3. Acceleration of particles in a breakdown leader. It is possible to accelerate particles by directional breakdown in a gas. Let us assume that a group of fast charged particles passing through a gas with an electric field close to breakdown value produces an ionized channel, in which the breakdown of the medium begins. Conditions can be realized under which the particles initiating the breakdown will be situated for a long time in the edge field of the breakdown cascade leader. Such a method of acceleration, in devices similar to spark chambers, can apparently be effective for particles which are first accelerated to velocities at which the dissipations of the directed velocities are small, but which do not differ greatly from the velocity of propagation of the breakdown through the ionized channel.

The quadratic dependence of the accelerating force on the field intensity in the first two variants in question, and the possibility of modification of the field of the point by the properties of the gas in the third variant, make it possible to make multiple use of alternating electrodes of one high-voltage source for through-acceleration. The acceleration mode is by its nature pulsed, since nonstationary processes are used.

We note that the described acceleration mechanism can appear when electric fields are used to draw out ions from a concentrated pulse-produced plasma. It is quite possible that this mechanism plays an essential role in the observed[2,3] effect of appearance of fast ions on application of an electric field to a plasma of a hot vacuum spark. The efficiency of appearance of the acceleration can depend strongly on the initial geometrical conditions, namely the dimension and the rate of spreading of the plasma jet, its compression, the limitation of the spark plasma by a dielectric tube, by magnetic fields, etc.

It must also be borne in mind that the appearance of a group of fast particles upon application of an electric field on a plasma inhomogeneity is not evidence of an initial high plasma temperature, and can be the result of electrostatic pressure of a large edge field (this will occur when $E_m^2 \gg 4\pi n_e kT_e$).

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Q-MODULATION OF A NEODYMIUM-GLASS LASER WITH THE AID OF A PASSIVE SHUTTER

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Passive shutters, the action of which is based on the bleaching of the solutions of certain substances by a strong light field, have come recently into use for the production of giant laser radiation pulses. An advantage of a shutter of this type is the simplicity of its construction, sufficiently short operating time (~ 10^{-8} - 10^{-9} sec [1, 2]), and large radiation power.

For a ruby laser, the working media presently used for passive shutters are several substances (cryptocyanine, phthalocyanines, glasses of the type KS-19), whereas only one substance, a polymethine dye, has so far been found for a neodymium-glass laser. The first results of its use are reported in [3].

In this communication we describe briefly the results of an investigation of neodymium-glass laser emission using a passive shutter with the same polymethine dye as in [3].

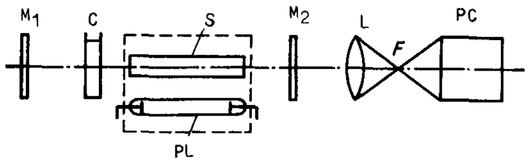

Fig. 1. Diagram of installation

A diagram of the set-up is shown in Fig. 1. Here M_1 is a dielectric flat mirror whith 98% reflection coefficient, M_2 is a plane-parallel glass plate which plays the role of the second cavity mirror, C is a cuvette with a solution of polymethine dye in methyl alcohol. The thickness of the cuvette is 3 mm. S is a neodymium-glass sample 120 mm long and 12 mm in diameter. PL is the pump lamp, and L is a lens with focus F. The concentration of the solution is chosen such that the transmission of the laser emission line (λ = 1.06 μ) is ~ 40%. The radiation was registered with a coaxial photocell PC, the signal from which was applied directly to the deflecting plates of an S1-11 oscilloscope. The time resolution of the entire circuit was ~ 10^{-9} sec. The pulse energy was measured with a calorimeter. The generation threshold without the cuvette in the resonator was 1.2 kJ. When the cuvette with the solution was placed in the cavity, the generation threshold rose to 3 kJ. Under these conditions, the laser emission was a single pulse of duration ~ 35 nsec (Fig. 2a). The peak power of the pulse was ~ 5 MW, and its energy was ~ 7% of the total emission energy of a laser operating without a shutter at the same pump energy. At this value of the power we observed breakdown in air - a spark - at the focus of the lens (f = 50 mm).

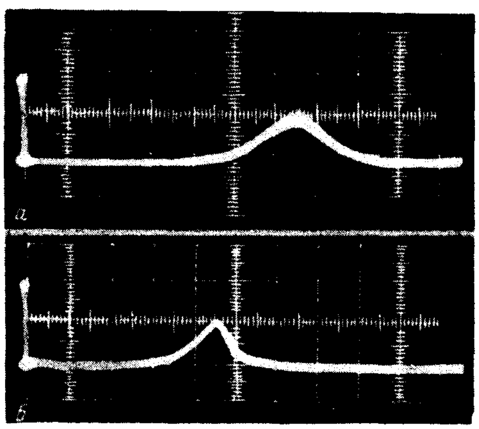

Fig. 2. Oscillograms of output signal. Sweep duration - 20 nsec/cm.

a - no breakdown in air.

b - signal in the presence of a spark.

We investigated the time dependence of the laser emission behind the focus of the lens in the presence of breakdown in the air. A sweep oscillogram is shown in Fig. 2b. As seen from the oscillogram, the leading front of the pulse is the same as in the absence of a spark (Fig. 2a), but the front of the pulse breaks abruptly after the maximum is attained and the breakdown begins as a result of the increased absorption in the discharge that is produced in the plasma.

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