cavities in the cathodes, making it possible to realize the hollow-cathode effect in the Penning electrode system. The discharge chamber was sealed off from the high-vacuum volume by means of a polyethylene ring and communicated with this volume only through the injection aperture. The electrons were extracted from the plasma with a high-frequency field extending from the resonator cavity through the injection aperture in the discharge region.

The discharge power supply generated pulses of 30 μsec duration with a repetition frequency 1 - 10 Hz. At a gas flow of 60 $cm^3$/hr and a discharge voltage 2 kV, the discharge current was 4 A (pulsed). The pressure in the microtron chamber was 3 x $10^{-5}$ Torr. The current of the electrons accelerated to 6 MeV reached 15 mA. With the discharge sufficiently stable, instability of the accelerated current appeared with increasing pressure.

Work on the stabilization of the accelerated current is continuing.

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## CONTROL OF THE FREQUENCY OF A $CO_2$ LASER BY A BORON TRICHLORIDE FILTER

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We present here the results of experiments aimed at controlling the frequency of a $CO_2$ laser by introducing in the laser resonator a cell containing $BCl_3$ at pressures $10^{-2}$ - 30 Torr.

The maximum of the radiation of a $CO_2$ laser without a dispersive element occurs at the rotational transition P(20) of the $00^01 - 10^00$ vibrational band. When the dispersive element is placed in the resonator, generation is possible at practically all the transitions of the P and R branches of the vibrational bands $00^01 - 10^00$ and $00^01 - 02^00$ (see, e.g., the review [1]).

The form and mutual arrangement of the absorption lines $_3$ of the molecules $B^{10}Cl_3$ and $B^{11}Cl_3$ (see Fig. 1), lying in the region of the possible $CO_2$-laser generation frequencies, make it possible to use $BCl_3$ as a selective element for the control of the frequency of this laser.

The experiments were performed on a laser with a resonator 200 cm long, made up of gold-coated spherical mirrors with curvature radius 500 cm. The diameter of the exit aperture was 0.7 cm. A cell with $BCl_3$, of 100 cm length and 5.5 cm diameter, was inserted in the resonator.

In the absence of $BCl_3$ (pressure in cell $10^{-2}$ Torr), generation takes place at

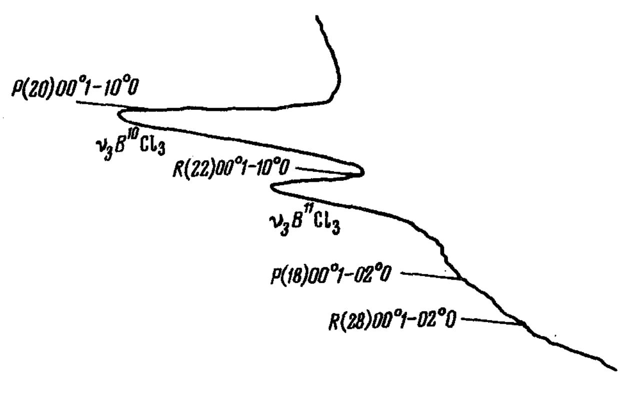


Fig. 1. Absorption spectrum of $BCl_3$ gas together with P and R branches of the $00^01 - 10^00$ and $00^01 - 02^00$ vibrational bands.

rotational transition P(20) of the vibrational band $00^01 - 10^00$, with 11 W output power. As the $BCl_3$ is admitted, the laser begins to generate at the neighboring rotational transitions of the same band. The maximum of the generation shifts to the P(28) line, corresponding to a 7.5 $cm^{-1}$ change in tuning. The total generation power is simulataneously decreased, and when the $BCl_3$ pressure is of the order of $1.5 \times 10^{-1}$ Torr the generation at the P branch of the $00^01 - 10^00$ vibrational band ceases (see Fig. 2).

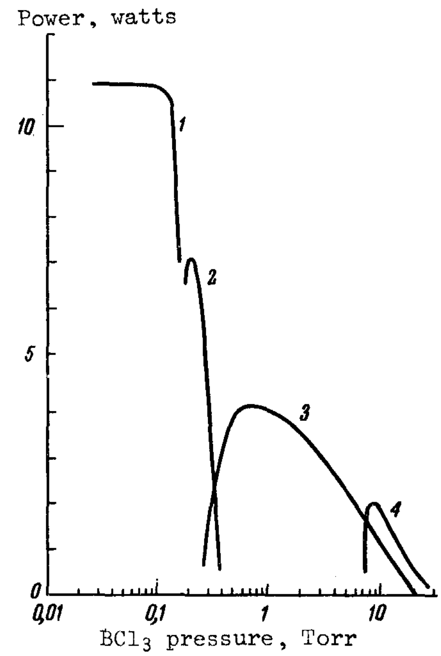


Fig. 2. Generation power vs. $BCl_3$ pressure in cell: 1 - P-branch of $00^01 - 10^00$ band, 2 - R-branch of $00^01 - 10^00$ band, 3 - P-branch of $00^01 - 02^00$ band, 4 - R-brnach of $00^01 - 02^00$ band.

When the $BCl_3$ pressure is increased from $1.5 \times 10^{-1}$ to $4 \times 10^{-1}$ Torr, generation takes place at the R(20) - R(26) transitions of the same vibrational band. It is seen from Fig. 1 that the vibrational absorption bands $\nu_3$ of the molecules $B^{10}Cl_3$ and $B^{11}Cl_3$ do not overlap fully, and the minimum absorption between them occurs at the rotational transitions R(22) and R(24) corresponding to maximum generation in the R-brnach of the $00^01 - 10^00$ band. This property was used in our earlier investigation [2] to Q-switch a $CO_2$ laser by means of a saturable filter based on this gas.

The peculiar form of the absorption band of $BCl_3$ in the frequency rante of the rotational transitions R(22) and R(24) makes it possible to vary the pressure until a pulsed generation regime is attained at these transitions. Boron trichloride is therefore an optimal saturable filter, from the spectral point of view, making it possible to obtain pulsed generation at the R branch of the $00^01 - 10^00$ vibrational band.

The average generation power in the pulsed regime at this branch was 70 - 80% of the generation power in the continuous regime at the P-branch of the same vibrational band. Stable generation of giant pulses was observed in the narrow pressure band from $2 \times 10^{-1}$ to $2.5 \times 10^{-1}$ Torr.

With further increase of pressure, generation sets in at the R branch of the $00^01 - 02^00$ vibrational band. At pressures from 0.25 to 0.4 Torr, generation occurs simultaneously at the R branch of the $00^01 - 10^00$ band and at P(10) + P(24) of the $00^01 - 02^00$ band in an irregular pulsed regime. At pressures above 0.4 Torr, generation occurs continuously at P(10) + P(24). An increase of the pressure leads to a shift of the radiation maximum from P(18) to P(12). An increase of the pressure to 10 Torr leads to generation at the R transitions of the $00^01 - 02^00$ band. Generation stops at pressures above 30 Torr.

Thus, variation of the pressure of $BCl_3$ in a cell introduced in the resonator of a $CO_2$ laser tunes the radiation frequency in the range from the P lines of the $00^01 - 10^00$ band to the R lines of the $00^01 - 02^00$ band, i.e., from 944 to 1085 $cm^{-1}$.

The dependence of the average generation power on the pressure is shown in Fig. 2. In each of the bands, the generation is maximal at the same transitions as in the case of a resonator with a dispersive element such as a prism or a diffraction grating.

We note that the measurements were made with the $BCl_3$ flowing through the cell. To obtain the same effects without flow, larger pressures are needed.

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## INVESTIGATION OF THE MECHANISM OF THE REACTION $C^{12}(\pi^-, \pi^-p)B^{11}$ AT 1.04 GeV/c MOMENTUM

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The purpose of the present investigation was to study the mechanism of the reaction $C^{12}(\pi^-, \pi^-p)B^{11}$ (1) by performing the measurements necessary for the identification of the pole mechanism, and to compare the experimental results with the predictions of the theory of direct nuclear reactions [1].

The program of such measurements was discussed earlier in [1, 2] and comprises the following: 1) Measurement of the distribution with respect to the Treiman-Yang angle. 2) Measurement of the dependence of the differential cross section on the momentum of the residual nucleus in the laboratory frame. 3) Measurement of the dependence of the differential cross section as a function of the kinematic invariants of the corresponding elastic reaction. 4) Investigation of the angular distribution of the recoil nuclei. 5) Determination of the absolute value of the differential cross section. 6) Investigation of the dependence of $|M|^2$ on the initial energy at fixed values of the remaining variables. 7) Study of the polarization effects in experiments with polarized targets. 8) Verification of the isotopic relation. Our experimental setup has made it possible, for the first time, to realize the first five items for the knock-out reactions.

The measurements were performed with a beam of negative 1.04-GeV/c pions from the ITEF

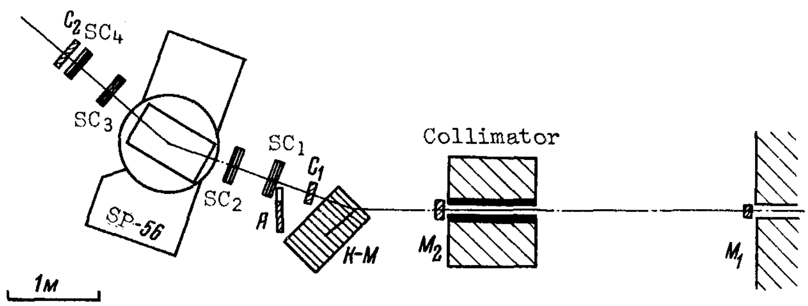


Fig. 1. Diagram of experimental setup