three-meter grating spectrograph (dispersion = 1.7A/mm), with the result that this line was shown to be a flag-pattern type hypermultiplet in which the first three components were resolved.

Larger samples of the isotope have become available and the spectrum has been investigated in some detail using a Fabry-Perot interferometer. The source used was a water-cooled Schuler type hollow cathode tube, and the spectrograph a Bausch and Lomb large littrow type with glass optics.

Under high resolving power all lines exhibiting hyperfine structure appear as flag patterns, some degraded in spacing and intensities toward the red and the others toward the violet. Approximately fifty of these lines have been completely resolved——in each case into six components. This is strong evidence that we are here concerned with a case analogous to that found in praseodymium, where every line showing hyperfine structure which can be resolved is shown to consist of six components.[2]

For neptunium, as in the case of praseodymium, this can be interpreted only to mean that for each of the widely split spectral terms involved, J is greater than I and, consequently, the number of hyperfine levels into which the term is split is equal to $2I+1$. Thus it appears that for Np^{237}, $I = 5/2$.

This work will be published in detail in the near future.

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Characteristics of the Parallel-Plate Counter

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The measurement, by means of particle counters, of very short time intervals is important in the study of successive nuclear transitions and in the measurement of the lifetime of the meson. Lifetimes as short as 10^{-7} second have been measured.[1,2] One of the fundamental limitations in such measurements is the inherent delay time of the counter. In a Geiger counter this delay has its origin in the drift time of the secondary electrons from the point of production to the small avalanche region surrounding the central wire, and consequently varies from one count to another. When the paths of the primary electrons are restricted, by means of slits, to a very small region about the central wire, the delay time can be limited to about 10^{-7} second. The lower limit in lifetimes that can be measured is about 0.3 the average delay time of the counters, provided the distribution of inherent counter delays is accurately known. Hence, the Geiger counter is not applicable to the measurement of lifetimes less than 3×10^{-8} second even with extreme collimation.

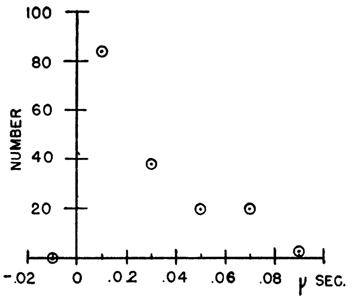

Fig. 1. Time delay distribution.

Since the delay time is inherent in the cylindrical geometry, it has been proposed[3] that parallel-plate electrodes be substituted for the cylindrical electrodes in the Geiger counter. In the case of the parallel geometry the whole counter volume should be uniformly avalanche sensitive; thus, the beginning of the avalanche should follow the formation of the initiating ion without delay.

For the experiment to be described a counter was constructed using 3-mil copper foil as the parallel surfaces. The foils were stretched as "drum heads" in 2-inch diameter circular frames, and were placed 1 mm apart. The counter was filled to a pressure of 2 atmospheres with a mixture of 90 percent argon, 10 percent N-butane. It was necessary to quench the discharge with a Neher-Pickering circuit having a time constant of 10^{-2} second. Under these conditions the counting threshold was 3000 volts with a 900-volt plateau. The pulses produced (without amplification) in a 70-ohm transmission line were about 600 volts in amplitude and had a rise time of less than 10^{-8} second, which agrees with the breakdown time given by Loeb.[4] The efficiency of the counter for electrons was 10 percent.

The delay was measured by causing beta-rays to traverse a thin walled cylindrical Geiger counter and the parallel-plate counter in tandem. To reduce as far as possible the delay in the Geiger counter the beam was restricted by slits which limited it to a 1-mm region surrounding the central wire.

The parallel-plate pulse initiated a $\frac{1}{2}$-microsecond sweep on an oscilloscope (5RP11 tube operated at 10 kv) and the Geiger pulse was displayed as a vertical deflection. A point on the sweep which represented "zero" delay for both counters was found in an auxiliary experiment by connecting the parallel-plate counter simultaneously to the horizontal and vertical circuits. To place the zero in the best part of the screen, a small fixed delay was introduced into the vertical deflection circuit. A deviation to the right of zero on a sweep going from left to right indicated an excess of Geiger delay over parallel-plate delay, whereas a deviation to the left of zero indicated a larger delay for the parallel-plate counter. Results of photographs of the dispersion of the Geiger pulses are shown in Fig. 1. It is seen that, within the accuracy of measurement, there are no pulses to the left of zero, while the distribution to the right shows an average delay for the cylindrical counter of 2×10^{-8} second. The delay error of the parallel-plate counter appears to be less than the accuracy of measurement which is 10^{-8} second.

The advantage of the short delay time, large solid angle, and large output pulse of the parallel-plate counter should make possible measurements of lifetimes of the order of 10^{-9} second. However, the present indications are that the efficiency is low (~10 percent) and that the recovery time is comparatively long (~0.01 sec.). A coincidence set of parallel-plate counters has been constructed to measure short-lived metastable states of nuclei.

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