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μ^+-MESON DEPOLARIZATION IN NUCLEAR EMULSIONS WITH DIFFERENT GELATIN CONTENT

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FRIEDMAN and Telegdi[1,2] and Gurevich et al.[3] have studied the asymmetry in nuclear emulsions in the angular distribution of electrons from the μ^+-e^+ decay to verify the failure of the parity conservation law in weak interactions.[4] Their results for the asymmetry coefficient in the angular distribution had a smaller absolute value than predicted by theory. One of the reasons for this is μ^+-meson depolarization in the emulsion. The results of Chadwick et al.[5] indicate that the depolarization effect is different for the two constituents of the nuclear emulsion (silver halide and gelatin).

The present work was undertaken to clarify the dependence of μ^+-meson depolarization on the relative content of each constituent of the emulsion (by studying the "forword-backward" asymmetry in the electron distribution from μ^+-e^+ decay). To this end a chamber was used consisting of layers of the usual NIKFI type "R" emulsion and of layers of emulsion whose gelatin content by weight was 2, 3, and 4 times that of the usual emulsion. We shall refer to these emulsions as 2-, 3-, and 4-fold diluted emulsions. The chamber was exposed to the π^+-meson beam from the synchrocyclotron of the Joint Institute for Nuclear Research. The emulsion chamber was placed inside a magnetic screen (within which the field intensity did not exceed 0.08 gauss) to prevent precession of the spin of stopped μ^+ mesons due to stray magnetic fields of the synchrocyclotron.

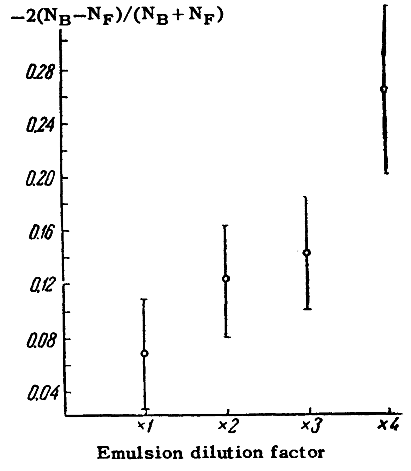
The various emulsions were prepared at the same time and were from the same batch. The thickness of each emulsion layer was measured before and after exposure.

In the scanning process those π^+-μ^+-e^+ decays were registered for which the μ^+-meson track was entirely within one emulsion layer. The direction of electron emission was measured relative to the direction of the μ^+-meson momentum at the point where the π^+ meson decayed. The plane perpendicular to this direction served as the dividing plane for decay electrons emitted forwards and backwards.

The events in which the μ^+ meson decayed within 50 μ from the surface of the unexposed emulsion were excluded in the processing of the results. The resultant data are given in the table.

Emulsion dilution factor	Number of $\pi\to\mu\to e$ decays	Number of undetected electrons	$-A$
×1	2300	11	0.065±0.041
×2	2300	13	0.118±0.041
×3	2300	21	0.14±0.041
×4	1133	53	0.37±0.06

For each emulsion we calculated the ratio $2(N_B - N_F)/(N_B + N_F)$ (N_B, N_F is the number of electrons emitted backwards and forwards respectively), which was taken to be the asymmetry coefficient A. The statistical root-mean-square error was taken to be $2/\sqrt{N}$. It was assumed that the electron angular distribution is of the form $1 + A\cos\theta$, where θ is the angle between the initial directions of the μ-meson and electron momenta. In the first three types of emulsion the number of undetected decay electrons was less than 1%. To exclude the comparatively large number of unseen electrons in 4-fold diluted emulsions it was assumed that all these electrons were emitted forwards. Clearly, this lowers the asymmetry coefficient. Nevertheless, as can be seen from the figure, the angular asymmetry tends to rise with the increase in the gelatin weight content of the nuclear emulsion.



To allow definitive conclusions to be drawn on the dependence of the asymmetry on gelatin content, we are continuing the experiment to improve our statistics.

In addition we processed 1198 π^+-μ^+-e^+ decay events in 4-fold diluted emulsions containing triethanolamine $(C_2H_4OH)_3N$. The events in which the μ^+-meson stopped in the emulsion surface (the thickness of the end zones was taken as 50 μ of unexposed emulsion) were excluded. The number of unseen decay electrons was 10. In those cases the asymmetry coefficient equals 0.182 ± 0.058.

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OBSERVATION OF NUCLEAR-ACTIVE PARTICLES OF COSMIC RADIATION WITH ENERGY $\geqslant 10^{13}$ ev.

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IN Autumn 1957 we measured the flux intensity of high-energy nuclear-active particles of cosmic radiation at 3860 m above sea level.

The detector of nuclear-active particles consisted of seven ionization chambers surrounded by lead (Fig. 1). Six chambers (1 — 6) 150 cm in length, 25 cm wide, and 15 cm high formed the upper part of the detector. This was shielded from above and below by ~ 45 g/cm^2 of lead. The dimensions of the lower ionization chamber (7) were 150 × 150 × 15 cm. A graphite absorber of varying thickness (40, 63, 100 g/cm^2), covered by 2 cm of lead, was placed above the detector. This was intended to reduce the contribution of the electron-photon component accompanying the nuclear-active particles. Five groups of cylindrical ionization chambers were placed around the detector to record extensive air showers accompanying the high-energy nuclear-active particles in the depth of the atmosphere. The sensitivity and total area of these chanbers made it possible to detect all events in which nuclear-active particles were accompanied by extensive air showers with total number of particles $\geq 3 \times 10^3$.

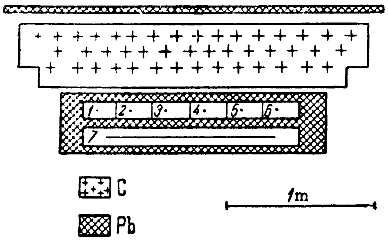

FIG. 1. Detector of nuclear-active particles. Side view.

The size of bursts in all chambers was automatically recorded whenever the ionization in both layers of the nuclear-active particle detector exceeded that due to 1000 relativistic particles. An estimate of the energy of nuclear-active particles producing the observed bursts was facilitated by the fact that we could assume, from the ratio of radiation lengths in lead and graphite, that the majority of nuclear interactions occurred in the graphite, while the electron-photon component, originating in the decay of π^0 mesons, multiplied in the layer of lead of a given thickness. Assuming that 30% of the energy of the nuclear-active particle is carried away by π^0 mesons in a single nuclear interaction and in the ensuing nuclear cascade in a slab of graphite 100 g/cm^2 thick, we obtain from the electromagnetic cascade theory the following relation between the energy of a nuclear-active particle E and the number of relativistic particles N detected in the ionization chamber under 90 g/cm^2 of lead:

$$E = N \cdot 10^9 / 0.35 \ln 0.015 N.$$

This expression is valid for $5 \times 10^{11} \leq E \leq 2 \times 10^4$ ev.

An analysis of the experimental data showed that nuclear-active particles with energy $\geq 2 \times 10^{12}$ ev are accompanied in 81 ± 3% of the cases