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Now that K mesons are available in large numbers from proton synchrotrons, experiments will soon yield precise values for the lifetime, or lifetimes, of the K mesons. Exposures of emulsions to K particles have been made by several groups at Berkeley, under quite different conditions, so far as distance from the target and magnetic resolution are concerned. If one knew the relative integrated currents on the targets for exposures with long and short flight paths, and if geometrical and resolution factors were properly taken into account, these experiments would yield a lifetime. Until recently, such an intercomparison of the results has appeared impossible. A method has now been found to tie the results of the various experiments together; this note describes the method and presents the lifetime so determined.

The earliest exposures(1, 2) were made in a re-entrant well with no magnetic resolution, 90° to the target at a distance of about 11 1/2 inches. One set of exposures was carried out in a well which had a 0.1-inch aluminum window and another in a well which had 1-inch aluminum window. Later work was done at a distance of about 106 inches from the target with magnetic resolution.(3) The "well exposures" yielded a total of 10 τ mesons from all groups in the laboratory. All groups tabulated the number of K_L and τ mesons stopping at a range corresponding to a momentum of about 350 ± 15 Mev/c, and the number of all π mesons stopping at the same range. We have also counted, in the stack exposed in the well that had a 0.1-inch aluminum window, the number of 350 ± 15 Mev/c protons and the number of π mesons that stop at the range corresponding to 350 ± 15 Mev/c K mesons. In the well exposures silver, lead, and brass targets were used. The ratio of stopped π mesons to protons, determined in the above exposures, was independent of the targets. The measurements of this ratio cannot be done for the exposure in the well that had the 1-inch aluminum window, since the desired protons stopped in the aluminum window. Using the π mesons as secondary standards, we can normalize the well exposures to the flux of 350 Mev/c protons.

In the magnetically resolved exposures,(4, 5) the K_L and τ mesons [illegible] counted relative to the protons of the same momentum. [illegible] a total of about 60 τ mesons from all groups in the laboratory. We then have the ratio of τ mesons to protons of 350 Mev/c at two distances (proper time of flight + slowing-down time: 1.8×10^{-9} second and 1.3×10^{-8} second, respectively), which yields a mean life for the τ mesons of

$$\tau_{\tau} = 1.6 \, {}^{+1.2}_{-0.7} \times 10^{-8} \text{ second.}$$

The main contribution to the rms error comes from the small number of τ mesons (10) found in the well exposure.

Unfortunately, the lifetime of the K_L mesons as determined by this method is not trustworthy, even though the statistics are better. The difficulty is that we do not know the scanning efficiency for K_L mesons for the method of scanning used in the well exposure. The efficiency for τ mesons can be assumed to be greater than 0.9, since the τ-meson decay is so easily distinguished.

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