The large specific ionization of the particles in the crystals makes it possible to place the filaments close to one another in the chamber, and this ensures high temporal and spatial resolution, greatly exceeding the resolution of gas-filled filament chambers.

In conclusion, we are sincerely grateful to V.P. Dzhelepov, B.M. Pontecorvo, G.I. Selivanov, L.M. Soroko, and V.I. Nikanorov for support of this investigation.

[1] S.E. Derenzo, D.B. Smith, R.G. Smits, H. Zaklad, L.W. Alvarez, R.A. Muller, and G. Smadja, Preprint UCRL - 20118, 1970; Phys. Rev. Lett. 27, 532 (1971).
[2] E.A. Kushnirenko and A.G. Chiligarov, in: International Conference on Apparatus and Physics of High Energies, Dubna, 1970, Vol. 1, 297, 1971.
[3] B.A. Dolgoshein, A.A. Kruglov, V.N. Lebedenko, V.P. Miroshnichenko, and B.U. Radionov, JINR Preprint R1-6245, Dubna, 1972.
[4] A.F. Pisarev, JINR Communication R13-5623, 1971.

EXPERIMENT ON MAGNETOSONIC HEATING OF IONS IN THE TOKAMAK TO-1

N.V. Ivanov, I.A. Kovan, L.I. Kozlov, E.V. Los', V.S. Svishchev, and N.N. Shvindt

Submitted 7 June 1972
ZhETF Pis. Red. 16, No. 2, 88 - 91 (20 July 1972)

As shown in [1], when resonant magnetosonic oscillations of the plasma filament in the Tokamak are excited, there are two possibilities for continuous transfer of high-frequency energy to the plasma. One is based on the build-up of the natural oscillations of the filament with the aid of a broad-band amplifier whose feedback loop is closed by the plasma [2]. The use of feedback makes it possible to maintain in the plasma oscillations of a definite type when the plasma concentration is varied and the natural frequency is tuned in time. Another possibility, which is considered in the present paper, presupposes the use of a generator of fixed frequency, corresponding to the quasicontinuous section of the natural-oscillation spectrum of the plasma filament. In this case, the generator frequency should be several times larger than the frequency of the lowest oscillation mode.

To heat the plasma we used in our experiment a self-excited oscillator based on the GI-4A tube. The oscillator operated in a pulsed mode at 50 MHz, delivering up to 5 kW to the plasma. The voltage pulse on the tube anode had an exponentially decreasing shape with a time constant of 25 msec. The HF energy from the oscillator was fed through a coaxial cable to a loop-type exciter introduced into the chamber of the apparatus through a lateral stub. The loop surrounding the plasma filament was 32 cm in diameter and was made of stainless steel. Unlike the HF lead used in [3], the loop was not insulated from the plasma with a dielectric. To decrease the plasma concentration near the exciter, the loop was placed between two molybdenum diaphragms with openings of 25 cm diameter, spaced 20 cm apart.

The main characteristics of the discharge in hydrogen at 8×10^{-4} Torr initial gas pressure and at 8.5 kOe longitudinal magnetic field intensity on the chamber axis are shown in Fig. 1. The HF generator was turned on during a macroscopically stable stage of the discharge, when the plasma concentration, according to the readings of a 4-mm interferometer, exceeded 10^{13} cm^{-3}. At such a concentration, the frequency of the HF oscillations corresponded to the dense section of the spectrum, and this led to a continuous loading of the oscillator. The amplitude of the fields excited in the plasma was several Oersted under these conditions, and the Q of the individual resonant maxima amounted to

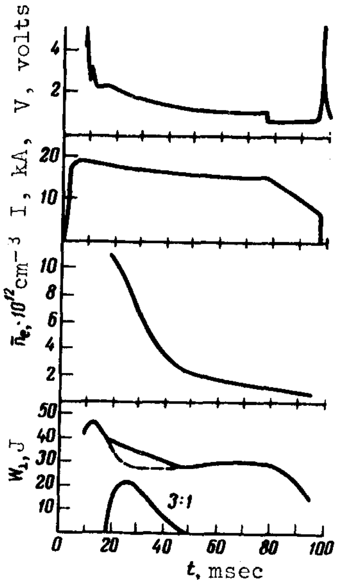

Fig. 1

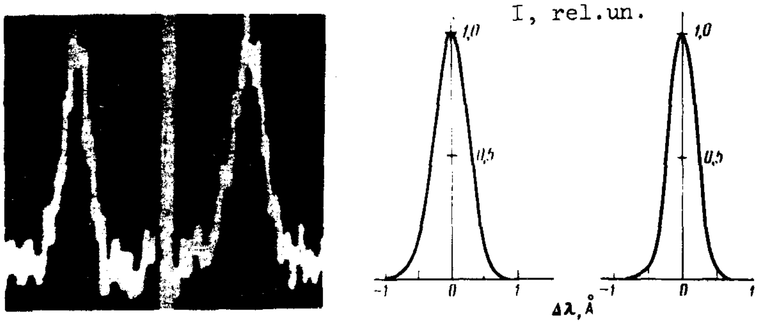

Fig. 2

Fig. 1. Variation of the voltage, current, plasma concentration averaged over the diaphragm diameter, and energy content of the plasma filament during the time of the discharge. The oscillator was turned on at the instant 18 msec. The dashed line shows the energy content in the absence of HF heating.

Fig. 2. Comparison of the contours of the line CV (2271 Å) with Gaussian contours in the presence (left) and absence (right) of HF heating.

several hundred. Of all the curves shown in Fig. 1, the turning on of the generator influenced only the time variation of the energy content of the plasma, which was determined from the diamagnetic effect.

The additional energy introduced into the plasma by the HF heating is shown in the same figure. The energy time estimated from this curve is 2.5 msec, and the power absorbed in the plasma, with allowance for the isotropy of the heating, is 4 kW. Within the limits of the measurement accuracy, this value coincides with the power developed by the oscillator. It should also be noted that the plasma heating is accompanied by an outward displacement of the plasma filament and by an increase of the current in the control windings that maintain plasma equilibrium in the TO-1 [4].

Since the absorption of HF energy does not lead to a change in the plasma conductivity, it is natural to attribute the growth of the energy content to an increase in the ion temperature. Under this assumption, the change of the ion temperature, averaged over the diaphragm diameter, is 30 eV.

The fact that the ions are heated is confirmed by a measurement of the Doppler broadening of the CV line, and also by an analysis of the energy spectrum of the charge-exchange atoms from the plasma. The line contour was registered with the aid of a scanning Fabry-Perot interferometer, which made it possible to scan the contour within ∿100 μsec [5]. Data reduction for a large number of contours yields, for 20 - 22 msec, an ion temperature of 150 ± 30 eV in the presence of HF heating and 90 ± 30 eV in its absence. The corresponding oscillograms of the line contours are shown in Fig. 2.

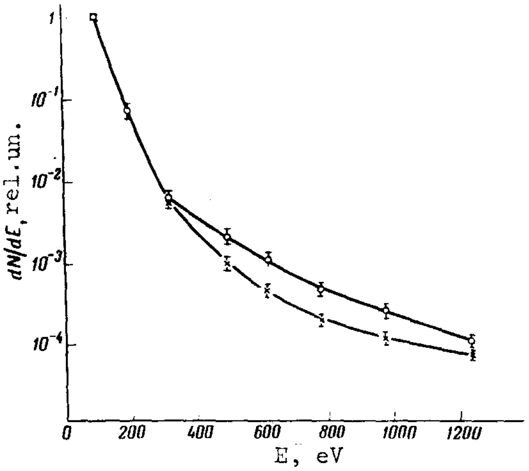

Fig. 3. Energy distribution of the charge-exchange atoms in the presence (circles) and in the absence (crosses) of HF heating in the interval 21 - 26 msec.

An analysis of the neutral hydrogen atoms emitted from the plasma in the direction of the major axis of the torus (R = 60 cm) was carried out by the procedure described in [6]. The change of the energy spectrum of the charge-exchange atoms under the influence of the HF heating is shown in Fig. 3.

Thus, the aggregate of the obtained data offers evidence that the ion component of the plasma is heated when the dense part of the spectrum of the natural oscillations of the plasma filament is excited.

The authors are grateful to L.N. Pankov, G.A. Gurov, and V.V. Siluyanov for help with the work.

[1] N.V. Ivanov, I.A. Kovan, and E.V. Los', Atomnaya Energiya 32, 389 (1972).
[2] N.V. Ivanov, I.A. Kovan, and E.V. Los', ZhETF Pis. Red. 14, 212 (1971) [JETP Lett. 14, 138 (1971)].
[3] V.L. Vdovin et al., ibid. 14, 228 (1971) [14, 149 (1971)].
[4] L.I. Artemenkov et al., Proceedings of Fourth International Conference of IAEA on Plasma Physics and Controlled Thermonuclear Fusion, 1971, CN-28/C-3.
[5] V.T. Goloborod'ko, A.P. Kirichenko, and L.N. Nemashkalo, Izmeritel'naya Tekhnika 7, 40 (1967).
[6] V.V. Afrosimov and M.P. Petrov, Zh. Tekh. Fiz. 37, 1995 (1967) [Sov. Phys.-Tech. Phys. 12, 1467 (1968)].

INFLUENCE OF PRESSURE ON THE FERMI SURFACE OF ZINC

V.A. Venttsel', O.A. Voronov, A.I. Likhter, and A.V. Rudnev
Institute of High Pressure Physics
Submitted 14 June 1972
ZhETF Pis. Red. 16, No. 2, 91 - 94 (20 July 1972)

Pressure produces changes in the lattice parameters, leading in turn to a change in the area S of the extremal sections of the Fermi surface (FS) both as a result of the change in the parameters of the Brillouin zone (BZ) and as a result of a change in the lattice potential. Significant changes in the main parts of the FS should be expected at pressures on the order of the elastic moduli of the crystal. Pressures on the order of 10 - 15 kbar at low temperatures, transmitted with the aid of a solid medium, are very far from hydrostatic, and this makes it impossible to observe large cross sections of the FS, which are very sensitive to inhomogeneous deformations. In the present study, in order to observe the influence of pressure on large sections of the FS, we used truly hydrostatic pressures up to 100 bar, transmitted by liquid helium. This yields a coefficient d ln S/dP, which can be regarded as constant at pressures much lower than the elastic moduli.

The investigation was made on zinc, since it has a hexagonal lattice with a large compressibility anisotropy [1], and its FS is well described in the