quencies in a biaxial antiferromagnet in the $\ell_{\parallel}$ phase. When $H > \mu_{\perp} H_t(T)$ ($\mu_{\perp}$ is the transverse permeability of the antiferromagnet), it is necessary to put $\xi = 0$ in (3) and (4), and we arrive at the resonance frequencies of a biaxial antiferromagnet in the $\ell_{\perp}$ phase. Finally, the variation of the frequencies in the field interval $\mu_{\parallel} H_t < H < \mu_{\perp} H_t$ is described by formulas (3) and (4) in which we must put $H = H_t$ and $\xi = (\mu_{\perp} H_t - H_E)(\mu_{\perp} - \mu_{\parallel})^{-1} H_t^{-1}$. The field dependence of the AFMR frequencies, in a wide range of fields, as described by formulas (3) and (4), is plotted in Fig. 1b. The AFMR frequencies for bodies of different shapes are similar, but the field interval in which ξ varies from zero to unity depends on the shape of the body. Since $\chi_{\perp} = (\mu_{\perp} - 1)/4\pi$, the field interval from $\mu_{\parallel} H_t$ to $\mu_{\perp} H_t$ is very small. Therefore the temperature dependence of the resonance fields corresponding to the intersection of the line $\omega = \text{const}$ with the resonance curves $\omega = \omega_{1,2}(H)$ in the interval from $\mu_{\parallel} H_t$ to $\mu_{\perp} H_t$ will duplicate the temperature dependence of the field $H_t(T)$, as was indeed observed in our experiments.

As seen from Figs. 1b and 2, the values of the larger resonance fields at the frequencies ν_2 and ν_4 and their dependence on the temperature coincide with those for $H_t(T)$. These data, together with the data of [2] concerning the smaller resonance field at 32 GHz offer evidence, in our opinion, that[2)] the transition from the phase $\ell_{\parallel}$ to the phase $\ell_{\perp}$ in $CuCl_2 \cdot 2H_2O$ at $T \geq 1.52°K$ is of first order, and that the antiferromagnet breaks up in this transition into domains of the phases $\ell_{\parallel}$ and $\ell_{\perp}$, as was deduced theoretically in [5].

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LINE SHAPE OF RESONANT STIMULATED RAMAN SCATTERING IN NEON

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Much interest is being evinced at present in stimulated shifted (Raman) scattering. In the quantum theory of radiation [1, 2], the scattering is regarded as a process that proceeds via definite intermediate states (virtual levels). The presence of real levels leads to a

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[2)] It might be assumed that absorption of the high-frequency field energy in the antiferromagnet at $H = H_t$ is connected with heterophase fluctuations, but this assumption is contradicted by the data of [8], where no absorption was observed at 9 GHz in a field $H = H_t$ and at $T < 2.2°K$.

growth of the scattering cross section in analogy with the effect of the increase of the growth of the cross section of the classical scattering near resonance (resonant fluorescence) [1]. In a low-pressure gas, investigations of the intensity and line shape resonant stimulated Raman scattering can yield important information concerning coherence-relaxation processes due to spontaneous damping, collisions, excitation diffusion in the dragging of resonant radiation, etc. We report in this paper the first experimental observation of the line shape of resonant stimulated Raman scattering in neon for monochromatic radiation, and direct observation of the diffusion of excitation in velocity space in dragging of resonant radiation.

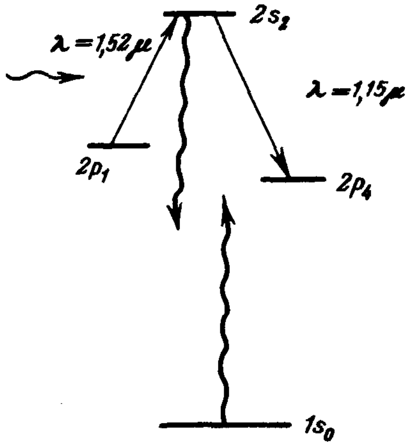

Fig. 1. Level scheme.

The neon transition scheme with the resonant stimulated Raman scattering is shown in Fig. 1. Extraneous linearly-polarized radiation of wavelength $\lambda = 1.52$ μ, resonant with the $2s_2 - 2p_1$ transition of neon, was produced by an He-Ne laser in which mode selection was effected by an internal absorbing cell [3]. The resonant stimulated Raman scattering was observed at the wavelength 1.15 μ ($2s_2 - 2p_4$) with the aid of a weak monochromatic field having the same linear polarization and passing through a discharge tube filled with neon, either in the propagation direction of the strong field (forward scattering) or in the opposite direction (backward scattering). The weak-field frequency was scanned slowly. The 1.52-μ radiation from the high-power laser was modulated mechanically in synchronism with the reference voltage of the phase detector. A light filter in front of the photoreceiver transmitted only at 1.15-μ radiation. By observing the ac component of the photoreceiver output signal, it was possible to determine the shape of the 1.15-μ amplification line due to the action of a 1.52-μ field.

The observed scattering-line shape is shown in Fig. 2a (forward scattering) and in Fig. 2b (backward scattering). The line profile is complicated. In either direction, a narrow peak is observed against the background of an appreciable "base." Reduction of these curves

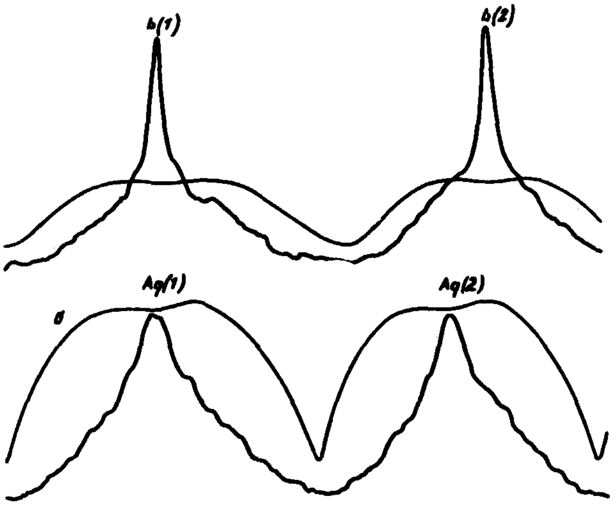

Fig. 2. Line shape of shifted stimulated resonance scattering in neon: a - forward scattering, $K_1 \cdot K_2 > 0$, $\lambda_2 = 1.15$ μ, P_{Ne} = 0.9 torr, I_{dis} = 10 mA; b - backward scattering, $K_1 \cdot K_2 < 0$, P_{Ne} = 0.9 torr, I_{dis} = 10 A. Distance between orders 1270 MHz.

with allowance for the frequency dependence of the weak field amplitude has shown that the "base" is a Gaussian curve of Doppler width.

In this experiment, the scattering line width is governed by the following factors: a) the velocity distribution of the atoms, which results from the interaction between the monochromatic field and the inhomogeneously broadened line (Bennett distribution [4]); b) diffusion of the excitation in velocity space on dragging of the resonant radiation from the level $2s_2$ (Fig. 1) [5]; c) coherent effects in the scattering.

The first factor causes the stimulated-emission line shape to take the form of a narrow peak of Lorentz shape. The second factor gives rise to the Doppler "base," since the spontaneous emission is almost isotropic and total loss of the phase memory occurs after several re-radiation acts. The last of the indicated factors causes the stimulated-scattering line shape to be dependent on the observation direction (nonlinear interference effects [6]). The existence of a narrow peak (Fig. 2) is due to those atoms that emit a 1.15-μ photon immediately after absorbing a 1.5-μ photon, the forward scattering being interpreted as partially-coherent scattering (two-photon process), while the backward scattering is regarded as fully incoherent scattering (stepwise process of absorption and subsequent emission).[1)]

The forward and backward scattering line widths amounted to 50 ± 5 and 103 ± 10 MHz, respectively, for a neon pressure ∿ 0.3 torr. In both cases, the Doppler "base" makes a noticeable contribution to the amplification line. The measured ratios of the amplitudes of the peaks and of the "base" are in agreement with the theory considered in [5]. Investigations of the scattering line shape as a function of the neon pressure have shown that collisions with the neon atoms greatly reduce the fraction of the coherent scattering. At low neon pressures, the stimulated Raman scattering line shape agrees qualitatively with the predictions of the theory of nonlinear interference effects [6].

We note in conclusion that the narrowing of the amplification line and the increase of the maximum gain as a result of the resonant stimulated Raman scattering effect can be used to produce optical amplifiers and generators. The amplification at $\lambda = 1.15\ \mu$ produced by a field of $\lambda = 1.5\ \mu$ has enabled us to produce generation in a three-level laser using the pair of neon transitions $2s_2 - 2p_1$ and $2s_2 - 2p_4$ [7].

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[1)] The coherence in the emission of the atoms can lead also to the occurrence of a directivity pattern for the radiation intensity upon scattering.