Vol 5 Issue 9 June 2016

ISSN No : 2249-894X

Monthly Multidisciplinary Research Journal

Review Of Research Journal

Chief Editors

Ashok Yakkaldevi
A R Burla College, India

Ecaterina Patrascu
Spiru Haret University, Bucharest

Kamani Perera
Regional Centre For Strategic Studies, Sri Lanka

Welcome to Review Of Research

RNI MAHMUL/2011/38595 **ISSN No.2249-894X**

Review Of Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial Board readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.ror.isrj.org

ISSN: 2249-894X Impact Factor : 3.1402(UIF) Volume - 5 | Issue -9 | June - 2016

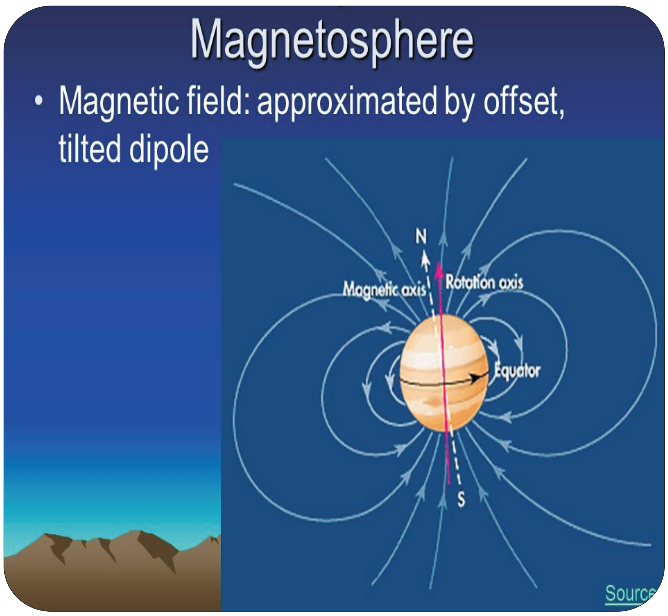
Review Of Research

THE STRUCTURE OF STANDING ALFVEN WAVES ,POLOIDAL ALFVEN WAVES IN A DIPOLE MAGNETOSPHERE WITH FINITE PRESSURE PLASMA AND MAGNETOSPHERE-IONOSPHERE COUPLING BY ALFVEN WAVES AT MID-LATITUDES.

Hanumantha Raju N
Maharani's Science college for women Bengaluru ,

Co - Author Details :

Gururaj A
GVPP Govt. First Grade College Hagaribommanahalli .



ABSTRACT

Waves were theoretically investigated in a dipole magnetosphere with moving plasma. Plasma motion was simulated with its azimuthal rotation. The model's scope allowed for describing a transition from the inner plasma sphere at rest to the outer magnetosphere with convecting plasma and, through the magnetopause, to the moving plasma of the solar wind. Solutions were found to equations describing longitudinal and transverse structures of standing Alfv´en waves with high azimuthal wave numbers $m^{>>}1$.Spectra were constructed for a number of first harmonics of poloidal and toroidal standing Alfv´en waves inside the magnetosphere.

Alfvén waves has proven to be a valuable tool in describing the propagation and evolution of field-aligned currents and the magnetic fields produced by these waves as observed on the ground. Although many models of this type have assumed that magnetic field lines penetrate the ionosphere vertically, this assumption is not valid at lower latitudes where the dipole tilt is significant.The structure and spectrum of standing Alfven For charged particles with velocities greatly exceeding the velocity of the background plasma, an effective parallel wave component of the electric field appears in the region occupied by such waves. This results in structured high-energy-particle flows and in the appearance of multiband aurorae. The transverse structure of the standing Alfv´en waves' basic harmonic was shown to be analogous to the structure of a discrete

auroral arc.

KEYWORDS :dipole magnetosphere, Alfven wave,

INTRODUCTION

The gradients in the Alfvén speed are particularly strong in the region up to about 1 RE altitude, since the mass density decreases exponentially with increasing altitude while the magnetic field falls off less rapidly. Thus, the Alfvén speed increases rapidly, reaching a peak at an altitude of about 1 RE that can be comparable to the speed of light. This sharp rise forms a resonant cavity, termed the ionospheric Alfvén resonator by Polyakov and Rapaport (1981) and studied extensively by Trakhtengertz and Feldstein (1984, 1991) and Lysak (1986, 1988, 1991,

1993). This cavity has resonant frequencies in the range of 0.1-1.0 H Micropulsation measurements in the magnetosphere provide important information on the processes of basic plasma physics, the fundamental structure of the magnetosphere, and substorm processes. Analysis of micropulsation events to determine the wave modes, growth characteristics, and propagation is therefore vital to an understanding of the magnetosphere. In this paper, we will show observations of a Pc 5 event seen near the magnetic equator by the retarding ion mass spectrometer (RIMS), the energetic ion composition spectrometer (EICS), the magnetometer (MAG), and the plasma wave instrument (PWI) on board Dynamics Explorer 1 (DE 1).The evolution of field-aligned currents can be described in terms of the passage of shearmode Alfvén waves along auroral field lines. The auroral flux tube is terminated by the conducting ionosphere, which reflects Alfvén waves unless the ionospheric Pedersen conductance is matched to the Alfvén wave impedance (e.g., Scholer, 1970; Goertz and Boswell,1979). Moreover, a realistic auroral flux tube contains strong gradients in the Alfvén speed, with scale lengths less than typical Alfvén wavelengths. Such gradients cause partial reflection of the wave (Mallinckrodt and Carlson, 1978), which can lead to a frequency dependence of the reflection coefficients (Lysak, 1991).

Alfv´en oscillations in a magnetosphere are known to enjoy two types of polarisation (Dungey, 1954; Radoski, 1967,1969). Oscillations in an axisymmetrical magnetosphere, exemplified by a dipole magnetic field model, may be representedas the sum of azimuthal harmonics of the form exp(im˃), where m is the azimuthal wave number, ˃ is the azimuthal angle. Oscillations with $m\to\infty$ are termed toroidally polarised, while those with m=0 are poloidally Precipitating in the ionosphere, these electrons are capable of triggering aurorae in polar latitudes. Taking into account dispersion kinetic effects in Alfv´en waves allows a longitudinal electric field $E_{\parallel}$ to be revealed in these waves (Hasegawa, 1976; Goertz, 1984). In a nonlinear Alfv´en wave, the $E_{\parallel}$ amplitude is one order of magnitude larger than in a linear one (Frycz et al., 1998). Taking into account the nonlocal conductivity effect for electrons in the field of a nonlinear Alfv´en wave can increase $E_{\parallel}$ by several orders of magnitude (Rankin et al., 1999; Tikhonchuk and Rankin, 2000; Samson et al., 2003; Watt et al., 2004). This is related to the fact that, within one oscillation period of an Alfv´en wave, electrons experience multiple bounce oscillations along field lines between the reflection points. Accelerated by the wave's longitudinal electric field, electrons can acquire energy necessary for aurorae to emerge in the ionosphere. Besides, kinetic dispersion effects and nonlinearities result in Alfv´en oscillations being nonlinearly structured across magnetic shells (Rankin et al., 2004).

Basic equations

First, we introduce the following designations: the capital letters B , P and J stand for the equilibrium values of the magnetic field, pressure and current, the small letters b, p and j denote the wave-associated perturbations of these quantities, ξ is the displacement of plasma from the equilibrium position, ρ is equilibrium plasma density, E is the wave's electric field, and ω is the wave frequency.

These quantities are related by the relation

$\nabla P = (4\pi)^{1} J \times B$ (condition of hydromagnetic equilibrium),

$J = \nabla \times B, \; j = \nabla \times b$

$i\omega b = c \nabla \times E$ (Maxwell equation),

$E = -\frac{i\omega}{c} \xi \times B$ (freezing-in condition).

We consider the hydromagnetic waves in those magnetospheric regions where the plasma to magnetic pressure ratio $\beta \equiv ?\,8\pi P/B$ is much less than unity. In these regions equilibrium plasma pressure across and along field lines differs no more than by 20% (Lui and Hamilton, 1992; Michelis et al., 1997); therefore, the anisotropy of the pressure tensor can be neglected. The pres- sure perturbation can then be found using the adiabaticity condition, the linearized form of which is written as

$$P = -\xi \cdot ?P - \gamma P ?\cdot \xi$$

The RIMS instrument is described fully by Chappell et al. [1981]. The instrument consists of three nearly identical ion detector heads aligned parallel, antiparallel, and perpendicular to the spacecraft spin axis, denoted -Z, + Z, and radial (RL), respectively. The instrument comprises a high-resolution mass spectrometer preceded by a retarding potential analyzer (RPA) stage, covering an energy range of 0 to 50 eV and a mass range of 1 to 32 amu. For a typical survey mode, in 16 s the instrument measures the integral flux spectra for the six principal ion species: H+, He+, O+, N+, He++, and 0++. RIMS has been working successfully since launch apart from one anomaly; after 1981 day 329, the RPA on the radial detector failed to function (the RPA voltage remains fixed at 0 V regardless of the RPA command setting); however, the RPAs on the + Z and -Z head detectors are still functioning normally. This means RPA analysis from the radial head is not possible for the chosen event. The energetic ion composition spectrometer (EICS) has been discussed by Shelley et al. [1981]. It resolves all major magneto- spheric ion species and covers the energy range from spacecraft potential to 17 keV/e. In the data presented here, 15-point energy spectra for H+ and 0+ were obtained for 24 "look" angles every 24 s. The lowest-energy channel was operated with a 10-V bias to reject all ions with energy less than 10 eV/e above the spacecraft potential. The lowest channel has a broad energy response and is sensitive to ions with energies up to -100 eV/e. The University of Iowa plasma wave instrument (PWI) includes a static electric field detector, which is used to measure Pc 5 electric fields directly. In high gain, the instrument is capable of measuring electric fields down to --0.5 mV/m, using the long electric antenna. This 200-m antenna is a fine-wire dipole, which is insulated except for 30 m on each end. Effective center-to-center separation of the uninsulated portions of the antenna is 173 m [Shawhan et al., 1981].

DISCUSSION

In the analysis above we neglected the coupling of the Alfven wave with the slow mode because of huge difference of their frequencies. Nevertheless, it is worth studying whether this coupling can significantly change our results. For this purpose, let us write a dispersion equation for the coupled poloidal Alfv´en and slow modes
(e.g.Klimushkin and Mager, 2008)

$$\left(w^2 - A^2 k_\parallel^2\right) - \frac{2PK}{\rho} = \frac{w^2 \quad - k_\parallel^2 v_s^2}{u \;\; w^2 v_s^2 k^2}$$

Here the prime means differentiating with respect to the radial coordinate,

$v_s = \frac{SA}{\sqrt{S^2 - A^2}}$ is slow magnetosonic speed,

$S = \sqrt{\frac{\gamma P}{\rho}}$ is the sound speed

Since the parallel reflection points are determined as the points where the condition k ‖ = 0 is satisfied, it is easily canbe seen that the reflection still takes place where w 2 = H, with the only difference that the sound speed is replaced by the slow magnetosonic speed, S→Vs . Therefore, we may conclude that the coupling with the slow mode cannot drastically change the results: it does not significantly shift the parallel reflection point found in this study, nor it introduces additional reflection points. The account of the finite-pressure effect has shown that regionswith strongly bent field lines may not just partially reflect poloidal Alfv´en waves, as was predicted in Pilipenko et al. (2005), but even impose a stop-band for them. We have to indicate that the effect of partial or even total Alfv´en wave reflection from this region may occur for an azimuthally-small scale (poloidal) mode. The Alfv´enic disturbances of this type are to accompany localized bursty or non-steady processes in the nighttime magnetosphere. A possibility of this effect for an azimuthally large-scale (toroidal) mode needs a special consideration, but most probably it is to be much less pronounced. But it can be observed also in the compressional component of the magnetic field b ‖ which is coupled with electric field in a finite pressure plasma .

CONCLUSION

This paper reports the particle detector and electric field measurements for a Pc 5 event encountered by the DE 1 spacecraft between 1830 and 1930 UT on July 14, 1982. These measurements (which have a "double-lobed" drift velocity variation over the event) for the first time show simultaneously measured E x B and particle-derived drift velocities during a Pc 5 event. The measurements indicate a rotation of the plasma in the direction normal to the magnetic field. The drift velocity modulation reaches peak values of 20 to 25 km s in both lobes, but shows a change in the direction of rotation of the plasma from left- to right-hand polarized between the two lobes of the event. Both regions extend over a 20-min period with Pc 5 oscillations within each lobe of 190 and 233 s, respectively. This "double-lobed" structure is present both in the low-energy particle data and in the quasi-static electric field data. The data in the first half of the event also indicate a relative increase in the eccentricity of the wave over the first lobe which is well correlated with the wave amplitude structure of the lobe. This suggests that the lobe structure is indicative of an encounter with a localized Pc 5 resonance structure in the afternoon magnetosphere. Since the observed electric field polarization was left-handed on both sides of the resonance and became essentially linear at the peak of the lobe, the 20-min period of the lobe structure can be interpreted as a resonance region (10 to 20 RE) traveling past, but radially within the orbit of DE 1, with a velocity of approximately 200 km s The second lobe is more complicated, and a predominance of highly eccentric right-hand polarization of the plasma suggests that the location of the traveling resonance was just radially outside of the location of the DE 1 spacecraft. Alternatively, the double-lobed structure and eccentricity changes may be interpreted as simply temporal variations in the pulsation.

REFERENCESS

1.Ansari, I. A. (2008), "Multipoint observations of Low Latitude ULF Pc3 Waves in South-East Australia", J. Astrophys. Astr., vol. 29, p. 303-311.

2.Ansari, I. A. and Eraser, B. J. (1985), "A statistical study of low latitude Pc3 geomagnetic pulsations", hdian J. Radio Space Phys., Vol. 14, p. 42-49.

3.Ansari, LA., Nafees, K.A., Khan, M.T., Sinha, A.K. and Pathan, B.M. [2009(a)], "Diurnal and seasonal variation in Pc4 occurrence at low latitudes in India", Ind. J. of Radio & Space Phys., vol. 38, p. 197-207.

4.Allan, W., White, S. P. and Poulter, E. M. (1985), "Magnetospheric coupling of hydromagnetic waves-initial results", Geophys. Res. Lett., 12, p. 287-291.

5.AlfVe'n, H., and Falthammar, C.-G. (1963), "Cosmical Electrodynamics: Fundamental Principles", Clarendon Press, Oxford 228.

6.Radoski, H. R. and Carovillano, R. R.: Axisymmetric plasmasphere resonance, Toroidal mode, Phys. Fluids, 7, 285-297, 1969.

7.Rankin, R., Lu, J. Y., Marchand, R., and Donovan, E. F.: Spatiotemporal characteristics of ultra-low frequency dispersive scale shear Alfven waves in the Earth's magnetosphere, Phys. Plasmas, 11, 1268-1276, 2004.

8.Ansari, LA. and Khan, M.T., (2012), "Pc4 occurrence and its dependence on Kp values at low latitudes in India", Indian J. of Radio & Space Physics, vol. 41, pp. 39-47.

9. Ansari, I. A. and Nafees, K. A., "Dependence of Pc4 Magnetic Pulsations activity on Solar Wind Velocity and Interplanetary Magnetic Field at Low Latitudes In India", Proc. of National Seminar on Recent Trends in advancement of Mathematical and Physical Science, D.N. (P.G.) Collage , Meerut (India), 17-18 March, 2012 (a), p. 24-28.

10. Ansari, I. A. and Nafees, K. A., "Pc4 Magnetic Pulsations at Low Latitudes in India and its Dependence on Solar Wind Velocity and Interplanetary Magnetic Field", Paper submitted to Indian Journal of Radio & Space Physics, May, 2012(b).

11. Arthur, C. W. and McPherron, R. L. (1977), "Micropulsations in the morning sector, 3. Simultaneous ground-satellite observations of 10-s to 45-s period waves near L = 6.6", J. Geophys. Res., 82, p. 2859-2866.

12. Arthur, C. W. and McPherron, R. L. (1981), "The statistical character of Pc4 magnetic pulsations at synchronous orbit", J. Geophys. Res., 86, p. 1325-1334.

13. Barker, M. D. (1977), "The characteristics of Pc3 and Pc4 geomagnetic micropulsations recorded at Sanae, Antarctica", Planet. Space Sci., Vol. 25, p. 689-701.

14. Belcher, J. W. and Davis, L. Jr. (1971), "Large-amplitude Alfv^e'n Waves in the Interplanetary Medium. 11", J. Geophys. Res. 76(16), p. 3534-3563.