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Berkeley, California

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Berkeley, California

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An extended series of measurements has been made on the ratios of meson masses to the mass of the proton. As in our previous work[1] momenta and ranges of the mesons were measured, but a number of improvements over our earlier procedures have been devised to reduce systematic errors. Using prior knowledge of the approximate mass ratios, protons and mesons from separate targets in the 184-inch cyclotron were magnetically selected so as to lie in the same 5 percent velocity interval. The particles were stopped in the same nuclear emulsion which they entered at a small angle to the surface. Relative momenta were calculated with errors of less than a part per thousand for the orbits[2], which are approximately semi-circular. The rectified ranges in emulsion of the particles were carefully measured. For a small interval, the range-momentum relation is well represented by a power law: $R/m = c(p/m)^q$, where R is the range, m the particle mass, p the momentum, and c a constant of the emulsion. We have used the exponent $q = 3.50$ derived from the range-energy relation[3]; the results, however, are insensitive to the value of q chosen. The utilization of protons

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[1] F. M. Smith et al., Phys. Rev. <u>78</u>, 86 (1950).

[2] W. H. Barkas, Phys. Rev. <u>78</u>, 90 (1950).

[3] H. Bradner et al., Phys. Rev. <u>77</u>, 462 (1950).

with velocities distributed about the average meson velocity enabled us to evaluate c, and only momentum and range ratios entered into the determination of the mass ratios. Since all the particles are stopped in the same body of nuclear emulsion, the stopping power of the emulsion is eliminated. The momentum ratios are independent of the absolute value of the magnetic field intensity.

Other statistical errors are small in comparison to the range straggling error of an individual observation. We have observed that for monoenergetic (π-μ decay) particles the straggling of ranges has closely a normal distribution. The most probable mass is therefore obtained by averaging the individual observations of that function of the mass in which the range occurs linearly (i.e. $R/p^{3.5}$).

We find the following mass ratios

$$\frac{\pi^+}{\text{PROTON}} = 0.1511 \pm 0.0006$$

$$\frac{\pi^-}{\text{PROTON}} = 0.1504 \pm 0.0007$$

Particles[4] which were presumed to be $\mu+$ mesons originating from decay of π^+ mesons stopping in the target were measured in the same experiment. The dispersion of apparent masses in this case, however, exceeds that to be expected if the particles were representatives of a single mass group all of which come from the target. $\mu+$ mesons which arise from decay of $\pi+$ mesons in flight doubtless contribute to the distribution found, and we therefore must defer quoting a new $\mu+$ mass measurement until a better separation of the groups is obtained.

[4] J. Burfening, E. Gardner, and C. M. G. Lattes, Phys. Rev. 75, 382 (1949).

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