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1) We use the asymptotic formula

$$T = \pi/2H\sqrt{\rho/\rho_c} \ ; \quad \rho_c = 3H^2/8\pi\sigma \ ; \quad \rho = 3\pi/32\sigma T^2.$$

Other more complicated estimates based on an investigation of remote objects give a similar result:

$$q_0 = \rho/2\rho_c < 2.5; \quad H \leq 120 \text{ km/sec.Mparsec},$$

$$\rho_c \leq 2.5 \times 10^{-29} \text{ g/cm}^3, \quad \rho < 1.25 \times 10^{-28} \text{ g/cm}^3.$$

EXCITATION OF SIGNALS IN A NEGATIVELY CHARGED POST OF AN ANTENNA UNDER THE INFLUENCE OF AN UNFOCUSED LASER BEAM

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In this article we describe the results of an investigation of current pulses produced when an unfocused laser beam strikes a metallic electrode or a post that serves as an antenna, on which a negative potential is applied.

An ordinary Q-switched ruby laser was used, whose beam was aimed onto an antenna post located several meters away and under a negative voltage $U \approx 0 - 3$ kV. The antenna post was connected to the ground through a capacitor of $\approx 10^4$ pF (to block the dc current) and through a resistor of ≈ 100 ohms (to pick off the pulse). The pulse from the resistor was fed through a capacitance ($C \simeq 10^4$ pF) and amplifiers (UR-3 and UR-4) to an oscilloscope (S1-10).

Fig. 1

Figure 1 (0.3 μsec sweep) shows the characteristic pulse produced by the laser beam. The pulse duration is ~50 nsec, commensurate with the duration of the laser flash.

Figure 2 shows the dependence of the pulse amplitude on the potential applied to the antenna. An unfocused laser beam of 1 cm diameter was incident on the central part of an antenna post 10 cm long of 1.5 and 6 mm diameter.

At first the magnitude of the pulse ϵ was approximately proportional to the voltage applied to the antenna ($\epsilon/U \sim (1 - 2)$ mV/kV $\sim 10^{-6}$); at $U \gtrsim 1$ kV, the magnitude of the signal increased sharply with increasing voltage. No noticeable signals were registered at zero and positive potentials.

The mechanism of the observed pulses can be connected with the current produced when the electrons knocked out by the laser radiation are removed from the post. According to the Ramo-Shockley theorem, this current is

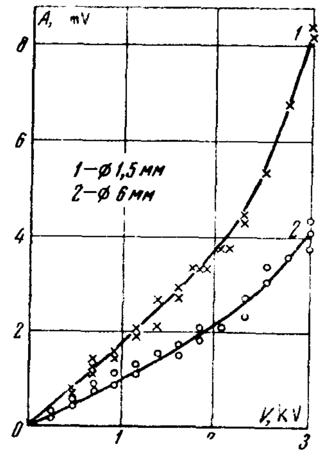

Fig. 2

$$I \simeq \frac{NeVE}{U} \simeq \frac{NekE^2}{U},$$

where N is the number of produced electrons, k the mobility, e the fringing field at the surface of the post, and U the post potential. Since near the post but far from its ends we have $E_a \simeq V/a \ln (A/a)$, where a is the radius of the post ($E \simeq 2\gamma_1/\rho$ and $U \simeq 2\gamma_1 \ln (A/a)$), we have $I \simeq NekU/a^2 \ln^2(A/a)$.

The production of free electrons may be connected with the photoeffect from the oxidized surface (if the surface is clean, the laser quantum energy is insufficient to produce the photoeffect), with the heating of the electrons on the surface of the metal upon absorption of the laser light, with a burst of photoelectric field emission, or with a cascade.

If the electric field is not too strong and merely removes electrons from the surface, but does not influence the efficiency of their production, then the magnitude of the current pulse should be proportional to NkE at not very low voltages in the saturation mode (if we neglect the weak k(E) dependence, then $I \sim NE$).

If for a given light intensity N depends only on the illuminated area of the antenna, then $N \sim a$ and $A \sim kU/a \ln^2(A/a)$.

If the role of the light were to consist of facilitating the cold emission under the influence of the field, or if cascade multiplication of the electrons in the gas at the post were to take place, then the I(U) dependence should be much stronger. It is possible that some of the foregoing processes are responsible for the intensification of the I(U) dependence at sufficiently large field intensities.

When the gas pressure around the antenna decreases, the electron mobility increases and the voltage needed to remove the electrons can be small.

The described effect can be used for remote excitation of receiving and transmitting antennas with the aid of a guided laser beam, to register and measure laser radiation power, etc.