Relation (3) makes it possible to establish whether the spins are noncollinear in both sublattices or only in one. Equation (3) still does not make it possible to determine the values of the angles at a given temperature (Fig. 2a). It can be proposed, however, in accord with [5], that the angular configurations are unstable and vanish with increasing temperature, giving way to a collinear arrangement of the spins. The limitation cos $\alpha_T \le 1$ makes it then possible to estimate the minimum value of the angle α^B_{min}, which turns out to equal approximately 50°. This angle corresponds to $\alpha^A_{min}(\tau)$. If in fact $\alpha^B > 50°$, then the angles α^A are also larger.

On the other hand, the dependence of α^B on the temperature leads to a corresponding change of the $\alpha^A(\tau)$ curve. Figure 2b shows the minimal values of the angles at which it is still possible to satisfy Eq. (3).

We see that the experimental data can be explained only by assuming that the spins are noncollinear in both sublattices.

Since the neutron-diffraction data do not give regular angular configurations in samples of similar composition [6], the angles α^A and α^B should be taken to mean, generally speaking, $\cos^{-1} \alpha^A$ and $\cos \alpha^B$.

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GENERATION OF MAGNETOSONIC OSCILLATIONS IN THE TOKAMAK TO-1

N.V. Ivanov, I.A. Kovan, and E.V. Los'
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In connection with the prospects of using magnetosonic resonance [1] for additional heating of the plasma in the Tokamak, a study was made of the possibility of exciting natural oscillations of the plasma column using a high-frequency amplifier in a feedback loop via the plasma. Unlike the methods in which the source of oscillations is an independent generator with fixed frequency, this method makes it possible to introduce energy into the plasma with sufficiently broad tuning of the natural frequency.

Experiments on the generation of magnetosonic oscillations were carried out on the Tokamak TO-1 [2]. The plasma oscillations were excited by a loop inserted through a lateral stub in the liner and producing an HF magnetic-field component parallel to the column axis. The loop did not surround the plasma column and was located in the shadow of the diaphragm. The feedback was produced by a magnetic probe having the same polarization and placed in a diametrically opposite section of the liner.

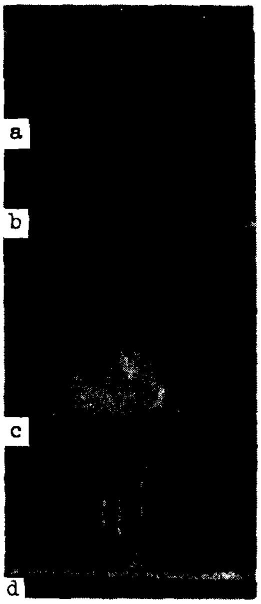

Fig. 1

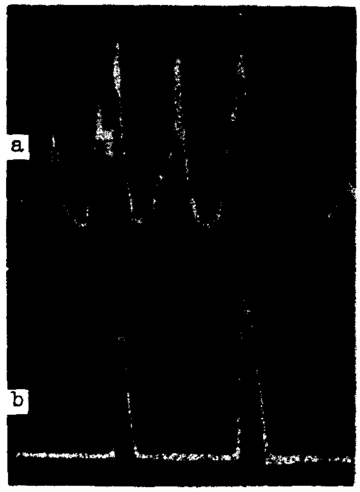

Fig. 2

Fig. 1. Oscillogram of discharge in hydrogen, sweep rate 2 msec/div; a - discharge current, maximum current 10 kA; b - voltage across discharge, sensitivity 20 V/cm; c - signal from magnetic probe; d - signal from amplifier output.

Fig. 2. Sweep of a section of the spectrum after delay of 8 msec relative to the start of the discharge, sweep rate 100 msec/div: a - signal from magnetic probe, b - amplifier output signal.

We first investigated the spectrum of the natural oscillations of the plasma column. To this end, the exciter was fed with voltage from an independent generator operating in the stationary regime at 50 MHz. The signal received by the magnetic probe was fed to an oscilloscope after amplification and detection. When the plasma concentration was varied in time, as monitored by interferometers at wavelengths 2 and 8 mm, successive excitation of the spatial-harmonic spectral lines was observed. An oscillogram of the signal from the magnetic probe, illustrating this result, is shown in Fig. 1c, together with oscillograms of the discharge current and voltage.

From the line width we determined the plasma-resonator Q, which depended on the plasma parameters and the oscillation mode. A section of the spectrum, obtained at a large sweep rate, is shown in Fig. 2a. In this spectral interval, values of $Q \simeq 250$ are attained for individual resonant maxima at a high-frequency magnetic field amplitude not exceeding 0.1 Oe.

The large value of the Q of the plasma resonator has made it possible to effect self-excitation of the oscillations using feedback. To this end, the magnetic probe and the exciter were interconnected through a narrow-band amplifier operating at 50 MHz and having a bandwidth 100 kHz. The generation signal produced at the output of the amplifier was fed to an oscilloscope after detection.

The effect of the generation is shown in Figs. 1d and 2b. As seen from these oscillograms, self-excitation occurs not at all lines of the spectrum. This is due to the fact that for generation, even in the presence of sufficient gain, phase relationships must be satisfied in the feedback circuit.

The use of a broadband amplifier makes it possible to maintain the generation of the chosen oscillation mode with sufficient variation of its frequency. The results of these experiments will be presented in our next paper.

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EXCITATION OF AN EXPLOSION WAVE BY INITIATING A CHAIN REACTION IN A GAS MIXTURE WITH CO_2-LASER RADIATION

N.V. Karlov, N.A. Karpov, Yu.N. Petrov, A.M. Prokhorov, and O.M. Stel'makh
P.N. Lebedev Physics Institute, USSR Academy of Sciences
Submitted 29 June 1971
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We report here for the first time a chain reaction initiated by CO_2-laser radiation and accompanied by an explosive wave. We have observed that when a mixture of H_2 and BCl_3, which do not react with each other, is exposed to radiation from a CO_2 laser (wavelength 10 μ), a vigorous chemical reaction is initiated by dissociation of the BCl_3 molecule by the laser radiation. The front of the reaction propagates in the form of a cylindrical explosive wave.

It is known that irradiation of gaseous BCl_3 by a CO_2 laser leads to dissociation of the molecules of this gas [1]. The laser radiation frequency coincides with the vibration frequency ν_3 of the BCl_3 molecule, and the dissociation occurs via cascade population of the upper vibrational levels of the molecules and represents predissociation during vibration, i.e., a nonradiative transition from higher vibrational levels $n\nu_3$ to the continuous spectrum adjacent to the dissociative vibration limit ν_2. In the case of ν_2 vibrations, the boron atom leaves the plane of the molecule. The detachment of the boron atom leads to disintegration of the molecule and to the appearance of atomic chlorine.

The appearance of the atomic chlorine upon dissociation should lead to the occurrence of chemically active centers. Therefore irradiation of stable gas mixtures containing BCl_3 can initiate chemical reactions, some of which are quite vigorous.

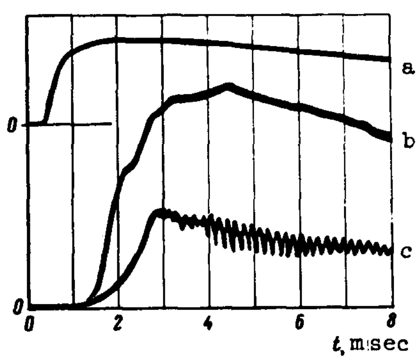

Fig. 1. Waveform of irradiating 10-μ pulse (a) and time dependences of the intensity of the visible luminescence (b) and of the gas pressure (c).

The experiment was performed for a mixture with $H_2:BCl_3$ ratio 20:1, at a total pressure 1 atm. We used a pulse-fed CO_2 laser. The emission pulse was close to rectangular with a rise time ~0.5 msec, duration 30 msec, and power up to 600 W. The laser radiation was collimated with a system of salt lenses into a practically-parallel beam of 0.3 cm diameter, and was directed along the axis of a cell with the investigated mixture. The cell was a thick-wall brass cylinder 10 cm long and with inside diameter 4 cm. The entrance window of the cell was sealed with a plate of crystalline ZnSe, and the output and side windows were covered with NaCl plates.