proportional to T^2, which is clear from the following simple considerations. The free energy of a Fermi system always varies proportionally to the square of temperature and level density near the Fermi surface. The presence of the surface affects only the density of levels which can be represented as the sum of the volume and surface components. The surface tension coefficient, which is the surface part of the free energy, varies proportionally to the surface component of the level density and to the square of temperature.

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[1)] Strictly speaking, such a surface can have ridges separating circular parts and corners. A crystal can have a completely spherical shape if the condition $\alpha + \partial^2\alpha/\partial\varphi^2 > 0$ is obeyed along all directions.[1]

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Temperature dependence of the critical power of optical pumping of nonequilibrium superconductors

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The temperature dependence of the intensity of the optical radiation at which a superconductor undergoes a transition to a spatially inhomogeneous state is determined. The experimental results are compared with theoretical models predicting such a transition. It is found that only the theory of F. V. Elesin [Sov. Phys. JETP **44**, 780 (1976)] is in qualitative agreement with these results.

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1. It has been shown[1] that homogeneous laser illumination transforms a superconductor to a spatially inhomogeneous state. In the case of a homogeneous distribution of excitations, the resistance R of a superconducting film remains zero on increase in the excitation density n as long as $n<n_0$ (here, n_0 is the critical concentration of excitations for a transition to a homogeneous normal state). When n is increased to the value n_0, the film resistance should suddenly change to its full value in the normal state R_N.

The experimental results give a different picture: the resistance appears at some pump power W and rises smoothly to R_N on increase in W. The same result is reported by Sai-Halasz *et al.*[2] The power at which the resistance appears is known as the critical value W_c. We shall report an investigation of the temperature dependence of W_c.

2. We investigated Pb and V_3Si films prepared by vacuum evaporation on polished sapphire substrates. The film properties (thickness d, critical temperature T_c, and width of the superconducting transition ΔT_c) are listed in Table I.

Films of Pb were prepared by thermal evaporation from a tantalum boat. Samples of V_3Si were produced by electron-beam evaporation of the alloy V_3Si, pre-

TABLE I.

Film	d, Å	T_c, °K	ΔT_c, °K
Pb	1000	7.2	0.04
V_3Si	2500	16.4	0.6

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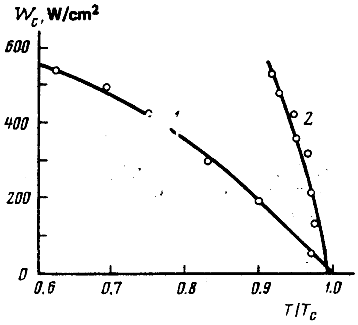

FIG. 1. Dependence of the critical power W_c for a transition to an inhomogeneous state on the reduced temperature T/T_c: 1) Pb; 2) V_3Si.

pared earlier. Measurements were made of the power at which a sample, kept at a given temperature T, exhibited a voltage drop under the action of a laser pulse. The critical power was deduced by extrapolation of the dependence of the voltage across the sample on the laser power to zero voltage. The measurements were carried out by the same method as that reported earlier.[3] Use was made of a GaAs semiconductor laser emitting photons of energy 1.4 eV in the form of 1 μsec pulses.

3. The results of the measurements are presented in Fig. 1. It is clear from this figure that an inhomogeneous state appeared in a wide range of temperatures right up to T_c and that the value of W_c increased on reduction in temperature. One should also point out that W_c of V_3Si was very much higher than W_c of Pb.

4. It has been shown in several theoretical papers[4-7] that, under certain conditions, a superconductor illuminated with laser light becomes unstable and undergoes a transition to a state with a spatially inhomogeneous distribution of excitations. This transition occurs when the average concentration of excitations in a sample reaches a certain critical value n_c. However, the experimental results do not give n_c but the associated quantity W_c. This makes it possible to carry out only a qualitative comparison of the experimental results with those given in Refs. 4 and 5, where the temperature dependence of the critical excess concentration $\Delta n = n_c - n_T$ is derived (n_T is the concentration of excitations in a superconductor in equilibrium at a temperature T).

Figure 2 shows the temperature dependences of Δn on T/T_c for Pb. Curve 1 is based on the results of Baru and Sukhanov,[4] and curve 2 on the results of Chang and Scalapino.[5] Use was made of the density of

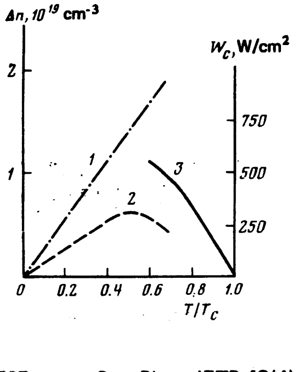

FIG. 2. Comparison of the experimental results on Pb with the theoretical predictions[4,5]: 1) dependence of Δn on T/T_c according to Baru and Sukhanov[4]; 2) dependence of Δn on T/T_c according to Chang and Scalapino[5]; 3) experimental dependence of W_c on T/T_c.

states on the Fermi surface $N(0) = 2.2 \times 10^{22}$ eV$^{-1}\cdot$cm^{-3} and of the energy gap $\Delta_0 = 1.4$ meV.

Equilibrium functions of the distribution of excitations are used in Refs. 4 and 5. If the temperature dependence of the quasiparticle recombination time τ_R is ignored (which is justified at high pump levels of the kind used in our experiments), the experimental value of the critical power can be described by $W_c \propto \Delta n_c$ with a temperature-independent coefficient of proportionality. Therefore, the experimental dependence $W_c(T)$ describes, apart from a scale factor, the experimental dependence $\Delta n_c(T)$. The temperature dependence W_c is included in Fig. 2 (curve 3).

It is clear from Fig. 2 that the temperature dependence of Δn, obtained by Baru and Sukhanov,[4] differs from the experimental dependence in respect of the sign of its first derivative. The dependence of Δn on T/T_c, obtained by Chang and Scalapino,[5] is nonmonotonic. In the temperature range of our measurements, the signs of the first derivatives are identical but curve 2 terminates at $T/T_c \approx 0.7$, i.e., according to the theory, an inhomogeneous state is only possible in the range $T/T_c \leqslant 0.7$, whereas the experiments indicate the existence of such a state right up to $T = T_c$. It should also be pointed out that the experimental results do not confirm the nonmonotonic nature of the dependence of Δn_c on T/T_c, obtained by Chang and Scalapino.[5] It follows from curve 2 that, at low temperatures, a spatially inhomogeneous state can be obtained at any pump rate, no matter how weak. In the experiments on Pb, we never reached temperatures corresponding to a change in the sign of the first derivative of the theoretical curve 2. However, in the experiments on V_3Si, when measurements were carried out in the reduced temperature range from 0.25 to 1, the laser power of 70 W was sufficient to convert V_3Si to an inhomogeneous state only for $T/T_c > 0.915$. No inhomogeneous state appeared at low reduced temperatures.

Elesin[6] used the nonequilibrium distribution function of excitations and predicted the instability of an illuminated superconductor resulting in a transition to a spatially inhomogeneous state at all temperatures $T/T_c < 1$. Moreover, according to his theory, the value of W_c should fall with rising temperature. An earlier paper by Elesin[7] can be used to obtain an analytic expression for the temperature dependence of the critical power in the range $T_c - T \ll T_c$. This expression is

$$W_c = A(1 - T/T_c).$$

Unfortunately, the considerable indeterminacy in the values of the various coefficients occurring in A does not permit a quantitative comparison. The experimental results give the following coefficients A:

$$A_{Pb} = 1.8\cdot 10^3\ \text{W/cm}^2,\quad A_{V_3Si} = 7.5\cdot 10^3\ \text{W/cm}^2.$$

It follows that the experiments are in qualitative agreement only with Elesin's theory.[7] A fuller comparison of experiment and theory requires better knowledge of all the coefficients occurring in the theoretical formulas.

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Erratum: Dipole magnetic interaction in plane Heisenberg magnetic substances [Sov. Phys. JETP 45, 291–294 (February 1977)]

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1. The renormalized correlator of the fluctuations in the magnetic field (accurate to terms $O(T^2)$ inclusive) is

$$G(k)=(k^2+R^{-1}Z^2k\sin^2\theta+hZ)^{-1}\ .$$

2. The equation of state takes the form

$$Z(R,h)=R^{-\Delta/(1-2\Delta)}F(hR^{(2-\Delta)/(1-2\Delta)})\ ,$$

where the function $F(x)$ is given implicitly by

$$\ln F=\Delta\int_0^\infty k\,dk\{[k(k^2+kF^2)^{1/2}]^{-1}-[(k^2+Fx)(k^2+Fx+kF^2)]^{-1/2}\}\ . \quad (1)$$

In weak fields, $x\ll 1$, the solution of (1) is

$$F(x)+\Delta x^{1/4}4\pi-{}^{1/2}\Gamma^2(3/4)\ .$$

The magnetic susceptibility is therefore $x\sim\Delta R^{1/2}h^{-3/4}$. The following formula is valid for arbitrary fields:

