TWO-FLAVOR OSCILLATION PARAMETERS AND LIMITS

Revised March 2002 by H. Murayama (LBNL).

In the following Figures 1–3 we show the best parameters and the most stringent limits for neutrino oscillations as analyzed in the context of two-neutrino mixing. When comparable limits were obtained at about the same time, we show both, *e.g.*, CHOOZ and Palo Verde, and NOMAD and CHORUS. Otherwise, results are shown only when they are the best in at least part of the parameter space. For example, BNL E776 is still shown, because it is slightly better than KARMEN2 for a narrow region of the parameter space. Lines indicate 90% exclusion limits for parameters at larger Δm^2 and $\tan^2\theta$ (or $\sin^2 2\theta$). Filled regions indicate allowed parameters at the 90% and 99% CL's, except where marked as excluded (the Super-Kamiokande zenith angle spectrum exclusion regions). CPT is assumed and neutrinos and antineutrinos are both shown.

CITATION: K. Hagiwara *et al.* (Particle Data Group), Phys. Rev. D **66**, 010001 (2002) (URL: http://pdg.lbl.gov)

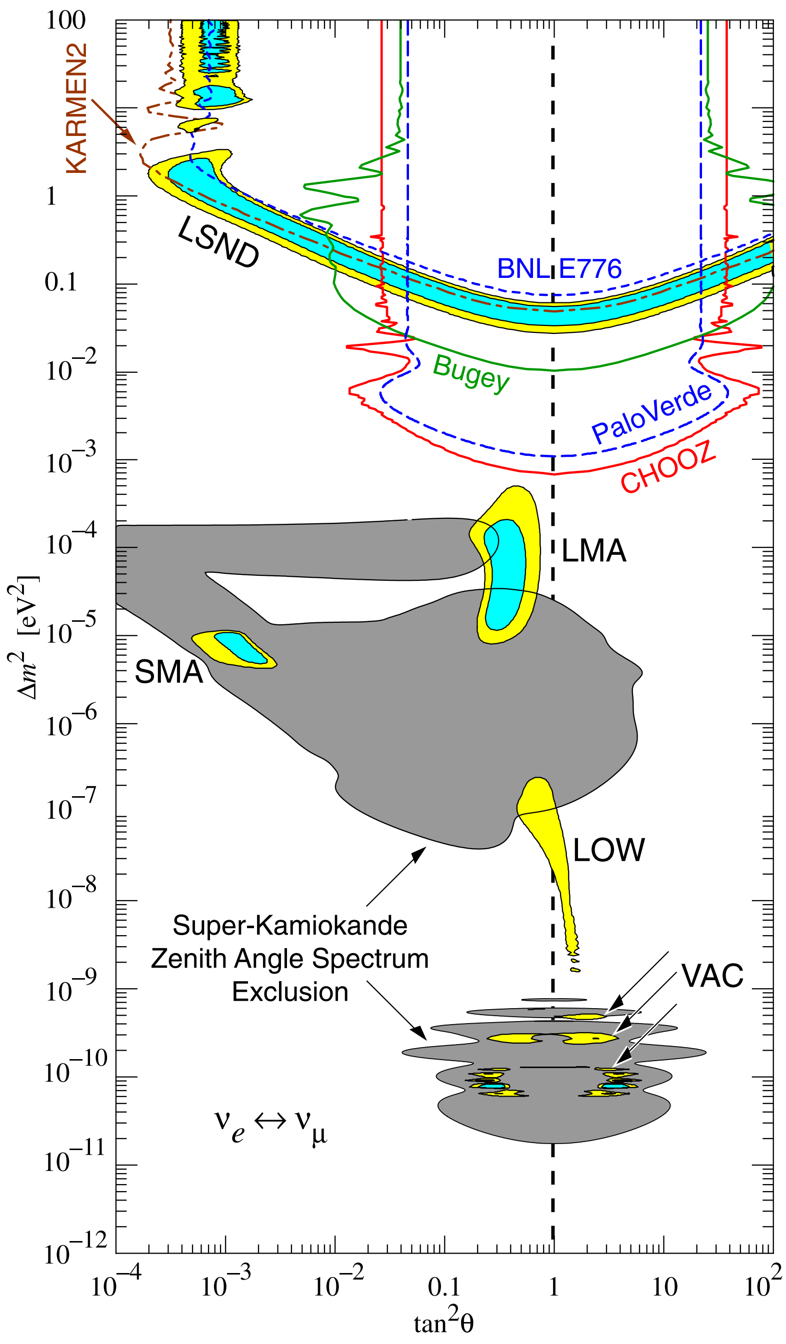

Figure 1: The most important exclusion limits as well as preferred parameter regions from $\nu_e \leftrightarrow \nu_\mu$ oscillation experiments in the context of two-neutrino oscillations.

- KARMEN2 excluded region on $\overline{\nu}_\mu \to \overline{\nu}_e$ appearance, from A. Armbruster *et al.*, `hep-ex/0203021`.
- BNL E776 excluded region on $\overline{\nu}_\mu \to \overline{\nu}_e$ appearance is from BORODOV 92.
- LSND preferred region on $\overline{\nu}_\mu \to \overline{\nu}_e$ appearance is from AGUILAR 01 at 90% and 99% CL.
- Bugey limit is on $\overline{\nu}_e$ disappearance from ACHKAR 95.
- CHOOZ limit is on $\overline{\nu}_e$ disappearance from APOLLONIO 99, Fig. 9.
- Palo Verde limit is on $\overline{\nu}_e$ disappearance from BOEHM 01, Fig. 7, solid curve.
- Solar neutrino preferred regions (solar LMA, solar SMA, solar LOW, and solar VAC) based upon ν_e disappearance at Homestake, SAGE, GALLEX, GNO, Super-Kamiokande, and SNO, and a small $\nu_{\mu,\tau}$ appearance effect at Super-Kamiokande, at 90% and 99% CL. From Fogli *et al.*, Phys. Rev. **D64**, 093007 (2001).
- Super-Kamiokande exclusion at 95% CL is based on zenith angle spectrum data from S. Fukuda *et al.*, Phys. Rev. Lett. **86**, 5656 (2001), extended to $\theta > \pi/4$ by Michael Smy at the author's request.

The plot shows the whole two-flavor parameter space $0 \le \theta \le \pi/2$. In the absence of the matter effect, the excluded/-preferred regions become symmetric around $\tan^2\theta = 1$ axis on the log scale. References in upper-case letters are given at the end of the Listings for "Neutrino Mixing."

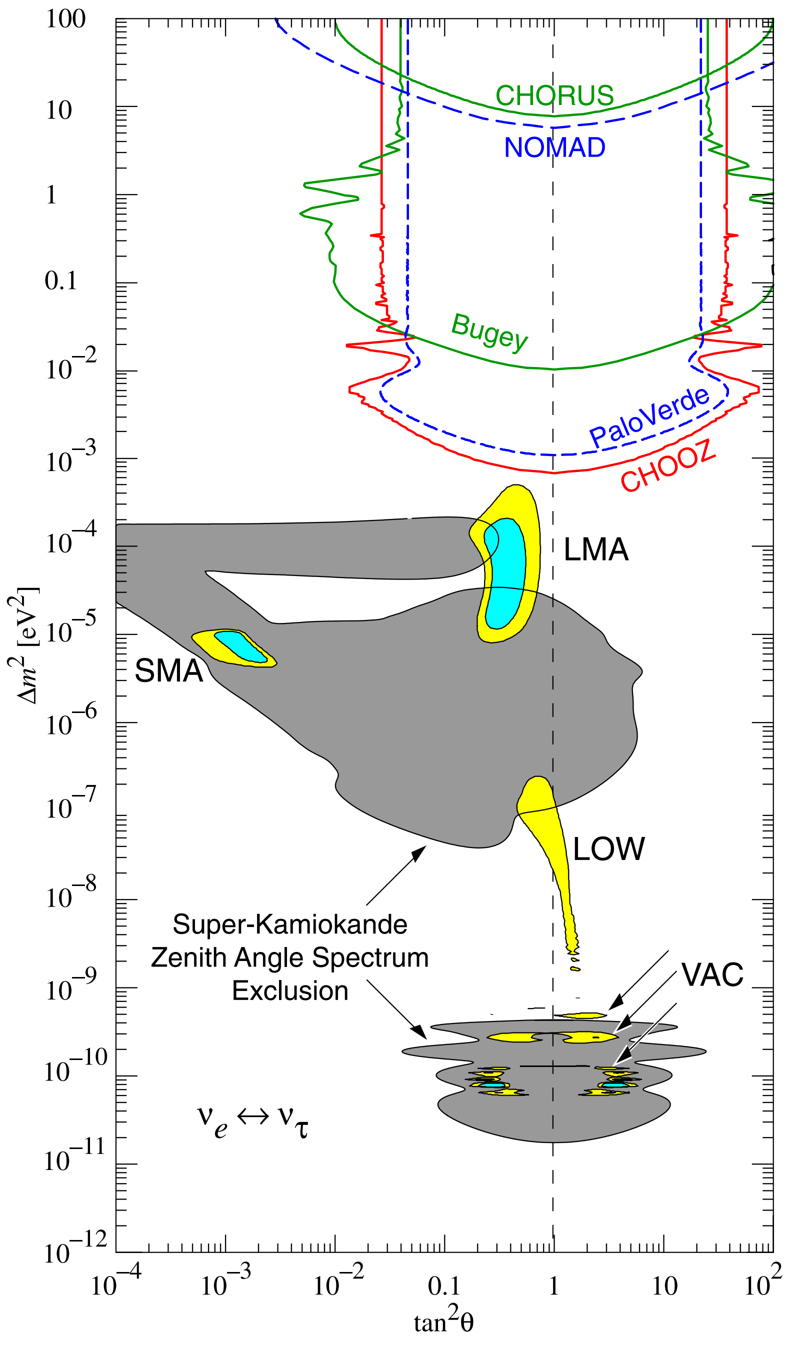

Figure 2: The most important exclusion limits as well as preferred parameter regions from $\nu_e \leftrightarrow \nu_\tau$ oscillation experiments in the context of two-flavor oscillations.

- CHORUS excluded region on $\nu_e \to \nu_\tau$ appearance is from ESKUT 01.
- NOMAD excluded region on $\nu_e \to \nu_\tau$ appearance is from ASTIER 01B.
- Bugey limit is on $\overline{\nu}_e$ disappearance from ACHKAR 95.
- CHOOZ limit is on $\overline{\nu}_e$ disappearance from APOLLONIO 99, Fig. 9.
- Palo Verde limit is on $\overline{\nu}_e$ disappearance from BOEHM 01, Fig. 3, solid curve.
- Solar neutrino preferred regions (solar LMA, solar SMA, solar LOW, and solar VAC) based upon ν_e disappearance at Homestake, SAGE, GALLEX, GNO, Super-Kamiokande, and SNO, and a small $\nu_{\mu,\tau}$ appearance effect at Super-Kamiokande, at 90% and 99% CL. From Fogli *et al.*, Phys. Rev. **D64**, 093007 (2001).
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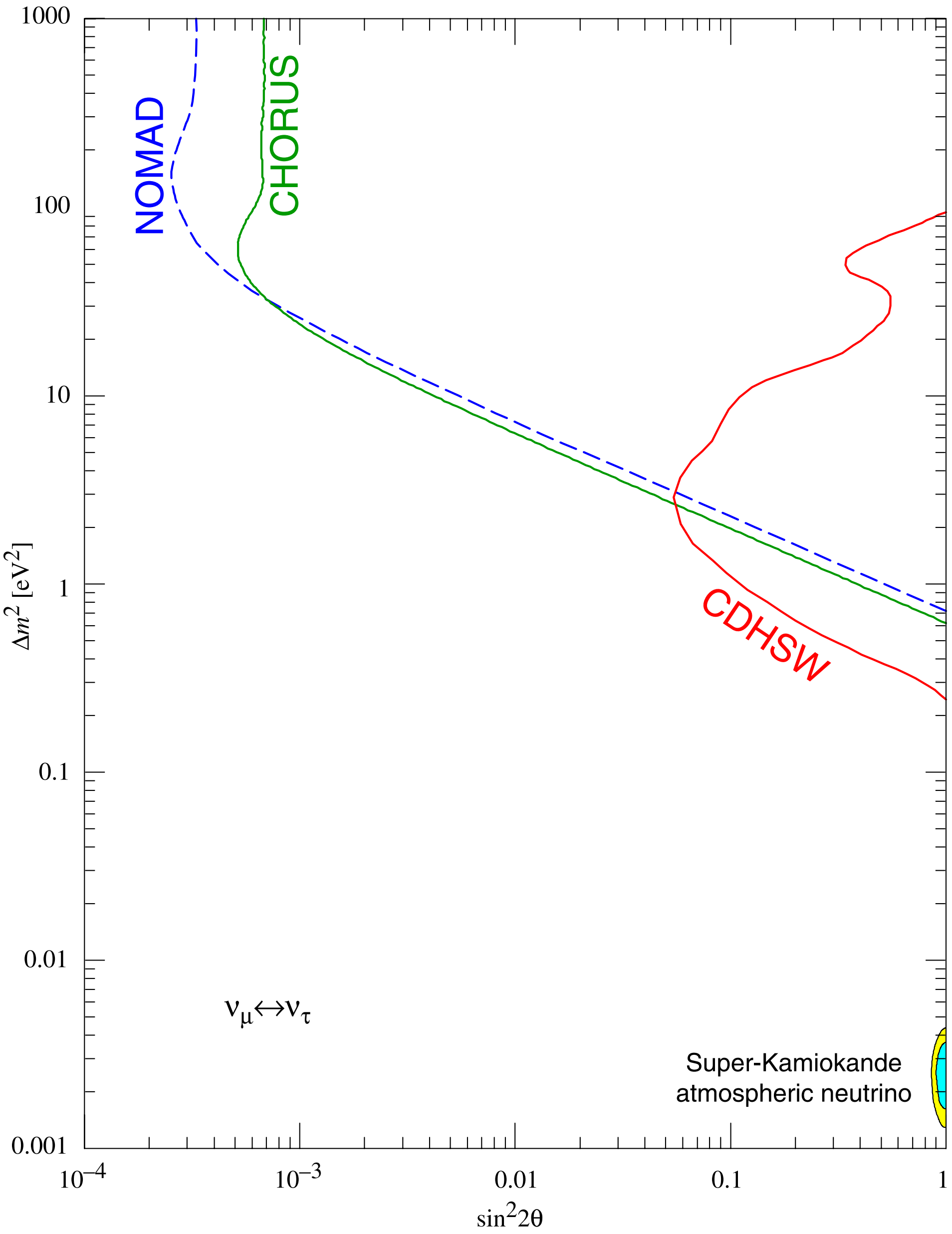

Figure 3: The most important exclusion limits as well as preferred parameter regions from $\nu_\mu \leftrightarrow \nu_\tau$ oscillation experiments in the context of two-flavor oscillations.

- CHORUS excluded region on $\nu_\mu \to \nu_\tau$ appearance is from ESKUT 01.
- NOMAD excluded region on $\nu_\mu \to \nu_\tau$ appearance is from ASTIER 01B.
- CDHSW excluded region on ν_μ disappearance is from DYDAK 84.
- Super-Kamiokande preferred region on ν_μ disappearance at the 90% and 95% CL, from a talk by K. Kaneyuki at NuInt01 conference. See `http://neutrino.kek.jp/nuint01/`.

The plot shows only a half of the parameter space, $0 \leq \theta \leq \pi/4$. There is no matter effect for this oscillation mode and hence the limits on the other half $\pi/4 \leq \theta \leq \pi/2$ is the exact reflection of the limits shown here. References in upper-case letters are given at the end of the Listings for “Neutrino Mixing.”