

## 2012 MINOS electron neutrino appearance results

This represents the allowed regions for  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming either normal or inverted hierarchy from the combined neutrino and antineutrino data set.

The parameter assumptions are as follows:

$$\sin^2\theta_{23} = 0.957 (+0.035, -0.036)$$

$$\theta_{12} = 0.60 \pm 0.02$$

$$|\Delta m_{32}^2| = (2.39 + 0.09, -0.10) \times 10^{-3} \text{ eV}^2$$

$$\Delta m_{21}^2 = (7.59 + 0.19, -0.21) \times 10^{-5} \text{ eV}^2$$

We assume  $\theta_{23} < \pi/4$  for these curves. Assuming  $\theta_{23} > \pi/4$  produces a very similar result (see next page).

The TGraph objects in the file (MINOS\_Nue\_2012.root) are listed below.

(Note: All the graphs have 41 points except for the best fit graphs, which have 21 points.)

Normal\_90\_LL: 90% CL lower limit on  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming normal hierarchy

Normal\_90\_UL: 90% CL upper limit on  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming normal hierarchy

Normal\_68\_LL: 68% CL lower limit on  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming normal hierarchy

Normal\_68\_UL: 68% CL upper limit on  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming normal hierarchy

Inverted\_90\_LL: 90% CL lower limit on  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming inverted hierarchy

Inverted\_90\_UL: 90% CL upper limit on  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming inverted hierarchy

Inverted\_68\_LL: 68% CL lower limit on  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming inverted hierarchy

Inverted\_68\_UL: 68% CL upper limit on  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming inverted hierarchy

Normal\_BestFit: Best fit value of  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming normal hierarchy

Inverted\_BestFit: Best fit value of  $2\sin^2\theta_{13}\sin^2\theta_{23}$  as a function of  $\delta$  assuming inverted hierarchy

