MEASUREMENT OF REFLECTION OF SUBNANOSECOND PULSES OF A HIGH-POWER LASER FROM A SOLID LiD TARGET

V.D. Dyatlov, R. N. Medvedev, V. N. Sizov, and A. D. Starikov
D.V. Efremov Insttiute of Electrophysical Apparatus
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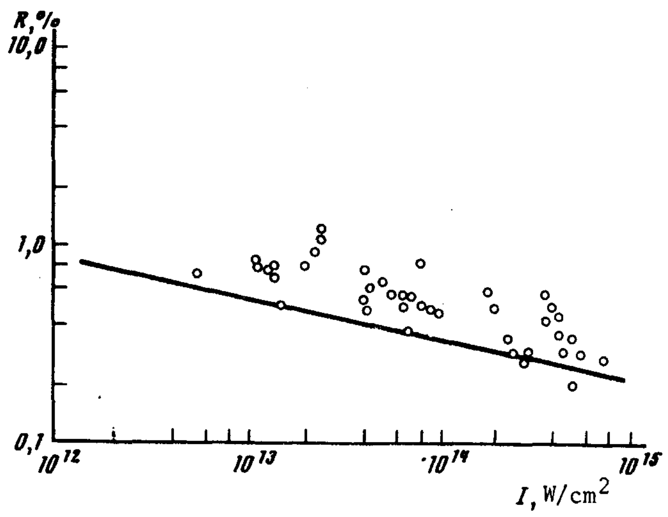
Results are presented of the measurement of the reflection coefficient of intense ($10^{13}$ - $10^{15}$ W/cm$^2$) laser radiation from an LiD target. The value of the coefficient and its dependence on the intensity of the incident radiation cannot be explained within the framework of collision absorption.

1. Reflection of radiation accompanied by heating of the target determines the effectiveness with which lasers can be used for thermonuclear reactions. In addition, at large reflection coefficients, special measures must be taken to prevent damage to high-power laser systems.

In view of the continuously increasing usable light fluxes, it is of particular impartance to determine the behavior of the reflection coefficient at high intensities. If the absorption of the incident-radiation energy is determined by bremsstrahlung processes, then the absorption should decrease with increasing intensity. The fraction of the reflected energy will increase, and the heating effectiveness decrease. On the other hand, if the absorption is due to nonlinear interaction, then it can be increased. The measured coefficients of reflection from deuterated ice [1 - 3] and from targets having high sublimation heats [4 - 6] differ greatly in magnitude, in view of their dependence on the intensity.

2. We have measured the coefficient of reflection from a lithium-deuteride target (heat of sublimation 54 kcal/mole) at incident-radiation ($\lambda$ = 1.06 $\mu$) intensities from $10^{13}$ to $10^{15}$ W/cm$^2$. We used in the experiment a high-power neodymium-glass laser [7], with output pulse duration $\tau$ = 90 psec and an output energy 300 J. However, for a better stability of the results, the investigations were carried out at energies up to 100 J. About 84% of the radiation energy fell in an angle $\psi = 10^{-3}$ rad and was gathered with a lens of focal length f = 235 mm and aperture f/2.5 into a spot of area $S_0 = 10^{-3}$ cm$^2$ on the target. During the time of the flash, the targets were irradiated with the low-intensity luminescence light ($I \sim 10^6 - 10^7$ W/cm$^2$, $\Delta t \sim 10^{-4}$ sec), and next, during the formation of the main pulse, they were exposed to the enhanced generator noise ($I \sim 10^{10} - 10^{12}$ W/cm$^2$, $\Delta t \sim 10^{-8}$ sec), and finally they were irradiated by the main energy pulse. An energy contrast $\geq 10^4$ was ensured by a number of active and passive shutters. The LiD crystals were irradiated in a vacuum $P = 10^{-5}$ Torr. The energy $E_{in}$ incident on the target, the energy $E_r$ reflected back into the aperture of the lens, and the energy $E_s$ scattered at an angle 135° relative to the incident energy were measured with calibrated calorimeters. A simultaneous time scan was carried out of the intensities of the incident and reflected radiation, using a photoelectronic recorder with a resolution ~60 psec. Besides these parameters, we measured the neutron yield, the electron temperature, and the intensity of the second harmonic of the reflected radiation.

3. The figure shows the measured dependence of the ratio $R = E_r/E_{in}$ on the intensity of the incident radiation $I = E_{in}/S_0\tau$. The intensity was varied by changing either $E_{in}$ or $S_0$, and both methods yielded identical results. The waveform of the reflected pulse coincided in the main with that of the incident pulse. The energy $E_s$ falling in a 0.12 sr solid angle was $(2 - 3)\times 10^{-4}$ $E_{in}$. The electron temperature $T_e \sim 1 - 2$ keV and the maximum neutron yield $\sim 10^6$ were registered with the radiation focused on the target surface. Under the same conditions, the intensity of the second harmonic in the back-reflected light was maximal. The presence of a second harmonic and the fact that the dependence of the reflection coefficient on the intensity does not agree with the classical value indicate that the absorption is nonlinear in character. It



is possible that unlike [1 - 3], where larger reflection coefficients were registered and were found to increase with increasing energy, in our case, owing to the higher heat of sublimation, the matter evaporated ahead of the main pulse forms a cloud with a lower optical density. Then the increase of the contrast in the devices that irradiate the easily-evaporated substances should lead to a decrease of the reflection.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## FLARE OF COSMIC GAMMA RADIATION AS OBSERVED WITH "COSMOS-461" SATELLITE


E. P. Mazets, S. V. Golenetskii, and V. N. Il'inskii
A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences


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Results are presented of a cosmic gamma-radiation flare observed on 17 January 1972.


Measurement of the intensity of gamma radiation in the 0.2 - 1.5 MeV range, performed simultaneously on several "Vela" satalites, have revealed rare short burts of intensity of cosmic gamma rays, and yielded estimates of the possible directions of their sources [1]. The small time scales of the observed events, which impose limitations on the source dimensions, as well as energy considerations, suggest that the flares are produced in supernova or nova outbursts, or else that a special class of bursting stars exist in the galaxy [1, 2]. Undoubtedly, more data on the flares are needed to explain the nature of this new astrophysical phenomenon.

One of the flares [1] (event 72-4, 13591 sec UT in accordance with Strong's classification) was observed also from the satellites OSO-7 and IMP-6 [2], the data from which were used to measure the spectral distribution of the radiation in the flare in the 10 - 1000 keV range, and to determine more accurately the direction to the source. There are reported confirmations of a few other events of [1], observed with the IMP-6 [3].

We report here the results of observation of the flare of 17 January 1972 (event 72-1, 63556 sec UT) from the satellite "Cosmos-461," which was equipped with a multichannel gamma spectrometer with an isotropic detector placed on a long bar. The geometric factor of the

Flash of gamma-ray intensity in the range 0.05 - 0.3 MeV.