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# PARAMETRIC INTERACTION OF INFRARED WAVES IN A MEDIUM IN WHICH INTENSE MOLECULAR OSCILLATIONS ARE EXCITED

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Parametric interactions of light waves in a nonlinear medium are of great interest in connection with the problem of producing light generators that can be tuned in frequency; these interactions have been observed until now in the frequency regions near 1 and 0.7  $\mu$  [1 - 3]. There is undisputed interest in the observation of similar effects in the more remote infrared region. The present communication is devoted to a report of the preliminary results of an experiment carried out in this direction. The pumping was, as proposed in [4], with intense molecular oscillations (which can be excited by using stimulated Raman scattering (SRS), for example, in the visible part of the spectrum). Thus, in such a system the energy of the visible light (say from a ruby laser) can be transferred via the molecular oscillations to infrared waves whose frequencies satisfy the relation

$$\Omega_M = \omega_1 + \omega_2, \quad (1)$$

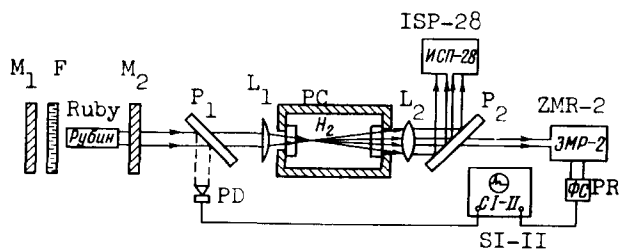
where  $\Omega_M$  is the frequency of the molecular oscillations, provided the wave vectors satisfy the synchronization condition

$$\vec{k}_M = \vec{k}_1 + \vec{k}_2 \quad (2)$$

We present below the results of experiments, in which we observed parametric interaction of this type in gaseous hydrogen. Hydrogen was chosen on the basis of the following considerations:

- 1) weak dispersion (hence possibility of satisfying condition (2)),
- 2) absence of absorption at the frequencies of the ruby laser, SRS, and the interacting infrared waves.

A block diagram of the experimental setup is shown in the figure.  $M_1$  and  $M_2$  -- resonator mirrors,  $P_1$  -- plane-parallel glass plate,  $L_1$  -- quartz lens,  $L_2$  -- fluorite lens, PC -- chamber with hydrogen, PD -- photodiode, ISP-28 -- quartz spectrograph,  $P_2$  -- plane-parallel germanium plate, ZMR-2 -- mirror monochromator with LiF prism, PR -- photoresistor of germanium doped with gold, SI-II -- high-speed oscilloscope. The coherent molecular oscillations were excited in the



hydrogen at 130 atm by the focused beam of a Q-switched ruby laser of 100 MW power and 15 nsec pulse duration (when SRS was produced in the working medium). One of the interacting infrared waves was the third Stokes component of the SRS in hydrogen. It is convenient to use this line, since it is close in frequency to  $\Omega_M/2$  (we recall that the interaction is maximal here). To record the parametric-interaction effect we registered the oscillations at frequency  $\omega_2$ . The registration system consisted of a monochromator, to the output of which was connected a germanium photoresistor doped with gold. The signal from the photoresistor was further fed to a high-speed oscilloscope. Pulses of infrared radiation with wavelengths 4.50 and 5.16  $\mu$  (corresponding to the difference frequency  $\omega_2$  and the third Stokes frequency  $\omega_1$ ) were recorded with approximately identical intensity, demonstrating the sufficiently large parametric interaction. The latter circumstance is important, since it is determined by the coherent-interaction length. We note also that the deduction that the dispersion is weak, and by the same token that the coherent-interaction length is large, is evidenced by our observation of 5 lines in the anti-Stokes region: 5388, 4403, 3723, 3217, and 2844 Å, the local intensity of the fifth anti-Stokes line amounting in the best case to 5% of the intensity of the first anti-Stokes line.

It follows therefore from the experimental data on observation of parametric interaction between infrared waves and coherent molecular oscillations, that we can hope to obtain self-excitation at infrared frequencies by selecting resonators for these frequencies.

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#### EFFECT OF SMALL TERBIUM IMPURITIES ON THE MAGNETOSTRICTION OF YTTRIUM IRON GARNET

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It was established in [1,2] that small impurities of terbium in yttrium iron garnet (YIG) exert a strong influence on the magnetic anisotropy of the resonance field and on the line width of the ferromagnetic resonance absorption in the low-temperature region. The high sensitivity of the parameters of the ferromagnetic resonance of YIG to small terbium impurities