goes mostly to increase the amplitude of the initial wave (the harmonics are generated at a lower rate, $\sim(\Delta/\varepsilon_F)^\ell$, where ℓ is the number of the harmonic).

The growth of the wave amplitude is proportional to the nondiagonal element of the density matrix $\rho_{p,p-k}$, which should be determined from (2). We can, however, use the energy conservation law directly.

In the particular case when all the levels below the gap are filled (i.e., $\varepsilon_F = \varepsilon_0 - \Delta/2$), all the calculations become exceedingly simple. In this case, j_{st} = neS and is independent of E, the power transferred to the sound is neSE and the wave amplitude increases like

$$A(t) = \sqrt{A^2(0) + \frac{2enS\,E}{dS^2k^2}\,t}\,.$$

We disregard the processes that limit the growth of A(t).

The model used by us does not reflect all the processes in real semimetals or semiconductors. We have neglected the interaction of the sound with carriers of other valleys (bearing in mind that it is possible to produce conditions when requirements 1 - 4 are satisfied for only one valley: for example, requirement 1 in bismuth is satisfied for holes in stronger fields than for electrons). No account was taken of carrier scattering by thermal phonons and zero-point lattice oscillations, or of intervalley scattering (these processes are less effective than intravalley scattering by impurities, and do not change the results). An important role can apparently be played by interparticle interactions. In spite of the relative weakness, they influence both the rate of the particle transition through the gap, and the distribution under the gap. These questions will be considered in another paper.

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POSSIBILITY OF GENERATING ULTRASHORT LIGHT PULSES IN LASERS WITH SMALL LUMINESCENCE LINE WIDTH OF THE MEDIUM

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A theory of stimulated Raman emission (SRE) in an optical resonator excited by an external longitudinal monochromatic light beam was developed in [1 - 3]. It was shown, in particular, that if the resonator is filled with a liquid or a solid the phases of the oscillations of the different SRE components are arbitrary, i.e., they are not interconnected. A theoretical investigation [4] of the case of a gas-filled resonator has shown that the phases of the SRE components are interconnected, and the output radiation is a sequence of ultrashort pulses with a spectrum width determined by the number of generated components. An investigation [5] of stationary stimulated Mandel'shtam-Brillouin emission (SMBE) under similar conditions has shown that the phases of the different SMBE components are also interconnected if the resonator contains a broadband nonlinear absorber in addition to the medium that is active in the Mandel'shtam-Brillouin spectrum. The practical realization of the SRE and SMBE regimes considered here is made difficult by the fact that excitation of the resonator by an external beam (from a separate laser) makes it necessary that the resonator natural frequency coincide with the beam frequency with a high degree of accuracy.

We propose here a coupled (laser-resonator) system in which the laser generation frequencies are automatically chosen to be close to the natural frequencies of the resonator in question. The proposed system consists of a common (ring or axial) resonator R_0, inside of which there is placed a selector for the transverse modes, the active laser medium, a medium active in the SRE spectrum (or in the SMBE spectrum and a broadband nonlinear absorber), and a plane-parallel resonator R_1. To prevent generation due to reflections from the resonator R_1 one can use a Faraday cell, or else one can tilt the resonator R_1 relative to the direction of the beam in the laser[1)]. In this case the highest Q is possessed by those modes of resonator R_0 for which the coefficient of transmission through the resonator R_1 is maximal. In turn, the coefficient of transmission through resonator R_1 has sharp maxima corresponding to its natural frequencies (the values of the transmission coefficients at the maxima are close to unity). It is therefore clear that the resonator R_1 plays simultaneously the role of a high-efficiency selector for the axial (longitudinal) modes in the resonator R_0 and selects generation frequencies close to its natural frequencies.

We consider below two cases: 1) a medium active in the SRE spectrum is located in resonator R_1 and only the active laser medium is located in the common resonator R_0 (there is no nonlinear absorber at all); 2) a medium active in the SMBE spectrum and a nonlinear absorber, as well as the active laser medium, are contained in the common resonator R_0; the resonator R_1 is filled with a linear medium.

In the <u>first case</u> the time of establishment of the oscillations at the laser and Stokes frequencies is determined by the Q's of the employed resonators. The parameters of the system should be chosen such that a quasistationary regime of the generation of Stokes components manages to become established during the characteristic time of variation of the intensity (or of the frequency) of the laser generation. The mirrors of the resonator R_0 should be practically non-reflecting at the Stokes frequencies, in order that the generation of the Stokes components be determined only by the resonator R_1. This makes possible, in analogy with [4], synchronization of the SRE components and generation of ultrashort pulses with a spectral width determined by the number of these components, i.e., in general greatly exceeding the luminescence line width of the laser medium. It should be noted that the laser efficiency may become lower in this system, for in accordance with [3], in the case of the SRE, the coefficient of reflection from the resonator R_1 at its natural frequency may become close to unity, leading to absorption of the light energy in the Faraday cells.

In the <u>second case</u> the role of the resonator R_1 reduces only to selection of axial modes of the resonator R_0, and owing to the higher efficiency of the given selector, its parameters can be chosen such that only one axial mode of the resonator R_0 is excited in each SMBE component[2)]. Although the results of [5] for the SMBE process are not directly applicable in this case, it is clear

[1)]We note incidentally that tilting of resonators is usually used for tuning purposes.

[2)]In particular, the interval between neighboring natural frequencies of the resonator R_1 should coincide with the Mandel'shtam-Brillouin shift in the medium.

that under the conditions in question, in analogy with [5], synchronization of the SMBE is also possible, since the main initial premise in this paper is the fact that only one resonator mode is excited in each SMBE component (if a large number of modes is excited with different frequencies, an internal parametric interaction between them is possible [2, 3] and the picture of the phenomenon can become much more complicated). Thus, in this case it is also possible to have generation of the ultrashort pulses with a spectrum width exceeding the luminescence line width of the active laser medium and apparently without a reduction in the laser efficiency, since the reflecting properties of the resonator R_1 remain unchanged during the generation process.

It is possible to avoid in similar fashion also the lowering of the laser efficiency during SRE, by using, for example, a system consisting of a ring resonator R_0 (with active laser medium) and an axial resonator R_1' for the Stokes components, subtending over a section of the resonator R_0 (together with the mirrors) containing a medium active in the SRE spectrum, as well as a hollow resonator R_1.

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TOKAMAK WITH NON-ROUND SECTION OF THE PLASMA LOOP

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The main task of the research performed with the Tokamak apparatus is to obtain a plasma with maximum possible temperature and density under quasistationary conditions. In the existing Tokamak installations, an annular plasma loop is produced with a nearly circular cross section. The plasma is heated by the Joule heat of current flowing along the loop. The magnetic field of this current performs the main function of containing and thermally insulating the plasma. To ensure stability of the plasma loop against large-scale deformations of the magnetohydrodynamic type, a strong external field is used, the annular force lines of which are parallel to the current in the loop.

The experiments performed with Tokamaks have shown that the average plasma pressure in the loop $\bar{p}$ is proportional to H_ϕ^2, where H_ϕ is the intensity of the magnetic field of the current at the plasma boundary. With increasing H_ϕ, the time τ of energy containment in the plasma also increases. In this case $\bar{p}$ and τ are practically independent of the intensity of the longitudinal magnetic field H_θ. To improve the main physical parameters of the plasma in the Tokamak installations it is therefore necessary to increase H_ϕ.

However, an analysis of the stability of the plasma loop shows that a certain limitation is imposed on the value of H_ϕ at a specified value of H_θ. The plasma loop is stable against helical deformations if the so-called safety factor,

$$q = \frac{H_\theta}{H_\phi}\,\frac{L_\phi}{L_\theta}, \quad (1)$$