(Fig. b), where there exists also a lower limit of the stability range [1]. On the periphery (Fig. a), one sees ring domains of large diameter, which are identical to the strip domain structure as $R \to \infty$ (Fig. c).

When an external magnetic field $H > H_{cr}$ is applied to the plate with the concentric domain structure (Fig. a), the cylindrical domain collapses, and the ring that follows it contracts towards the center and collapses into a cylinder; the field required for the collapse is $H'_{cr} > H_{cr}$. A gradual increase of the field is accompanied by a contraction of the peripheral rings towards the center. At a certain field on the plate, a single annular domain remains, the properties of which are analogous to those investigated in [2].

The regular domain structures shown in Figs. a - c, and readily realized in large and low-coercivity orthoferrite plates, constitute diffraction gratings of different types for transmitted polarized light. The application of a sinusoidal magnetic field makes it possible to modulate the period of such gratings. Owing to the high domain-wall mobility of orthoferrites, modulation of this type is possible up to the megahertz range.

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CHANGES IN THE SPECTRUM OF BACK-REFLECTED RADIATION IN LASER HEATING OF A PLASMA

A.R. Zaritskii, S.D. Zakharov, P.G. Kryukov, Yu.A. Matveets, and A.I. Fedosimov
P.N. Lebedev Physics Institute, USSR Academy of Sciences
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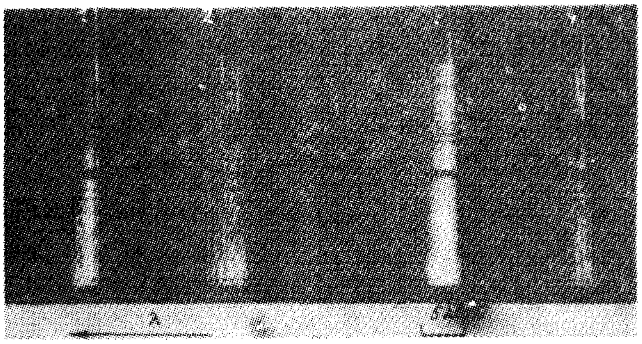
It is known that when a plasma is heated by powerful laser radiation and solid targets are used, the laser light is strongly reflected backward [1 - 2]. Such a reflection is the optical analog of microwave cutoff for low-density plasmas (see, for example, [3]). In the case of laser heating, the fraction of the reflected-light energy may reach 30 - 50% of the incident energy [4 - 5].

We have undertaken measurements of the spectrum of the laser light reflected from a plasma. The targets used were LiD, $(CH_2)_n$, $(CD_2)_n$, D_2O ice, and aluminum. The source was a mode-locked Nd laser consisting of a driving generator and a six-stage amplifier. The plasma heating and the spectral measurements were performed both at the fundamental frequency ($\lambda = 1.06\ \mu$) and at the second harmonic frequency ($\lambda = 0.53\ \mu$). Conversion into the harmonic, with efficiency up to 50%, was effected with the aid of a KDP crystal.

To increase the accuracy of the spectral analysis, the initial generation spectrum was narrowed down to ≤ 0.05 Å by introducing axial-mode selectors of the Fabry-Perot interferometer type into the resonator. The laser pulse was then lengthened to 1 nsec. The output energy per pulse at the fundamental frequency reached 20 J, and the radiation divergence was 2×10^{-4} rad at a beam diameter 4 cm. The laser light was focused on the target by an objective having a focal length f = 4.5 cm, and in some cases by a lens having f = 30 cm. The transmission of the objective and of the window of the vacuum chamber was 60% at $\lambda = 0.53\ \mu$, and the diameter of the focal spot in the absence of a plasma was estimated at 20 - 30 μ (f = 4.5 cm).



Spectrograms of heating laser light and of light reflected from the plasma for four laser flashes with output energy (from left to right) 5, 3, 9, and 2 J. Top - incident radiation, bottom - reflected. LiD target, λ = 0.53 μ, f = 4.5 cm.

The measurements were performed with a diffraction spectrograph having f = 130 cm. The upper part of the exit slit, with width 20 μ for λ = 0.53 μ and 50 μ for λ = 1.06 μ was illuminated with the incident radiation, and the lower half with the reflected radiation. Spectrograms for four laser flashes with an LiD target and an objective with f = 4.5 cm at λ = 0.53 μ are shown in the figure. The spectrum of the light reflected from the plasma shows clearly a large number of equidistant lines located, in the general case, both in the Stokes and in the anti-Stokes parts of the spectrum. The number of lines depends on the energy and, as a rule, increases with the flash energy (see the figure). Opposite the spectral line of the incident radiation there is usually located one of the lines of the reflected radiation, but the latter differs little in intensity from the neighboring ones. The width of each line lies within the limits of the apparatus resolution (0.05 Å). For one and the same level of output energy, approximately 5 J, the spectra were obtained with different degrees of focusing: with the objective having f = 4.5 cm and with the lens of f = 30 cm. In the former case, multiplication of the lines was always observed, and in the latter case, it was observed in approximately half the flashes. This indicates that the effect has a threshold character, since the diameter of the focal spot for the lens was larger by one order of magnitude. The spectral interval δλ between the lines was the same, within the limits of measurement accuracy (0.5%), namely 0.23 Å, and was independent of either the energy or the type of target. A similar picture, but with δλ = 0.46 Å, was observed at the wavelength 1.06 μ.

Additional measurements have shown that the reason for the appearance of equidistant lines in the reflected-radiation spectrum is that the incident-radiation lines have weak satellites (with intensity weaker by at least a factor of 100), and the distance between the satellites is equal to the interval between the lines of the reflected light, when such satellites in the Stokes part of the spectrum can be seen in the second flash on the figure. It was established that the satellites are due to mode selection in the generator and exceedingly weak parasitic reflections by optical elements of the interferometer.

From an examination of the spectrograms it can be concluded that the observed process is stimulated. It may be due to phase modulation of the powerful light pulses in the plasma layer. A theoretical analysis, under conditions close to that in the experiment's conditions, of phase modulation of two plane waves (one of which is strong and the other is weak), differing in frequency by $\Delta\omega \ll \omega_0$ and passing through a nonlinear medium, was made in [6]. In our opinion, the spectrum of the reflected light (δλ = 3 Å) in [7], observed when plasma is heated by laser radiation with a broad line, has a similar origin, although the authors of [7] advance the scattering of the photons by the plasma oscillations as an explanation.

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DISPERSION OF RESONANT NONLINEAR SUSCEPTIBILITY IN POTASSIUM VAPOR

S.A. Akhmanov, A.I. Kovrigin, S.A. Maksimov, and V.E. Ogluzdin
Moscow State University
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1. We report in the present article the results of an experimental investigation of the dispersion of the nonlinear susceptibility of potassium vapor near the transitions $4S_{1/2} - 4P_{3/2}(\nu_{01} = 13043\ \text{cm}^{-1})$ and $4S_{1/2} - 4P_{1/2}(\nu_{02} = 12985\ \text{cm}^{-1})$. The use of a source in the form of a powerful pulsed parametric light generator (PLG) with tunable frequency, and observation of self-modulation, self-focusing, and self-defocusing effects have made it possible to trace for the first time the dispersion of the modulus and of the sign of the nonlinear susceptibility in the entire frequency region ($\nu > \nu_{01}$, $\nu_{01} > \nu > \nu_{02}$, $\nu < \nu_{02}$).

New circumstances that distinguish self-action in a vapor from self-action in a condensed medium are the strong influences of saturation of nonlinearity and of the group-velocity dispersion. Both factors became noticeably pronounced in the experiments described below.

2. A PLG based on an $LiIO_3$ crystal was excited by the second harmonic of a one-mode neodymium laser and operated both in the single-resonator and in the two-resonator schemes. The generator pulse duration was $\tau_g = 7 \times 10^{-9}$ sec, the maximum power was 1 MW and the beam diameter ranged from 1 to 2.5 mm. Depending on the operating regime and on the resonator system, the line width ranged from 0.5 to 15 cm^{-1}; the broad spectrum was made up of clearly pronounced mode groups (the so-called "clusters" of the PLG, see Fig. 1).

3. To study the dispersion of the nonlinear susceptibility we investigated the frequency dependence of the self-action effects in potassium near the resnant transitions. Self-action in vapor was observed earlier at fixed frequencies in [1 - 4]; quantitative data on the cubic susceptibility of potassium at $\nu = \nu_{01} + 12\ \text{cm}^{-1}$ are contained in [2]. We investigated the broadening of the frequency spectrum, self-focusing, and self-defocusing. Figure 1 shows typical spectrograms of the broadened spectra; Fig. 2 shows experimental plots of the relative broadenings $Y = \Delta\nu_{out}/\Delta\nu_{in}$ of the spectrum of the radiation passing through the vapor.

We see that at $\nu - \nu_{01} > 70\ \text{cm}^{-1}$ there is practically no broadening; as ν approaches ν_{01} from the high-frequency side, the broadening first increases and then decreases, vanishing at the resonance. In the region $\nu_{01} > \nu > \nu_{02}$ the experimental $Y(\nu)$ plot has two maxima: Y_{min} corresponds to $\nu \simeq \nu_{02} + 17\ \text{cm}^{-1}$.