It is obvious that an analogous method can be used to register, in condensed media, the electron image of any type of ionizing radiation (e.g., x rays) and to convert the electron image into an optical one (see Fig. 3).

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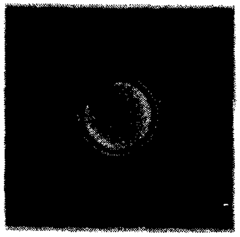

Fig. 3. Image of active surface of α source immersed in liquid argon. Active-region diameter 35 mm, liquid layer 0.4 cm. The bright ring around the active region is due to the reflection of the light of the sparks from the rounded part of the polished electrode (Fig. 1c).

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## GASDYNAMIC $CO_2$ LASER WITH ESCAPE OF THE SHOCK-TUBE HEATED WORKING MIXTURE THROUGH A SLIT

A.P. Dronov, A.S. D'yakov, E.M. Kudryavtsev, and N.N. Sobolev
P.N. Lebedev Physics Institute, USSR Academy of Sciences
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We measured and observed generation in the 10 μ region on the vibrational transitions of $CO_2$, during the course of escape of a heated gas mixture through a slit into vacuum (the escape was accompanied by rapid cooling).

The suggestion that gnneration can be attained by adiabatic expansion of a mixture of $CO_2$ and $N_2$ gases was formulated in the invention disclosure [1] and in [2]. The general idea of the possibility of obtaining inverted population between energy levels with different relaxation times following an abrupt change of the system temperature was advanced in [3]. Calculation of the inversion produced when nitrogen with carbon dioxide is cooled were made for the general case and for the case of a Laval nozzle in [2, 4, 5], and for the case of escape through a slit in vacuum in [6]. Experimental investigations of the problem were initiated in [7], where escape through a slit was used. Cooling of $CO_2$ and mixtures based on it by the substance in which inversion is obtained was investigated by the rarefaction-wave method in [8, 9] and by the method of expansion through a slit in [10], where promising results were obtained. Lasing on $CO_2$ molecules was recently obtained [11] with the aid of a nozzle, using a ternary mixture (He, $N_2$, $CO_2$).

In the present investigation, amplification and generation of laser radiation by $CO_2$ molecules were observed with the gas expanded through a slit. In this case [6], the rates of cooling are larger than those obtained with a nozzle. Just as in [11], we used a ternary mixture (73% He, 18% $CO_2$, 9% $N_2$). The mixture was heated to 1800 ± 200°K (and a pressure of 25 atm) in a shock tube behind a reflected shock wave (SW). The shock tube (see Fig. 1), with inside diameter 90 mm, had a partition with a slit 0.7 × 60 mm. The slit was covered with foil (thickness 10 μ), making it possible to obtain different pressures on both sides of the slit (in the forechamber and in the receiver) prior to the experiment. Reflection of the SW broke the foil practically instantaneously, after which the gas mixture, heated by the reflected shock wave, escaped from the forechamber into the receiver (the pressure in the latter was 1 Torr).

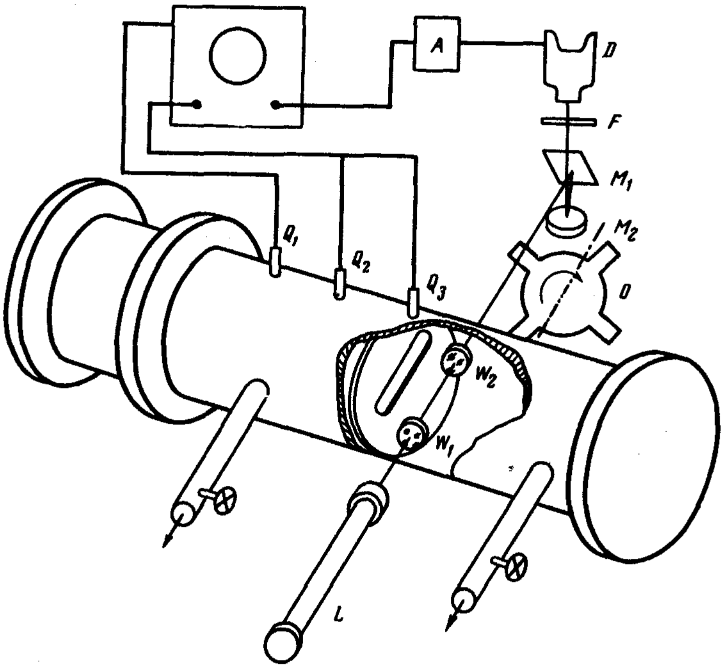

Fig. 1

Measurements of the gain were made in accordance with the scheme shown in Fig. 1. Here L - continuous $CO_2$ laser with 1 W power, $W_1$ and $W_2$ are polished NaCl windows, O is a moving shutter interrupting the laser beam, $M_1$ is a flat rotating mirror and $M_2$ is a spherical mirror for the focusing of the radiation on the receiver. A filter (of InSb) was selected such that only radiation in the range from 7 to 11 μ was incident on the receiver (Ge-Au). The signal from the receiver was registered (either with or without a preamplifier) with a two-beam oscilloscope (S1-17) together with the signals from the contact pickups $Q_2$ and $Q_3$, which were used to measure the velocity of the incident shock wave. The oscilloscope was triggered by contact pickup $Q_1$.

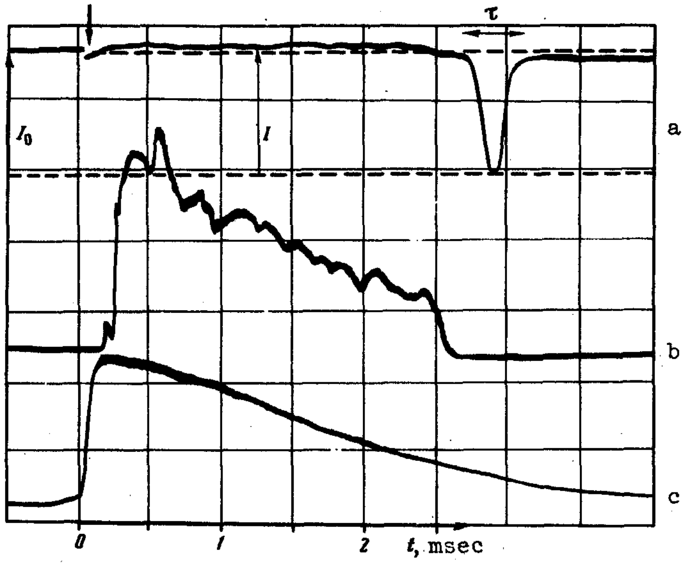

Fig. 2

Figure 2 (oscillogram a) shows a typical plot of the laser-radiation gain. The oscillogram section from the triggering of the oscilloscope to the instant noted by the short vertical arrow, shows the value of the intensity of the incident radiation $I_0$. This arrow corresponds to the instant when the shock wave, propagating in front of the mixture and causing the absorption jump, reaches the observation axis. Following a brief(0.2 msec) setting time of the escape, a rather stable amplification is observed, which changes after 2.5 msec into absorption. During the time interval τ designated by the horizontal arrow, at the end of the oscillograms, the laser beam was covered by the shutter. This made it possible to determine the position of the null line (dashed) and by the same token the value of $I_0$, which remained unchanged during the course of the experiment, as well as the intensity of the transmitted radiation I. The smallest measurable value of the gain (or absorption) $k = (I - I_0)/I_0$ amounted to about 2%.

The cooling of carbon dioxide by expansion of the jet in vacuum, and the decrease of its density, should give rise to a maximum of inversion (and gain) in the receiver at a certain distance from the slit [6]. This was confirmed in our experiments (see Fig. 3, where the curve represents the result of averaging of experimental data). The maximum value $k \sim 10\%$ was reached under our conditions at a distance of 35 mm from the slit. The scatter of the values shown for each point corresponds to the limit of the variation of k within a time on the order of 0.7 msec following the settling of the escape. The estimated accuracy with which k was measured is ±25%.

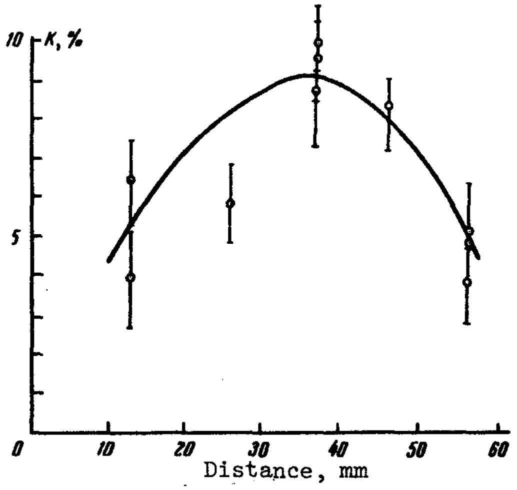

Fig. 3

In accordance with the variation of the gain, we located the resonator axis in the lasing experiments at a distance of 35 mm from the slit. We used a gold-coated internal mirror with f = 500 mm and a Ge mirror with f = 100 mm. The latter had a gold coating (with reflectivity ∿100%) over the entire field with the exception of a central spot of 1.5 mm diameter. The laser radiation passing through this spot was registered by the same receiver, which was shifted to a position 45 mm away from the Ge mirror.

Oscillogram b on Fig. 2 is a typical plot of the generation (to arbitrary scale). Oscillograms 2a, 2b, and 2c were obtained in three differene experiments, but their starting points were made to coincide in Fig. 2 with the aid of plots obtained with the contact pickups (not shown in the figure). The length of the generation pulse coincides with the duration of the amplification pulse (oscillogram 2a). On the other hand, this agrees with the picture of the infrared radiation of the mixture in the receiver (oscillogram 2c). The cross section begins somewhat earlier than the processes registered in Figs. 2a and 2b, and the glow of the mixture (together with its temperature) decreases very strongly 3 msec after the instant of reflection, as a result of the action of the rarefaction waves that arrive at the slit. This leads to the interruption of the amplification and of the generation.

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# GROSS STRUCTURE OF GIANT DIPOLE RESONANCE ON NUCLEI OF THE TRANSITION REGION N ≈ 90

O.V. Vasil'ev and V.A. Semenov
Saratov State University
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Nuclei with N ≈ 90 neutrons are noted for the instability of their form. Thus, as a result of a small increase of N from 88 to 90, the mean-square deformation of the ground state $\bar{\beta} = (01\ \beta^2\ 10)^{1/2}$ increases (e.g., $\beta = 0.167$ for $Gd^{152}$ and $\beta = 0.304$ for $Gd^{154}$ [1]), and the energy of the first excited level decreases (from $E_{2+} = 0.33$ to $E_{2+} = 0.12$ MeV); the approximate equidistant arrangement of the lowest excited levels is replaced by a characteristic rotational spectrum [2].

There are also experimental indications [3, 4] that the form of nuclei with N ≈ 90 can be noticeably altered upon excitation.

The internal structure of such nuclei is determined by the intersection of two groups of Nelsson levels (β) with positive and negative directions [5, 6].

Mottelson and Nilsson, who first called attention to this circumstance, have shown by means of simple calculations that in this case the same nucleus can have states with both small and large (positive) equilibrium deformations [5]. In this connection it is sometimes stated that these nuclei have two different self-consistent fields, one weakly deformed and the other strongly deformed [4, 7].

The purpose of our experiment was to ascertain how such an instability of the form can affect the properties of the dipole spectrum of a nucleus.

We present here the results of the measurement of the photoneutron cross sections of the isotopes $Gd^{152,\ 154,\ 156,\ 158}$ and $Eu^{151,\ 153}$ in the photon energy range $E_\gamma = 8 - 22$ MeV.

The measurement and analysis of the results were performed by the standard procedure used in experiments with a bremsstrahlung spectrum [8. 9]. The photoabsorption cross section $\sigma_t$, at photon energies below the threshold of the reaction (γ, 2n), was identified with the photoneutron cross section; at energies above threshold, $\sigma_t$ was determined from the photoneutron cross section in accordance with the statistical theory.

The photoabsorption cross sections and the photoneutron cross sections for the isotopes Gd and Eu are shown in Figs. 1 and 2 respectively.

The most interesting results is the clear-cut splitting of the giant resonance (the Okamoto-Danos effect) on the $Gd^{152}$ nucleus (N = 88). This phenomenon indicates that $Gd^{152}$ is not (as was proposed relatively recently) a spherical nucleus executing harmonic quadrupole oscillations, since, in accord with