The authors of [1, 2] have previously established that for the light nuclei Li^7, Be^9, B^{11}, and C^{12}, at a photon energy not higher than 335 MeV, the proton polarization is close to zero in the kinematic region where the real pions do not take part in the reaction.

In the present paper we show that at higher photon energies (700 - 900 MeV) the proton polarization in the same kinematic region is also close to zero for the nuclei Li^7 and C^{12}.

The figure shows the dependence of the proton polarization on the photon energy.

As seen from the figure, the proton polarization in the meson region II changes strongly with increasing photon energy, from - 0.76 to + 0.48.

The small proton yield in the kinematic region I and the results presented for the proton polarization in the kinematic region II have made it possible to calculate the proton polarization in the reaction $\gamma + n \to \pi^- + p$ for the photon energies 650, 715, and 840 MeV. The obtained values of P turned out to be, respectively, 0.74 ± 0.33, -0.16 ± 0.40, and +1.66± 1.04. The absence of published data on the proton polarization in the reaction $\gamma + n \to \pi^- + p$ does not make it possible to compare the obtained values of the polarization for all the presented photon energies. For the energy E = 715 Mev, the value -0.26 ± 0.06 obtained in [4] agrees with our result.

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DYNAMICS OF RADIATION AND SPECTRUM CHANGES OF A NEODYMIUM LASER WITH SELF LOCKING OF AXIAL MODES

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Experiments [1] on the mode-locking in lasers with saturable filters have shown that complete locking, which we shall define as the presence in the axial period of one spike of duration $\tau \sim 1/\Delta\nu$ ($\Delta\nu$ - width of spectrum) and exceeding in energy by at least one order of magnitude all the remaining spikes, rarely occurs in such lasers. The proposed statistical approach to the development of generation from spontaneous noise [2,3] predicts the possibility of incomplete locking and gives certain quantitative criteria for this possibility. It is of interest to compare the experimental results with the theoretical ones. In the experiments set up for this purpose, we investigated both the temporal structure of the emission of a neodymium laser, and the time evolution of the spectral distribution of this emission.

The experimental setup was similar to that described earlier in [1]. The neodymium-laser resonator length was 140 cm, the cell with the saturable filter was mounted in the center of the resonator. Separation of the axial modes only was effected with the aid of a diaphragm of 2.7 mm diameter.

In the first part of the work we investigated the temperal structure of the generation. The laser emission was time-scanned with an electron-optical camera. Unlike in [1], where the most intense part of the generation pulse was investigated, in the present study we have compared different stages of this pulse. To this end, the laser beam was split into two, and both halves were directed to the input slit of the electron-optical camera, one being delayed in time relative to the other. The delay could be varied from zero to 100 nsec. The most instructive is the comparison of the start and end of the giant pulse. In accordance with the experimental results, we can single out the three most typical cases: a) only two intense spikes exist during the axial period, both at the start and at the end of the generation, b) there are many spikes in the axial period at the start and at the end of the generation, c) there are two spikes at the start of the generation and many at the end. These three characteristic cases are illustrated in Figs. 1a, b, and c, respectively. The processing of more than 100 flashes has revealed that the probabilities of the indicated cases are 0.004, 0.59, and 0.37, respectively.

The second part of the investigation was devoted to the time evolution of the generation spectrum. The spectral instrument was a diffraction spectrograph of dispersion 12.2 cm^{-1}/mm. Examples of the obtained scans are shown in Fig. 2. We note that, just as the case of integral registration [4, 5], non-uniformity of the spectrum was observed, wherein an intense region ("nucleus") with half-width $\sim 5 - 7$ cm^{-1} was observed against the background of a spectrum with a width reaching sometimes 100 cm^{-1}. In addition, the scanned spectrum shows that both the "nucleus" and the wings have a distinct structure, which is sometimes periodic. The characteristic dimension of this structure is 1 - 10 cm^{-1}. For each spike, the width spectrum can change quite strongly in the axial period. The structure of the spectrum also changes from spike to spike. The width of the spectrum in the spike and its structure are usually reproduced, on going from one axial period to the other, although the intensity distribution in the wings may change somewhat. The observed structure of the radiation spectrum in the individual spikes is not connected with any parasitic selection. This was verified by replacing the cell with the saturable filter with a cell containing pure solvent. The corresponding scanned spectrum of the first free-generation spike is shown in Fig. 2c. We see that both the spectral structure and the temporal structure have a random character in this case.

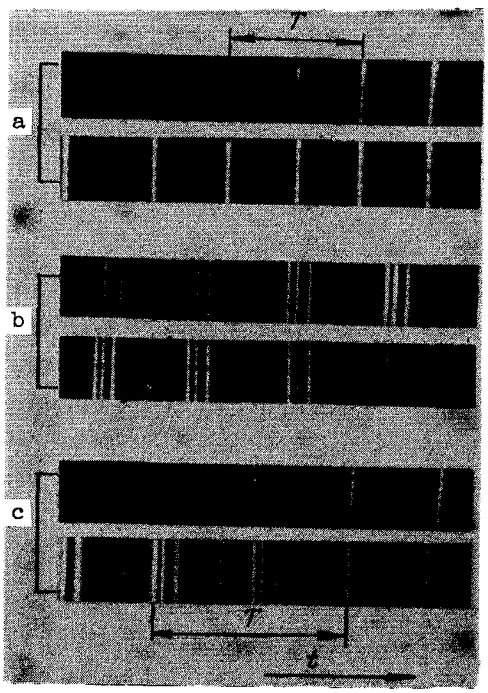

Fig. 1. Evolution of generation of a neodymium laser with mode self-synchronization. Upper lines for eahh flash - start of giant pulse, lower - end of pulse; delay 100 nsec. T - axial period, 9.4 nsec.

We now proceed to discuss the results. The approach developed in [2] enables us to calculate the probability of the full synchronization as a function of the linear conversion coefficient

$$P \approx \frac{\pi}{2} (\Delta\nu / \Delta\nu_0)^2$$

($\Delta\nu$ - half-width of the spectrum of the synchronized modes, $\Delta\nu_0$ - half-width of initial-field spectrum) and of the initial number of modes, m. The quantity $\Delta\nu_0$ can be regarded, with a good degree of accuracy, as equal to the half-width of the spectrum of the first free-generation spike. For $\Delta\nu \approx 100$ cm^{-1} and $\Delta\nu_0 \approx 10$ cm^{-1} we get $P \approx 160$. The initial number of modes is $m = \Delta\nu_0/\delta\nu$, where $\delta\nu$ is the distance between the neighboring axial modes. In our case $m \approx 4 \times 10^3$. For the obtained values of P and m, the theory of [2] predicts a full synchronization probability ~ 0.5. The experimentally obtained probability of full synchronization at the very start of the giant pulse (cases a and c of Fig. 1) is 0.41, and at the end of the pulse (case a) it equals only 0.04.

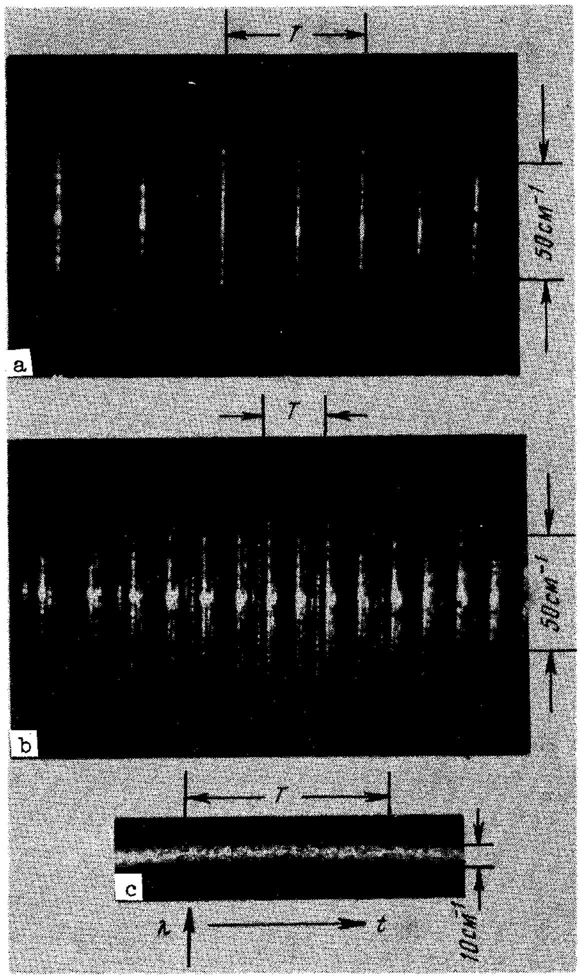

Fig. 2. Time scans of spike spectrum of neodymium laser with mode self-synchronization. a and b - good and poor self-synchronization, c - sweep of first free-generation spike, T = 9.4 nsec

The existence of a structure in the spectrum of the individual spikes offers evidence of their rather complicated time structure, confirming the results of [1]. When the relative intensity of such close spikes changes during the time of the giant pulse, certain changes should also be observed in the structure of the spectrum from one axial period to the other.

The presence of a "nucleus" in the spectrum of the individual spikes can be attributed to the existence of a broad pedestal for the short spikes, or to the asymmetry of the spikes, resulting for example from the finite relaxation time of the saturable filter.

On the basis of the foregoing experimental data, it can be assumed that the statistical theory describes satisfactorily only the stage of formation of the self synchronization prior to the start of the giant pulse itself. Apparently the saturation of the gain, and possibly also some other nonlinear effects, are responsible for the complication of the temporal structure of the generation during the time of the giant pulse, similar to the one shown in Fig. 1b. The structure in the spike spectrum and the corresponding temporal structure observed during the time of the entire giant pulse cannot be satisfactorily explained as yet for either good or poor self-synchronization.

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DETERMINATION OF THE PARAMETERS OF QUADRUPOLE INTERACTION IN YTTRIUM IRON GARNETS

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Yttrium iron garnets (YIG) have been thoroughly investigated by various methods, including NGR [1, 2]. In the present investigation we made sufficiently full use of the characteristic physical and methodological features of the NGR method.

The absorbers were oriented cuts of single-crystal YIG about 70 μ thick. The source was Co^{57} in chromium, which produced in our electrodynamic setup, with a sodium nitroprusside absorber, two perfectly symmetrical lines with $\Gamma = 0.25$ mm/sec. The spectra were recorded with a 400-channel analyzer operating in the time mode. From 1.5×10^5 to 10^6 pulses were accumulated in each channel. Such statistics, together with computer processing of the spectra, has made it possible to determine their parameters quite accurately.

It is known that the case $e^2qQ \sim \mu H$ is realized in YIG. Consequently, the expression

$$E_m = -g_{3/2}\,\mu_{\text{nuc}}\, mH + \frac{e^2qQ}{4I(2I-1)}[3m^2 - I(I+1)]\,\frac{3\cos^2\theta - 1}{2} \qquad (1)$$

for the determination of the hyperfine structure (hfs) levels of the nucleus is in general incorrect. Greatest interest attaches in this sense to the NGR spectrum of single-crystal YIG with orientation [100] in a longitudinal magnetic field $H_{\parallel}$. The value H was varied from 2 to 11 kG. The obtained NGR spectra constitute superpositions of three "quartets," since there are no lines corresponding to transitions with $\Delta m = 0$. One of the quartets corresponds to the atoms Fe^{57} in positions a and a', and the two others, designated by us d_1 and d_2, with an intensity ratio 1:2, correspond to Fe^{57} atoms in d-positions, for which $\theta = 0°$ and $\theta = 90°$ respectively (see the figure).

Indeed, it is impossible to interpret this spectrum under the assumption that formula (1) is valid (since this formula presupposes the equality of all the quantities $E_n(Q)$, where

$$E_n(Q) = \epsilon_n - E_n(H),$$

ϵ_n is the energy of the n-th level of hfs the nucleus in the excited state, n = 1, 2, 3, 4, and $E_n(H)$ is the energy of this level assuming the presence of magnetic interaction only). The parameters of the obtained spectrum are listed in the table.

To calculate the positions of the hfs levels of the nucleus, we must solve the secular equation with the Hamiltonian

$$\hat{\mathcal{H}} = -g_{3/2}\mu_{\text{nuc}} H[\hat{I}_z\cos\theta - \frac{1}{2i}(I_+ - I_-)\sin\theta] + \frac{e^2qQ}{4I(2I-1)}[3\hat{I}_z^2 - I(I+1)], \qquad (2)$$