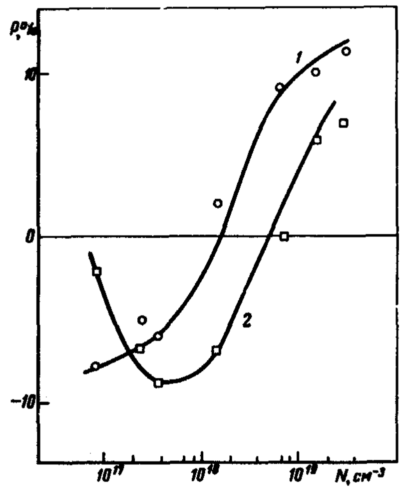

Fig. 3. Dependence of the degree of orientation of the electrons (P) in GaAs on the impurity concentration for two fixed values of the quantum energy of the exciting light, 1.96 eV (1) and 2.14 eV (2). The values of P are normalized as follows: for each impurity concentration P = 0.5 stands for the value of the degree of orientation at $h\nu \approx E_g$.

an inversion center [7]: the relaxation is due to the spin splitting (at points $k \neq 0$) of the conduction band and increases strongly with increasing electron energy. The effectiveness of the relaxation is determined by the ratio of the spin-relaxation time to the relaxation time with respect to the energy and momentum of the "hot" electron. In doped crystals, the decrease of the relaxation time with respect to the energy and momentum of the hot electron with increasing content of the impurity should lead to a weakening of the spin relaxation, and accordingly to an increase of the threshold value of ε_{cr} for the spin relaxation due to this mechanism.

The point P = 0 on the curves of Fig. 3 corresponds approximately to an impurity concentration at which $\varepsilon_{cr} \approx h\nu - E_g$. From the presented data for two values of the frequency of the exciting light we can estimate that, in accordance with the theory [7], the relation $\varepsilon_{cr} \sim N_p^{1/3}$ is approximately satisfied.

In conclusion, the authors thank M.I. D'yakonov and V.I. Perel' for useful discussions.

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CONCERNING THE NATURE OF THE COSMOLOGICAL CONSTANT AND THE MECHANISM OF GRAVITATION OF VACUUM

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Submitted 3 March 1971; resubmitted 14 April 1971
ZhETF Pis. Red. 13, No. 12, 704 - 706 (20 June 1971)

1. A study of the behavior of quasars has made it necessary again to call attention to the Λ term in the gravitational equations [1]. Effects connected with this term were considered by Kardashev, Shklovskii, Petrosyan, et al., see [2, 3]. Academician Ya.B. Zel'dovich pointed out a possible connection between effects of gravitation of vacuum and interactions of elementary particles [4]. However, preliminary calculations performed with account of both

quantum and relativistic effects had so far not yielded results that agreed with the experimental data. Thus, according to the data of Novikov [5], if the elementary particles "responsible" for the gravitation of the vacuum are assumed to be electrons or protons, then the repulsion acceleration will be higher and lower by seven and eleven orders of magnitude, respectively, than the value obtained from existing observations.

Without touching upon the problem of reliability of the results of modern astrophysical observations, let us use the considerations advanced by Zel'dovich [4] to calculate the mass of the virtual particle "responsible" for the gravitation of the vacuum and the associated effect of expansion of the (Friedmann-Hubble) universe, although at the present time the astrophysical proof in favor of the assumption that the Λ term has a non-zero value have been somewhat less convincing.

2. Let us consider the case when the gravitational repulsion forces of the vacuum are equal to the gravitational attraction forces of the matter, corresponding, according to the known views [2, 3], to a red shift in the spectra of the quasars, Z = 1.95. It is known [3] that the state of "equilibrium" corresponds to a critical density

$$\rho_k = \rho_0 (1 + Z)^3, \tag{1}$$

where ρ_0 is the average density of the matter in the universe in the modern epoch.

According to the Einstein relation, the critical density of matter satisfies the equation (at a zero expansion velocity)

$$\rho_k = \frac{\epsilon_V}{c^2}, \tag{2}$$

where the density of the gravitational energy of the vacuum, with allowance for the characteristic distance of the particle in accordance with quantum mechanics, is equal to

$$\epsilon_V = \frac{G c^4}{\hbar^4} m^6, \tag{3}$$

$G = 6.67 \times 10^{-8}$ cm^3/g-sec^2 is the gravitational constant, $\hbar = 1.05 \times 10^{-27}$ erg-sec is Planck's constant, $c = 3 \times 10^{10}$ cm/sec is the velocity of light in vacuum, and m is the mass of the particle generating the gravitation of the vacuum.

We thus have from (1), (2), and (3)

$$m = \left(\frac{\hbar^4 \rho_0 (1 + Z)^3}{G c^2}\right)^{1/6} \tag{4}$$

or, recognizing that $\hbar$, G, and c are constants, we get

$$m \approx 0.91 \cdot 10^{-20} \rho_0^{1/6} . \tag{5}$$

According to modern views, $\rho_0 \sim 10^{-29}$ g/cm^3, and consequently for the sought particle "responsible" for the gravitation of vacuum we have $m \sim 1.6 \times 10^{-25}$ g or $m \sim 170 m_e$. In other words, within the limits of the estimate, the mass of the sought particle is of the order of the muon mass.

3. In conclusion, it should be noted that the advanced considerations should be regarded so far only as a hypothesis, since there are no other data confirming them at present.

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POSSIBILITY OF DETERMINING THE SPIN AND PARITY OF THE X^0 (960) MESON IN ELECTROMAGNETIC INTERACTIONS

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Submitted 3 May 1971
ZhETF Pis. Red. 13, No. 12, 706 - 710 (20 June 1971)

1. The spin and parity of the X^0 (960) meson have not yet been firmly established [1, 2]. The available skimpy experimental data can be reconciled equally well with the hypotheses 2^- and 0^- for the X^0 (960) meson, with 2^- being the preferable hypothesis [3]. An analysis of the decays $X^0 \to \eta 2\pi$, $X^0 \to \rho^0\gamma$, and $X^0 \to 2\gamma$ does not make it possible to distinguish between the hypotheses 0^- and 2^-, owing to the lack of clearly pronounced forbiddennesses. In this connection, it becomes important to study the mechanism of production of X^0 (960) in different reactions in strong and electromagnetic interactions.

We analyze in this paper processes of electromagnetic production of the X^0 (960) meson, in order to establish its spin and parity.

2. Photoproduction of X^0 (960) on a nucleus with spin 0. An interesting possibility of determining the spin of the X^0 meson is contained in the reaction[1)]

$$\gamma + \mathrm{He} \to \mathrm{He} + X^0(960). \qquad (1)$$

The choice of helium is dictated both by the zero spin of the nucleus, and by the absence of closely-lying exciting states. In the reaction γ + He $\to$ He + X^0 (960) there exists an entire aggregate of effects leading to conclusions concerning the spin and parity of X^0 and based on the fact that the spin of the helium nucleus is zero. For the alternative 0^-, the differential cross section of the reaction (1) depends strongly on the angle of production of X^0, and vanishes like $\sin^2\theta$ as $\theta \to 0°$. For the hypothesis $J^P(X^0) = 2$, the simplest angular distribution does not vanish at $\theta = 0°$ (180°).

The dependence of the differential cross section of the process γ + He $\to$ He + X^0 on the polarization of the initial photon for $J^P(X^0) = 0^-$ is strongly *pronounced*

1) At the present time there are experimental data on the photoproduction of X^0 (960) on protons [4]. The maximum $\sigma \sim 1.5$ μV is reached at $E_\gamma \sim$ (1.6 - 1.7) GeV.