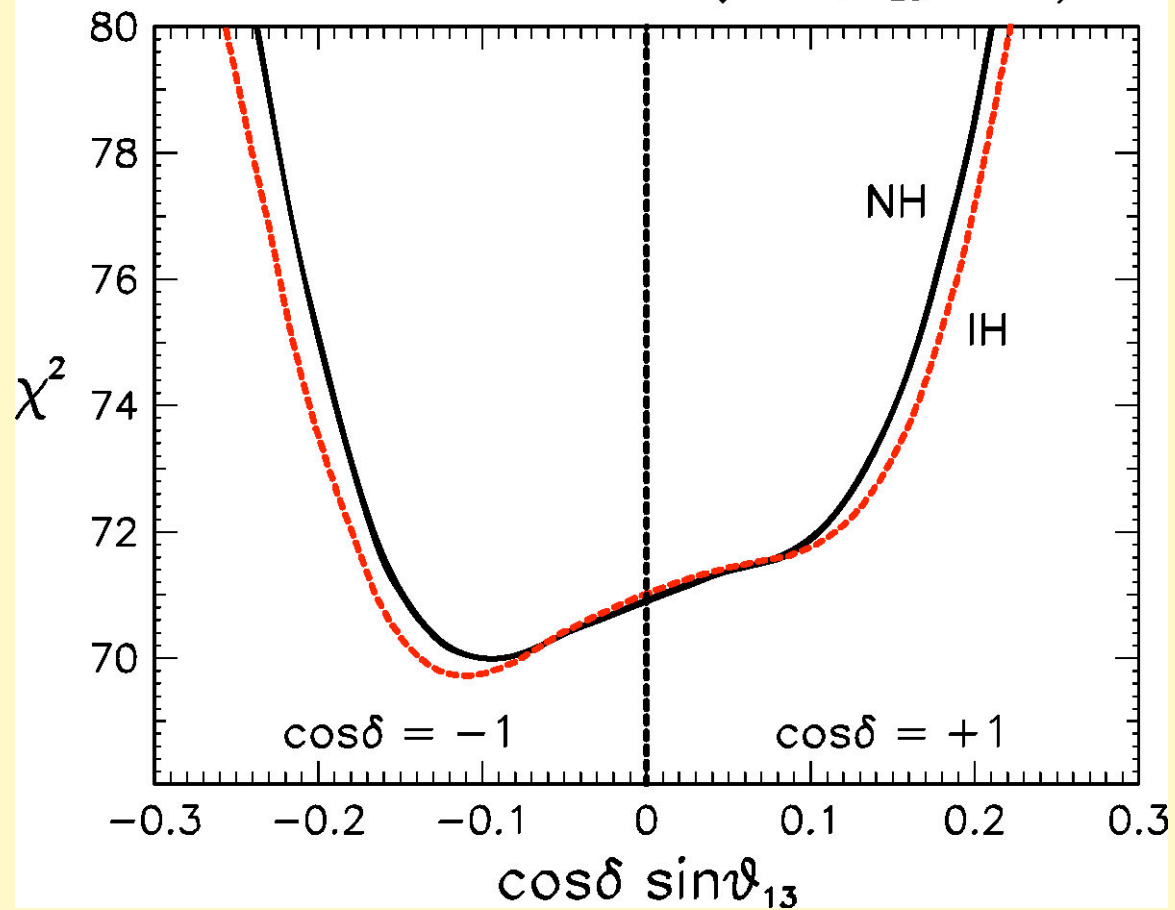
MGe asymmetry $[(U/D)/(U_0/D_0)-1] \times 100$

$\Delta m^2 = +2.4E-3 \text{ eV}^2$

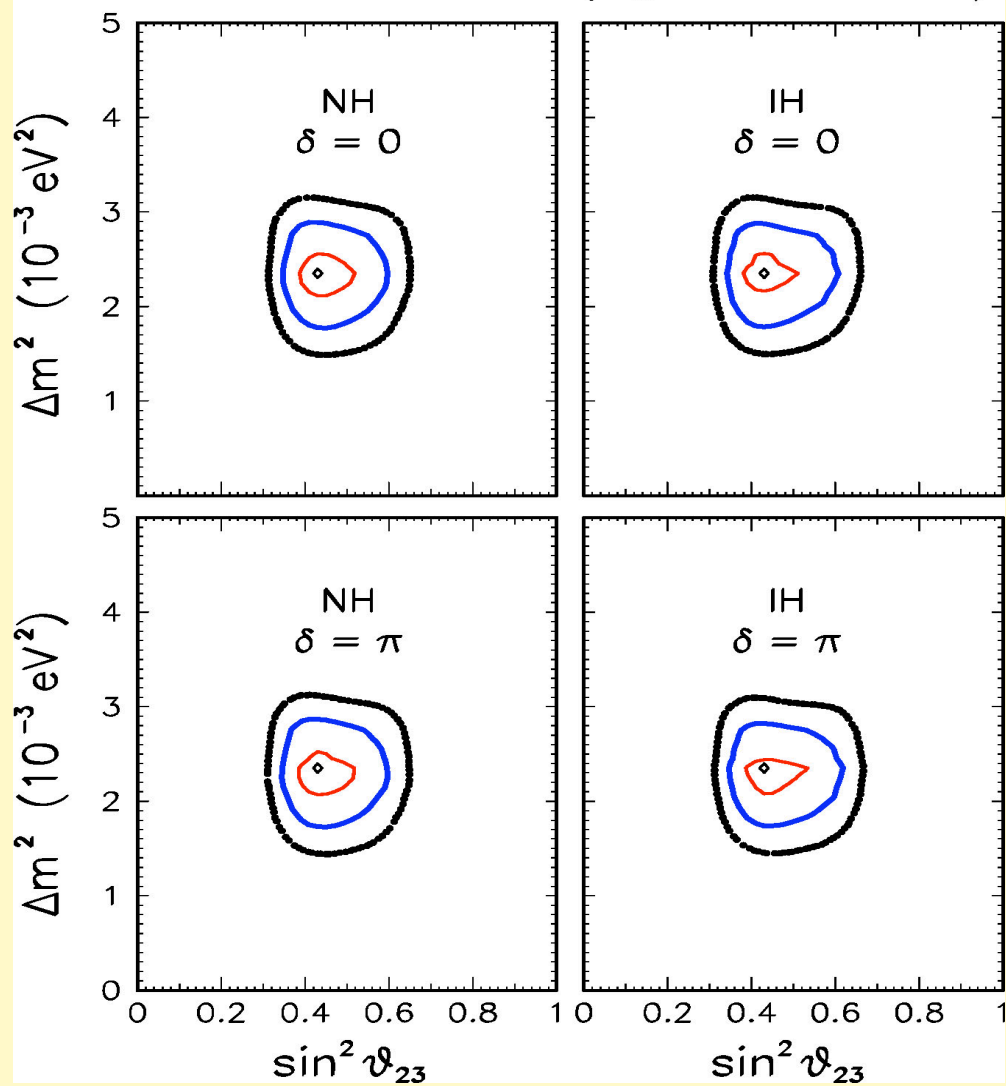
$\Delta m^2 = -2.4E-3 \text{ eV}^2$

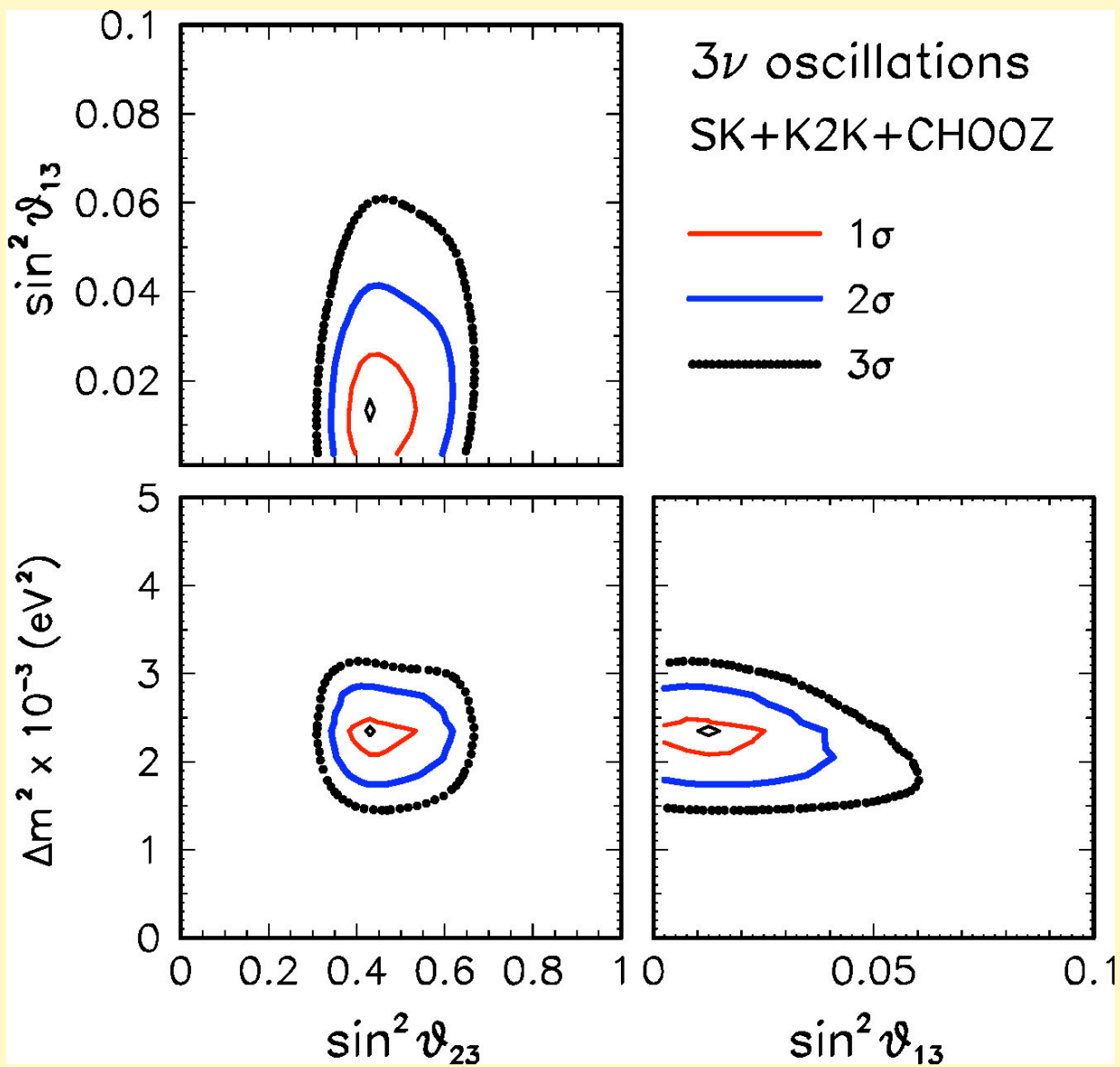


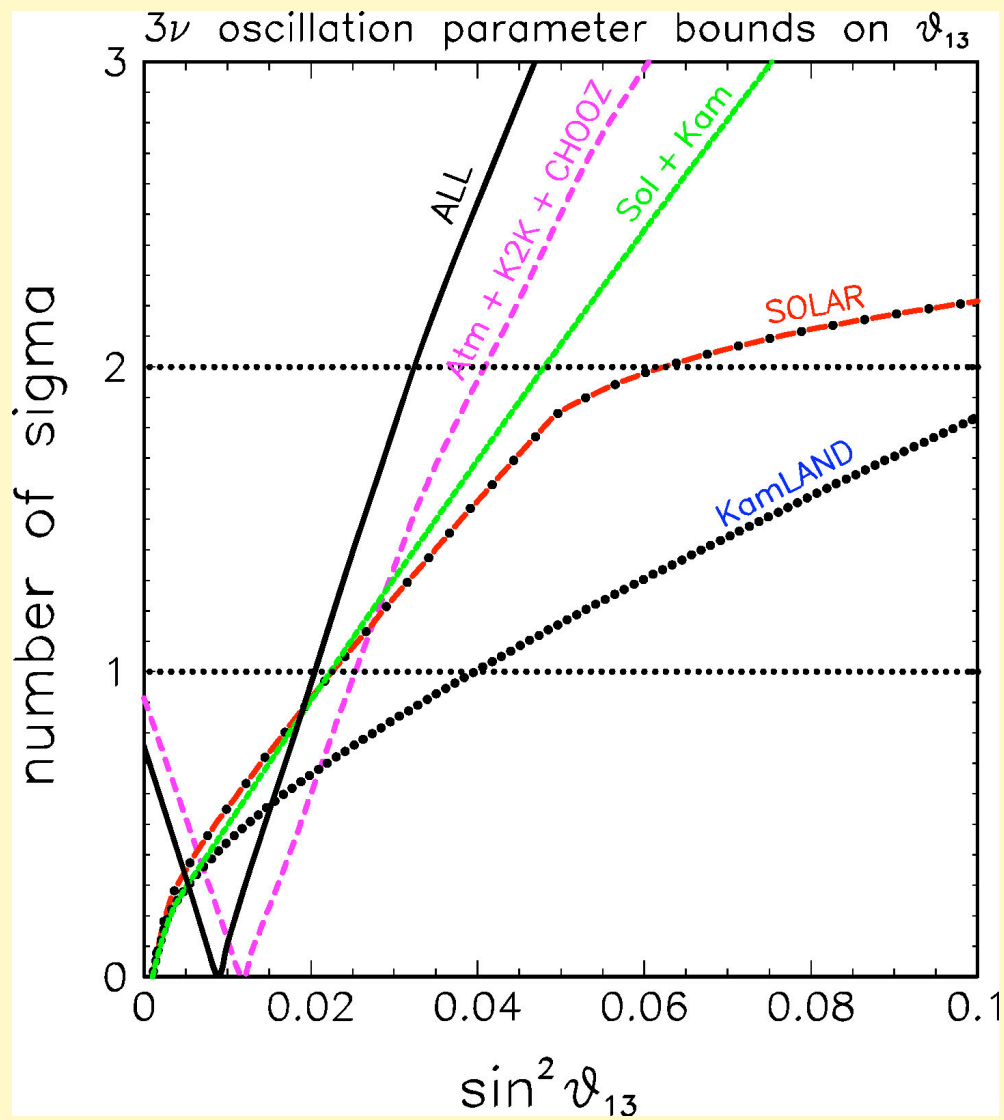
SK+K2K+CHOOZ ($\Delta m^2, \vartheta_{23}$ free)



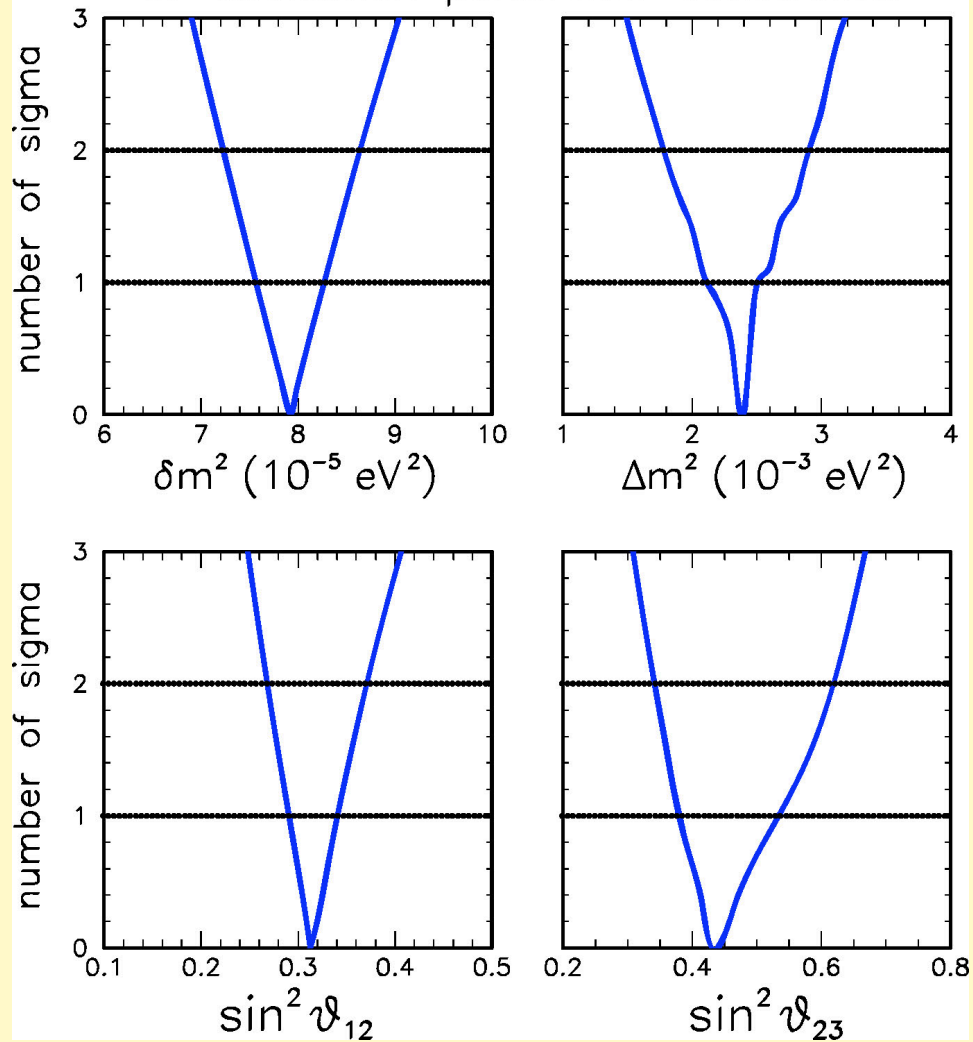
SK + K2K + CHOOZ (ϑ_{13} unconstrained)







3ν oscillation parameter constraints



2σ (95% C.L.) ranges:

$$\sin^2 \theta_{13} = 0.9_{-0.9}^{+2.3} \times 10^{-2} ,$$

$$\delta m^2 = 7.92 (1 \pm 0.09) \times 10^{-5} \text{ eV}^2 ,$$

$$\sin^2 \theta_{12} = 0.314 (1_{-0.15}^{+0.18}) ,$$

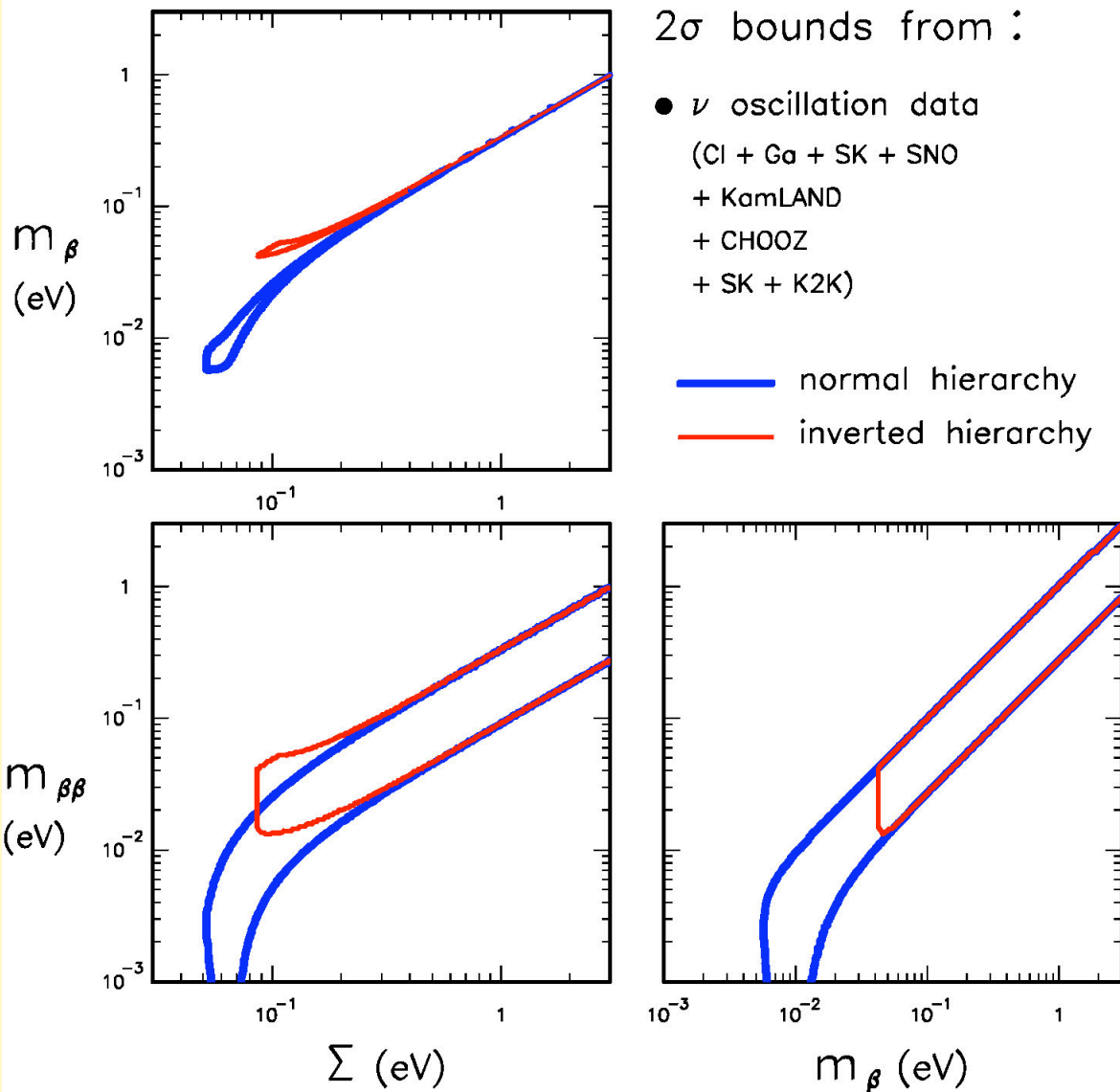
$$\Delta m^2 = 2.4 (1_{-0.26}^{+0.21}) \times 10^{-3} \text{ eV}^2 ,$$

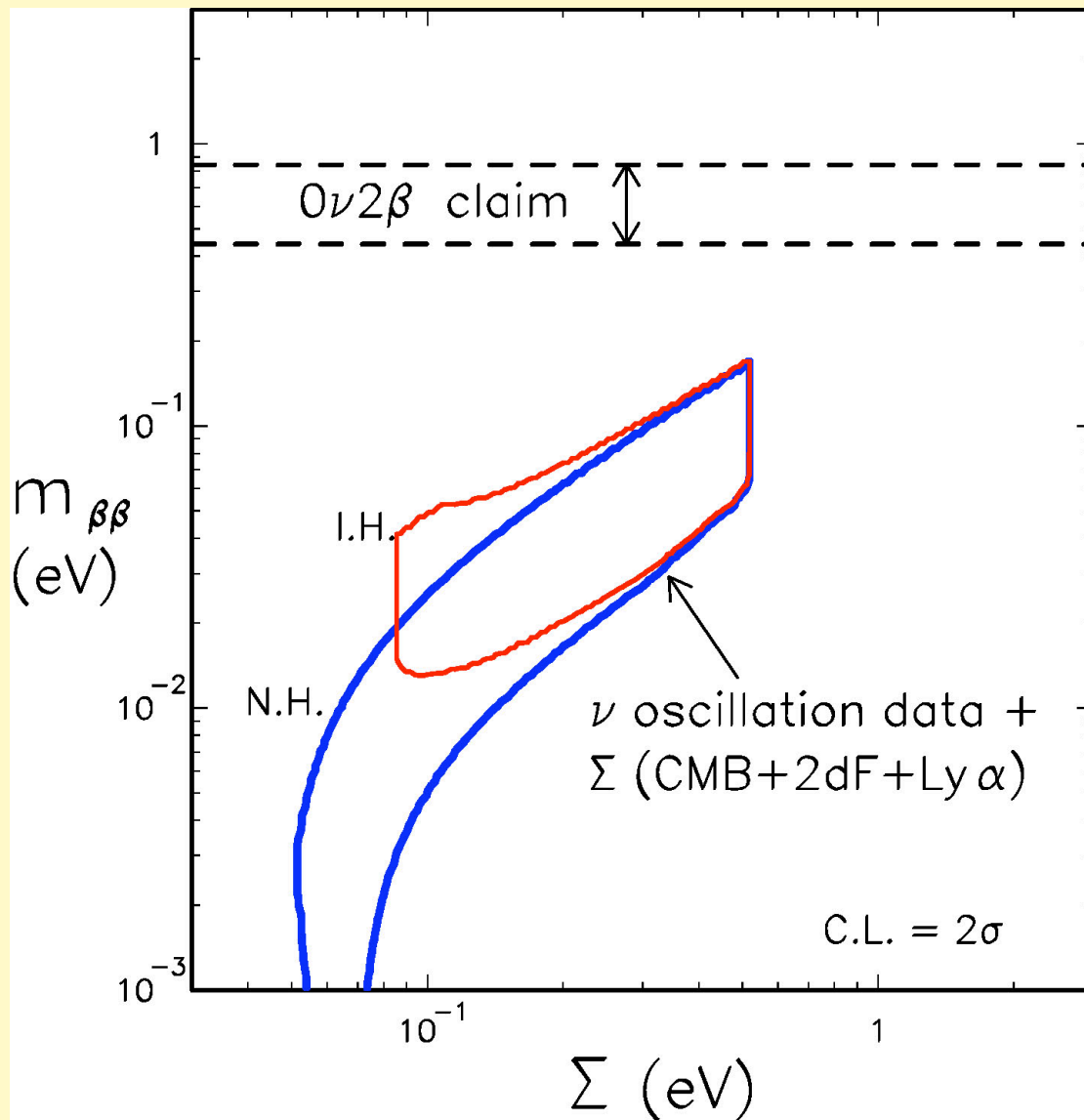
$$\sin^2 \theta_{23} = 0.44 (1_{-0.22}^{+0.41}) .$$

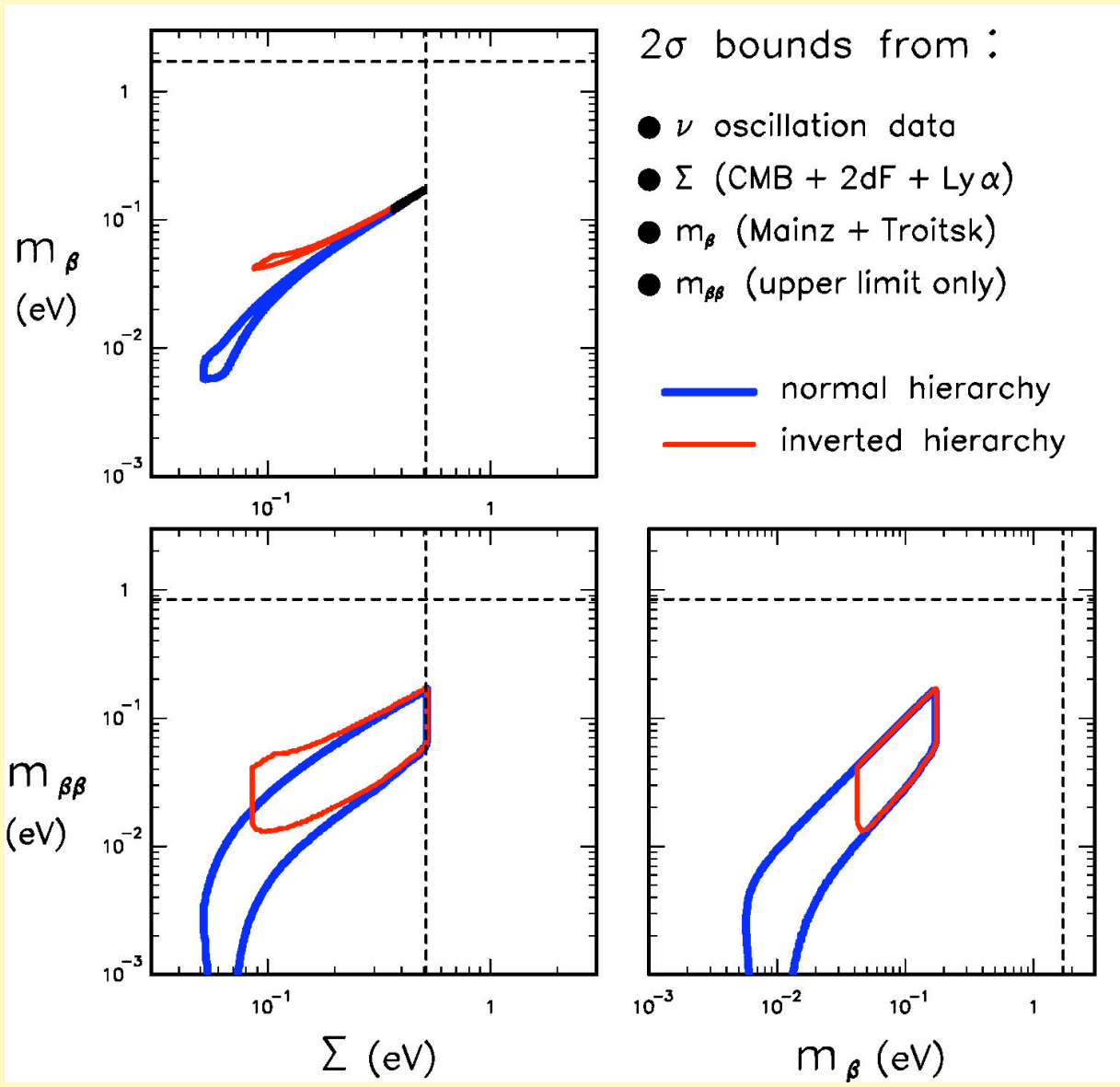
2σ bounds from :

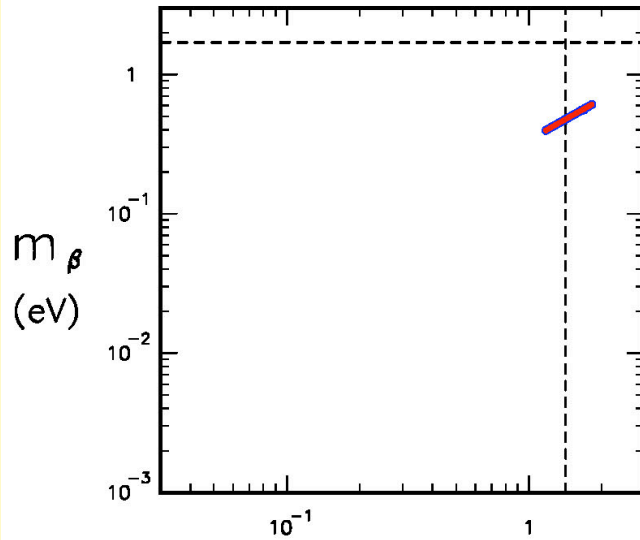
- ν oscillation data
(Cl + Ga + SK + SNO
+ KamLAND
+ CHOOZ
+ SK + K2K)

— normal hierarchy
— inverted hierarchy





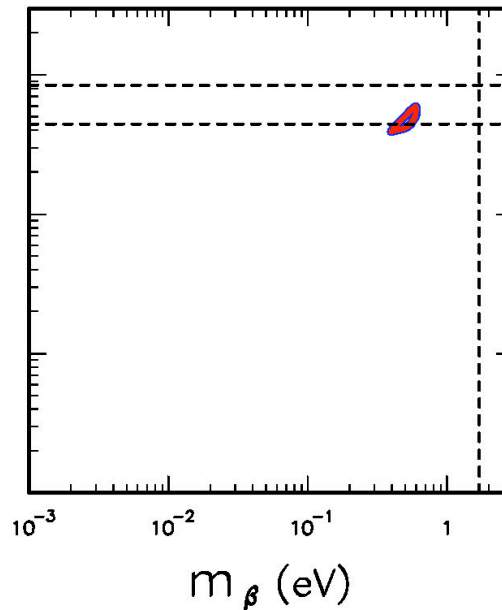
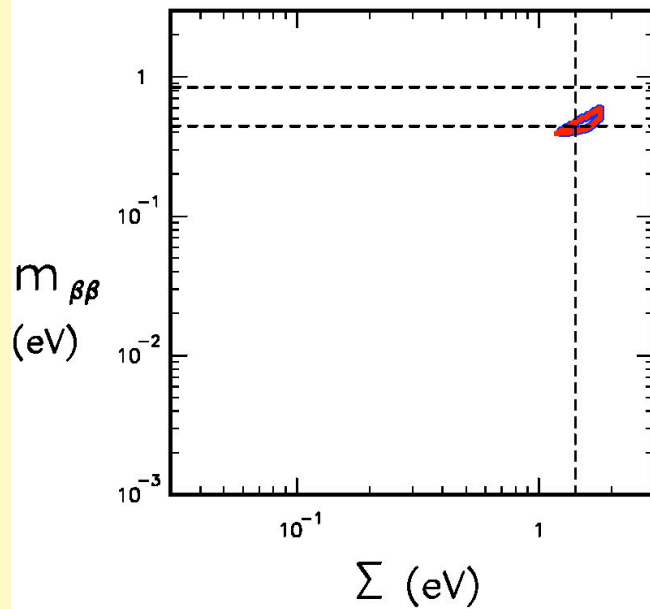




2σ bounds from :

- ν oscillation data
- Σ (CMB + 2dF)
- m_{β} (Mainz + Troitsk)
- $m_{\beta\beta}$ (Klapdor et al. claim)

— normal hierarchy
— inverted hierarchy



Planisphaerium

Neutrinorum



Atlas

Coelestis



NOW

MMIV

ELIGIO LISI

Thank you for your attention