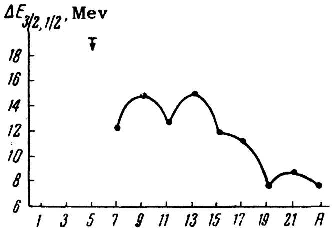

FIG. 2

we conclude that H^5 can be stable only if for the α particle the level with $T = 1$ lies below approximately 22 Mev. As is known, no such levels of He^4 have been observed in the energy range below 22 Mev, and this refutes the assumed[4] stability of H^5. We note that if the decay $H^5 \rightarrow H^4 + n$ requires (because of the pairing effects) the consumption of energy, the decay energy of H^4 cannot exceed 2.86 Mev. In this case the level with $T = 1$ should not be higher than approximately 23.4 Mev for He^4. However, extrapolation to hydrogen of the difference in the binding energy of the first and third neutrons leads to the conclusion that the energy of the decay $H^4 \rightarrow H^3 + n$ is so large, that the decay $H^5 \rightarrow H^4 + n$ becomes energetically feasible (to approximately 1.8 Mev). Then the upper limit of the $T = 1$ level for He^4 rises to approximately 25.2 Mev. These estimates (23.4 — 25.2 Mev) confirm the value of approximately 24 Mev given for the energy of this level in reference 5.

Stability of H^5 relative to the decay into H^3 and 2n agrees also with the energy of the first $T = 3/2$ level at $A = 5$: $\Delta E_{3/2\ 1/2} \leqslant 19.4$ Mev (arrow on Fig. 2). Blanchard and Winter[4] estimated this energy at 19.1 Mev. As is seen from Fig. 2, however, the data regarding $\Delta E_{3/2\ 1/2}$ cannot serve as a proof of the stability of H^5, for the case H–He–Li (transition from $A = 5$ to $A = 7$), which is magic in the number of protons, has an analogue in the case N-O-F (transition from $A = 19$ to $A = 17$) in which a sharper increase is observed in the energy of the first $T = 3/2$ level than in the other cases.

The collective data on the binding energies of neutrons and protons are also evidence in favor of the instability of H^5.

$\underline{H^7}$. If, however, H^5 is nevertheless stable, one would expect also the presence of a stable "superheavy" isotope of hydrogen H^7 (just as the presence of He^6 is proof of the existence of He^8).

In addition to searching for delayed neutrons in the reactions $Li^7(\gamma, 2p)$[6] or $H^3(H^3p)$, a possible method of verifying the existence of H^5 is to observe the reactions (n, 2p) or (π^-, p) in emulsions doped with Li^6. If H^7 is stable, these nuclei could be observed in the reactions $Be^9(\pi^-, 2p)$ in the emulsions.

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CONNECTION BETWEEN OSCILLATION AND RATE OF LOSS OF CHARGED PARTICLES IN A CYLINDRICAL PLASMA OF LOW PRESSURE IN A LONGITUDINAL MAGNETIC FIELD

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THE principal purpose of this investigation was to study the plasma oscillations in a longitudinal column in a constant longitudinal magnetic field. In addition, we investigated the diffusion current on the wall of the discharge tube and the effect of the magnetic field on the longitudinal potential gradient in the column. Such investigations have been attracting attention in recent years in connection with the question of the mechanism by which charged particles are displaced transversely to the magnetic flux lines in a magneto-ionic medium and with other problems in plasma dynamics.[1-4]

The discharge was produced in a cylindrical tube with an inside diameter of 2 cm and an interelectrode gap of 90 cm, filled with helium at 0.2 — 0.05 mm Hg. The anode current ranged from 50 to 350 ma. The positive column was homogeneous under these conditions. The degree of ionization of the gas did not exceed 0.1%. The discharge tube was placed in a solenoid with its cathode and anode ends projecting 25 and 15 cm respectively beyond the solenoid. The magnetic field was varied from 0 to 2.5 koe.

When there is no magnetic field, noise is generated in the discharge in a frequency range from 10^3 to 10^6 cps. A magnetic field amplifies this noise considerably and changes its spectrum. As the magnetic field is increased to a certain critical field value, oscillations are suddenly launched in the discharge, 10 or 15 times more intense than the maximum noise level at the pre-critical field. The corresponding amplitude of the electrode-voltage oscillations reaches 7 to 10 volts. The critical value of the field, above which oscillations are produced, is independent of the current and increases with increasing pressure, as can be seen from the following data:

p, mm Hg	0.05	0.07	0.1	0.2
H_{cr}, oe	750	990	1400	1630

Simultaneous with the appearance of the intense oscillations is an abrupt decrease of the anode current by 5 to 8%. Probe measurements show (Fig. 1)

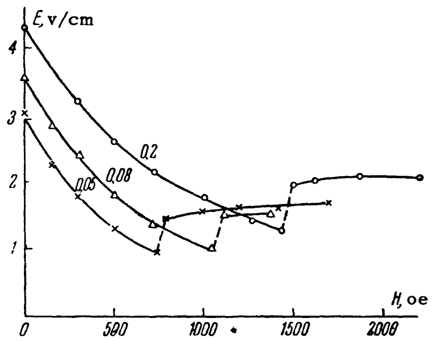

FIG. 1

that the oscillations are accompanied by an increase in the average value of the longitudinal potential gradient in the positive column located in a magnetic field (the numbers next to the curves give the pressure in mm Hg). If the magnetic field is less than critical, the increase in field reduces the potential gradient in accordance with the theory of paired collisions.[2,3] At fields exceeding the critical value, the curves exhibit an anomalous behavior. Figure 2 shows the current on the walls of the tube. The curves show clearly that the effective rate of diffusion loss of charged particles increases in a strong magnetic field.

The sudden occurrence and the irregular character of the oscillations is of interest. Orderly os-

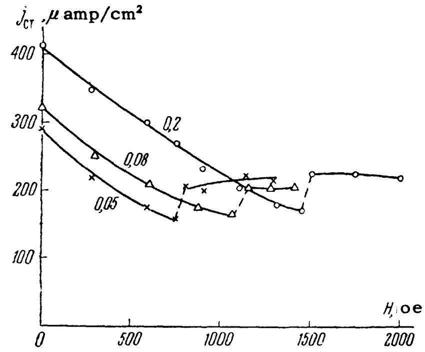

FIG. 2

cillations at frequencies of 80 — 140 kcs were noted only in a narrow range of variation of the magnetic field, near the critical value.

Preliminary observations have shown that the potentials of probes located along the tube are delayed in time toward the anode. This delay indicates propagation of the oscillations toward the anode. The rate of propagation of the oscillations approaches, in order of magnitude, the drift velocity of the electrons. At the same time, a phase shift is observed in the fluctuations of the voltage between probes located on the axis and on the wall in the same cross section of the tube.

Under different conditions, moving layers may appear in the discharge. Under the conditions of Lehnert's experiments,[3] the moving layers produced oscillations of large amplitude in the absence of a magnetic field. These oscillations, however, changed neither the current on the wall nor the potential gradient in the column.

It is possible that the type of oscillations observed and the associated increase in the effective rate of diffusion loss of charged particles are the result of a macroscopic displacement of the plasma pinch in the magnetic field.

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