course, there is no summation implied in (7) with respect to M and M'). M and M' should have different parities, $|M| + |M'| \leq 2j$, and it can be assumed that $M > 0$ and $M' > 0$, so that $T_L^M = (-1)^M T_L^{M*}$.

If the target is not polarized, then the polarization moments contained in (7) are equal to zero.

In order to be able to determine with the aid of (7) the parity $\eta_{N*}$ of the isobar it is necessary to measure Im $T_L^M(\vartheta)$ and Im $\tilde{T}_L^M(\vartheta)$ with even L. As is well known [6], the polarization moments with even L are determined from the angular distribution of the isobar decay products.

The proposed method is suitable for the determination of the parity of the $\Omega$ hyperon.

If the isobar spin is $J = 3/2$, (7) takes the form

$$\text{Im } T_2^1(\vartheta) = -\frac{\eta_{N*}}{\eta_p} \text{Im } \tilde{T}_2^2(\vartheta),$$
$$\text{Im } T_2^2(\vartheta) = \frac{\eta_{N*}}{\eta_p} \text{Im } \tilde{T}_2^1(\vartheta). \quad (7)$$

The author is sincerely grateful to L. I. Lapidus and Yu. A. Simonov for useful discussions.

[1] S. M. Bilen'kii, L. I. Lapidus, and R. M. Ryndin, UFN 84, 243 (1964), Soviet Phys. Uspekhi 7, 721 (1965).
[2] M. S. Dubovikov, YaF 3, No. 2, 1966, transl. in press.
[3] G. Shapiro, Phys. Rev. 134B, 1393 (1964).
[4] S. M. Bilenky and R. M. Ryndin, Phys. Lett. 18, 346 (1964).
[5] M. K. Gaillard, Nuovo Cimento 32, 1306 (1964).
[6] N. Byers and S. Fenster, Phys. Rev. Lett. 11, 52 (1963).
[7] M. Jacob and G. C. Wick, Ann. Phys. 7, 404 (1959).

## STATES WITH POPULATION INVERSION IN A SELF-COMPRESSED DISCHARGE

S. G. Kulagin, V. M. Likhachev, E. V. Markuzon, M. S. Rabinovich, and V. M. Sutovskii
P. N. Lebedev Physics Institute, USSR Academy of Sciences
Submitted 11 November 1965
ZhETF Pis'ma 3, No. 1, 12-14, 1 January 1966

Stimulated emission is usually observed in gases at relatively low currents, when the electromagnetic forces exert no influence on the discharge development process. It is known, however, that in the case of cumulation of a strong-current pulsed discharge (pinch effect) the plasma is heated at an unusually fast rate, and magnetohydrodynamic instabilities develop. An unstable turbulent state is produced. The heating time is of the order of the time of ionic collisions at maximum pinch compression (without account of the collective processes). Estimates show that for singly-ionized atoms of argon this time amounts to

$10^{-9}$ sec under the conditions of such an experiment. It is natural to assume that negative-temperature states become possible in such a rapid heating and with so fast a development of the instabilities. It will be shown in this paper that such states indeed exist in the plasma of a self-compressed discharge, as evidenced by a stimulated-emission pulse which coincides in time with the instant of cumulation.

The experiment was carried out with a setup which permits currents up to 15 kA to be generated at a discharge duration of 2 - 5 μsec. The discharge was produced in a quartz tube 100 cm long and 2.5 cm in diameter. The electrodes were in the form of rings with inside diameter of 2.5 cm and were made of copper. The radiation was allowed to escape through Brewster windows. The optical resonator consisted of two spherical mirrors (R = 3000 mm) with dielectric coating, placed 140 cm apart. The reflection coefficients of the mirrors in the generation region were 90 and 45%. The energy was supplied by 0.1, 0.4, and 2.5 μF capacitors charged to 20 - 30 kV. The main experiments were made at 10 kA current and discharge duration 2 μsec. The working gas was spectrally pure argon at $10^{-2}$ mm Hg.

Photographs of such a discharge are shown in Fig. 1. The narrow bright pinch in the axial part of the chamber is due to the cumulation of the discharge. The generation of the stimulated emission occurred at the frequency $\lambda$ = 4765 Å of singly-ionized argon and is observed in a narrow pressure interval $9 \times 10^{-3}$ - $3 \times 10^{-2}$ mm Hg (Fig. 2). This pressure interval also corresponds to the best conditions for the formation of the self-compressed discharge. The experiments were made at $1.25 \times 10^{-2}$ mm Hg pressure, corresponding to the intensity maximum.

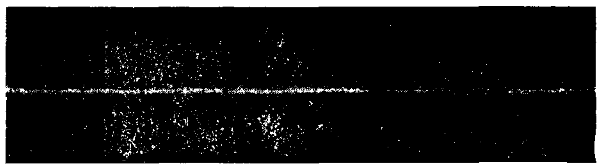

Fig. 1. Integral radiation from an argon discharge at $10^{-2}$ mm Hg.

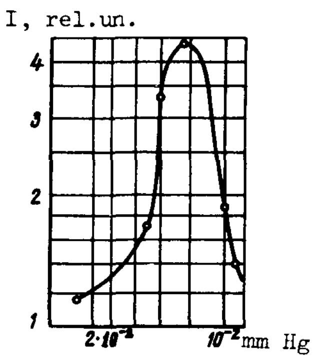


Fig. 2. Intensity of stimulated emission vs. pressure.

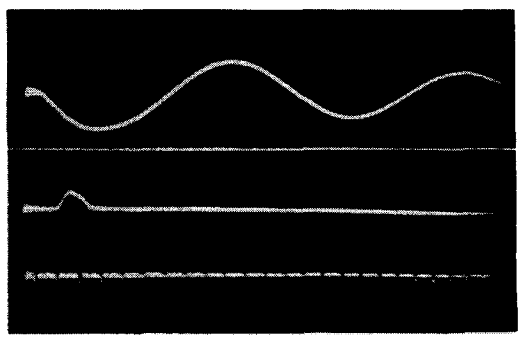

Fig. 3. Oscillograms of the current and generation pulse. Time markers correspond to 0.2 μsec.

The generation pulse was recorded photoelectrically. The current pulse was recorded with a Rogowski loop. Typical oscillograms are shown in Fig. 3. Generation sets in 0.2 μsec after the appearance of the current and lasts 0.2 μsec. The generation power at the maximum is 20 - 25 kW (corresponding to ~0.005 J radiated in the pulse). Calculation has shown that under the conditions of our experiment the compression of the discharge occurs 0.2 - 0.3 μsec after the start of the discharge. The appearance of the generation pulse thus coincides in time approximately with the instant of discharge compression.

The realization of negative-temperature states in a pinch discharge uncovers new possibilities for the production of pulsed gas lasers. Indeed, the plasma energy pumping in a powerful compressed pinch discharge can in principle reach or even exceed the corresponding value for a solid. Therefore the elucidation of the mechanism and of the conditions under which negative-temperature states are produced in such discharges is of great interest both for plasma physics and for quantum electronics, and calls for additional experimental research.

The authors thank Corresponding Member of the USSR Academy A. M. Prokhorov for interest in the work and valuable discussions, and also to the laboratory staff members M. R. Bedilov and Yu. K. Dmitriev for help with the experiments.

## REAL PART OF THE pn SCATTERING AMPLITUDE IN THE ENERGY INTERVAL 2 - 10 GeV

L. S. Zolin, L. F. Kirillova, Lu Ch'ing-ch'iang, V. A. Nikitin, V. S. Pantuev, V. A. Sviridov, L. N. Strunov, M. N. Khachaturyan, M. G. Shafranova [1)], Z. Korbel, L. Rob [2)], P. Devinski, Z. Zlatanov, P. Markov, L. Khristov, Kh. Chernev [3)], N. Dalkhazhav, and D. Tuvdendorzh [4)]
High-energy Laboratory, Joint Institute of Nuclear Research
Submitted 12 November 1965
ZhETF Pis'ma 3, No. 1, 15-21, 1 January 1966

We investigated elastic pd scattering in the energy interval 1 - 10 GeV. On the basis of these experimental data, as well as information on the pp scattering amplitude in the same energy range, we found the value of the real part of the pn scattering amplitude. The experiment was performed by a method involving registration of slow recoil deuterons from a film-target of deuterated polyethylene 0.5 - 0.6 μ thick [1,2]. The investigated range of squared momentum transfer was $0.003 < |t| < 0.2$ (GeV/c)$^2$.

The differential cross sections of elastic pd scattering at energies 1, 2, 4, 6, 8, and 10 GeV are shown in Fig. 1. The statistical error is ≈3% and the accuracy of the absolute monitoring is 7%.

In the range of angles where the influence of Coulomb scattering can be neglected, the differential cross section of elastic pd scattering is approximated by the formula $d\sigma/d|t| = \exp(a + bt + ct^2)$. The values of the parameters a, b, and c are indicated in Fig. 1. The total cross sections for elastic pd scattering are listed in Table 1.