We propose that the periodic reversal of the sign of the PEM emf in n-type InAs with change in the magnetic field, observed by Kikoin and Lazarev [9], is connected with the mechanism described above.

We note that the analysis of the concrete cases calls for allowance for a number of factors and requires a separate study.

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*We put $\hbar = 1$ throughout, and the phonons referred to are optical phonons.

STIMULATED RAYLEIGH SCATTERING OF LIGHT IN SOLUTIONS OF LIQUIDS

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A number of papers [1] have reported observation of stimulated scattering of the Mandel'shtam-Brillouin component (SMBS) and stimulated scattering of light of the wing of the Rayleigh line (SRWS) in liquids. We report in this note some results of observations of SMBS and SRWS as well as of stimulated scattering of the central Rayleigh component (SCRS) in liquid mixtures.

The experimental setup was similar to that described in [2]. A light flash ($\lambda = 0.6943$ μ, spectrum width < 10^{-2} cm^{-1}) of duration $\sim$ 20 nsec and power $\sim$ 5 MW was focused (F = 15 cm) inside a cell containing the investigated liquid. A Faraday valve was used to eliminate feedback between the cell and the laser. The spectrum of the light passing through the cell and backscattered was analyzed with the aid of a Fabry-Perot interferometer.

2. Since the initial purpose of the experiment was to investigate the possibility of obtaining a specified frequency shift by selecting the solution concentration, we chose for the mixtures such liquid pairs (quinoline C_9H_7N and ethyl alcohol C_2H_5OH, nitrobenzene $C_6H_5NO_2$ and carbon tetrachloride CCl_4), in which the shift due to SMBS is appreciably different. The results of the investigation of the light-frequency shift following SMBS in the backward direction is shown in Fig. 1. The horizontal axis represents the concentration of the quinoline and nitrobenzene in

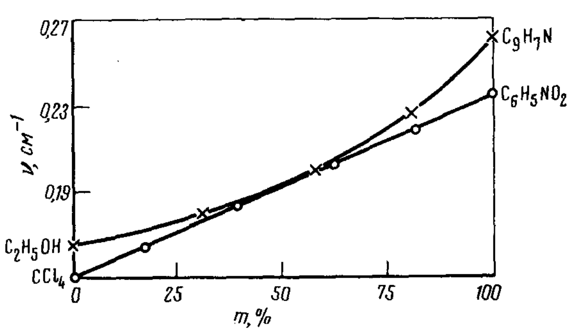
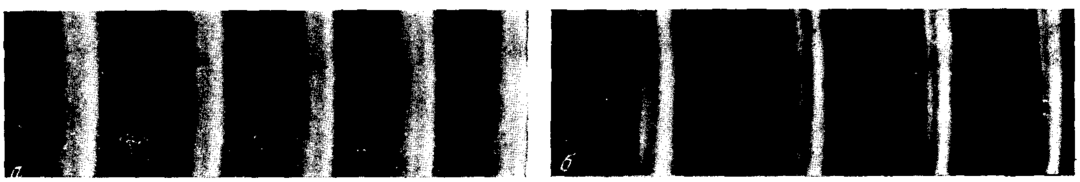


Fig. 1

the corresponding solutions. As assumed, when the concentration is varied from 0 to 100% the shift changes smoothly from ν_1 to ν_2, where ν_1 and ν_2 are quantities corresponding to the pure components of the mixtures. It is therefore possible, by using solutions of suitable liquids, to obtain a light source whose frequency can be tuned (in a range of ~ 0.1 cm^{-1}).*

3. The spectrum of the light scattered by all the investigated liquids and solutions in the backward direction revealed always, even at ten-fold excess over threshold, only one Stokes SMBS component.** Its intensity and excitation threshold remained approximately constant for all the investigated $C_6H_5NO_2$-CCl_4 ratios, whereas the intensity of the SMBS in the C_9H_7N-C_2H_5OH solution depended on the concentration. Thus, at 58% C_9H_7N, the intensity decreased by one order of magnitude compared with emission in pure liquids.

4. For some liquids, the spectrum of the light passing through the cell revealed SRWS. The SRWS band widths were ~ 0.8 cm^{-1} for C_9H_7N and ~ 0.6 cm^{-1} for pure and slightly diluted CCl_4 (Fig. 2a). The SRWS intensity first increases noticeably as the carbon tetrachloride is added to the nitrobenzene, so that the intensity in a solution containing 62.4% nitrobenezene is larger by one order of magnitude than for pure nitrobenzene (at maximum exciting-beam intensity) and the threshold of its occurrence is lower by a factor of two or three. At lower nitrobenzene



a b

Fig. 2

concentrations, however (39.1% and 17%), and in pure CCl_4, no SRWS was observed. Addition of as little as 17% alcohol to C_9H_7N *** stops the SRWS. Nor is SRWS observed in pure alcohol. In some cases one could see against the SRWS background one or two lines with shifts ν and 2ν (see Fig. 2a). Since it is customarily assumed that the forward SMBS Stokes components can be observed as a result of feedback between the cell and the laser, measures were taken, as already mentioned (Faraday valve), to eliminate this feedback. Although we did not succeed in fully eliminating the feedback, the intensity of the first Stokes component in the incident light was much lower (by approximately two orders) than the intensity of the main line. The second Stokes component was not observed in the incident light. Its appearance is apparently due to secondary weak SMBS of the intense backward SMBS component. The weak forward emission with shifts ν and 2ν can then be amplified by parametric effects with two-photon pumping [4,5], which lead, in particular, to SRWS and to self-focusing and self-modulation effects. In pure alcohol, analogous two coponents were observed in transmitted light without SRWS (Fig. 2b).

5. We observed in the C_9H_7N-C_2H_5OH solution intense quasi-isotropic nonlinear scattering of light at an unshifted (accurate to 10^{-2} cm) frequency. It is apparently connected with scattering from the concentration fluctuations, which become more intense as a result of the interaction with the light. This scattering, in analogy with the already established terminology, can be called stimulated scattering of the central (unshifted) Rayleigh component (SCRS). Stimulated scattering of this type should be particularly intense near the critical points,

a

b

Fig. 3

and is, in essence, stimulated critical opalescence. Figure 3a shows a photograph of a beam in a 58% solution of quinoline in alcohol, obtained with a neutral filter (attenuation factor 32) placed in the path of the scattered light (ahead of the camera lens). Photograph 3b was obtained under the same conditions, but with the filter moved from the path of the scattered light to the path of the exciting beam (ahead of the cell). Comparison of the photograph does indeed show the presence of nonlinear quasi-isotropic scattering. Photography of the beam from different directions has shown that the SCRS is produced intensively in a direction perpendicular to the polarization of the electric vector in the incident beam, and weakly in the direction parallel to this vector.

It is the appreciable attenuation of the incident beam by the SCRS which caused the other scattering processes to become weaker in the quinoline-alcohol solution.

The quasi-isotropic nonlinear scattering makes it possible to observe with greater contrast the amplitude structure of the beam. Thus, a number of photographs show more intense and relatively thin ($\sim 10^{-2}$ cm) filaments whose constant diameter over the entire length of the beam ($\sim$100 mm) is apparently the result of self-focusing.

A similar process, but less intense (by approximately two orders of magnitude) was observed in the solution of nitrobenzene in CCl_4. Another difference was that the scattering had in this solution a fine-grain local character. Results of more detailed investigations of SCRS will be published in the future.

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*When used with independently-measured values of the refractive index n and density ρ, the plots can be used to determine the coefficient of adiabatic compression β_s from the relation $v = (\rho \beta_s)^{-1/2}$, where $v = c\lambda\nu/2n$ is the speed of sound.

** No emission at the anti-Stokes frequency was observed in any of the experiments. When the Faraday valve decoupling the cell from the laser was removed, many Stokes and anti-Stokes SMBS were observed. A similar feedback from the cell to the laser apparently occurred in [3].

*** No investigations were made at lower concentrations of the alcohol in the C_9H_7N.