where $\varphi_{n_0 l_0 m}$ is the wave function of the mesic atom without taking spin into account, $\chi_{1/2}$ is the spin function of the μ^- meson polarized along the z axis, $\Phi_{n_0 l_0 j_0 m+\frac{1}{2}}$ is the wave function of the mesic atom with the quantum numbers $n_0 l_0 j_0$, and finally, $\mu_0 = m + \frac{1}{2}$. For $t > 0$,

$$\Psi = \sum_{mj_0} a_m C^{j_0 m+1/2}_{l_0 m, 1/2 1/2} \Phi_{n_0 l_0 j_0 m+1/2} \exp(-iE_{n_0 l_0 j_0} t/\hbar). \qquad (6)$$

In view of Eq. (1), the states with $j_0 = l_0 + \frac{1}{2}$ and $j_0 = l_0 - \frac{1}{2}$ must be considered independently. Considering that all values of m are equally probable, it is not hard to find that for given n_0 and $l_0 \gg 1$, the probability of falling into states with $j_0 = l_0 + \frac{1}{2}$ and $j_0 = l_0 - \frac{1}{2}$ is equal to $\frac{1}{2}$. Here, the average value $\bar{\sigma}_z$ in each of these states (for $l_0 \gg 1$) is equal to $1/3$. From states with $j_0 = l_0 + \frac{1}{2}$, the μ mesons reach the K shell, retaining the value of $\bar{\sigma}_z$ ($\beta_K \approx 1$) equal to $1/3$. But from states with $j_0 = l_0 - \frac{1}{2}$, the μ^- mesons, in dropping into the K shell, are almost completely depolarized ($\beta \approx 0$). Consequently, the average value of σ_z, i.e., the degree of polarization of the μ^- mesons in the K shell, must be equal to $1/6 \approx 17\%$. This agrees approximately with the experimentally-observed value.[5,6]

I would like to express my sincere thanks to S. S. Gershteĭn, V. N. Gribov, and A. Z. Dolginov for their interest in the work and for useful discussions.

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Translated by D. Lieberman
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ON $\mu^+\mu^-$ ANNIHILATION AND THE DECAY OF NEUTRAL MESONS

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Submitted to JETP editor December 10, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 646-647 (February, 1959)

By analogy with e^+e^- annihilation (see reference 1), it can be expected that the $\mu^+\mu^-$ "atom" will yield two quanta in the para-state and three quanta in the ortho-state.

Berestetskii and Pomeranchuk[2] have pointed out the possibility of the direct transformation of an e^+e^- pair into $\mu^+\mu^-$ through one virtual quantum.* Considering the inverse process, we come to the conclusion that in addition to $\mu^+\mu^-$ annihilation with emission of quanta, the transformation of $\mu^+\mu^-$ into an e^+e^- pair is also possible. This process is of the same order with respect to $e^2/\hbar c$ as two-quantum annihilation.

It is easy to convince oneself that the transformation of $\mu^+\mu^-$ into e^+e^- in this order cannot occur in the para-state. On the other hand, in the ortho-state of $\mu^+\mu^-$, the transformation into e^+e^- proceeds with a probability three times smaller than the probability of two-quantum annihilation of the para-state. Thus, the probability of the transformation of ortho-$\mu^+\mu^-$ into e^+e^- is approximately 400 times greater than the probability of the three-quantum annihilation of ortho-$\mu^+\mu^-$.

The pseudoscalar neutral meson π^0 is similar (see reference 3) to the para-state of $\mu^+\mu^-$ or e^+e^-; the decay of π^0 into two quanta conforms to this analogy. The ortho-state of $\mu^+\mu^-$ would be similar to a neutral odd-parity meson with spin 1. As is clear from what has been presented above, such a meson would decay not into three quanta, but directly into an e^+e^- pair, with a lifetime of the order of the lifetime of the π^0 (compare reference 4).

Careful measurements of e^+e^- pairs during energetic collisions of cosmic particles with nuclei were performed[5,6] in connection with measurements of the lifetime of the π^0. The results of these measurements apparently rule out the existence of a nuclearly-active neutral meson with spin 1, because the number of e^+e^- pairs produced in the vicinity of the collision agrees with Dalitz's calculation[7] of the relative probability of the process $w(\pi^0 = \gamma + e^+ + e^-)$ namely $w(\pi^0 = 2\gamma) = 1/80$.

Clearly, no electromagnetic processes, including production of an e^+e^- pair, can be observed in the $\pi^+\pi^-$ "atom," because the transformation of $\pi^+\pi^-$ into $2\pi^0$ will occur with overwhelming probability.

I would like to thank I. Ya. Pomeranchuk for opportunely calling my attention to reference 2.

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*As noted by the authors, the expressions for the cross section, given in reference 2, must be multiplied by 4.

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Translated by D. Lieberman
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ELECTRON PARAMAGNETIC RESONANCE OF Co^{2+} IN CORUNDUM

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Submitted to JETP editor December 16, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 647-648 (February, 1959)

LINES of electron paramagnetic resonance of the cobalt ion were observed at frequencies of 9800 and 37500 Mcs at T = 4.2°K in a monocrystal of corundum containing cobalt as an impurity. All the lines have a superfine structure of eight components in accordance with the value of the spin of the Co^{59} nucleus, $I = 7/2$.

When the magnetic field is parallel to the trigonal axis of the crystal, an intense line is observed; the components of this line are strongly non-equidistant at the frequency 9800 Mcs. When the magnetic field is perpendicular to the trigonal axis, the components of the superfine structure of this line are equidistant at both frequencies.

The observed spectrum can be ascribed to Co^{2+} with an effective spin of $S' = 1/2$. The superfine structure was not studied in detail; the g-factors, measured with respect to the center of the line, are $g_{\parallel} = 2.27$ and $g_{\perp} = 4.95$.

In addition to the intense line, several weak lines with a superfine structure characteristic of cobalt are observed.

As compared with the ions Cr^{3+}, Fe^{3+}, and V^{3+}, the ion Co^{2+} in corundum has a considerably longer relaxation time, so that at T = 4.2°K the saturation effect occurs at powers $\sim 10^{-8}$ w.

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