take into account that at energies ~ 5 - 10 mev
the free betatron and synchrotron oscillations are
already sufficiently attenuated. This would be
the cheapest way of eliminating the transition energy.

*It is necessary to remark that for the calculation of
\( \alpha \), only that part of \( \Delta p / p \) is important which corre­
sponds to an oscillation of the momentum about some
equilibrium value. We denote it by \( \Delta p / p \) _synch_.

**By parametric resonance we mean one due to a
perturbation of the gradient \( \partial H / \partial r \); by an external
resonance, one due to a perturbation of the field \( H_0 \).

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Translated by M. Rosen

Relaxation Times \( T_1 \) and \( T_2 \) in Anthracite

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The authors were the first to measure the elec­
tronic para-magnetic resonance in anthracite (Ref. 1). It was found that the half-width of the
absorption line in anthracite is \( \Delta H = 0.7 \) oersted i.e., considerably smaller than in other types of
stone coals. The value \( \Delta H = 0.3 \) oersted was obtained for anthracite in Ref. 2. Probably the
half-width varies somewhat for the different kinds of
anthracite. Our last measurements on the
samples of Kuzbask anthracite for the frequencies
12.25 and 22 mc gave \( \Delta H = 0.5 \) oersted. We
wanted to determine for anthracite the time of spin­
lattice relaxation, \( T_1 \). For this purpose, with the
above mentioned frequencies, measurements of the
degree of saturation (Ref. 3) were made for
different amplitudes of the oscillating magnetic
field. The magnitude of the amplitude was deter­
mined with the method previously used in Ref. 4. The
method was checked on \( \alpha \)-diphenyl - \( \beta \) -
picrylhydrazyl, for which \( T_1 = 6.6 \times 10^8 \) sec; moreover, the parameter of the half-width \( T_2 \)
was taken equal to \( 6.0 \times 10^8 \) sec in correspondence
with the halfwidth of the line \( \Delta H = 0.95 \) oersted
found for the monocrystal of the above-named
free radical (Ref. 5). The magnitude of \( T_1 \) is in
good agreement with the researches of Refs.
3 and 6. For the Kuzbask anthracite sample the
time \( T_1 \) was equal to \( 12 \times 10^{-8} \) sec for the core
\( T_2 = 11.4 \times 10^{-8} \) sec.

The theory of paramagnetic resonance in sys­
tems with large exchange interaction (Ref. 5)
demands that \( T_1 = T_2 \); therefore, our result
confirms the presence of strong exchange in
anthracite, noted in Ref. 1.

In conclusion, we point out that for the tempera­
ture of liquid air, the relaxation time for anthra­
cite is somewhat longer, since the saturation
occurs for smaller amplitudes of the oscillating
field. This is in agreement with the concept that the
 carriers of paramagnetism in anthracite are
"broken bonds" between the carbon atoms.

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Translated by M. Polonsky

Concerning the Blatt, Butler, and Shafroth
Paper on Superfluidity and Superconductivity
Theory

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In a series of papers, Blatt, Butler and
Shafroth 1-6 concern themselves with the theory
of superfluidity and superconductivity, and come
forth with some far-reaching conclusions, with
which it is impossible to agree. Two points stand
out. 1-6 The first, associated with a consideration
of the superfluidity and superconductivity of an
ideal Bose gas in a vessel, has already been dis­
cussed, 7 and has only methodological significance.
The second essential point - the statement con­
cerning the finiteness of the correlation length \( \Lambda \)
for the momenta of a pair of particles in all real
systems, in contrast to an ideal Bose gas, is
incorrect. The momentum correlation coefficient
is introduced in such a way that it is not directly
The problem of the correlation length is not connected in any explicit way with the properties of the matrix density (a mixed representation of this matrix, the so-called quantum distribution function is actually used, see for example Ref. 3). In this connection, consideration of the matrix density

\[ \rho(r', r) = \int \psi^*(r', q) \psi(r, q) dq \]

(see Ref. 9) brings a greater clarity to the problem. Actually, for an isotropic body (liquid)

\[ \rho(r', r) = \rho(|r' - r|) \equiv \rho(R) \]

and in the usual liquids \( \rho(R \to \infty) \to 0 \). In this case the corresponding correlation length \( \Lambda' \) is finite (\( \Lambda' \) is the distance \( R \), beginning from which one can say that \( \rho = 0 \)). An infinite correlation length corresponds to the case where \( \rho(R \to \infty) = \rho(\infty) \neq 0 \), which occurs (at temperatures below the critical temperature) for an ideal Bose gas, and as follows from a series of considerations, for helium II also and for electrons in superconductors. In the case for which \( \rho(\infty) \neq 0 \), the Fourier-representation

\[ \rho(k) = \int \rho(R) e^{i\mathbf{k}\mathbf{R}} dR \]

contains a term \( w_0 \delta(k) \), which corresponds to the presence in the system of a number of particles not equal to zero, possessing momenta exactly equal to zero (we assume that the volume of the system \( V \to \infty \)). A difference of \( \rho(\infty) \) and \( w_0 \) from zero appears as that property of a degenerate ideal Bose-gas, which establishes its superfluidity and superconductivity in the sense as given in Refs. 1, 2, 7. Thus, the statements contained in Ref. 3 denote in essence that in real systems we always find \( \rho(\infty) = 0 \) or \( w_0 = 0 \). All the corresponding arguments of Ref. 3 reduce, however, to the observation that for very much larger systems it is improbable that there is present a correlation between particles at opposite ends of the system. However for any monocrystal, for example, there is a correlation between the particles independent of the dimensions so that the actual boundedness of the latter in the plane is clearly not essential; the same pertains to the “remote order” in ferromagnetics etc. Finally, it follows from Ref. 12, in a direct contradiction to Ref. 3, that the consideration weak interaction in a Bose-gas does not lead to the disappearance of \( \rho(k) \) of a term of the type \( w_0 \delta(k) \). Therefore, the existence of an analogous situation in helium II and in superconductors, although not strictly shown, is still quite possible and even almost certain (or, in any case, very probable). On the strength of what is shown above, the statement on the non-equilibrium character of the superfluidity of helium II is likewise clearly unfounded, not to mention the fact that such a representation encounters other serious objections. In Ref. 6, no basis or justification is made for, nor any changes brought about, from the basic work on the theory of superconductivity. Comparisons between theory and experiment do not change the conclusions, in particular observations concerning changes in the depth of penetration of the field are linked for (no discernible reason) to a change in frequency (see Refs. 13, 14; in these works, experiments interpreted from a different point of view do not agree with those of Ref. 6).


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