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MASS VALUES OF THE K-MESONS

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R. W. Birge, J. R. Peterson, D. H. Stork, and M. N. Whitehead

July 19, 1955

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Additional data have been obtained from the stack of emulsions¹ exposed to 114-Mev K mesons at the Bevatron and from another stack exposed to 170-Mev K mesons. Both exposures were made with the use of the strongfocusing magnetic spectrometer.²

In the preliminary report the stopping point of each K mesons was used to determine its lateral position, and hence its momentum. We have now calculated the masses of all the K mesons in the first stack, (stack 16), using the lateral position where the track was first picked up (about 3 cms from the end) to determine the momentum of the particle. The results plotted separately for K_L and τ mesons are shown in Fig. 1. The distribution includes 459 K_L mesons, 42 τ mesons and 13 alternate decays of τ mesons into one charged pion.

Of the 15 τ mesons in the preliminary report, three were found to have large angle scatters causing a large error in the projected range. These few events caused most of the apparent mass difference between the τ and K_L mesons. These events represent a large statistical deviation from the number of scatterings predicted using nuclear area for the interaction cross section. In the much larger sample of K_L mesons such a fluctuation is unlikely.

In the emulsion exposed to 170 Mev K mesons, (stack 17) each K meson track has been followed back to the stopping proton position to determine its momentum. The results shown in Fig. 2 include 177 K_L mesons, 12 τ mesons and four alternate decays of τ mesons.

The mass values obtained in units of the electron mass are,

	<u>Stack 16</u>	<u>Stack 17</u>
K_L	971 ± 1.3	962.9 ± 1.9
τ	978 ± 4	965.4 ± 3.8

The uncertainties given are $\frac{\sigma}{\sqrt{N}}$, where $\sigma = \sqrt{\Delta^2}$ is the root-mean-square deviation from the average mass and N is the total number of events in the distribution.

The absolute values for the masses include systematic errors due to uncertainties in measurement of the momentum of the K particles, to the errors in the proton range measurement, and to scattering and ionization loss in the air path. In addition the resolution is somewhat broadened from that expected, by multiple scattering in the window of the Bevatron tank and in the emulsions and by aberrations of the strong focusing lens. Relative masses of the mesons should not be affected by the above errors. However, a different interaction cross section for the γ and K_L particles could cause a range shortening of one with respect to the other and hence an apparent mass shift.

A more complete report of this work will appear in the summary of the International Conference on Elementary Particles held in Pisa, Italy, in June, 1955.

This work was performed under the auspices of the U. S. Atomic Energy Commission.

REFERENCES

1. R. W. Birge, R. P. Haddock, L. T. Kerth, J. R. Peterson, J. Sandweiss, D. H. Stork, and M. N. Whitehead. Phys. Rev. to be published.
2. L. T. Kerth, D. H. Stork, R. W. Birge, R. P. Haddock, and M. N. Whitehead Bull. Am. Phys. Soc., Vol. 30, No. 3.

LEGENDS

Fig. 1. Masses of 459 K_L and 55 τ mesons found in stack 16.

Fig. 2. Masses of 177 K_L and 16 τ mesons found in stack 17.

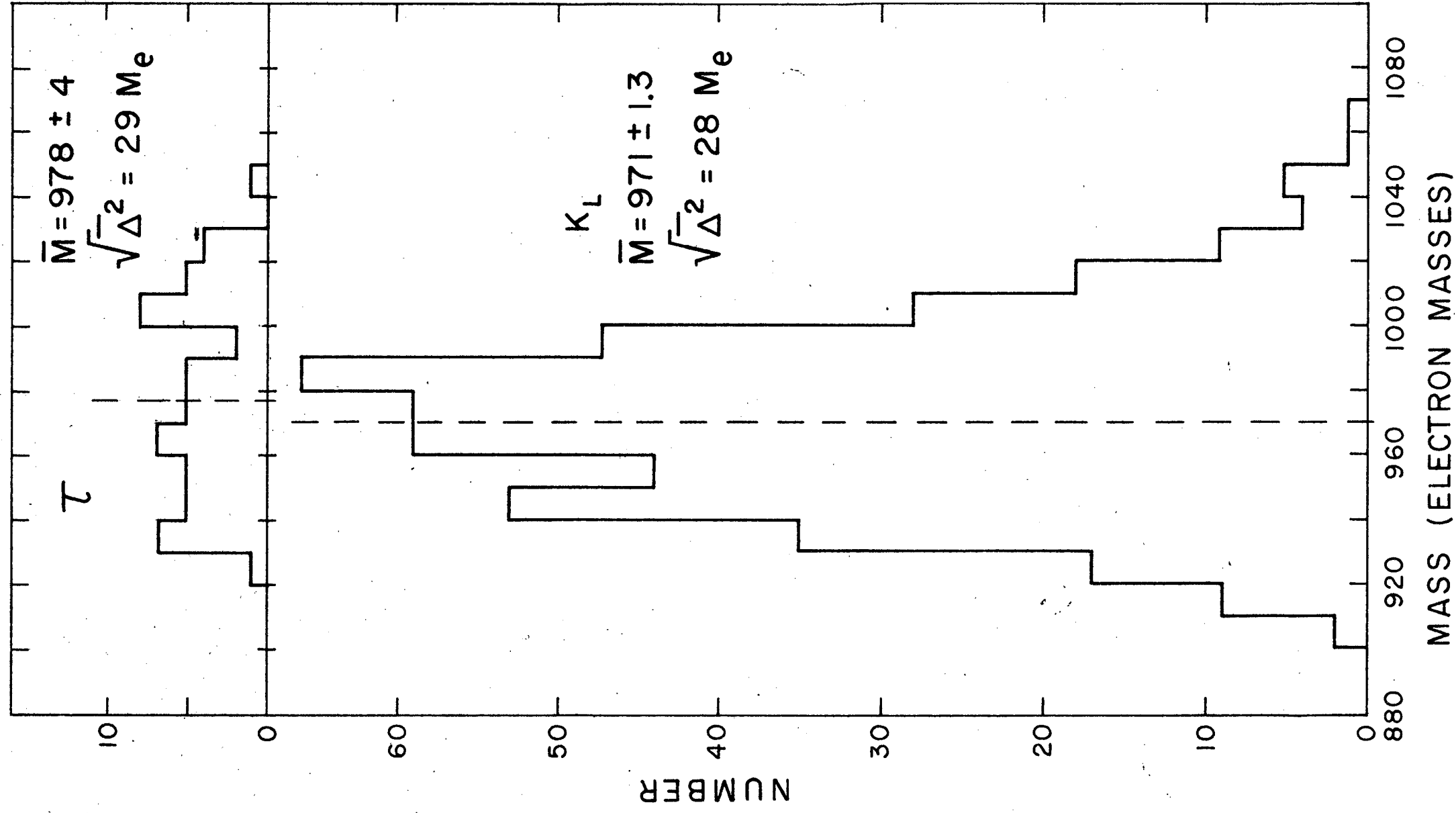


Fig. 1

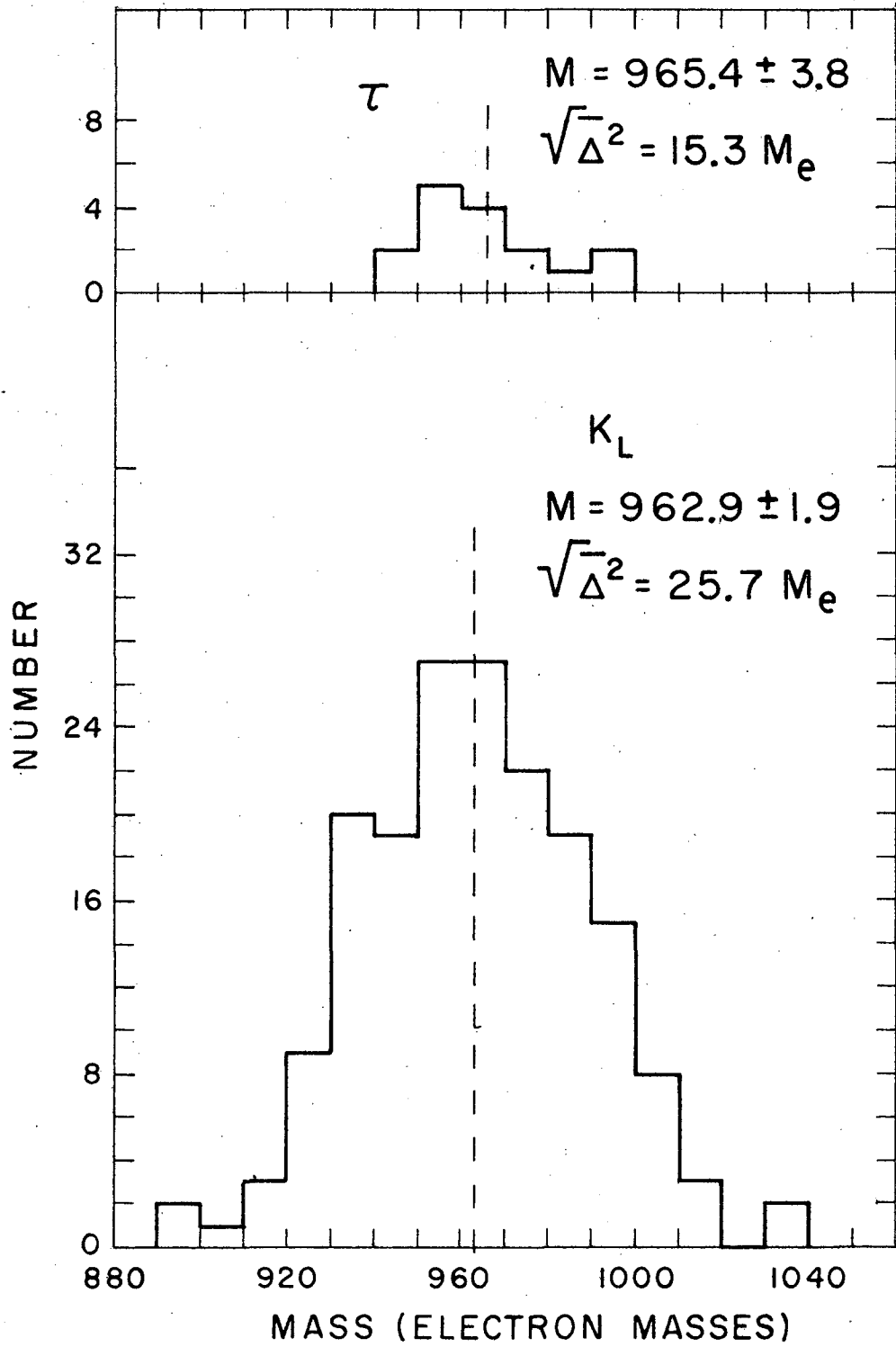


Fig 2