In addition, a narrowing of the central line is observed with increasing temperature. It occurs most effectively in a sample with phosphorus concentration $N_D = 6 \times 10^{17} cm^{-3}$. As noted in [2], a similar effect is observed in germanium and can be due to the jumping of the electrons between atoms, a process occurring with phonons taking part.

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POSSIBLE CONNECTION BETWEEN K_2^0 DECAY AND STATISTICAL IRREVERSIBILITY

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Data on the decay of K_2^0 mesons into two pions offer evidence of lack of CP invariance and consequently of t-invariance in this process [1].

Attempts to explain this result without foregoing CP invariance as a whole are based on the assumed existence of external fields that cause the K_1^0 and K_2^0 particles to be superpositions of CP-even and CP-odd states [2]. The observed effect is then proportional to the external action (the proportionality coefficient is not anomalously large) which must therefore be sufficiently large.

We wish to call attention to another possible approach. Time-irreversible processes are common in macroscopic physics. However, in the physics of elementary particles there are no models or theories in which dissipative processes are involved. The most highly developed theory of this type - the statistically-hydrodynamic theory of multiple particle production in collisions between high-energy nucleons - is the Fermi-Landau theory, which does not discuss in explicit form the question of absence of t-reversibility. It is clear, however, that if there is a system of interacting particles or fields with a large number of degrees of freedom, then statistical theory is generally speaking applicable to such a system. The basic principles are the same here as in macroscopic physics. We can assume, for example, that there is always an arbitrarily weak external interaction which, by virtue of the complexity of the system, can give rise to a strong effect (increasing exponentially in time) [3]. The intensity of the external action is then multiplied by a very large factor, which increases exponentially in time with increasing complexity of the system, i.e., with increasing level density, with increasing number of degrees of freedom, etc. [4].

The physical cause of such an "amplification" of the external action, the origin of which becomes essentially immaterial, is the instability of the regular motion in the complex system against an infinitesimally small disturbance.

It is perfectly correct to assume that the decaying particle (in our case K_2^0) is itself a system with a large number of degrees of freedom, and that the statistical approach is applicable to its time evolution. We note that statistical notions concerning the internal properties of strange particles were already developed earlier by Sachs [5]. Of course, it is hardly possible to present at this time a quantitative theory based on such an assumption. We can make only several remarks.

Assume that at the initial instant of time (instant of formation of the K_2^0 meson) the state is characterized by a vector Φ, which can be represented in the form of a Fock column. We break up the Fock column arbitrarily into two parts Φ_1 and Φ_2 such that the occupation numbers are small in Φ_1 and large in Φ_2. 1) In order to apply statistical considerations to Φ_2 it is necessary that the time τ necessary to establish static equilibrium be low compared with the lifetime of the system $T \simeq 10^{-10} - 10^{-8}$ sec. The time of establishment of static equilibrium (which is proportional to the time of development of the instability) is assumed in the case of strong interaction at high energy (for example in the Fermi-Landau theory) to be $\tau = \hbar/m_\pi c^2\gamma$, where γ is the Lorentz factor of the colliding nucleons. At low energy $\gamma \to 1$ and $\tau \simeq 10^{-24}$ sec. For static equilibrium to be established between the lepton degrees of freedom it is apparently necessary to have a longer time. We can expect that the time is larger by the ratio of the cross sections of the strong and weak interactions 2): $\tau_1 \simeq \tau\sigma_{had}/\tau_{lep} \simeq 10^{-17}$ sec [2]. Both estimates lead to times that are considerably lower than the lifetime T, thus showing that the statistical approach can be used.

After development of the instability and thermalization of the system, the latter can no longer be described by a state vector. For its description we must use the density matrix ρ, which by virtue of the irreversibility of the process of its production is not proper for the CP operator. The question of the degree of violation of CP invariance and of the fraction of the $K_2^0 \to 2\pi$ decays depends on the further concretization of the scheme, for which several variants are possible.

The most attractive of them, from all points of view, is the following. Let the contributions Φ_1 and Φ_2 be of the same order, and let Φ_2 correspond to the lepton degrees of freedom. Then, after thermalization, we shall have maximum violation of CP invariance in lepton decays. It is shown in [6] that in this case the fraction of the expected $K_2^0 \to 2\pi$ decays agrees in order of magnitude with the observed value. The proposed variant can be regarded as a supplement to [6], in which the possible causes of violation of CP invariance in lepton decays are indicated.

We must, however, emphasize a difference of fundamental nature.

It was assumed in [2,6] that at the instant of the K_2^0 decay, the particle is described by a state vector which contains a CP-even admixture. As a result, the two-pion state obtained from the decay of the K_2^0 particle should interfere with the two-pion state from K_1^0. In our case it is possible that such an interference will not take place, since the decay into two pions is not from the pure state. At any rate, it should be smaller than in the case when both decays come from the pure state.

In conclusion it must be stated that the considerations advanced here were extensively discussed with E. L. Feinberg, M. I. Podgoretskii, V. I. Ogievetskii, A. M. Molchanov, D. A. Kirzhnits, I. M. Dremin, I. I. Roizen, and the entire staff of the Theoretical Division of the Physics Institute of the Academy of Sciences. The remarks made on this occasion were very

useful, for which the author expresses deep and sincere gratitude.

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1) We have in mind occupation numbers of both strongly interacting particles and leptons.

2) We can for example, in analogy with [5], estimate it in the following model: Φ_2 is the solution of the problem involving the behavior of many leptons in a potential well due to the self-consistent field. The dimensions of this well are governed by both strong and weak interactions, so that we can assume them to be $R \sim \hbar/m_{\pi}c$. The lepton interaction includes a short-range part, the radius of which is of the order of the length of the weak interaction $l \sim 10^{-17}$ cm, and the cross section is $\sigma_{lep} \sim 10^{-34}$ cm². These assumptions comprise a set of sufficient conditions for the development of instability and for the occurrence of time-irreversible processes. The relaxation time coincides in this case with τ_1 given in the text.

STEPWISE EXCITATION OF FLUORESCENCE OF $CaWO_4$ ACTIVATED WITH Er^{3+}

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Brown and Shand [1] reported that they obtained stepwise excitation of fluorescence of Er^{3+} in fluoride hosts. We observed an analogous effect in single-crystal $CaWO_4:Er^{3+}$. The crystals used in the experiment were grown by the Czochralski method, the concentration in the initial charge was 0.75%, and no special impurities were introduced to compensate for the excess charge. The samples were in the form of a parallelepiped measuring 17 x 4 x 7 mm. The exciting monochromatic beams were aimed on the crystals opposite to each other through the smaller faces. The radiation from the sample first passed through a filter absorbing the exciting light and was then registered with a FEU-27 photomultiplier.

The stepwise excitation of fluorescence at wavelengths near 543 nm was observed when the wavelength of one of the exciting beams was approximately 1.5 μ and corresponded to the region of infrared absorption of Er^{3+} in the $^4I_{15/2} \rightarrow {}^4I_{13/2}$ transition, while the wavelength of the second exciting beam corresponded to the 710 - 850 nm region. No fluorescence was excited by any of the beams separately, and the effect was observed only when the sample was simultaneously excited by both beams.

The scheme of the transitions responsible for the effect can be represented in the form shown in Fig. 1. Figures 2a and 2b show the dependence of the fluorescence intensity on the