with increasing incident radiation power, as in the case of direct current [2,3]. This change is all the more noticeable the lower the temperature. Using a simple two-band model [1], it can be shown that when the impurities are ionized the Hall constant increases when the impurity conductivity increases. At 4.2°K the change in the Hall constant, due to the increased number of the free electrons, is offset by the change due to the change in the number of electrons participating in the impurity conductivity. It can also be shown [3] that at sufficiently low temperature T = 1°K, the observed change in the electric conductivity and in the Hall constant under the influence of the radiation cannot be attributed to the change in the ratio of the mobilities of the free electrons and the impurity electrons, since the effect increases with decreasing temperature. Thus, the change in the electric conductivity of the samples following irradiation by an electromagnetic wave with λ = 10 mm is connected with the change in the recombination of the electrons at the donor levels under the influence of the electric field and the subsequent change in the number of carriers at the impurity levels and in the conduction band [3,4].

The field intensity corresponding to the abrupt change in the electric conductivity and in the Hall constant ranges from 0.2 to 0.4 V/cm, although these figures may be overvalued, since we do not know the penetration of the field in the samples. The independence of the Hall constant on the radiation power when n-InSb is irradiated by millimeter waves, observed in [5], may be connected with insufficiently low temperatures and insufficiently pure samples.

In conclusion, the author considers it his duty to thank N. G. Basov for stimulating discussions, V. D. Burmistrov for help during the measurements, and Yu. P. Zakharov for preparing the samples.

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LEPTON DECAY OF VECTOR MESONS

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The matrix element for the probability of the decay of a vector meson (ρ^0, ω, or φ) into an e^+e^- or $\mu^+\mu^-$ pair is determined by the same diagram as its proper energy. In a recent paper [1] it was proposed to use this circumstance to determine the nonrenormalized mass of vector mesons, with an aim at checking unitary symmetry. In this note we start from somewhat stronger assumptions, which make it possible to estimate the probability of the lepton decay of ρ^0, ω, and φ.

We assume, first, that strong interactions have (with good approximation) unitary symmetry, and that the vector mesons interact with conserving currents [2]. Then the strong-interaction Lagrangian for the ρ^0 meson and the 8th component of the octet X^8 takes the form

$$g\,[\rho_\mu J^3_\mu + X^8_\mu J^8_\mu],$$

where g is a constant and J^3_μ and J^8_μ are conserved currents transforming like the third and eighth components of the unitary octet. The same currents enter in the Lagrangian of the electromagnetic interaction

$$\frac{1}{2}\, e\, A_\mu\, [J^3_\mu + \frac{1}{\sqrt{3}} J^8_\mu].$$

In addition, we assume further that the bulk of the vector-meson mass is due to the strong interaction and not to the bare mass. Since the vertex part for the transition of the vector meson into a virtual γ quantum and the value of the mass operator for such a meson are determined by identical diagrams, these assumptions lead to the relations

$$\langle\gamma|\rho^0\rangle = \frac{em^2_\rho}{2g},$$

$$\langle\gamma|\omega\rangle = \frac{em^2_\omega}{2g\sqrt{3}}\sin\theta,$$

$$\langle\gamma|\varphi\rangle = \frac{em^2_\varphi}{2g\sqrt{3}}\cos\theta.$$

Here θ is the ω-φ mixing angle, defined by the relations (X^0 = unitary singlet)

$$X^8 = \varphi\cos\theta + \omega\sin\theta,$$

$$X^0 = -\varphi\sin\theta + \omega\cos\theta.$$

Corresponding to the experimental masses of φ and ω, besides the Gell-Mann - Okubo relations, is $\sin\theta = \sqrt{1/3}$. In the absence of mixing $\theta = 0$. The foregoing relations were obtained with unitary-symmetry-breaking interaction taken into account in first order.

According to [3,4,1], the probability of the decay of ρ^0, ω, and φ into a pair of leptons l^+ and l^- can now be written in the form

$$\Gamma(\rho^0 \to l^+l^-) = \alpha^2(g^2/4\pi)^{-1} m_\rho/12,$$

$$\Gamma(\omega \to l^+l^-) = \alpha^2(g^2/4\pi)^{-1}\, m_\omega \sin^2\theta/36,$$

$$\Gamma(\varphi \to l^+l^-) = \alpha^2(g^2/4\pi)^{-1}\, m_\varphi \cos^2\theta/36,$$

where $\alpha^2 = e^2/4\pi = 1/137$, and the lepton mass is neglected.

To obtain a final result, we must also estimate the constant $g^2/4\pi$. This can be done by using the experimental probability of the decay $\rho \to \pi + \pi$, for which $g^2/4\pi = 0.5$. Assuming this value, we obtain

$$\Gamma(\rho^0 \to l^+l^-) = 6.8 \text{ keV},$$

$$\Gamma(\omega \to l^+l^-) = 2.3 \sin^2\theta \text{ keV},$$

$$\Gamma(\varphi \to l^+l^-) = 3.0 \cos^2\theta \text{ keV}.$$

Relative probability of vector-meson decay into an electron-positron pair

Vector meson	Relative probability of lepton decay x 10^4		
	$\sin\theta = \sqrt{1/3}$	$\sin\theta = 0$	Experiment [5]
ω	0.83	0	$1.0^{+1.2}_{-0.8}$
φ	6.5	10	6 ± 3
ρ^0	0.64		$0.5^{+0.6}_{-0.3}$

The relative probabilities of the decay of a vector meson into an l^+l^- pair, calculated with the aid of these equations, are listed in the table. Its last column gives the experimental data of [5]. It is evident that there are no contradictions within a range of large experimental errors, but it is too early to speak of agreement between theory and experiment, or of preferred values of the mixing parameter.

It must be mentioned in conclusion that the constants e and g, which enter in the matrix element of the transition of a vector meson into a γ quantum, should be defined as vertex parts for the same value of the photon or vector-meson mass. This does not agree with the customary definition, since the electric charge is defined for $q^2 = m_\gamma^2 = 0$ and the strong-interaction constant for $q^2 = m_\rho^2 \neq 0$. The results obtained here are therefore valid if the dependence of these vertex parts on q^2 is weak.

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CORRECTION

to article "Lepton Decay of Vector Mesons" by V. M. Shekhter

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1. No account is taken in the article of the fact that the transition matrix element $\langle\gamma\rho^0\rangle$ is determined by the renormalized ρ-meson polarization operator Π, whereas the mass of ρ^0 includes also a renormalization constant Z_ρ, viz., $m_\rho^2 = m_0^2 + Z_\rho^{-1}\Pi$ (m_0^1 is the bare mass of the ρ meson). In the language of Feyman diagrams this means that m_ρ^2 is determined only by the irreducible self-energy diagrams, and not by all diagrams. If the relation for m_ρ^2 is written in the form $m_\rho^2 = \Pi + [m_0^2 + (Z_\rho^{-1} - 1)\Pi]$, then the hypothesis advanced in the paper is equivalent to the assumption that $\Pi \approx m_\rho^2 \gg m_0^2 + Z_\rho^{-1} - 1)\Pi$. The quantity in the right side of this inequality is in all cases finite, by virtue of renormalizability, and can be regarded as "the finite part of the bare mass." The author is grateful to A. A. Polyakov for calling his attention to the presence of the factor Z_ρ^{-1} in the self-energy diagram, and to A. A. Ansel'm for a discussion.

2. The value of the relative probability of the decay $\varphi^0 \to e^+e^-$ listed in the table corresponds to the hypothetical (not experimental) cross section $\sigma(\pi^- + p \to n + \varphi) = 50$ μb.