Fermi National Accelerator Laboratory

FERMILAB-Pub-87/74-A-Rev.
October 1987

How Reliable Are Neutrino Mass Limits Derived from SN1987A?: Addendum and Erratum:

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Abstract. We correct several minor errors in a recent paper[1], and provide simple analytic expressions for the mean and variance of the actual energies of the positrons detected by the IMB and Kamiokande II groups.

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I. ERRATUM

The following corrections should be made in Ref. 1.

In Table III, the entry for event 33162 in the column labeled 'T = 3 MeV' should be $28.8^{+6.4}_{-5.6}$, rather than $28.8^{6.4}_{-5.6}$.

In Table IV, the 'energy deposited' entry for event 8 should be 21.0 ± 4.2, rather than $21.0 + 4.2$.

On p. 3601 the last line in column 1 should read, 'trons) and for positrons is given by', rather than, 'trons) and is given by'.

In the last paragraph above Sec. III on p. 3602, we state that the background trigger rate for IMB is 0.77 events per 10 sec interval, as given in Ref. 10. We have been informed[2] that this number actually represents the 'raw' background rate, i.e., the rate for events which satisfy the trigger criteria, and that when individual events are examined in detail almost all of the 'raw background events' can be identified (e.g., as corner-clipping, through-going muons). Thus the probability that any of the 8 IMB events are due to *unidentifiable* background, i.e., events which could be confused for neutrino-induced events from SN1987A, is negligible. Since no interesting neutrino mass limits follow from the IMB events alone, this point does not affect any of the conclusions in our paper. The distinction between 'identifiable' and 'unidentifiable' background does not apply to KII, whose background is primarily due to low energy events caused by radioactivity in the detector. Their unidentifiable background rate is as stated in our paper.

Ref. 5, cited only on p. 3598, referred to papers that used SN1987A to constrain neutrino properties other than mass; specifically, mixing angles, lifetime, and magnetic moment. The paper by R. E. Shrock[3] cited in Ref. 5 *only* places a limit on the neutrino magnetic moment, and not on neutrino mixing angles or lifetime. We regret any confusion Ref. 5 may have caused.

II. ADDENDUM

On p. 3601 we discuss the probability distribution for the actual positron energy given the observed energy, $E_{\rm obs}$, and the variance in the observed energy, σ_E. We would like to point out that where the detection efficiency is approximately energy independent and $\sigma_E \ll E_{\rm obs}$ the actual energy distribution is approximately Gaussian with mean and variance given by

$$E_{\rm mean} = y + (y^2 + 4\sigma_E^2)^{1/2}$$

$$\sigma_{\rm eff} = (\sigma_E^{-2} + 4E_{\rm mean}^{-2})^{-1/2}$$

where $y = (E_{\rm obs} - \sigma_E^2/T)/2$ and T is the temperature of the neutrino source. Furthermore, if $\sigma_E \ll \sqrt{E_e T}$ is also satisfied then, these expressions simplify to

$$E_{\rm mean} = E_{\rm obs}(1 - \frac{\sigma_E^2}{T E_{obs}} + 4\frac{\sigma_E^2}{E_{obs}^2})$$

$$\sigma_{\rm eff} = \sigma_E(1 - 2\frac{\sigma_E^2}{E_{\rm obs}^2})$$

Finally, the notation in Eqn(6) may be somewhat confusing; the quantity $p(x)$ is meant to denote 'the probability of x', and not the function $p(x)$. Thus $p(E_e)dE_e$, the probability for a $\bar{\nu}_e$ to interact in the detector and produce a positron of energy $E_e \to E_e + dE_e$, is not to be confused with, $p(E_{obs})dE_{obs}$, the probability for a $\bar{\nu}_e$ to interact in the detector and produce a positron which deposits an energy $E_{obs} \to E_{obs} + dE_{obs}$. To be specific,

$$p(E_{obs}) = \int_0^\infty p(E_{obs}|E_e)p(E_e)dE_e$$

ACKNOWLEDGMENTS

This work was supported in part by the NASA (at Fermilab), by the DoE (at Fermilab and The University of Chicago), and by MST's Alfred P. Sloan Fellowship.

REFERENCES

1. E.W. Kolb, A.J. Stebbins, and M.S. Turner, *Phys. Rev.* **D35**, 3598 (1987).
2. We thank J. van der Velde for clarifying the issue of background in the IMB detector.
3. R.E. Shrock, State University of New York at Stony Brook Report No. ITP-SB-87-18, 1987 (unpublished).