$$W_{diss} = \frac{\gamma\sigma_{ortho}P}{\hbar\omega}\frac{L_{cell}}{V_{cell}}. \quad (2)$$

From the obtained value of W_{diss} and the measured value of the absorption coefficient follows an estimate of the quantum yield of predissociation from the excited state $B^3\pi_{0^+u}$ with v = 43, namely $\gamma \simeq 0.5\times10^{-2}$.

We note in conclusion that our experiment uncovers a possibility of investigating the predissociation of molecules and the conversion of ortho- and para-modifications of molecules, and of separating the radioactive iodine isotopes.

The authors thank O. N. Kompanets for help with the experiments and Professor I. I. Sobel'man for a discussion of the results.

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1)This method of realizing selective chemical reactions was proposed in [2] and used in [3] to separate the hydrogen isotopes in H_2CO, a process likewise considered in [2].

2)The formation of I_3, accompanied by the reaction $I + I_3 \rightarrow 2I_2$, was used in [8] to explain the anomalously large value of the rate constant of recombination of iodine atoms in the presence of I_2 molecules.

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SATURATION EFFECTS IN STIMULATED RAMAN SCATTERING AND RESONANT ABSORPTION (AMPLIFICATION) OF A STRONG NONMONOCHROMATIC FIELD

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Submitted 16 August 1973
ZhETF Pis. Red. 18, No. 8, 519 – 522 (20 October 1973)

1. We consider in this article stimulated Raman scattering (SRS) in the field of strong optical noise, with saturation effects taken into account. We discuss a new regime of strong energy transfer from broadband exciting radiation to a harmonic Stokes signal.

To analyze the nonlinear effects produced when incoherent light interacts with quantum systems, we propose to use an approach analogous to the Dyson-equations technique in the theory of waves in turbulent media [1], generalized to include nonlinear problems [2, 3].

2. Let $\hat{L}$ and $\hat{N}$ be a nonlinear and a linear operator. We seek the mean value $\overline{x}$ of a quantity x satisfying the equation $\hat{L}x = \hat{N}(x)$, in which N or the initial (boundary) conditions for x contain a random function ξ with known characteristics. In our case $\xi(t)$ is the complex amplitude of a nonmonochromatic field incident on the medium and having a line shape $G(\omega)$, an average intensity $I_0 = \int_{-\infty}^{\infty} G(\omega)d\omega$, and a spectral width $\Delta\omega$. Putting $x = \overline{x} + \tilde{x}$ ($\tilde{x}$ is the fluctuation), we obtain two equations: (a) $\hat{L}\overline{x} = \langle\hat{N}\rangle$ and (b) $\hat{L}\tilde{x} = \overline{N} - \langle N\rangle$. By determining $\tilde{x}$ from the second equation in the form of a series in ξ (in which case $\overline{x}$ is regarded as a variable parameter of Eq. (b) and is assumed independent of ξ) and substituting the result in (a), we obtain for $\overline{x}$ the equation

$$\hat{L}\overline{x} = \sum_{n=0}^{\infty} N^{(2n)}(\overline{\overline{x}}),$$

in which $N^{(2n)}$ are certain functionals that are nonlinear in x and are proportional to the correlation functions of ξ of even order 2n (under the condition $\langle\xi^{2n+1}\rangle = 0$, which holds true for Gaussian noise and for some other models of noise radiation). Taking into account only the first term of the expansion, we have

$$\hat{L}\bar{x} = N^{(2)}(\bar{x}), \qquad N^{(2)} \sim G(\omega). \tag{1}$$

For linear problems we have $N^{(2)}(\bar{x}) \sim \bar{x}$, and (1) corresponds to the Bourret approximation in the theory of multiple scattering [1] or to the "ladder" approximation for the Bethe-Salpeter equation (if $\bar{x}$ is taken to be a correlation function [9]). In the limit of large $\Delta\omega$, Eq. (1) goes over into the Fokker-Planck approximation equation [4, 5].

The described approach is generalized directly to the case of a system of equations.

3. We turn now to the analysis of SRS in pumping noise field. We assume that a pump wave with amplitude $A_p(t, z = 0) = \xi(t)$ and a sinusoidal Stokes signal of amplitude $A_S(t, z = 0) = A_{S0}$ are incident on a Raman-active medium occupying the region $z > 0$, with a spontaneous line contour $F(\omega) = 1 + \omega^2T_2^2)^{-1}$. In the medium we have

$$\left(\frac{\partial}{\partial z} - i\beta_p\frac{\partial^2}{\partial\theta^2} + \alpha_p\right)A_p = -\sigma_p A_S Q, \tag{2}$$

$$\left(\frac{\partial}{\partial z} + \nu\frac{\partial}{\partial\theta} - i\beta_S\frac{\partial^2}{\partial\theta^2} + \alpha_S\right)A_S = \sigma_S A_p Q^*, \tag{3}$$

$$T_2\frac{\partial Q}{\partial\theta} + Q = \sigma_Q T_2 A_p A_S^*, \qquad (\theta = t - z/u_p) \tag{4}$$

Q is the amplitude of the molecular vibrations $\alpha_{p,S}$, $\sigma_{p,S}$, and $\beta_{p,S}$ are constants, with $\beta_i = (1/2)(\delta^2k/\delta\omega^2)_{\omega=\omega_i}$ (i = p, S) describe the variation of the group velocities about their mean values u_p and u_S within the corresponding wave packets; $\nu = 1/u_S - 1/u_p$.

The most interesting result, pertaining to the regime without saturation ($A_p \gg A_S$), is the conclusion that even a pump with a rather broad spectrum ($\Delta\omega \gg T_2^{-1}$, $\Delta\omega \gg 2\pi\ell^{-1}|\nu|^{-1}$, where ℓ is the interaction length) is scattered by the medium just as effectively as a monochromatic pump, provided its average intensity exceeds a certain critical value, $I_0 > I_{cr} = 4c|\nu|g^{-1}\Delta\omega$, where $g = 2T_2\sigma_S\sigma_Q$ is the SRS gain (at $\beta_{S,p} = 0$ [2, 3, 5, 10]). The experimental results agree with this conclusion and show that SRS saturation in the case $\Delta\omega T_2 \simeq 10^3$ sets in at the same power levels as in the case $\Delta\omega T_2 < 1$ [6, 7]. We note that by considering a multimode pumping model (see also [11]), when $G(\omega) = \Sigma I_n\delta(\omega - \omega_n)$ and the distance between modes exceeds T_2^{-1}, we obtain for the SRS increment $\Gamma(|A_S|^2 \sim \exp\Gamma z)$ the equation

$$1 = g\sum_n \frac{I_n}{\Gamma + i2[\nu\Omega n + (\beta_S - \beta_p)\Omega^2 n^2]},$$

from which we see likewise that Γ tends to $\Gamma_0 = gI_0$ with increasing $I_0 = \sum_n I_n$.

4. As follows from the linear theory, when a monochromatic Stokes signal is amplified and $I_0 < I_{cr}$ the wave velocity dispersion causes the coherent component to predominate in the SRS spectrum, $A_S \simeq \bar{A}_S$, and the fluctuating component is suppressed. The natural assumption that this picture remains in force also in the saturation regime at large z (I_{cr} is independent of z) corresponds precisely to the "nonlinear" Bourret approximation considered above, and (1) takes the form

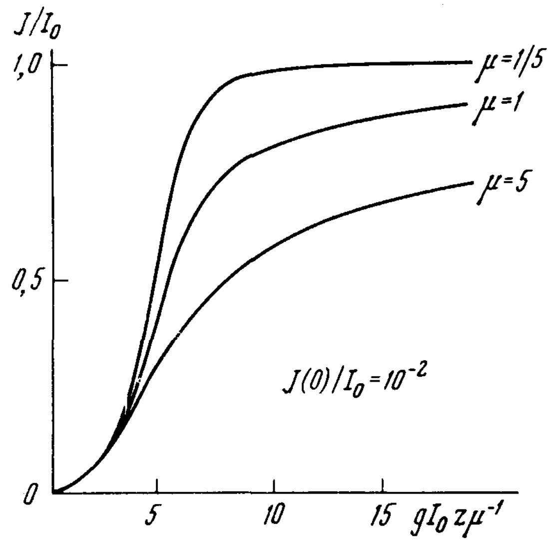
$$\frac{dJ}{dz} + 2\alpha_S J = e^{-2\alpha_p z} gJ \int_{-\infty}^{\infty} G(\omega)F(\omega)\exp\left[-\frac{\omega_p}{\omega_S} gF(\omega)\int_0^z J(z')dz'\right]d\omega, \tag{5}$$

where $J = |\bar{A}_S|^2$ is the intensity of the coherent SRS component ($\beta_{p,S} = 0$). In the limiting case $G(\omega) = I_0\delta(\omega)$, Eq. (5) goes over into a known equation that describes SRS saturation in the case of monochromatic pumping [8].

According to (5), in a lossless medium the quantity J tends with increasing z to the maximum limit $|A_{S0}|^2 + (\omega_S/\omega_p)I_0$ permitted by the Manley Rowe relation, meaning that all the optical noise power can be transferred to the monochromatic component of scattered light whose frequency coincides with the priming frequency. The rate of this transfer is determined in this case by the quantity $\mu = 1/\Delta\omega T_2$ (see the figure). This result is explained by the picture of transformation of the spectra, which can be obtained from the fluctuation equations (2) and (4) ($A_p = \bar{A}_p$, $Q = \bar{Q}$), analogous to (b)

$$G_p(\omega, z) = G(\omega)\exp\left\{-\frac{\omega_p}{\omega_S} gF(\omega)\int_0^z J(z')dz'\right\},$$

$$G_Q(\omega, z) = \sigma_Q^2 T_2^2 F(\omega)\, G_p(\omega, z),$$



namely, the first to be transferred is the energy contained at the center of the spectral line of the noise, followed by the energy in the wings of the spectrum, owing to the beats of the correlated fluctuations of the pump and of the phonons. As seen from the last formula, the relative role of the wings of the phonon-wave spectrum increases in the energy transfer with increasing z.

5. The Dyson-equations method was used by us also to analyze the propagation of a noise-filled light pulse in a two-level system, with saturation taken into account. These results will be published in another article.

The authors thank V. N. Pet'kov for the computer calculation.

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ELECTRODYNAMICS OF SURFACE SUPERCONDUCTIVITY

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Submitted 20 August 1973
ZhETF Pis. Red. 18, No. 8, 523 – 526 (20 October 1973)

The energy spectrum of the excitations and the surface of impedance of a metal are investigated under conditions when surface superconductivity is present.

We consider the energy spectrum of the excitations of a semi-infinite superconductor in an