has been predicted, for this momentum range, by Ram and Downs.[4] The second feature is the large cross section in interval III, $\bar{p}_\Lambda = 216$ MeV/c. No explanation is offered at this time, other than the possibility of a two= standard-deviation fluctuation of the data.

We are greatly indebted to the very conscientious efforts of our scanners, Mrs. L. Coggiano, Mrs. A. Gurney, Mrs. M. Kocik, and Mrs. M. Resio, and to Mrs. B. Laycock for her assistance in the analysis of the data. This work could not have been begun without the contribution of our collaborators in other aspects of this CERN stopping-K^- experiment, particularly H. Courant, H. Filthuth, A. Segar, and W. Willis.

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EXAMPLE OF $K_{\mu 4}$ DECAY IN EMULSION*

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We have accumulated ≈4000 examples of three-prong K^+ decay by scanning emulsion exposed to a stopping K^+ beam from the Bevatron. The direction of each prong was measured with a digitized-coordinate microscope and an IBM-7094 was used to calculate the deviation from coplanarity of the prongs. The events which violated coplanarity were then examined in greater detail.

This process isolated an event which we believe represents the decay mode $K^+ \to \pi^+ + \pi^- + \mu^+ + \nu_\mu$. A projection drawing of it is shown in Fig. 1. The K^+ decayed at rest as well as could be determined. Each prong was traced to its stopping point, and all follow-throughs were verified by an independent observer. The range of each prong was measured with our digitized-coordinate microscope, and the associated energies and momenta were computed from the range-energy relation with an IBM-7094. The program used includes the correction of ranges to standard emulsion density.

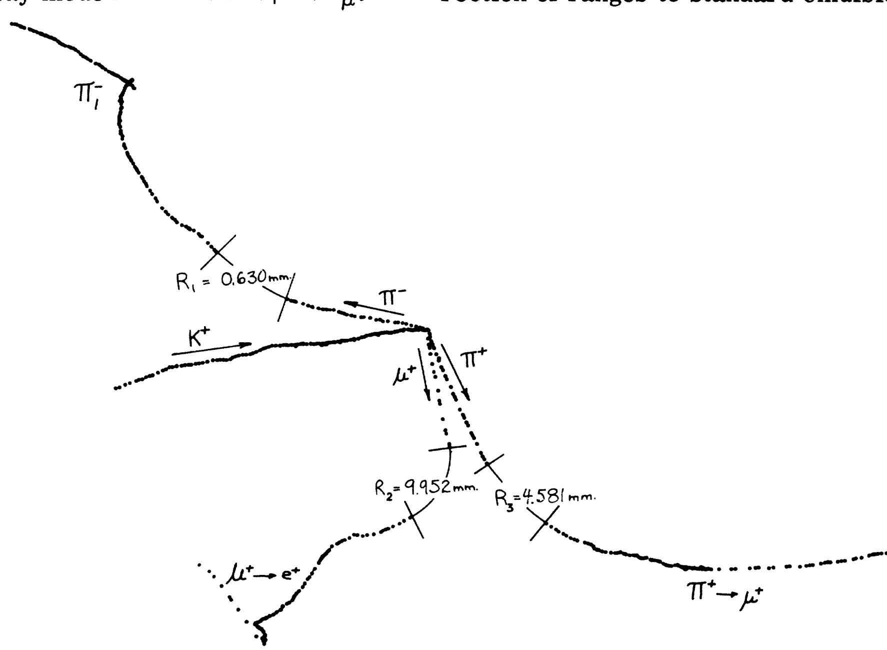

FIG. 1. Projection drawing of $K_{\mu 4}$ event.

Table I. Data for $K_{\mu 4}$ event.

Prong	Direction cosines x	y	z	Range (mm)	Terminal behavior	Particle	Momentum (MeV/c)
1	0.369 ± 0.038	-0.737 ± 0.041	-0.567 ± 0.060	0.630	One-prong star	π^-	36.78 ± 0.37
2	-0.694 ± 0.014	0.101 ± 0.011	-0.713 ± 0.014	9.952	$\mu^+ \to e^+$ decay	μ^+	69.13 ± 0.75
3	-0.511 ± 0.022	0.282 ± 0.019	0.812 ± 0.016	4.581	$\pi^+ \to \mu^+$ decay	π^+	65.85 ± 0.62

The observations and measurements made are listed in Table I.

The resultant momentum of the three charged products is 70.1 ± 2.4 MeV/c and the missing energy is 68.94 ± 0.56 MeV. The measurements are therefore consistent with a four-body decay wherein the neutral product has vanishing rest mass. Careful examination of track 2 has revealed no sudden changes of grain density or deflections which could be attributed to $\pi \to \mu$ decay in flight. We therefore have no reason to suspect that the event is not a genuine example of a new decay mode, $K_{\mu 4}$.

We have, however, eliminated the possibility of two conceivable alternative interpretations. One of these consists of an ordinary τ decay with π-μ decay at a point so near the K-decay vertex as to be unobservable. The experimental value of the quantity $[(M_K - E_1 - E_3)^2 - (\vec{P}_1 + \vec{P}_3)^2]^{1/2}$ is 191.13 $\pm$ 0.68 MeV. This is clearly inconsistent with the pion rest mass. The second alternative consists of a radiative τ decay ($K^+ \to \pi^+ + \pi^+ + \pi^- + \gamma$) with subsequent π-μ decay in flight. The measured directions of tracks 1, 2, and 3 together with the measured momenta of particles 1 and 3 are sufficient to determine completely the assumed decay. The maximum length of track 2 obtainable from this scheme is 7.08 mm. This is inconsistent with the measured value of 9.95 mm.

Although some events remain to be analyzed, we have already seen two examples of the known[1,2] decay mode $K^+ \to \pi^+ + \pi^- + e^+ + \nu_e$. We should expect to see three such decays in our sample from the K_{e4}^+/τ^+ branching ratio[3] of $(7.8 \pm 1.6) \times 10^{-4}$. We estimate that our efficiency for finding the $K_{\mu 4}$ mode is almost 100% so the $K_{\mu 4}^+/\tau^+$ branching ratio is $\approx 1/4000$, based on the one event.

In all K_{l4}^+ decays observed to date, the rule $\Delta S = \Delta Q$ is satisfied. However, one of us (W.Z.O.) has pointed out that these decays do not necessarily provide a good test of the rule if the $T = 0$ dipion resonance, σ, postulated by Brown and Singer[4] does in fact exist. The effect that this resonance would have upon various distributions in K_{l4} decay has been considered by Brown and Faier.[5] It is at least conceivable that a large enhancement of the $\Delta S = \Delta Q$ modes with respect to the $\Delta S = -\Delta Q$ modes could ensue. It therefore seems hazardous to base far-reaching conclusions upon the observation of even a large excess of the $\Delta S = \Delta Q$ modes before resolution of the presently uncertain[3,4,6-8] experimental situation relevant to the σ resonance.

We wish to acknowledge the excellent work of our scanning and measuring staff. Mrs. Marilyn Mollin found the event, Mr. Robert Trankle performed the original follow-throughs, and the digitized-coordinate microscope measurements were carried out by Mr. James Webber and Mr. Peter Lindstrom.

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