to the state K = 1, $\nu = 0$, in which case we can obtain, starting from the Schrödinger equation for K = 0 and K = 1, that

$$I_2 = \frac{m_d}{2}(E_0^0 - E_0^1)\int_0^\infty h_0^0(\rho)\,h_n^1(\rho)\,d\rho \approx 0,5; \tag{5}$$

2) If the transition is to a high vibrational level lying at the dissociation boundary, then we can take in (4) quasiclassical wave functions. Such an integral was calculated in [5], where it was found that $I_2 \approx 10^{-4.5}$.

Assuming that $|E_d| < 4.6$ eV, we obtain for $\bar{E}_w$ the following limits for the production rate: $2 \times 10^{12} > w > 3 \times 10^2$ sec^{-1}. Comparing with the expected value $w = 1.7 \times 10^6$ sec^{-1}, we conclude that the mechanism considered above explains the experimentally observed effects if $(dd\mu)^+$ indeed has a level of several eV.

I take this opportunity to thank S. S. Gershtein for suggesting the topic and M. Kyiv for discussions.

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CURRENTS PRODUCED BY LIGHT PRESSURE WHEN A LASER BEAM ACTS ON MATTER

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Absorption of light in a conducting medium may induce conduction currents under the influence of light pressure. The field intensity equivalent to the action of the light pressure is $E_{eq} \simeq (Ik_1)/(cn_e e) \simeq (eE_0^2\nu)/[m(\omega^2 + \nu^2)c]$, where e and m are the charge and mass of the electron, E_0 and ω the amplitude and frequency of the light field, ν the electron collision frequency, k_1 the linear light-absorption coefficient, and I the flux density of light radiation. The field E_{eq} is nonpotential, and its action is equivalent to the action of an electromotive force that pumps the electrons through the volume where the light pressure is localized and produces a system of closed currents.

We have registered the currents produced by light pressure on the surface of a metal and in the plasma of the flare produced when a laser beam acts on a surface.

We used an ordinary ruby laser which was Q-switched by a rotating prism. The laser beam was focused on the surface of a small target which could be turned to any angle relative to the beam axis. An induction coil recording the current field was fastened to the edge of the target. The axis of the coil coincides with the target rotation axis. In some measurements we also used a laser mode in which two light pulses were produced in sequence, making it possible to investigate effects due to the action of light on the plasma or on the gas in the flare produced by the light of the first pulse.

1. Surface Currents Produced when Light Strikes an Absorbing Surface

If a light flux of power W is incident on the surface of a conductor at an angle θ to the normal, then the tangential force acting on the electrons is $F_t = (1/c)\alpha W \sin\theta \simeq (1/c)W_{abs}\sin\theta$, and the equivalent field intensity is $E_{eq} \simeq F_t/S\delta n_e e$, where α is the absorption coefficient, δ is the depth of penetration of the light, and S is the area of the light-beam spot. The values of α and δ may depend very strongly on the flux density, angle of incidence, and the dynamics of heating the surface by the beam. (In particular, at sufficiently large beam flux density we can have $\alpha \simeq 1$.)

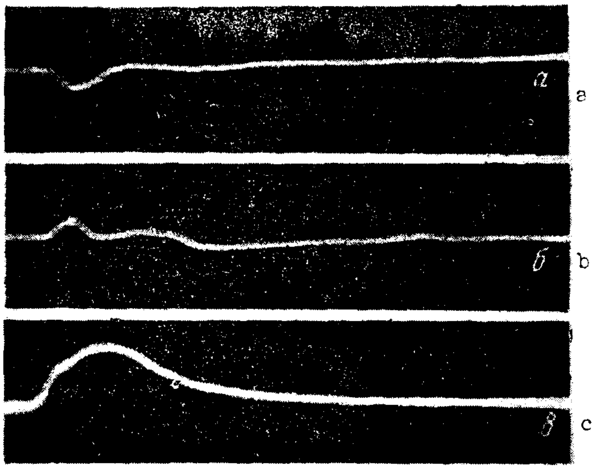

Fig. 1

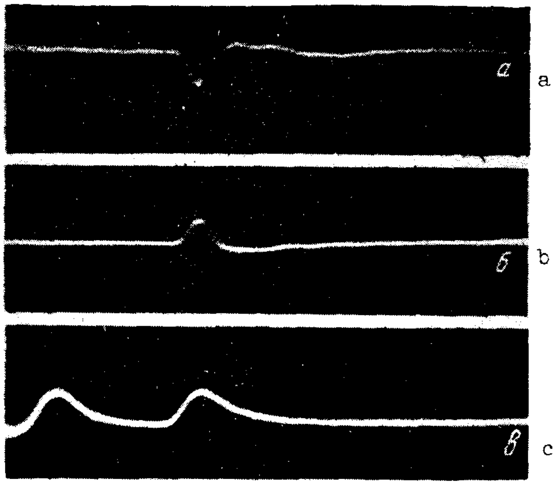

Fig. 2

The occurrence of currents along the surface gives rise to inductive screening of their field - oppositely directed currents - inside the conductor. The resistance of the medium leads to an increase in the area of the section through which the current flows, to a change in the magnetic moment of the currents, and then to damping of the currents. The field of the magnetic moment of these currents was registered with an induction coil located at the end surface of the target.

The coil parameters were such that the signal from it was proportional to the derivative of the magnetic field.

In Fig. 1 (a and b) we show signals from the coil (upper traces) as compared with the signal provided by the circuit used to register the laser beam power (lower trace), with a 0.5 μsec sweep. Figures 1 (a) and (b) were obtained with the target inclined 45° and 90° to the light beam, respectively. Such a rotation changes the polarity of the signal, since the twist direction of the current changes and consequently also the direction of the magnetic moment.

2. Currents Produced by a Laser Beam in the Plasma of a Flare

If the plasma is produced by the laser beam itself, then currents produced by the pressure of the light absorbed in the plasma can circulate in it.

To intensify the effect and to separate in time the plasma production from the excitation of currents in the plasma, the laser was used in a mode such that two light pulses of approximately equal energy, spaced 240 nsec apart, were produced. The first pulse produced the flare on the target (the current signal was small at that instant of time), while the second pulse produced in the flare currents which were registered by a near-by induction coil. The current signal due to the second pulse was much larger (by approximately one order of magnitude) than the first, this being apparently due to the large volumes through which the currents flowed.

It turned out that the magnetic moment of such currents reverses sign when the Q-switching prism of the laser reverses rotation. This can apparently be attributed to the different inclination of the beam (the generation flash is produced just before the prism becomes strictly perpendicular to the laser axis) and to the fact that the beam is incident on different sides of the flare. In Fig. 2 (a and b), where a 1 μsec sweep is used, we show the signal representing the moment of the currents (upper traces) as compared with the record of the laser flash (lower trace) for two directions of prism rotation.

The appearance of currents in the plasma under the influence of light is similar to the appearance of a magnetic moment of a spark in the focus of the laser, recently observed by V. Korobkin and co-workers [1] (and called the "Korobkin effect"). In our case the plasma was produced in the target by the flare, and this may be why no strong change was observed in the direction of the moment as the beam moved away from the lens axis.

The effect of current production under the influence of electromagnetic-radiation pressure may become manifest in a variety of conditions. For example, powerful radio beams in the ionosphere or in a laboratory plasma can cause circulation of currents, uneven illumination of a conducting medium by high-intensity light may give rise to currents, magnetic moments, electric polarization, etc. Similar effects can be expected in semiconductors such as in injection lasers, in semiconductor lasers with intense light pumping, etc.

In conclusion, we thank V. V. Korobkin for a discussion of the article, and graduate student I. I. Korotkevich who took part in the measurements.

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