Curie temperatures. Very interesting is the observed change in the sign of the value of the quadrupole interaction as a function of the temperature. This is particularly clearly seen with the octahedral sublattice as an example. On this basis it can be assumed that the Morin temperature of the garnet under consideration lies in the region 220 ± 50° K.

The NGR spectra obtained by us for the mixed indium-gallium garnet in a parallel magnetic field on the order of 3000 G also point to the existence of only two magnetic sublattices.

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STABILIZATION OF POTENTIAL OSCILLATIONS OF A PLASMA IN A Q-MACHINE BY MEANS OF A HIGH FREQUENCY MAGNETIC FIELD

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Experimental investigations of thermally ionized plasma in Q machines reveal oscillations of the charged-particle density and of the potential. These oscillations are due to the development of drift-type instabilities in the plasma column, with which the anomalous diffusion of the plasma across the magnetic field is connected [1 - 3]. This explains the recent interest in the possibility of suppressing oscillations of this type. The described method of stabilization with the aid of shear [4] and a high frequency electric field [5] have significant shortcomings. The former calls for the production of a very large azimuthal magnetic field, which is difficult to realize technically. The second calls an appreciable deviation of the plasma parameters, due to the electron heating, making it difficult to interpret the results correctly.

The theory of stabilization with a high frequency magnetic field of potential plasma oscillations was developed in [6, 7], where we investigated the stabilization of drift kinetic instabilities, particularly the instability that exists when $\eta = (d \ln n / d \ln T_e) = 0$ and builds up in Q-machines in the collisionless regime $(k_z v_{Te} \gg \nu)$ [8]. The conditions for a noticeable decrease of the increment are $\Omega > \omega^*$ and $H_1/H_0 > \max [L/m_\pi a; \Omega/k_y v_{Te}]$, where m - number of mode, H_0 - amplitude of the constant magnetic field, H_1 - amplitude of the alternating magnetic field, v_{Te} - thermal velocity of the electrons, n - concentration of the plasma charged particles, L - length, and a - radius of the plasma column. In the collision regime [3, 9] there is also a drift-dissipative instability. The influence of the high-frequency magnetic field on this instability can be investigated by the methods developed in [7].

We present the results of the calculation:

The conditions for stabilization is the inequality $H_1/H_0 > 2^{3/2}\sqrt{\nu\Omega}\, k_y V_{Te}$ and $\mu > 1$,

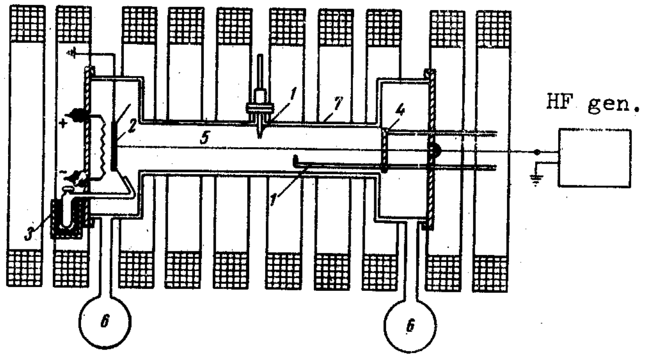

Fig. 1. Over-all view of Q-machine: 1 - double electric probes, 2 - tungsten electrode, 3 - potassium evaporator, 4 - cold end, 5 - tungsten filament, 6 - pumps, 7 - metallic liner.

where ν - collision frequency and Ω - frequency of the high-frequency magnetic field. The calculations show that for increment for the drift instability decreases by a factor of 400.

In the Q-machine there can exist also the regime of the so-called "white noise," in which $k_y \sim 10^{-1}$ cm. It follows there from the stability conditions that at the characteristic parameters the stabilization condition is

$$H_1/H_0 \gtrsim 1/100.$$

The experiments were performed with a potassium plasma on a single-end Q-machine (Fig. 1). The ionization was by means of a hot tungsten electrode having the form of a disc and kept at ground potential. The cold end, located one meter away from the hot electrode, was at a floating potential. An insulated tungsten filament of 1.5 mm diameter along the axis of the setup, and carried the current that produced the alternating magnetic field. The oscillations of the potential were measured with a double electric probe; the signal was subsequently analyzed with a spectrum analyzer. A qualitative estimate was also made of the diffusion coefficient. The main parameters of the plasma were $5 \times 10^{8} \le n \le 5 \times 10^{10}$, $200 \le H_0 \le 1500$ Oe, and $T_e = T_1 = 0.2$ eV.

The alternating magnetic field H_1 of frequency 120 kHz and pulse duration 3 sec was produced by a vacuum tube generator. The maximum amplitude of the current in the filament was 250 A, corresponding to $H_1 = 50$ Oe at a distance of 1 cm from the filament.

The investigations have shown that the alternating magnetic field suppresses the potential oscillations observed in Q-machine. Figure 2 shows typical spectra of the oscillations, obtained without and with a magnetic field.

Figures 2a and b correspond to the regime of broadband oscillations which appear at above-critical values of H and n [9]. Stabilization of these oscillations occurs already at $H_1/H_0 = 0.01$.

Figures 2c and d illustrate the stabilization in the periodic-oscillation regime. In this case, the suppression is less effective. No complete vanishing of the instability is observed even at $H_1/H_0 = 0.05$, corresponding to the presented pictures. We see that the suppression of the first harmonic is worse than that of the second (the amplitude of the first harmonic decreases by a factor 1.5 whereas that of the second decreases by a factor of 3).

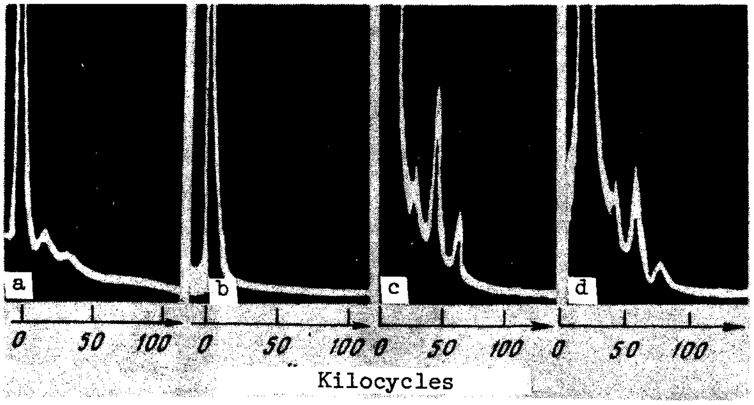

Fig. 2. Potential-oscillation spectra: a and b pertain to the broadband oscillation regime; c and d pertain to the periodic regime. $H_1 = 0$ in cases a and c and is maximal in cases b and d.

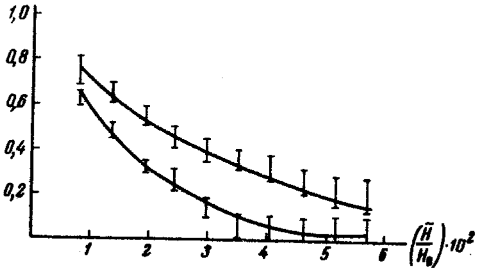

Fig. 3. Relative amplitudes of harmonics 1 and 2 vs. H_1/H_0. Upper and lower curves pertain to harmonics 1 and 2 respectively.

Figure 3 shows plots of the ratio of the amplitudes of the oscillations without the high frequency magnetic field for harmonics 1 and 2 at different values of H_1/H_0.

A decrease of the diffusion across the magnetic field was qualitatively observed.

The change of the electron temperature following application of the high-frequency magnetic field was monitored against the probe characteristic. The increase of T_e did not exceed 30%.

The investigated method of stabilizing the potential waves can be used also with other installations. It is more promising than the methods proposed in [3, 4], since it requires a smaller energy input and can be realized at very low frequencies.

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