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SCIENTIFIC SESSIONS OF THE DIVISION OF GENERAL PHYSICS AND ASTRONOMY OF THE USSR ACADEMY OF SCIENCES, DEVOTED TO LENIN'S 100-th BIRTHDAY

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A scientific session of the Division of General Physics and Astronomy of the USSR Academy of Sciences, jointly with the Radiotechnical Institute of the USSR Academy of Sciences, was held on 25 March 1970 in the conference hall of the Radiotechnical Institute of the USSR Academy of Sciences. The following papers were delivered:

1. A. L. Mints. Lenin and the Founding of Soviet Radio Electronics.
2. M. V. Samokhin. Convective Motion of a Plasma in a Quiet Magnetosphere, Its Causes, and Its Geophysical Consequences.
3. A. D. Vlasov. Methods of Increasing the Proton Current at the Output of a Linear Accelerator.
4. M. L. Levin. Formation of a Ring of Relativistic Electrons with the Aid of Axial Injection.
5. G. V. Voskresenskiĭ and V. N. Kurdyumov, Radiative Losses of Electron Storage Rings in Inhomogeneous Structures.
6. M. G. Nikulin. Dynamic Stabilization of Plasma Pinches.

We publish below brief summaries of the delivered papers.

M. V. Samokhin. Convective Motion of a Plasma in a Quiet Magnetosphere, Its Causes, and Its Geophysical Consequences.

According to present-day notions, the boundary of the magnetosphere is the limiting case of a tangential discontinuity, characterized by the fact that the plasma density inside the cavity is negligibly small, and there is no magnetic field outside the cavity.

The author presents a more general definition of the boundary of the magnetosphere from the point of view of a continuous medium. The equilibrium of the boundary of the forbidden band is considered for different equations of the continuous medium, namely the equations of hydrodynamics, gasdynamics, quasihydrodynamics with straight magnetic force lines perpendicular to the plane of flow, and magnetohydrodynamics in the case when $v_{\parallel} = 0$, where $v_{\parallel}$ is the velocity of the plasma along the magnetic field. It is shown that in the case of a tangential discontinuity the existence of motion of matter inside the forbidden band is a condition for the equilibrium of the separation boundary, and the frontal points of the external and internal regions of the flow coincide. The velocity of the flow inside the forbidden band is equal to zero only in the case when the total pressure (gas and magnetic) does not vary along the boundary. Power series are used to determine the structure of the plasma flow in the vicinity of the frontal points inside the magnetosphere and the plasmosphere. A comparison of the corresponding calculations of the current systems S_p^q and S_q^o in the vicinity of the projections of the frontal points of the magnetopause and plasmopause in the ionosphere with the experimental data offers evidence of satisfactory agreement between the directions of the currents, the slopes of the streamlines, and the distance in latitude between them at a given total current flowing between them; this makes it possible to assume that the source of the unperturbed middle- and low-latitude geomagnetic variations is the "residual" convective motion inside the plasmopause, caused by the solar wind.

A. D. Vlasov. Methods of Increasing the Proton Current at the Output of a Linear Accelerator

The paper is devoted to a review of work on estimating proton currents attainable in a linear accelerator under different injection and acceleration regimes, and also to the choice of the most promising regimes.

At the present time, proton pulse currents on the order of 140 mA have been attained in Soviet and foreign linear accelerators. The requirements of physical experiments are already two or three times larger, and in the future the requirements will increase even more. The attainable currents are limited principally by the longitudinal repulsion of the proper charge of the accelerated plasmoids.

An investigation of this problem was initiated at the Radiotechnical Institute of the USSR Academy of Sciences about ten years ago. In 1960, an expression was obtained for the proton current in the regime of shaped stable plasmoids represented approximately as uniformly charged ellipsoids. Two years later, a paper appeared in which the current was estimated numerically on the basis of another, cylindrical approximation of the plasmoids, identical in essence with the well-known disc model. Later on it became possible to consider cylindrical plasmoids also analytically, and the results, including the expression for the current, coincided with the results of the ellipsoidal approximation. The calculated currents exceeded somewhat those actually obtained.

It was necessary to seek other, more effective regimes. In 1967 and 1968 there appeared two papers, in which numerical methods were used to consider cases of injection of denser and longer bunches, and also of a continuous beam. In spite of the loss of particles during the course of the shaping of the bunches, the currents increased in this case to 200—700 mA.

In 1969, the regime of indifferent equilibrium of the bunches was investigated and the maximum attainable currents without particle loss were estimated. These currents are on the average twice as large as in the previously considered stable bunches.

The results offered evidence of a rapid increase of