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National Aeronautics and Space Administration
Goddard Space Flight Center
Contract No.NAS-5-12487

ST-PF-GM-10557

ON THE DISTRIBUTION OF ALFVÉN VELOCITY IN THE MAGNETOSPHERE

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30 JANUARY 1967

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Kosmicheskiye Issledovaniya
Tom 4, vyp.6, 935-6,
Izdatel'stvo "NAUKA", 1967

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SUMMARY

From a peculiarity in the distribution of Alfvén velocity in the magnetosphere the authors derive a series of consequences that are of impotance for the understanding of the nature of geomagnetic micropulsations. The reasonings are based upon the data relative to the plasma jump, called "knee", of which a large number has been lately accumulated.

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It is now customary to consider that geomagnetic micropulsations with periods in tens of seconds are the consequence of propagation in the magnetosphere of hydromagnetic perturbations occurring at its boundary. Obviously, these properties of micropulsations depend essentially on the distribution of Alfvén velocity in the region of their propagation.

It is well known that if we neglect gas pressure by comparison with the magnetic pressure, this velocity determines the propagation of Alfvén, as well as of fast magnetoacoustic waves. Usually the Alfvén velocity is computed by formula

$$V_A = H / \sqrt{4\pi\rho},$$

where H is the intensity of the magnetic field, and ρ is the density of charged particles. At first, the computation of V_A for the magnetosphere was performed by Dessler [1], taking into account the monotonic decrease of plasma density with height, and for the intensity of the dipole field (dashed line in Fig.1).

However, sharp decrease of plasma density at geocentrical distances of $R = (4 \div 5)R_E$, where R_E is the Earth's radius, was already revealed in 1959 [2] during the flight of Soviet cosmic rockets. A series of data relative to this plasma jump have been collected to-date [3]; it was called "knee", near which the cold plasma density drops by several tens of times.

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* K VOPROSU O RASPREDELENII AL'FVENOVSKOY SKOROSTI V AMGNITOSFERE.

It is natural that such a sharp density decrease must lead to a significant increase of Alfvén velocity. The corresponding graph, computed for the dipole field, is shown in Fig.1 by solid line (a similar graph was exhibited by Dungey during a lecture at the Institute of Earth's Physics of the USSR Academy of Sciences in 1965).

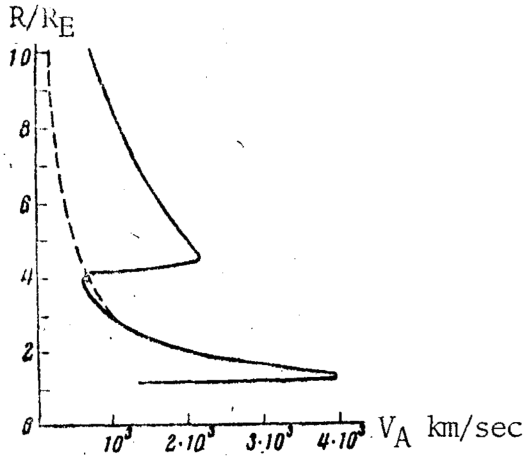

Fig.1

The characteristic departure of this graph from the data [1] is the second maximum of V_A at $R = (4 \div 5)R_E$ and the region of relatively low values of V_A, bounded by two maxima. From this peculiarity of distribution of Alfvén velocity in the magnetosphere emerge a series of consequences which are important for the understanding of the nature of geomagnetic micropulsations.

1) The region of decreased velocities may serve as an additional resonator for the magnetoacoustic waves, propagating isotropically in the exosphere. (So far it was considered [4] that the magnetoacoustic resonance encompasses the entire cavity of the magnetosphere).

2) The resonator referred to exists not only on the daytime, but also on the nighttime side of the magnetosphere. Thus, there appears the possibility of explaining the type-Pi2 night oscillations, which involved specific difficulties for the theories juxtaposing the resonator wall with the magnetosphere boundary (see [5]).

3) As may be seen from Fig.1, three regions may be pinpointed in the magnetosphere, in which magnetoacoustic resonances are possible:

a) the region bounded by the "knee" and the velocity jump at magnetosphere boundary (note that for specific conditions this jump may be fairly small, which impairs the quality of the outer resonator);

b) the region between the "knee" and the Alfvén velocity maximum at $R \approx 1.5R_E$;

c) the region, of which the ionosphere and the velocity maximum region serve as boundaries for $R \approx 1.5R_E$.

In the first two regions the fundamental periods of natural oscillations are estimated by the doubled time of wave path length and constitute 20 to 40 seconds in each resonator, while in the lower region they are estimated by the quadruple run time and constitute 15 to 20 seconds [6].

4. In case of interconnection between the resonators there may emerge beat-type oscillations with difference frequencies, by which one may apparently explain the broad spectrum of simultaneously existing micropulsations of various periods.

**** T H E E N D ****

Manuscript received
on 11 July 1966

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Contract No.NAS-5-12487
VOLT TECHNICAL CORPORATION
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Translated by ANDRE L. BRICHANT

on 30 January 1967

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