voltage. At V = 58 V, the amplitude of the oscillations is 33 V. At V = 60 V, pre-breakdown noise appears. Attention should be called to the high efficiency of the conversion of the dc energy into ac energy in both frequency modes, reaching 16% in the second mode.

Figure a shows the oscillations observed in the D2 diode at V = 23 V, and figure b shows the second mode of the oscillations of diode D5 at V = 54 V.

The oscillations are quite sensitive to changes of the temperature. Thus, an increase of the pulse repetition frequency to 200 pulses/sec, which leads to an increase in power dissipated by the sample, changes noticeably the dynamics of the oscillations in both types of diodes.

If the oscillations described by us have the same nature as those observed in [1], then their appearance can apparently not be attributed to the occurrence of some type of "slow domains" [5,6].

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PRODUCTION OF A HIGH TEMPERATURE DENSE PLASMA BY GAS BREAKDOWN WITH THE AID OF A LASER

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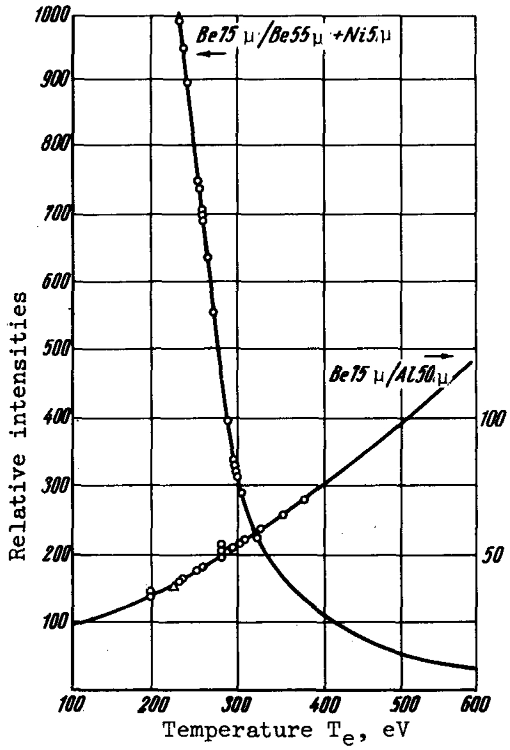
The production of a high-temperature dense plasma by means of lasers has recently been the subject of ever increasing efforts of scientists in a number of laboratories. The use for this purpose of the breakdown produced by focusing large-power coherent optical radiation is one of the most promising methods of obtaining a hot plasma with the aid of lasers [1-3]. Further increase of the radiation power of Q-switched lasers will make it possible to advance further towards obtaining uncontaminated plasma at thermonuclear temperatures, in spite of many difficulties involved in this method, connected with the dynamics of the development of the laser "spark" [4-6].

We present here the results of an experiment on the measurement of the temperature of the plasma of the "spark" in air and in a mixture of air with deuterium, in the pressure interval 70 - 160 mm Hg. The spark was produced by focusing the radiation of a neodymium-glass laser. The schematic diagram of the experiment is similar to that used in [3]. A three-stage laser, using KGSS-3 neodymium-glass rods of 45 mm diameter, with each element 260 mm long, produced in the giant pulse a power on the order of 6 GW at a pulse duration ~20 nsec. The Q-switch was a phototropic shutter based on liquid filter No. 2535. The laser output beam was focused inside a working chamber filled with the investigated gas. The focusing was either by a weakly paraboloidal lens of TK-16 glass, with F = 120 mm and relative aperture 1:2, or by an aberrationless three-element lens with F = 60 mm and relative aperture 1:0.9, designed for the laser wavelength $\lambda = 1.06\ \mu$.

The temperature of the plasma produced by the breakdown was determined from the relative intensity of the x-radiation passing through Be, Al, and Ni foils of different thicknesses [2,3,7]. The x-radiation was recorded by two plastic scintillators made of polystyrene to which n-terphenyl and POPOP were added, coupled to two FEU-36 photomultipliers. The photomultiplier output signals were amplified and fed to the inputs of a two-beam oscilloscope of the DESO-1 type. The oscilloscope was triggered by the laser-emission pulse detected by a type FEK-09 photocell, thus ensuring good time discrimination against parasitic signals and noise pulses of the photomultiplier current. The scintillators with the foils were located 42 mm away from the "spark" and had effective areas $S_1 = 0.84\ cm^2$ and $S_2 = 0.184\ cm^2$.

The theoretical plasma temperature dependence of the ratio of the signals in the two channels was calculated (without account of the geometric factor) for the following working combinations of the foils: 1. Channel I - beryllium foil 75 μ thick, channel II - aluminum foil 50 μ thick. 2. Channel I - beryllium foil 75 μ thick, channel II - beryllium foil 55 μ thick together with a nickel foil 5.6 μ thick. The corresponding theoretical curves are shown in the figure. The relative sensitivity of the channels (including the sensitivity of the scintillators, the photomultipliers, the overall gain in channels, and also the geometric factor) was calibrated against the x-ray signal from the laser spark in air when both scintillators were covered with identical beryllium foils 75 μ thick.



Experimental results of the measurements of the electron temperature T_e of a laser spark in air and in a mixture of air with deuterium. □ - theoretical curves, o - experimental points for air at p = 80 mm Hg, Δ - experimental points for a mixture of air at 70 mm Hg + deuterium at 100 mm Hg.

The measured ratio of the signals for air at 80 mm Hg and for the mixture of air at 70 mm Hg and deuterium at 100 mm Hg is shown in the figure.

The abscissas of the experimental points obtained in several measurement runs gives the value of the electron temperature of the plasma obtained in each "shot" of the laser. The considerable scatter in the value of T_e is due to the insufficiently high reproducibility of the parameters of the output laser pulse and of the breakdown character.

As seen from the character of the theoretical curve in the figure, the use of the Be-Al foil pair does not yield a sufficiently high measurement accuracy in the given temperature interval. This is connected with the presence of the K absorption edge for aluminum at $\lambda = 7.95$ Å, making the absorption coefficient in the aluminum foil approximately equal in the wavelength intervals 3 - 8 and 8 - 15 Å. The measurements were therefore made also with another pair of foils, Be - (Be, Ni). Such a foil combination eliminated the aforementioned shortcoming at temperatures above 100 eV, and the very strong dependence of the signal ratio in the two channels on T_e ensured sufficiently high accuracy of measurement of T_e in each "shot."

As shown by the arrangement of the experimental points in the figure, it is possible to obtain quite reliably, using the aforementioned laser parameters, plasma with $N_1 = 10^{19}$ cm^{-3}, $N_e = 5 \times 10^{19}$ cm^{-3}, and $T_e = 300$ eV $\simeq 3.5 \times 10^6$ °K. This raises hopes that thermonuclear reactions will be observed in the near future in a plasma produced with the aid of lasers.

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EXPERIMENTAL OBSERVATION OF SCATTERING OF LIGHT BY LIGHT IN A SOLID, ACCOMPANIED BY A CHANGE IN FREQUENCY

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The scattering of light by light in a solid is connected, in the phenomenological treatment, with the optical nonlinearity of the medium. In view of the far-reaching analogy between the electron-positron vacuum, on the one hand, and the electron-hole structure of the "vacuum" of a solid on the other, there exists an equally close connection, as shown in [1], between the scattering of light by light in vacuum [2] and in a solid when the latter is described at the microscopic level of the electronic processes. In this language, the process of scattering of light by light is connected with the virtual production of electron-positron or respectively electron-hole pairs by the two colliding photons, followed by their "annihilation," which is accompanied by emission of two photons. The directions and magnitudes of the quanta of all four photons are related by the energy and momentum conservation laws. In vacuum, the photon-photon scattering cross section at energies $\hbar\omega$ on the order of the electron, i.e., m_0c^2, amounts to 10^{-30} cm^2, and $\sigma \sim \omega^6$ when $m_0c^2 \gg \hbar\omega$. Consequently, in the wavelength region of visible light ($\hbar\omega \sim 1$ eV) the cross section is negligibly small ($\sigma \sim 10^{-66}$ cm^2), and on the other hand, owing to the lack of sufficiently powerful gamma sources, a cross section $\sigma \sim 10^{-30}$ cm^2 turns out to be very small to be able to observe this effect