LEPTON MIXING AND HEAVY NEUTRINOS

J.-M. Frere
Randall Laboratory of Physics
University of Michigan, Ann Arbor, MI 48109

In view of the considerable interest displayed at this meeting in experiments looking for $K \to e\nu_x$, $K \to \mu\nu_x$, where ν_x is an hypothetical heavy neutrino mixing with the electronic and/or muonic neutrino, I think it may be appropriate to comment on a more general (although less sensitive) approach to such mixings.

Once we accept the possibility of having heavy neutrinos there is no a priori reason to assume that they are lighter than the K. Although K decays provide us with extremely strict bounds on the mixing of such neutrinos, they are necessarily only sensitive to a relatively small window of the possible mass spectrum.

More general bounds can be obtained by comparing neutral and charged-current data at low energy. The basic idea is very simple; if very heavy neutrinos are present and mix with ν_e and ν_μ they will "sterilize" part of the charged current (e.g. if $m_{\mu_x} > m_\mu$, the rate $\mu \to e\nu\nu$ will be decreased in proportion of the mixing). The departure from μ-e universality will not be observable if the mixing is small, or, more precisely, if the difference between ν_μ-ν_x and ν_e-ν_x mixing is small.[1] On the other hand, heavy neutrinos do not influence the neutral current or electric coupling of charged leptons. Therefore, a direct comparison between neutral and charged-current data should provide us with some information (bound) on the mixing with heavier neutrinos.

The issue is somewhat complicated by our relative ignorance of the exact value of M_W and M_z. How much can then be said from low energy experiments?

From the above, it should be clear that the determination of $\rho = \frac{M_W}{M_z \cos\theta}$ from ν_μ, ν_e scattering and the e-d experiment would be biased by neutrino mixing, in which case ρ should be replaced by a parameter $\rho' > \rho$. (Since the charged currents are suppressed by the mixing, the apparent value of M_W is increased.) The fact that in the standard model radiative corrections to the relation $\rho = 1$ are usually positive,[2] and that the presently observed value is close to unity,[3] already puts a limit of 6% on the mixing between ν_μ and <u>any</u> combination of heavy neutrinos.[4] More precise low energy measurements and/or a precise knowledge of the W mass should allow us to improve considerably on this.

REFERENCES

1. B.W. Lee and R.E. Shrock, Phys. Rev. D16, 3444 (1974).
2. M. Einhorn, D.R.T. Jones and M. Veltman, Nucl. Phys. B191, 146 (1981).
3. See for instance, M. Davier, in Proceedings, 21st International Conference on High Energy Physics, Paris, 26-31 July, 1982, page C3-474.
4. For more details, see J.-M. Frere, Nucl. Phys. B177, 389 (1981).