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PASSIVE Q SWITCHING AND STABILIZATION OF A RUBY-LASER FREQUENCY WITH MOLECULAR RUBIDIUM VAPOR

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We observed generation of a giant ruby-laser pulse with a stable emission frequency when a cell with molecular-rubidium vapor was placed in the resonator.

The use of molecular potassium vapor for passive Q switching of lasers was reported in [1]. The presence of a rotational structure in the absorption spectra of diatomic molecules gave grounds for hoping that the generation would occur at the frequency of minimum absorption, as a result of which the generated giant pulse would have high monochromaticity and atomic stability.

The difficulty in using K_2 vapor to verify this hypothesis lay in the need for working at relatively high temperatures (400 - 450°C) in order to obtain sufficiently high K_2 concentrations, when the potassium enters quite rapidly into the softened glass of the cell. This has made it impossible to obtain a stable generation regime and to determine the frequency stability of the generated radiation. Preliminary experiments have established that Rb_2 vapor has a larger absorption cross section than K_2 at $\lambda \sim 694$ nm, and becomes noticeably bleached under the influence of ruby-laser radiation of intensity $\sim 10^3$ W/cm^2. Since the stipulated Rb_2 concentration is reached at much lower temperatures than that of K_2, we chose Rb_2 for the purpose of verifying the aforementioned hypothesis.

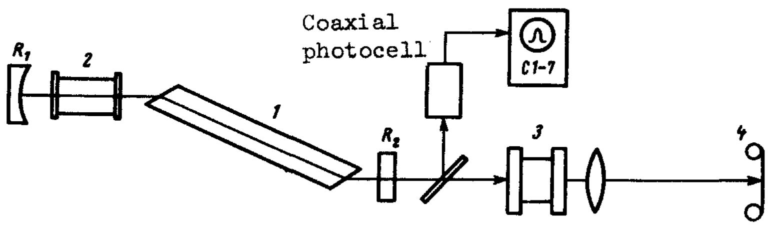

Fig. 1. Experimental setup: 1 - ruby rod; 2 - cell with saturated Rb_2 vapor, 3 - Fabry-Perot interferometer, 4 - photographic camera.

The experimental setup is illustrated in Fig. 1. A ruby rod 1, with end faces cut at the Brewster angle, was placed in an illuminator consisting of two straight IFP-1500 lamps, with a pump energy $\sim$3 kJ, and was cooled with thermostat-controlled running water. Cell 2, 70 mm long, filled with saturated rubidium vapor at 375 - 400°C was placed in the hemispherical laser resonator with mirrors R_1 and R_2 (reflection coefficients 99 and 40%, respectively). Under these conditions, we observed generation of a giant bell-shaped pulse of duration $\sim$50 nsec at the half-width and of energy 0.1 J. With further increase of the pump energy beyond the threshold of saturation of the rubidium Q-switch, the giant pulse was followed by several (from 1 to 60) pulses of much smaller amplitude. The number of these pulses and the distances between them varied with the pump intensity.

Fig. 2

Figure 2 shows a cumulative interference pattern of the ruby-laser radiation in the described regime after five flashes of the pump lamp. It was obtained with an interferometer having a base of 20 cm (distance between orders 0.025 cm^{-1}). The measured width of the laser radiation spectrum in the monopulse regime and the frequency of the radiation frequency from flash to flash did not exceed the apparatus width of the measuring system (~150 MHz). In order to verify the stability of the described generation regime at the temperature of the shift of the ruby luminescence-line frequency [2], and also to verify the possibility of tuning the laser frequency, the latter was measured at different temperatures of the water used to cool the ruby rod. It was found that the laser radiation frequency remains constant when the water temperature changes by 3°, and with further change of this temperature the frequency changes abruptly by several tenths of a cm^{-1}. It should be noted that under conditions when the pump greatly exceeded the threshold of the bleaching of the rubidium filter, in the multiple-pulse generation regime, the laser emission spectrum contained additional frequencies besides the stabilized giant-pulse frequency.

The results show that molecular systems with inhomogeneously broadened absorption bands can be successfully used for simultaneous passive Q-switching and frequency stabilization of lasers with a relatively broad spectrum of the generation band.

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EFFECT OF SMALL-ANGLE MAGNETIC SCATTERING OF NEUTRONS IN IRON-NICKEL ALLOYS

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In order to determine the features of the magnetic structure of invar alloys, we investigated magnetic elastic diffuse scattering of neutrons by fcc iron-nickel alloys containing 25, 40, 50, 55, 60, 63, 65, and 67 at.% iron.

The alloys were molten in vacuum from pure components and subjected to prolonged homogenization at 1100°C. The samples were parallelepipeds measuring 20 × 20 × 2 mm and were quenched in water from 1100°C. The diffuse scattering was investigated at 100°C using a neutron diffractometer mounted in the horizontal channel of the IVB-2 reactor. The magnetic diffuse scattering was separated with the aid of a 5000 Oe magnetic field. The neutron beam collimation was such that a minumum angle $2\theta = 1°30'$ could be reached at $\lambda = 1.13$ Å.