the current with increasing equilibrium phase. When the latter increased from the usual values 35–45° to 85–90°, the current increased to 6–10 A. However, the preliminary bunching necessary to obtain indifferent equilibrium is quite difficult to accomplish. In addition, the increased equilibrium phase shifts can be allowed only in limited regions of the accelerator.

An accelerator was therefore considered with an equilibrium phase shift equal to 85–90° at the beginning and then decreasing gradually. The investigation has shown that the admissible decrease of the equilibrium phase shifts along the accelerator is limited from below by a certain limiting curve. In the case of injection of the continuous beam, other accelerator parameters remaining the same, the proton currents do not exceed 1 A. Preliminary bunching into constant-density bunches makes it possible to increase the currents attainable in the considered examples to 3 A. The attainment of such currents is perfectly realistic.

G. V. Voskresenskiĭ and V. N. Kurdyumov. Radiative Losses of Electron Rings in Inhomogeneous Structures

The calculation of radiative losses accompanying the motion of electron rings in inhomogeneous structures, for example when passing through junctions of waveguides with different cross sections, resonators of the accelerating system, etc., is of interest in connection with the development of the collective method of ion acceleration. In practice, the most important aspect of this calculation is a clarification of the dependence of the total loss to radiation on the kinetic energy of the source. However, the sought equation for the losses turns out to be different and to depend essentially on the model assumptions used by the different authors. The present paper considers critically certain models which make it possible to obtain an approximate estimate of the losses: 1) excitation of a completely closed resonator [1,2]; 2) geometrical-optics calculation[3]; 3) the Lawson diffraction model[4]; 4) calculation in the Kirchhoff approximation[5]. The shortcomings inherent in approximate calculation methods require a rigorous electrodynamic calculation of the radiation in a single resonator with connecting waveguides. The paper presents the results of a solution of the electrodynamic boundary-value problem for such a region. The problem, reduced to an infinite system of linear algebraic equations for the coefficients of excitation of the eigenwaves in the connecting waveguides, is solved by numerical methods. The spectral distribution of the losses is calculated. The solution is different qualitatively in different frequency regions. In the low-frequency band there is excited a denumerable number of discrete harmonics, analogous to the modes of a closed cavity. In the region of high frequencies, a continuous radiation spectrum is generated. The spectrum broadens with increasing source energy, leading to a linear dependence of the loss on the energy for ultrarelativistic electron rings. The rapid growth of the losses with the energy imposes stringent requirements on the choice of the accelerating system for high-energy electron-ring accelerators.

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M. G. Nikulin. Dynamic Stabilization of Plasma Pinches

The paper considers different schemes for high-frequency dynamic stabilization of a current-carrying plasma pinch against long-wave flexural perturbations. The flexural instability of the pinch with direct current, in the absence of an external longitudinal field, can be suppressed, as is well known, by a well-conducting jacket located close enough to the surface of the pinch. In systems with large degrees of plasma compression, where this stabilization method is not effective, and also in systems without a conducting jacket, the suppression of long-wave deflections of the pinch can be realized by means of the standing or rotating high-frequency quadrupole magnetic field. To stabilize a pinch with alternating current, one can use either a constant or a high-frequency quadrupole field.

In systems with an external longitudinal field, the changeover from a direct current to a high-frequency alternating current makes it possible to weaken greatly the limitation imposed on the value of the current by the condition that the pinch be stable against long-wave helical perturbations. Consequently, an alternating longitudinal current in conjunction with a transverse high-frequency magnetic field can be used for equilibrium containment of an annular θ pinch, and in conjunction with a conducting jacket or a quadrupole magnetic field that adds an additional margin of stability to the plasma pinch against long-wave perturbations, it is possible to suppress the unstable Shafranov-Kruskal mode of a pinch with direct current or the unstable Haas-Wesson mode of a corrugated θ pinch.

The paper also considers the effect of parametric buildup of natural oscillations of the plasma pinch under the influence of high-frequency magnetic fields. Possible methods of eliminating this effect are considered.

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On 26 March 1970 there was held in the conference hall of the Physics Institute of the USSR Academy of Sciences a scientific session of the Division of General Physics and Astronomy of the USSR Academy of Sciences, jointly with the Scientific Council on Solid-state Physics of the USSR Academy of Sciences. The following papers were delivered:

1. S. V. Vonsovskiĭ, Lenin's Theory of Learning and Modern Physics.
2. A. F. Andreev and I. M. Lifshitz, Quantum Theory of Defects in Crystals.
3. P. A. Rebinder and E. D. Shchukin, Physical-Chemical Phenomena in Processes of Deformation, Failure, and Working of Solids.
4. B. K. Vaĭnshteĭn, V. I. Simonov, and D. M. Kheĭker, The Project "Aroks" (Automatic X-ray Determination of Crystal Structures).
5. Kh. S. Bagdasarov and V. Ya. Khaimov-Mal'kov, New Methods and Results of Synthesis of High-Melting-Point Single Crystals.
6. E. A. Turov, Certain Problems in the Contemporary Theory of Magnetism.
7. S. A. Al'tshuler, Electron-Nuclear Magnetic Resonance.

We publish below brief contents of the delivered papers.

S. V. Vonsovskii, Lenin's Theory of Learning and Modern Physics.

The content of the paper was published in the April (Jubilee) No. 4 of v. 29 of the Journal "Physics of Metals and Metallography" in 1970.

A. F. Andreev and I. M. Lifshitz. Quantum Theory of Defects in Crystals

At sufficiently low temperatures, localized defects or vacancies are transformed into excitations that move practically freely through the crystal. As a result, instead of ordinary diffusion of the defects, there arises a flow of a "fluid" consisting of "defectons" and vacancions." It is shown that at absolute zero, in crystals with large amplitude of zero-point oscillations (for example, such as solid helium), there can exist zero-point defectons, as a result of which the number of sites of the ideal crystal lattice may not coincide with the number of atoms. The thermodynamic and acoustic properties of crystals with zero-point defectons are discussed. Such a crystal is neither a solid nor a liquid. Two types of motion are possible in it—one has the properties of motion in an elastic solid and the other in a liquid. Under certain conditions the "liquid" type of motion of the crystal has the property of superfluidity. Analogous effects should be observed also in quasi-equilibrium states with a given number of defectons.

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P. A. Rebinder and E. D. Shchukin, Physico-chemical Phenomena in Processes of Deformation, Failure and Working of Solids

The paper reports results of a study of the main laws and physical nature of the influence of surface-active media on the strength and deformability of solids.

Effects whereby the processes of deformation and failure and facilitated as a result of a reversible physico-chemical influence of the medium, to the extent that the strength of the body decreases by many times and the body becomes very brittle, have been established by now for all types of solids—crystalline and amorphous, continuous and porous, with metallic, covalent, or ionic molecular structures. The common nature of these phenomena is that the breaking and realignment of the interatomic bonds becomes facilitated in the presence of definite foreign atoms or molecules (having a sufficient mobility to ensure their penetration into the bond-breaking zone), and can be described as a decrease of the work of formation of new surfaces during the course of the deformation and rupture, i.e., as a lowering of the free surface energy of the solid under the influence of the surrounding medium.

A comparison of the theoretical estimates and of the direct experimental determination of the magnitude of lowering of the surface energy of solids and of the observed effects of decreased strength under the influence of the medium reveals a rigorous correlation in all cases when these effects become manifest: for solid metals (and also for some covalent crystals), in contact with liquid metals, for ionic crystals in the presence of molten salts, water, alcohols, and other polar media, and for molecular crystals or organic compounds in contact with non-polar and low-polarity organic liquids.

The main condition under which a medium has a strong influence on the mechanical properties of a body (in the considered cases of reversible adsorption interaction not connected with solution, corrosion, and other chemical processes) is that the solid be genetically related to the medium; this relation causes the low values of the surface energy on the boundary between the solid and liquid phases. At the same time, the form and degree of the manifestation of these effects depend in a complicated manner on the real structure of the body (defects) and on the deformation conditions—stresses, temperature, rate of deformation, contact time, etc. The optimal combination of these factors makes it possible to use the influence of the medium to facilitate the processes of dispersion and working, especially of hard and difficult-to-work materials. To the contrary, the elimination of the individual factors needed for the manifestation of absorptive lowering of the strength uncovers ways of protection against the influence of the medium.

The main data included in the paper were published by the authors and co-workers in 1967—1970 in a number of communications in Doklady AN SSSR. See also the review by N. V. Pertsov and E. D. Shchukin in the Journal Fizika i khimiya obrabotki materialov (Physics and Chemistry of Material Working) No. 2 (1970).