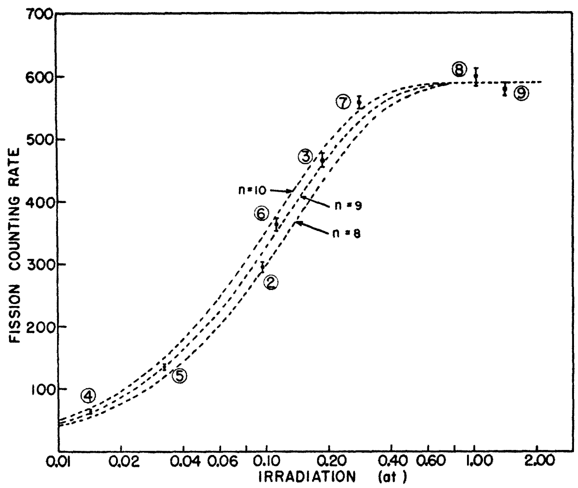

FIG. 1. The relation between Am^{242} fission rate (corrected for the presence of Am^{241}) and irradiation. The fission rate is expressed in counts/min per 10^6 α-*dpm* of the accompanying Am^{241} in a flux of 4.5×10^8 neutrons/cm²/sec. The abscissas are in units of $at=\sigma_1\int(\rho v)dt$, which measures the destruction of Am^{241}.

knowledge of g, that is, of the actual amount of Am^{242} g sec present. However, the deduction of the fission cross section (σ_{2f}) does involve g. On comparison of the saturation fission rate of Am^{242} g sec with that of the Pu^{239} monitor, we obtain $\sigma_{2f}=500/g$. Recently O'Kelley and co-workers[4] gave a value of 0.2 for the I.T. branching ratio of Am^{242m}; this is clearly a lower limit for g, but probably a fairly close one.[3] With $g=0.2$, $\sigma_{2f}=2500$ barns; and hence the capture cross section is 5500 barns.

The shape of the curve (Fig. 1) in the very heavy irradiation region shows that any contribution from fission in Am^{243} is negligible. Taking $g=0.2$, we obtain an upper limit of about 25 barns for the fission cross section of Am^{243}.

It is a pleasure to acknowledge our debt to Mr. Philip B. Aitken for the design of equipment used in the handling of large α-activities.

* Now at Atomic Energy Research Establishment, Harwell, England.
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Note on Soft Gamma-Component of Cosmic Rays*

F. G. REST, L. REIFFEL, AND C. A. STONE
Armour Research Foundation of Illinois Institute of Technology, Chicago, Illinois
December 4, 1950

THE soft gamma-component of cosmic rays has been studied at 30,000 feet using the G-M counter geometry illustrated in Fig. 1. This arrangement minimizes the effects of dead space between tubes and the intrinsic inefficiency of the tubes for ionizing particles. Copper tubes with 0.031-inch walls were used to absorb Compton electrons with energies greater than 2 Mev. $A-B$ (A without B) counts, therefore, correspond to gamma-rays of energy less than 4 Mev. This nominal high energy cutoff is not sharp, owing to the distribution of Compton electrons and the geometry of the detector.

TABLE I. Counting rates at 30,000 feet.

Radiation	Counting rate	Omnidirectional flux
$A-B$ (soft gamma)	78 ± 2 cpm	3.4 photons cm⁻² sec⁻¹
AB (ionizing)	718 ± 6 cpm	0.45 particles cm⁻² sec⁻¹
A (both)	797 ± 6 cpm	3.9 rays cm⁻² sec⁻¹

$A-B$, AB, and A counts were observed simultaneously with circuits of 1 μsec resolution. The data thus obtained, corrected for aircraft contamination, are given in Table I.

The omnidirectional $A-B$ flux was calculated assuming a mean counter efficiency of 1 percent for photons.[1] There is good agreement between this observed photon flux and that calculated from the area under the gamma-ray portion of the cosmic-ray pulse distribution curve obtained with a scintillation counter and a differential analyzer.[2] (For a 10-percent mean crystal efficiency the scintillation data yields 3.8 photons cm^{-2} sec^{-1}.)

The calculation of the omnidirectional AB flux is based on a measured mean counter efficiency of 97 percent and a cosine squared variation with zenith angle.[3] The value obtained here compares closely with an interpolated value of 0.48 particle cm^{-2} sec^{-1} at 30,000 feet, using the estimates given by Montgomery.[4]

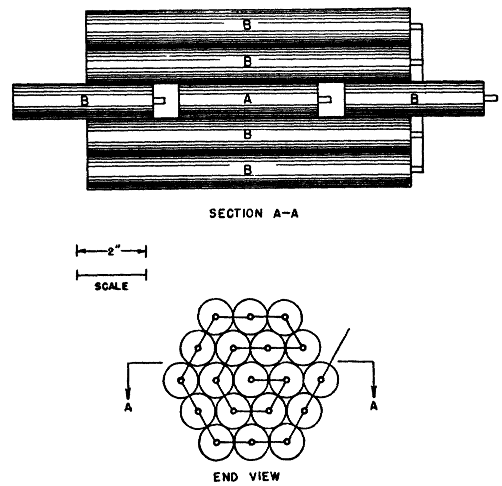

FIG. 1. Detector for soft gamma-radiation.

These investigations are being carried further, and data regarding altitude and directional intensity variations will be presented in a future publication.

* This work has been performed as one aspect of a project carried on under contract with the United States Department of the Air Force.
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Detection of Positive π-Mesons by π^+ Decay*

M. JAKOBSON,** A. SCHULZ, AND J. STEINBERGER†
Radiation Laboratory, University of California, Berkeley, California
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POSITIVE π-mesons have been detected by means of a delayed coincidence between a π^+ meson and its decay μ^+ meson. This method is similar to that of previous investigators[1-3] who have used the characteristic $\mu^+-\beta^+$ decay for meson detection.

A polyethylene target bombarded by the photon beam of the Berkeley synchrotron provided a source of mesons. Two trans-stilbene crystals in the form of a counter telescope were placed 90° from the direction of the photon beam. The scintillations from the crystals were detected and amplified by 1P21 photo-multipliers. The photo-multiplier pulses, caused by a π^+ meson passing through one crystal and stopping in the second, open a gate of width 0.08 μsec which is then delayed 0.025 μsec. If the μ^+ meson pulse arising from the decay of the stopped π^+ meson appears during the time the gate is open, the meson is counted

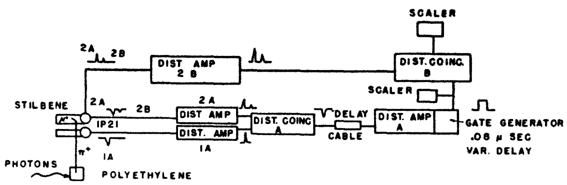

FIG. 1. Block diagram of electronics.

(Fig. 1). The amplifiers and coincidence circuits are of a distributed type.[4] The gate generator is a non-symmetrical cathode coupled multivibrator using miniature tubes.

In order to determine the detection efficiency, the meson counting rate was measured as a function of pulse height for (1) the π^+ meson pulse in the first crystal, (2) the π^+ meson pulse in the second crystal, (3) the μ^+ meson pulse in the second crystal. Curves for the π^+ meson pulses are of the same type as those of Steinberger.[3] A plateau was obtained for the μ^+ meson pulse (Fig. 2) by varying the gain of the amplifier providing the signals for the $\pi-\mu$-coincidence circuit. This plateau shows that all μ^+ mesons, which stop in the crystal during the time the gate is open, are counted.

With delayed coincidence detection, the accidental background is proportional to the length of gate used. Since the ratio of the π^+/μ^+ mean lives is of the order of 0.01, the accidental background is reduced by going to the faster decay scheme. With the present apparatus, the background is reduced only by a factor of 10 from that of reference 3. This is due to the larger ratio of pulse width to half-life and the difficulty of discrimination with narrower pulse widths. To lower the background further, a triple delayed coincidence involving $\pi^+-\mu^+-\beta^+$ decay has been used. This requires that the $\mu^+-\beta^+$ decay as well as the $\pi^+-\mu^+$ decay must take place in the second crystal. The background and counting efficiency are both lower when the $\pi^+-\mu^+-\beta^+$ detection scheme is used, but the ratio of counting efficiency to background is increased.

As an application of this method, the π^+ meson mean life[5-7] was measured by varying the gate delay. The delay was increased and decreased in cycles to minimize the effect of beam fluctuations and detection sensitivity changes. In order to obtain the accidental delayed coincidences, the gate is delayed for a time long compared to a π^+ mean life. The finite length of the gate does not need to be taken into account, since this does not affect the slope of the curve. Calculations show that the effect of the decay of the μ^+ mesons into positrons can be neglected. This is owing to the fact that only a small fraction of the positrons occur at each delay; in addition, only about 30 percent or less of these positrons lose sufficient energy in the crystal to be counted.

Eight lengths of RG 63/U cable were used to provide the variable delay. The delay of each cable was measured, using a synchroscope, by photographing the reflections of pulses sent down the cable. Cable delays were measured to 2 percent.

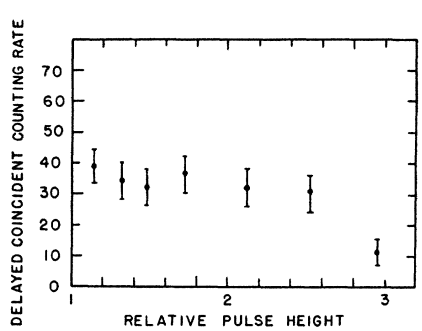

FIG. 2. Pulse 2B plateau. Plot of delayed coincidence counting rate against the relative height of a pulse required to make a delayed coincidence. Obtained by counting the number of delayed coincidences for different gain settings of amplifier 2B.

The 5641 meson counts, with a background of 398 at each of the seven points (Fig. 3), give for the mean life

$$\tau_m = 2.54 \pm 0.11 \times 10^{-8} \text{ sec. (Standard deviation.)}$$

The corresponding half-life is $\tau_{\frac{1}{2}} = 1.76 \pm 0.08 \times 10^{-8}$ sec. This value agrees with that of reference 5 but lies outside the standard deviations of previous measurements.[6,7]

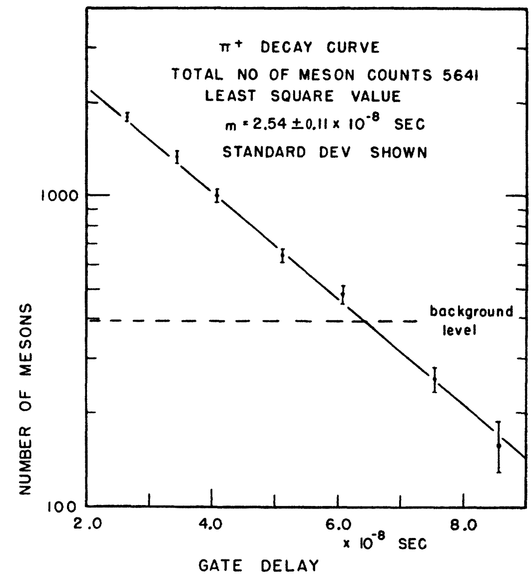

FIG. 3. The number of π^+ mesons at each gate delay plotted against the gate delay.

We wish to thank Professor E. McMillan and Professor O. Chamberlain for their encouragement and advice. Thanks also are due to Dr. Leininger for kindly providing the crystals and to the synchrotron crew for aid in carrying out the bombardments.

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** Whiting Fellow, University of California.
† Now at Columbia University, New York, New York.

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The Neutrons from the Nucleonic Component as an Indicator of Changes in Primary Intensities*

J. A. SIMPSON, JR.
Institute for Nuclear Studies, University of Chicago, Chicago, Illinois
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TWO important factors in the selection of a suitable secondary component for low altitude observation of the changes and fluctuations of the primary cosmic-ray intensity are (a) uniqueness of interpretation of the observed intensity changes and (b) response of the secondary component to changes in the primary intensity. In this note the meson component and the neutrons from the nucleonic component will be compared briefly with respect to these factors.

Interpretation.—It has been shown that, owing to the short mean lives of the π and μ mesons, the temperature expansion and contraction of the atmosphere, especially in the 50 to 150-mb region,[1] where the meson production is large, has a pronounced