tude of the microwave absorption jumps. Nor is this effect influenced by application of an alternating current of frequency 10^2 - 10^5 Hz, E ∿ 10^4 V/cm.

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FOCUSING OF ION BEAMS BY A PLASMA LENS

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The idea of using axially-symmetrical space-charge shapes for the focusing of charged particles was advanced earlier (cf., e.g., [1, 2]). It was shown theoretically recently [3] that stationary axially-symmetrical plasma formation with closed electron drift in an external electromagnetic field act as focusing systems with respect to ion or plasma beams passing through them. This uncovers the possibility of developing a new type of corpuscular optics - plasma optics. Lenses of such optical systems - plasma lenses - on top of having a refractive power several orders of magnitude higher than that of an ordinary electrostatic or electromagnetic lens, should theoretically have no limitations with respect to the intensity and density of the focused beam, up to very high values of these quantities. Such a fortunate combination of the properties is due to the fact that in these systems the magnetic-induction lines are transformed into equipotentials of the focusing electric field within the volume of the plasma. The focal distance of a "short" lens of this type, made up of a stationary axially-symmetrical plasma in the vicinity of a metallic ring carrying a current I and having a potential +U relative to the ion source and collector, was later calculated [4] to be

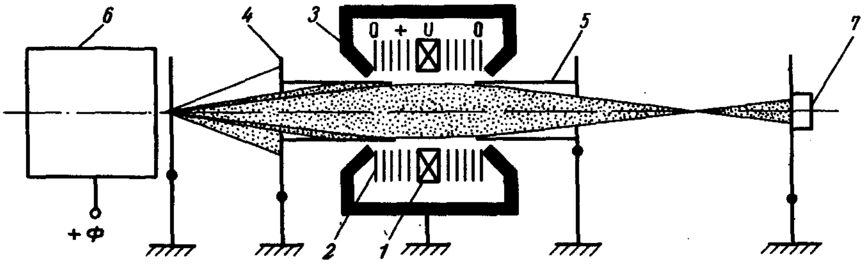
$$f = \frac{\Phi}{2U} R \frac{1}{\theta} , \qquad (1)$$

where R - radius of ring, Φ - potential difference accelerating the ions, and θ ∿ 1 depends on the geometric features of the system.

Putting θ = 1 and denoting by f_E and f_H respectively the focal distances of the purely electrostatic and electromagnetic lenses formed by the same ring, we can readily verify that $f/f_E \approx 3.7 \times 10^{-2}\, U/\Phi$ and $f/f_H \approx 2.8 \times 10^{-6} I^2/MU$ if the potentials are in volts, the current in amperes, and the mass M of the focused ions in atomic mass units. For example, for singly-charged argon ions ($M = 40$) at $\Phi = 10^4$ V, $U = 10^3$ V, and $I = 10^3$ A the focal distance of the plasma lens turns out to be smaller by two orders of magnitude than that of an electrostatic lens and four orders smaller than that of a magnetic lens, other conditions being equal.

Figure 1 shows schematically the setup for an experimental investigation of a plasma-lens model (1 - 5), where 1 - cross section of ring with current I and potential +U; 2 - sections of thin metallic rings on which the potential is linearly distributed in the range 0 - U; 3, 4, 5

Fig. 1



- respectively the cross sections of the iron housing of the lens and of the two electronic compensator with secondary electron emission produced by ion bombardment of their internal surface; 6 and 7 - ion source and collector. The collector was equipped with a pickup for the measurement of the current density distribution over the cross section of the beam, and could be moved to permit location of the narrowest beam section (focus). The shaded area is the section of the ion beam on emerging from the source, inside the lens, and on leaving the lens. The more heavily shaded region is the conical zone of the beam, used to obtain the compensating secondary electrons needed to porduce the plasma when focusing ion beams.

The experiments were performed at ion-beam currents 0.5 - 15 mA at the lens input and at vacuum-chamber pressures ∿ 1 x 10^{-5} mm Hg. In all cases, a focused ion beam was observed at the output of the lens, the focus of which was a magnified, reduced, or equal-size image of the ion-beam crossover at the source output, depending on the distance between the crossover and the lens, other conditions being equal. Figure 2 shows the measured focal distance f_m and the one calculated from formula (1) f_c of the plasma lens as a function of the ion-accelerating potential difference, for the entire range of values of Φ. This demonstrates the good agreement with the theory. In all cases the potentials on ring 1 were U = 0.5 - 1.2 kV, depending on the value of Φ, and the currents were equal to 50 - 100 A, with 12 turns in the ring. When one of the fields (electric or magnetic) was turned off, the plasma focusing immediately disappeared. It was also noted that when the rays of the ion beam ceased to be paraxial, a spherical-aberration effect was observed in the form of a halo having a low ion-current density in the focal region. However, the spherical aberration decreased appreciably when the potential distribution on the rings 2 was properly chosen.

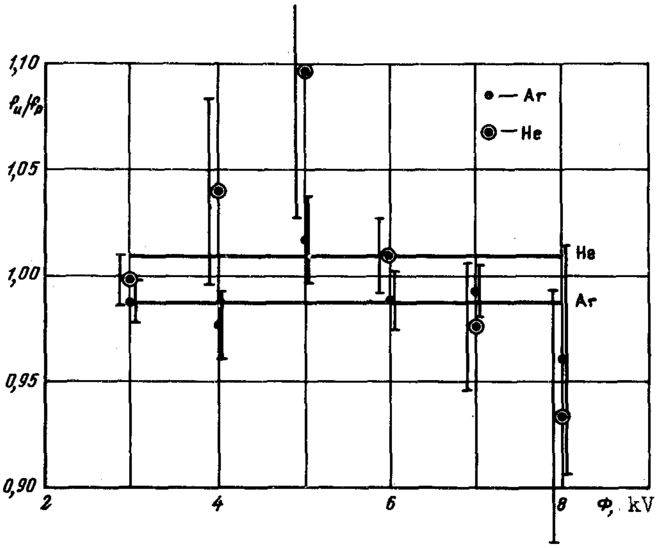


Fig.2

We have thus shown that plasma focusing is actually realized in a very simple system with closed electron drift, in good agreement with the theory, and results in a higher refractive index than that provided by electrostatic or magnetic lenses.

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SUPERCONDUCTIVITY OF ALLOYS OF THE SYSTEM Nb_3Al-Nb_3Ge

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We have reported earlier [1 - 4] that an investigation of the Nb_3Al-Nb_3Ge system revealed a maximum on the plot of T_c against the composition; this maximum was located near the composition $(Nb_3Al)_4Nb_3Ge_2$, and its magnitude was greatly increased by heat treatment.

We performed additional investigations of the properties of these alloys and of the influence of heat treatment on T_c.

For the heat treatment, the samples were placed in a quartz tube which was evacuated, filled with helium gas, and sealed. A quartz ampoule with the samples was placed in an oven, and was rapidly immersed in water at T = 0°C after the end of the annealing. To determine the optimal heat-treatment regime, the annealing was performed at different temperatures and at different lengths of time (Figs. 1 and 2).

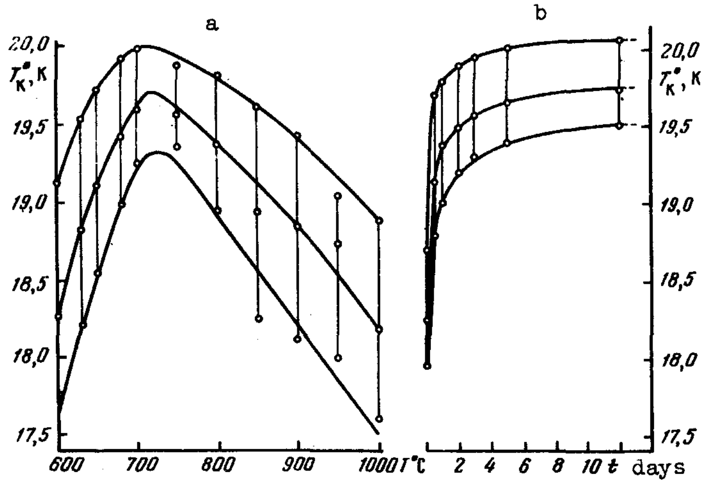

Fig. 1 a - Dependence of T_c on the heat-treatment temperature. The vertical lines characterize the width of the transition. b - Dependence of T_c on the heat-treatment time at T = 700°C. The vertical lines charectarize the width of the transition.

Figure 2 shows the change of the resistance in the transition region, for one of the metal-ceramic samples subjected to optimal heat treatment.

By measuring the resistance of the sample as a function of the magnetic field at different temperatures it is possible to plot the temperature dependence of the critical field. The value of $\partial H_c/\partial T$ for values of T close to T_c turns out to be in this case 30 kOe/°K. If we estimate H_c at T = 0°K assuming that $H_c = H_{c0}[1 - (T/T_c)^{3/2}]$, then H_{c0} should amount to 380 kOe.

An investigation of the transition curve obtained for a bulky sample (in the form of an irregular cylinder of height usually 7 mm and diameter 4 - 5 mm) and for powder prepared from this cylinder has shown that the transition curve of the powder is shifted towards lower temperatures and is strongly elongated compared with the curve of the bulky sample, and when the