The statistical errors are indicated. At gamma-quantum energies 24.8, 26.0, 28.0, and 30 MeV one can clearly see the peaks. The distribution shown in Fig. b includes events in which the tritium emergence angle relative to the direction of the gamma quantum does not exceed 110°, thus improving the energy resolution. The normalization was against the angular distributions of all the events. It is seen that the peaks at 24.8, 26.0, and 28.0 MeV are more pronounced. The first three peaks of the distributions (see the figure coincide at the corresponding energy with the peaks observed by Milone [2].

The peak at 30 MeV has been observed for the first time.

The cross section of Fig. a are averaged over intervals of 1 MeV, then the obtained curve is in good agreement with Gorbunov's curve [7].

In conclusion, the authors are grateful to A. N. Gorbunov for a discussion of the result results.

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OBSERVATION OF SELF-BENDING OF A NON-UNIFORM INTENSE LASER BEAM IN AN NaCl CRYSTAL

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We present here the results of first observations of a unique manifestation of self-action of a laser beam with non-uniform intensity distribution over its cross section in a medium, namely self-bending. This effect is due to an inhomogeneous variation of the refractive index n of the medium, due to the non-uniform field of the beam, i.e., to the appearance of a gradient of n in a direction perpendicular to its axis; it was recently described in [1]1).

We investigated the propagation of a focused ruby-laser beam (Q-switched, initial mean peak power 50 - 80 MW) in an NaCl crystal. The form of the beam in the crystal was assessed from the distribution of the damage tracks produced along the path of the beam [3]. The cross section of the initial beam was close to elliptic, and an intensity gradient existed along the long axis of the ellipse (see Fig. 1, upper part). This was evidenced, in particular, from the distribution of the damage points produced on the surface of the crystal where the concentrated beam was applied. To increase the density gradient of the beam entering the crystal, the beam was incident on the crystal at an angle, as shown in Fig. 1 (the plane of the figure corresponds to the longitudinal section of the beam along the major axis of the

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1) The bending of a homogeneous beam propagating in a medium with a refractive-index gradient is known from classical optics [2].

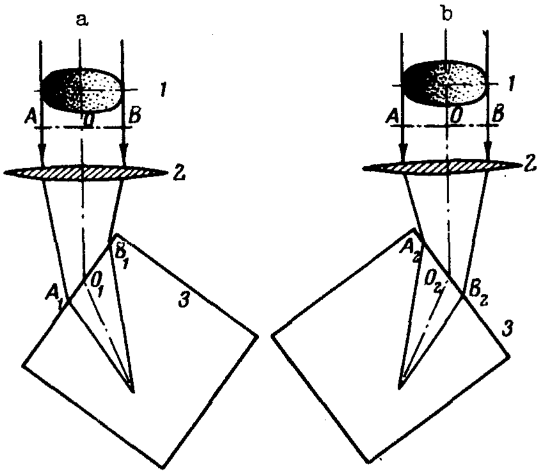

Fig. 1. Experimental setup: 1 - beam cross section, 2 - lens, 3 - NaCl crystal; a - intensity gradient of beam increases on entering the crystal, b - intensity gradient is smoothed out.

ellipse; the density of the beam incident on the crystal decreases from the point A_1 to the point B_1). Inasmuch as the angle of incidence on the crystal, and consequently also the coefficient of reflection from its surface, increases smoothly from A_1 to B_1, the beam entering the crystal in the same direction acquires an additional density gradient. In addition, the considered gradient is intensified by the deformation of the cross section of the beam that enters the crystal at the chosen oblique incidence (it is seen from Fig. 1a that $A_1O_1 < O_1B_1$ and $AO = OB$).

We used a lens with focal distance 5 cm, located 2.5 cm from the crystal surface. The axis of the beam incident on the crystal made an angle 55 - 60° with the normal to the surface. In the general case, the change of the intensity of the beam in the sample from A to B was 80%.

Figure 2a shows a photograph of the damage tracks in the crystal, obtained in a direction perpendicular to the beam axis. The intensity gradient of the beam lies in the plane of the figure and is directed downward. It is seen from the figure that in the region of the focus F the beam axis bends and is deflected downward from its initial direction CD, and then

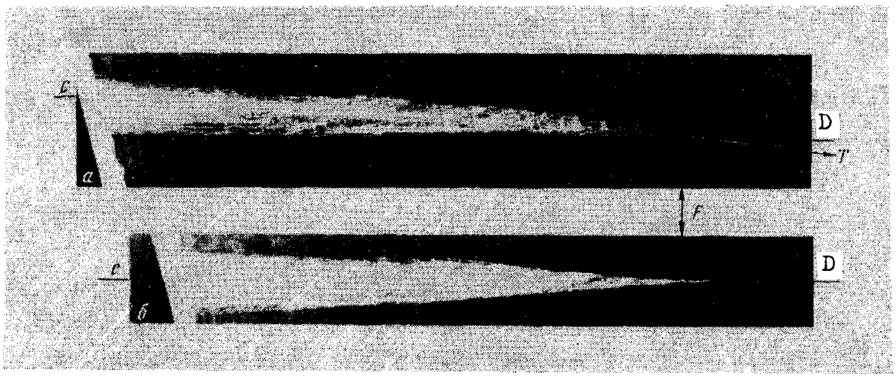

Fig. 2. Photographs of damage tracks in NaCl crystal. magnification 6×: a - beam entering crystal has an intensity gradient (in a downward direction in the figure), b - no intensity gradient in beam entering crystal. CD - axis of beam entering the crystal, F - focal region, T - direction of beam axis after bending and emerging along a straight line.

emerges along a straight line. This emergence is apparently connected with the destruction of the profile of the beam inhomogeneity, as a result of diffraction [1], in the location under consideration. The angle ϕ between the direction of this line and the axis CD of the beam entering the crystal is 6°.

In the case of normal incidence of the beam on the crystal (axis of the focused beam perpendicular to the crystal surface), the bending is much smaller, this being due to the relatively small intensity of the gradient of the laser emission in this case.

For control purposes, the propagation of the same beam in the crsytal was considered at the same oblique-incidence angle, but at a geometry such that the unequal reflection and deformation of the cross section of the beam causes its density gradient not to increase, but to the contrary, to become smoothed out, and the beam to become almost homogeneous (see Fig. 1b). In this case practically no bending of the beam axis was observed, as is seen from the photograph (Fig. 2b).

From the measured bend angle of the beam (Fig. 2a) it is possible to estimate the magnitude of the nonlinear change of the refractive index of NaCl, or more accurately of the coefficient n_2 of the quadratic term in the expression $n = n_0 + n_2E^2 + \ldots$, using the relation [1]:

$$\phi = \frac{16\pi^2 n_2 P}{\lambda_0 n_0^2 c a},$$

where P is the total power of the beam having a linear intensity gradient, a is the beam diameter, and λ_0 and c are the wavelength and the velocity of light in vacuum.

Assuming, in accord with experiment, that $P = 5 \times 10^{14}$ erg/sec and $a = 0.01 - 0.03$ cm (the limits of variation of a in the bending region), we get $n_2 = 7 \times 10^{-14} - 2 \times 10^{-13}$ cgs esu.

The bending of the beam in the direction of the transverse gradient of its intensity is evidence of a positive change in the refractive index of the NaCl crystal under the influence of the field of the radiation under considertion. At a definite intensity, a beam should become self-focused in such a crystal. We have actually observed earlier [3] syptoms of self-focusing in NaCl crystals, namely, photography of the cross section of the beam emerging from the crystal has established that it has no divergence at a sufficiently large distance from the focal region. In our opinion, the distribution of the damage tracks on the photographs of Fig. 2 (especially photograph b) are proof of self-focusing. Indeed, no divergance of the damage is observed beyond the focus, and they are seen to be concentrated along a line coinciding with the beam axis.

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