to the energies $E \ll E_{1/2} = mc^2(Rmc/\hbar)^{1/2} (\simeq 10^{15}$ ev for usual conditions) one can, with good reason, use classical concepts and consider only the statistical (quantum) character of radiation. For this purpose the following term should be added to Eq. (3):

$$W(R) - \sum_i \varepsilon_i \delta(t - t_i), \qquad (7)$$

where ϵ_i is the energy of a separate photon, emitted at the moment t_i, δ is the delta function. The physical meaning of the changes introduced in the motion because of the introduction of (7) into (3), was considered by us in Refs. 1 and 2. The solution of Eqs. (2), (7), (4) gives for the average square values of $\overline{\rho}^2_{bet}$ and $\overline{\rho}_M^2$ very similar expressions which also hold for the synchrotron (Refs. 5,6) and for the betatron (Refs. 1, 2).

$$\overline{\rho^2_{bet}} \leqslant \frac{55\sqrt{3}}{96} \frac{\Lambda}{Rn(1-n)} \left(\frac{E}{mc^2}\right)^2; \qquad (8)$$

$$\rho_M \leqslant \frac{55\sqrt{3}}{96} \frac{\Lambda}{R(1-n)(3-4n)} \left(\frac{E}{mc^2}\right)^2,$$

where $\Lambda = \hbar / \nu c$ is the Compton wavelength.

The expression for $\overline{\rho}^2_{bet}$ was found also by a different, more complicated, method in the works of Sokolov and Ternov.[7] However, since they did not consider the damping (6), their results are erroneous.

It is interesting to follow the mechanism of damping, z_{bet}, in more detail for the case when the statistical character of losses is taken into consideration. At the time of emission of the i th quantum, a vertical recoil force acts on the electron

$$(d/dt)(m\dot{z}) = (\varepsilon_i/c^2)\dot{z}\delta(t - t_i)$$

(we omit quasi-elastic forces). On the other hand, $(d/dt)(m\dot{z}) = \dot{z}\dot{m} + m\ddot{z}$. The change of mass can be broken up into two parts: loss of energy during the radiation, and its receipt from the accelerating field

$$\dot{m} = -(\varepsilon_i/c^2)\delta(t - t_i) + \dot{m}_{accel}$$

$$\dot{m}_{accel} = \frac{1}{c^2}(W + e\dot{H}_0 R).$$

It is not difficult to see that the increase of the oscillation amplitude at the expense of the mass at the time of radiation is fully compensated by the radiation friction. Consequently only the increase of the mass m_{accel} influences the amplitude of the betatron oscillations. This increase is due to the compensating field. From this, there immediately follows an equation of the type (6).

*Here we generalize our result from Refs. 1,2.

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Superconductivity of Barides, Carbides, Nitrides and Silicides of Transition Metals

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DORFMAN and Kikoin[1] concerned themselves with the interesting fact that the transition point to the superconducting state increases in the series TiB —TiC—TiN; the same increase was noted in the series VC—VN and ZrB—Zr—C—ZrN.

The data available in the literature on the transition temperatures of similar compounds are given in Refs. 2 – 4. In spite of the wide spread of the transition points obtained by different investigators, one can make the following preliminary observations. The value of T_k is connected with the electron density distribution, i.e., it depends on the acceptor capability of the atom of the transition metal 1 / Nn[5] and of the ionization potential of the non metal (φ). *

In titanium compounds, the transition points are very low, and although some increase of T_k probably takes place in the series TiB_2 — TiC—TiN, i.e., with increase in the ionization potential of the metalloid, the probabilities of realization of high acceptor probability of the 3d-level of Ti are lessened. This appears more clearly for the compounds of Zr. A significant increase in the transition points takes place for compounds of Ta and Nb, but not of V, although all these elements belong to the subgroup Va. There is a high scattering capacity in vanadium, yielding only to Ti and Zr, which also brings about a lowering of the transition point.

In compounds of Nb and Ta, there is evidently a very favorable relation of the value of 1 /Nn of the metal and φ of the metalloid; therefore in the series Me (V) B → Me (V) C → Me (V) N there is a more clearly expressed rise in T_k ; moreover, the transition points are high in absolute value.

For a transition to compounds of W and Mo, the values of T_k are much higher than for compounds of Ti, Zr, Hf and V, but lower than for compounds of Nb and Ta; this is possible as a consequence of the increase of screening of the d–band of these metals by the natural excitations of the electrons,[6] which makes difficult the excitation of the valence electrons of the metalloid. In each case, it is characteristic that the sharp decrease in the number 1 / Nn from 0.167 – 0.100 for Ti, Zr, V, Hf to 0.5 – 0.67 for Ta, Nb, W and Mo_+, is accompanied by such a sharp increase in the value of T_k.

It should also be noted that in a number of cases the value T_k increases with increase in the metallic content, for example, for Nb_2N, $T_k = 9.5°$ K, but for NbN, $T_k = 15°$ K, Mo_2C, $T_k = 2.9°$ K, and for MoC — $8°$ K, for Mo_2N, $T_k = 5°$ K, for MoN — $12°$ K, for W_2C, $T_k = 2.74°$ K, for WC, 2.5 — 4.21 ° K.

The relatively lower transition values for all borides in comparison with carbides and nitrides are probably explained by the presence of strong covalent bonds between the boron atoms , which leads to the formation of the characteristic structure of the elements — little chains, lattices, shells of boron atoms in boride crystals.[7] In this connection, the fraction of electrons capable of completing the electron deficiency of the atoms of the transition metals is not large and T_k is correspondingly decreased.

Actually, in the case of all metallic compounds, especially Nb, Ta, W and Mo, the increase of T_k in the transition from Me — B to Me — C, is, as a rule, much sharper than for the transition from Me — C to Me — N. Therefore the borides are essentially different from the carbides and nitrides. The latter are close to each other in values of T_k, but the smaller ionization potential of carbon in comparison with nitrogen enhances the effect of the increase of T_k in series MeB — MeC — MeN, especially for compounds of the transition metals with low electron deficiencies. Compounds of silicon, which have still lower ionization potentials than boron ought, from this point of view, to possess still lower transition temperatures, i.e., there ought to be the series: MeSi → MeB → MeC → MeN, which actually takes place in most cases, with the exception of some silicides (V_3Si, TaSi, W_sSi_2) whose superconductivity is related chiefly to purely structured factors, for example, in V_3Si, which has the structure β — W).

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*N is the principal quantum number, n is the number of electrons of the incomplete d-level.

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Production of Nuclear Stars by γ-Quanta

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IN this article is investigated that particular mechanism of the production of nuclear stars by γ- quanta in which the γ-quantum creates a virtual π-meson pair at a large distance from a nucleus. This pair is thereupon absorbed by this nucleus and a star is produced. All considerations are conducted in the region of high energies $\omega >> \mu$* (where ω is the frequency of the quantum, μ is the meson rest mass).

In Ref. 1 there was considered a process in which only one member of the pion pair created by the γ-quantum is absorbed by that nucleus, creating a star, and the remaining pion carried away an energy of the order of the total energy of the star. The method used in the calculation of this process, we also use in the present case, i.e., the cross section can be found with the help of the matrix element of the radiative transition for which a form of the ψ-function describing the absorbed meson was determined in Ref. 1.