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Automated detection of Pi 2 pulsations using wavelet analysis: 2. An application for dayside Pi 2 pulsation study

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We investigated statistical characteristics of dayside Pi 2 pulsations observed at Mineyama (25.5° geomagnetic latitude) from November 1994 through June 1996, using an algorithm to detect Pi 2 pulsations which was introduced in Part 1 of the accompanying paper. We obtained the following results. (1) The ratio of the number of Pi 2 pulsations on the dayside (06–18 MLT) to that on the nightside (18–06 MLT) was about 31%. (2) The polarization of the dayside Pi 2 pulsations changed from right-handed before local noon to left-handed after local noon. (3) Wave power of dayside Pi 2 pulsations in the H-component has a peak around local noon and dips on both dawn and dusk sides. (4) Frequency of the fundamental wave is ranging from 9 mHz to 30 mHz with dominant frequency of 17–24 mHz, and frequency ratios of the first three harmonics are 1 : (1.7 ± 0.5) : (2.3 ± 0.7). We found that the magnetospheric cavity model can explain most of these observational results.

1. Introduction

Dayside Pi 2 pulsations have been investigated mostly from a viewpoint of simultaneous occurrence with nightside Pi 2 pulsations. Yanagihara and Shimizu (1966) investigated simultaneous occurrence of dayside Pi 2 pulsations at the dip equator, using the rapid-run magnetograms at Fredericksburg (49.6° geomagnetic latitude (GMLAT)), Koror (−3.2°GMLAT), and Guam (3.9°GMLAT). They found that among 112 Pi 2 pulsations observed at Fredericksburg in the night hours, 74 events correspond clearly in occurrence time and phase to those observed on the dayside at Koror and Guam. Stuart and Barsczus (1980) reported that 59 of the 83 Pi 2 pulsations observed at Eskdalemuir (58.5°GMLAT) are coincident with daytime Pi 2's identified at Pamatami (15.3°GMLAT). About 40% of nightside Pi 2 events identified at Fredericksburg correspond with dayside Pi 2 pulsations identified at low-latitude Onagawa station (Yumoto *et al.*, 1980). Sutcliffe and Yumoto (1989, 1991) investigated the occurrence of dayside Pi 2 pulsations, utilizing the Correlated data Adaptive Noise Canceling (CANC) method. Sutcliffe and Yumoto (1989) reported that dayside Pi 2 pulsations which correspond to nightside Pi 2 pulsations at low-latitude (Onagawa) are identified commonly (83%) at low-latitude (Hermanus) and occasionally (18%) at mid-latitude (Marion). Sutcliffe and Yumoto (1991) found that 29 nighttime Pi 2 pulsations were identified at Hermanus, of which 24 events (79%) were accompanied by daytime Pi 2 pulsations at Onagawa. Using geomagnetic field measurements at Green Hill (52°GMLAT) and L'Aquila (42.5°GMLAT), Villante *et al.* (1992) showed clear dayside Pi 2-like pulsations can occasionally be detected at mid-latitude.

Some previous authors reported equatorial enhancement of dayside Pi 2 pulsations in the equatorial region. Yanagihara and Shimizu (1966) found that an amplitude of dayside Pi 2 at equatorial region is about 4 times as large as that at Kakioka (26.0°GMLAT). Daytime Pi 2's existed in a narrow band belt around the equator (Stuart and Barsczus, 1980). Sastry *et al.* (1983) examined the ratio of Pi 2 amplitude in the H-component observed at Etaiyapuram (−0.6°GMLAT) to that at Choutuppal (7.5°GMLAT) and found the average value of the ratio reaching maximum of 2.6 between 11 and 12 LT. They suggested that the enhancement of daytime Pi 2 pulsations is ascribed to the enhanced ionospheric conductivity in the equatorial electrojet region. Recently, Shinohara *et al.* (1997) showed that the amplitude of daytime Pi 2 pulsations at dip equator is 3–4 times as large as those at low-latitude, using multipoint measurements from the 210° magnetic meridian magnetometer chain. The phase of daytime Pi 2 pulsation at dip equator is found to lag ∼34° behind those at low-latitude. They suggested that the dayside Pi 2 pulsations at the equator are caused by the electric field which penetrates from the nightside polar ionosphere to the dayside equatorial ionosphere.

An excitation mechanism for dayside Pi 2 pulsations at low-latitudes was proposed by some authors. Sutcliffe and Yumoto (1991) found that spectra of the dayside and nightside Pi 2 pulsations are almost identical, and concluded that these characteristics are a consequence of the cavity mode nature of low-latitude Pi 2 pulsations. The periods of Pi 2 pulsations detected at high- and low-latitude stations on the nightside and those at low-latitude station on the dayside are found to be identical by Yumoto *et al.* (1990). They also suggested that Pi 2 events are a forced field line oscillation of global scale, coupled with the magnetospheric cavity resonance wave in the inner magnetosphere. Yumoto (1990) reviewed the wave characteristics of global Pi 2 pulsations and proposed magnetospheric cavity model for excitation

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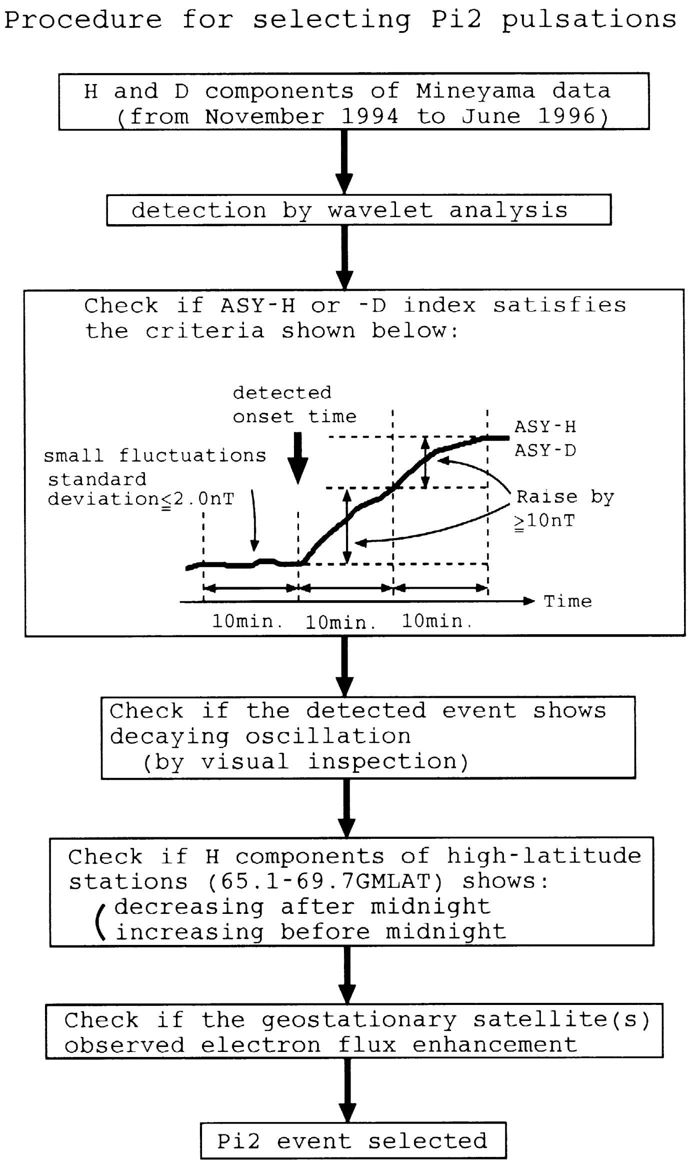

Fig. 1. Procedure for selecting Pi 2 pulsations from the Mineyama data.

mechanism.

In this paper we investigated dayside Pi 2 pulsations observed at Mineyama observatory (25.5°GMLAT). Dayside Pi 2 pulsations are shown to be rather common phenomena. We found some new characteristics of dayside Pi 2 pulsations which support the magnetospheric cavity model. In Section 2, procedure for selecting Pi 2 pulsations is described and the results of statistical analysis of Pi 2 pulsation are presented. In Section 3 excitation mechanism of dayside Pi 2 pulsations is discussed.

2. Analysis

In Part 1 of the accompanying paper (Nosé *et al.*, 1998), we introduced an algorithm to detect Pi 2 pulsation automatically, which is based on the wavelet analysis. Using this algorithm for Pi 2 detection, we investigated statistical characteristics of Pi 2 pulsations observed at Mineyama from November 1994 through June 1996. Dayside Pi 2 pulsations are mainly concerned, because their characteristics have been treated statistically by only a few papers.

2.1 Preparation of Pi 2 list

Pi 2 pulsations were selected from the Mineyama data by utilizing the algorithm based on wavelet analysis and other selection procedures, as illustrated in Fig. 1. In the first step, using the algorithm to detect Pi 2 pulsations by wavelet analysis (Nosé *et al.*, 1998), we analyzed the H- and D-components of the 1-second resolution geomagnetic field data from Mineyama and made a list of events.

In the second step, we checked if the detected events are associated with clear substorm signatures, in order to ensure Pi 2 selection. A longitudinally asymmetric (ASY) disturbance index (Iyemori *et al.*, 1992) are used to identify substorm, because ASY-H and ASY-D indices show variations which correspond to mid-latitude positive bay at substorm onset (Iyemori and Rao, 1996). An event which satisfies the following two criteria is identified as a substorm-associated

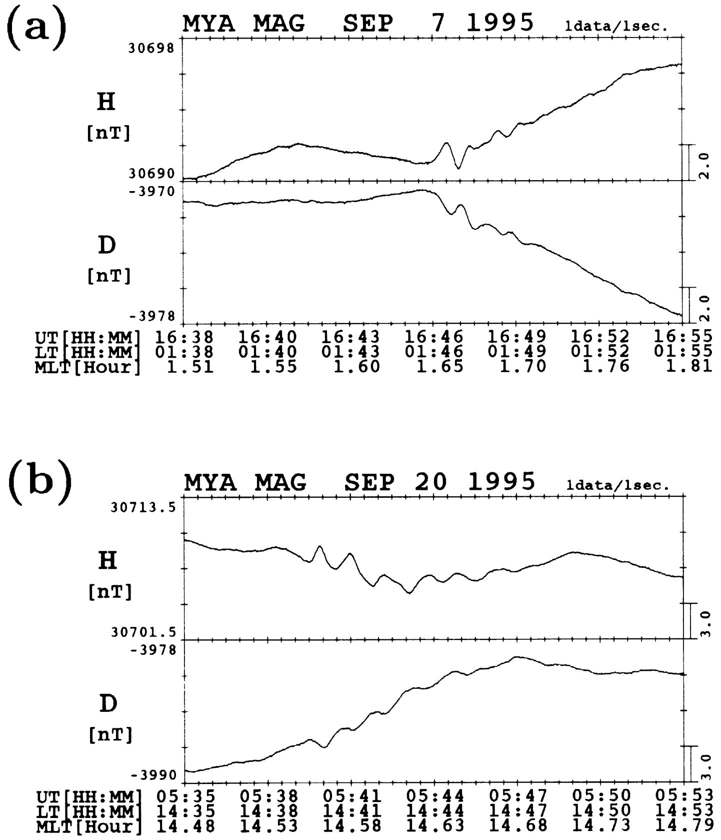

Fig. 2. Examples of Pi 2 pulsation detected by the selection procedure shown in Fig. 1. (a) An example of nightside Pi 2 pulsation observed on September 7, 1995. (b) An example of dayside Pi 2 pulsation observed on September 20, 1995.

event. (1) ASY-H or ASY-D index shows only small fluctuations for the time interval of 10 minutes before the occurrence of the event (standard deviation for the time period of $\leq$2.0 nT). (2) ASY-H or ASY-D index exhibits a rise more than or equal to 10 nT over the time interval of 10 minutes after the occurrence of the event, and besides a rise more than or equal to 10 nT over the next time interval of 10 minutes.

In the last step, we also used the geomagnetic field data obtained at 7 high-latitude stations (65.1°–69.7°GMLAT) and the electron flux data from the LANL geosynchronous satellites, in order to identify substorm. The names (geomagnetic latitudes) of the high-latitude stations used here are College (65.1°), Kiruna (65.1°), Pos. de la Baleine (66.2°), Fort Churchill (68.5°), Barrow (69.1°), Yellowknife (69.1°), and Leirvogur (69.7°). We checked if (1) the event shows decaying oscillation; (2) the H-components of the magnetic field data at high-latitude decrease after midnight or increase before midnight around the occurrence time of the event; (3) the LANL geosynchronous satellites observed electron flux enhancement around the occurrence time of the event. Using the criteria above, we identified 251 Pi 2 pulsations associated with clear substorm signatures.

Examples of Pi 2 pulsations detected by this selection procedure are shown in Fig. 2. Figure 2(a) gives an example of Pi 2 pulsation on the nightside (1.7 MLT) observed on September 7, 1995. Pi 2 pulsation with a peak-to-peak amplitude of about 2 nT and a period of about 60 seconds appeared clearly at 1646 UT. Figure 2(b) shows an example of Pi 2 pulsation on the dayside (14.6 MLT) observed on September 20, 1995. We can see that a distinctive Pi 2 pulsation, which has a peak-to-peak amplitude of about 2 nT and a period of about 80 seconds, appeared even on the dayside. The onset time of this Pi 2 pulsation was 0538 UT.

2.2 Observational results

2.2.1 Occurrence distribution Figure 3 gives MLT dependence of the occurrence of Pi 2 pulsations observed at Mineyama. Pi 2 pulsations occur frequently in the MLT range of 21–01 MLT and have an occurrence peak at 23–00 MLT. Although there are dips of number of event at 01–03 MLT and 22–23 MLT, we consider these dips are due to the statistics based on small number of data set. The number of events decreases generally as the local time shifts from midnight to dawn and dusk sides. This occurrence distribution of the nightside Pi 2 pulsations are consistent with the previous results (e.g., Saito and Matsushita, 1968; Smith, 1973; Sakurai and McPherron, 1983; Singer *et al.*, 1983).

Pi 2 pulsations appear in the wide range of MLT on the dayside (06–18 MLT). Out of 251 events, 60 events of Pi 2 pulsations were observed on the dayside. Thus the ratio of the number of dayside Pi 2 pulsations to that of nightside Pi 2 pulsations was calculated to be about 31% (60/191), which agrees with that derived from Fig. 7 in Part 1 of the accompanying paper (Nosé *et al.*, 1998).

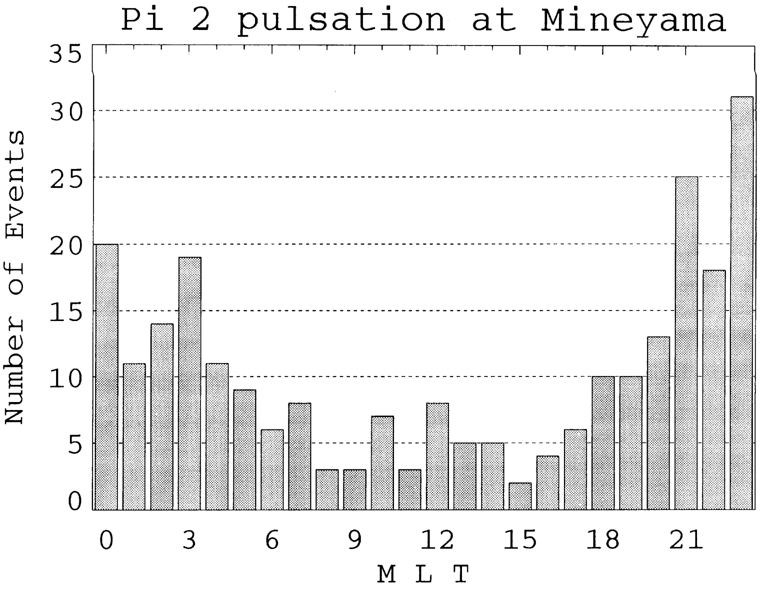

Fig. 3. MLT dependence of the occurrence of Pi 2 pulsations observed at Mineyama.

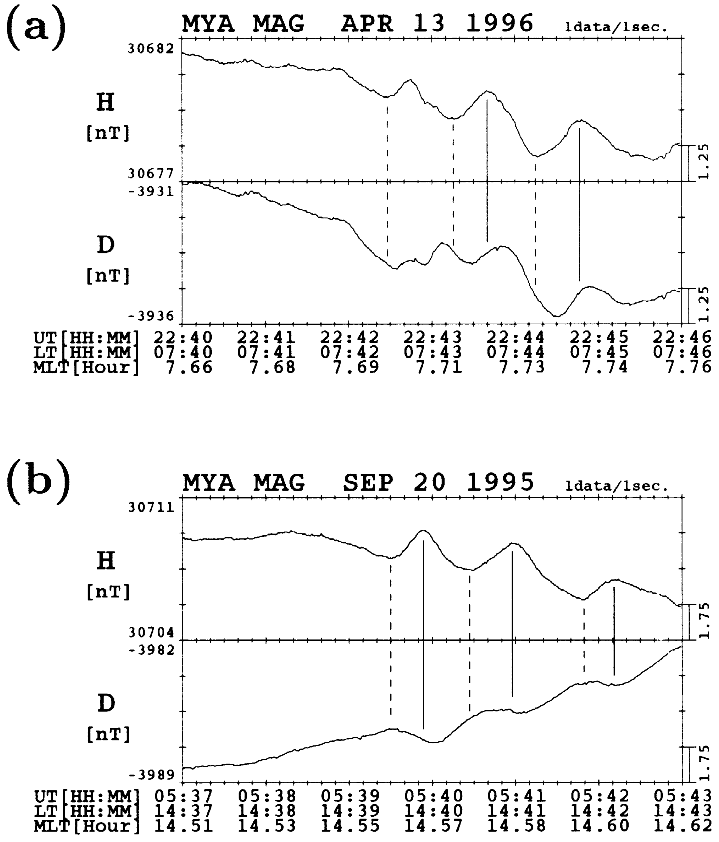

Fig. 4. (a) An example of dayside Pi 2 pulsation observed before local noon (7.7 MLT). The vertical solid and broken lines indicate the times of peaks and troughs in the H-component, respectively. (b) Same as Fig. 4(a) except for dayside Pi 2 pulsation observed after local noon (14.6 MLT).

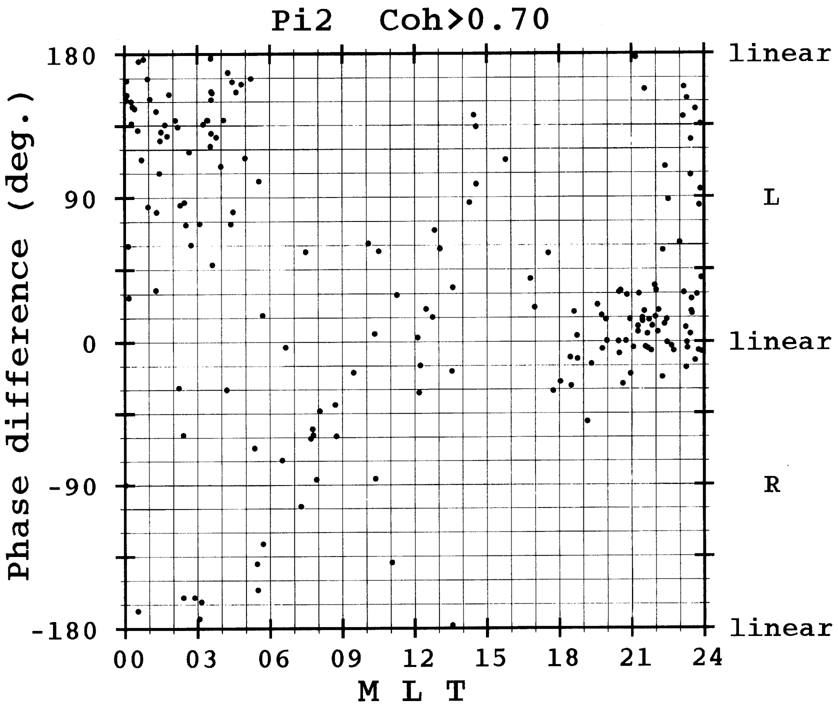

Fig. 5. MLT dependence of phase difference between H- and D-components, which is defined as the phase of the D-component minus that of the H-component. A left-handed polarized wave is represented by the positive phase difference, and vice versa, where the polarization is defined in the H-D plane from a view looking down onto the earth. A small dot shows one Pi 2 pulsation event which has the coherency between the H- and D-components of more than 0.70.

2.2.2 Polarization Figure 4 shows examples of Pi 2 pulsation on the dayside. Pi 2 pulsation observed before local noon (7.7 MLT) is shown in Fig. 4(a). Pi 2 pulsation started with a negative variation in the H-component at 2242 UT. The vertical solid and broken lines in Fig. 4(a) indicate the times of peaks and troughs in the H-component of the magnetic field, respectively. Comparing the H- and D-components of the magnetic field, we found that the oscillation in the H-component leads that in the D-component. The relative phase difference between the H- and D-components was derived to be 60°. Therefore Pi 2 pulsation before local noon is right-handed polarized, where the polarization is defined in the H-D plane from a view looking down onto the earth. Pi 2 pulsation observed after local noon (14.6 MLT) is shown in Fig. 4(b), which is the same event as that in Fig. 2(b). The H-component of this Pi 2 pulsation also started with a negative variation at 0538 UT. The oscillation in the H-component lags behind that in the D-component by the relative phase difference of 134°, indicating that Pi 2 pulsation after local noon is left-handed polarized.

The polarization of Pi 2 pulsations were examined statistically. Figure 5 shows MLT dependence of phase difference ($\Delta\phi_{HD}$) between the H- and D-components, which is defined as the phase of the D-component minus that of the H-component. A left-handed polarized wave is represented by the positive phase difference, and vice versa. A small dot in Fig. 5 corresponds to one Pi 2 event which has the coherency between the H- and D-components of more than 0.70. We can see three clusters of dots in Fig. 5, that is, first cluster after local midnight with $\Delta\phi_{HD} \sim 90°$–$180°$, second cluster before midnight with $\Delta\phi_{HD} \sim 0°$–$90°$, and third cluster on the dayside with $\Delta\phi_{HD}$ which depends on MLT. The first and second clusters of dots indicate that (1) Pi 2 pulsations on the nightside are predominantly left-handed polarized; (2) the major axis of the wave ellipse is located in the first (third) quadrant of the H-D plane before midnight, and in the second (fourth) quadrant after midnight. These characteristics of the nightside Pi 2 pulsations are consistent with those at mid-latitude stations reported by the previous studies (e.g., Lester *et al.*, 1983, 1984; Lanzerotti and Medford, 1984). The third cluster of dots shows that the polarization is right-handed before local noon and left-handed after local noon. The examples of polarization found in Fig. 4 are consistent with this statistical result. We also found that the phase difference of dayside Pi 2 pulsations is roughly proportional to MLT, that is, the phase difference increases from about $-180°$ around dawn side through about 0° at local noon to about 180° around dusk side. The characteristics of Pi 2 polarization on the dayside are quite different from those on the nightside.

2.2.3 Wave power Figure 6 shows MLT dependence of power spectral density of Pi 2 pulsations in the H-component. The power spectral density, in which a background level is subtracted, is indicated by small open squares. We used only Pi 2 events which are associated with ASY index whose rise to the peak is less than 40 nT, because wave power of Pi 2 pulsations could depend on magnitude of substorms. The large diamonds in the Fig. 6 indicate running averages of power spectral density for the interval of 3 hours of MLT, and are plotted in the center of the interval. For the interval

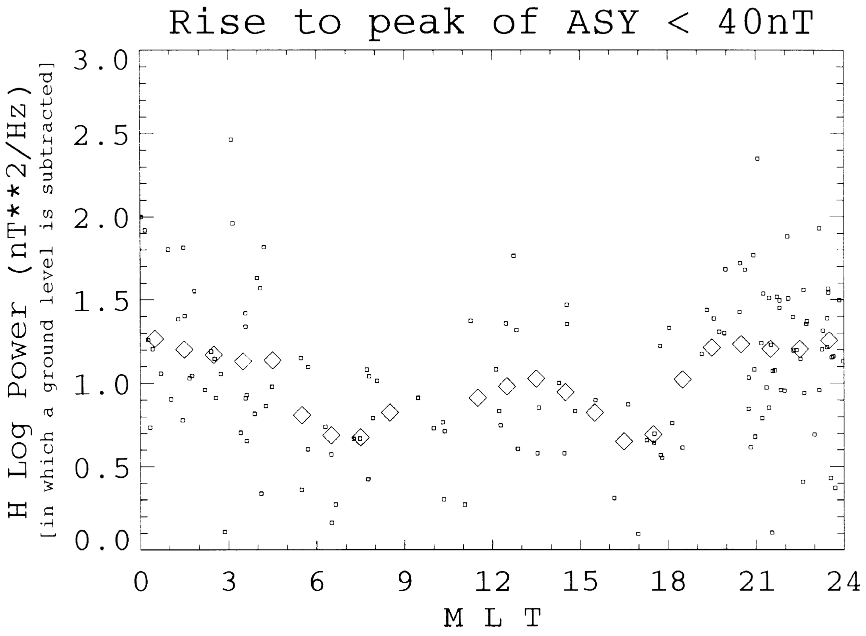

Fig. 6. MLT dependence of power spectral density of Pi 2 pulsations in the H-component. A small open square shows power spectral density of one Pi 2 event in which a background level is subtracted. Large diamonds indicate running average of power spectral density for the interval of 3 hours of MLT, and are plotted in the center of the interval. Only Pi 2 events which are associated with ASY index whose rise to the peak is less than 40 nT are shown.

in which the number of events is small, large diamonds are not shown. We found a peak of wave power around local noon and dips on both dawn and dusk sides. The average wave power around local noon is about $10^{0.5}$ times as large as that at dawn/dusk side.

2.2.4 Frequency Figure 7(a) shows the H-component of dayside Pi 2 pulsation observed on March 19, 1996 at Mineyama. The magnetic field data in the interval from 120 seconds before the onset time (0358 UT) to 392 seconds after the onset time are shown. This dayside Pi 2 pulsation had a period of about 60 seconds and a duration of about 5 minutes. We calculated a power spectral density for the interval of 512 seconds. The power spectral density, in which a background level is subtracted, is shown in Fig. 7(b). We notice that first three harmonics are clearly observed at 17.6 mHz, 29.3 mHz, and 39.1 mHz, which correspond to periods of 56.8 seconds, 34.1 seconds, and 25.6 seconds, respectively. It should be noted that the fundamental wave has the strongest power. The frequency ratios from the fundamental to the third harmonic waves are $f_1 : f_2 : f_3 = 1 : 1.66 : 2.22$, where f_1, f_2, and f_3 denote frequencies of the fundamental, second harmonic, and third harmonic waves.

We investigated frequency of the fundamental wave and frequency ratios for all dayside Pi 2 events. The results are shown in Fig. 8. We found that frequency of the fundamental wave is ranging from 9 mHz to 30 mHz and predominant in the range of 17–24 mHz (Fig. 8(a)). The fundamental frequency of the event in Fig. 7 (17.6 mHz) is included in this dominant frequency range. Figure 8(b) shows the number of dayside Pi 2 events as a function of the frequency ratios. White and shaded bars in Fig. 8(b) represent the frequency ratios of f_2/f_1 and f_3/f_1, respectively. The number of events was counted in each bin of 0.2 of frequency ratio. Events in which higher harmonic waves do not appear clearly were excluded from statistics. We notice from Fig. 8(b) that f_2/f_1 is in the range of 1.2–2.2 with a peak at 1.6–1.8. The frequency ratio of the third harmonic wave to the fundamental wave (f_3/f_1) is distributed in wider range (1.6–3.4) and has a maximum at 2.2–2.4. The mean values of f_2/f_1 and f_3/f_1 are 1.63 and 2.28, respectively. Therefore the frequency ratios of the first three harmonics are derived to be $f_1 : f_2 : f_3 = 1 : (1.7 \pm 0.5) : (2.3 \pm 0.7)$, which is consistent with the result of Fig. 7(b).

3. Discussion

3.1 Excitation model of dayside Pi 2 pulsations

We found from Fig. 3 that the number of dayside Pi 2 pulsations is about 31% of that of nightside Pi 2 pulsations. This result can be interpreted that about 31% of nightside Pi 2 pulsations have simultaneous occurrence of dayside Pi 2 pulsations. Some previous studies reported that 71–83% of the nightside Pi 2 pulsations correspond to dayside Pi 2 pulsations at low-latitude (Stuart and Barsczus, 1980; Sutcliffe and Yumoto, 1989, 1991). The difference of the rate of dayside Pi 2 observation between this study and the previous studies is thought to be due to the difference of the detection procedure, that is, in previous studies dayside Pi 2 pulsations were identified using the onset times of nightside Pi 2 pulsations as reference or the CANC method, but in this study dayside Pi 2 pulsations were detected by the same procedure as that for nightside Pi 2 pulsations. The rate of dayside Pi 2 observation will have much larger value than 31% if we adopt a detection procedure similar to that in the previous studies. Thus we conclude that Pi 2 pulsations are observed commonly even on the dayside, which suggests that Pi 2 pulsations are global phenomena.

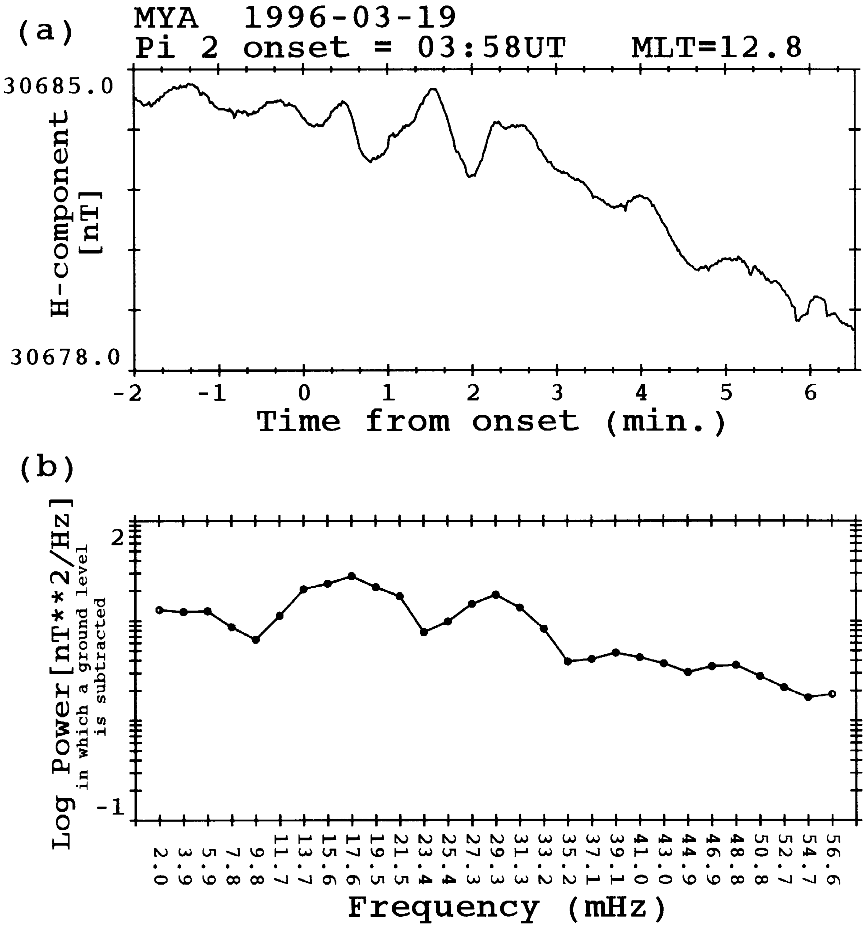

Fig. 7. (a) The H-component of dayside Pi 2 pulsation observed on March 19, 1996. The onset time is 0358 UT which corresponds to 0 minute in the horizontal axis. (b) The power spectral density of the dayside Pi 2 pulsation shown in Fig. 7(a), in which background level is subtracted.

Our finding that dayside Pi 2 pulsations have the fundamental frequency ranging from 9 mHz to 30 mHz is consistent with those by Lin *et al.* (1991) (typical period of 30–100 seconds) and Li (1994) (9–25 mHz). We also found that the frequency ratios of the first three harmonic waves are $f_1 : f_2 : f_3 = 1 : (1.7 \pm 0.5) : (2.3 \pm 0.7)$, which accord with the previous results of $1 : (1.5 \pm 0.3) : (2 \pm 0.4)$ by Lin *et al.* (1991) though in the present study the ratios are slightly high. To explain this frequency ratios, Lin *et al.* (1991) solved the MHD equations in the rectangular box in x-z plane which corresponds to the meridian plane of the magnetosphere, and showed that frequency ratios of the waves excited by a magnetosphere cavity model are about $1 : 1.5 : 2.0$. They also showed that the observed period of the fundamental wave is close to the computed eigenperiod of a magnetospheric cavity wave. Li (1994) compared observational results of Pi 2 pulsation with numerical modeling results in terms of fundamental frequency and frequency ratios of the first three harmonic waves. The observations agree with the fundamental frequency (10–22 mHz) and the frequency ratios ($\sim 1 : 1.5 : 2.0$) calculated from the magnetospheric cavity resonance model.

From the above discussion, we suggest that dayside Pi 2 pulsations are due to magnetospheric cavity mode waves. Figure 9 shows a fundamental mode oscillation of magnetospheric cavity mode waves at $t = (n + 1/4)T$, where T is a wave period, n is an integer, and $t = 0$ corresponds to the onset time of dayside Pi 2 pulsation. The left panel of Fig. 9 illustrates displacement of geomagnetic field lines in the equatorial plane on the dayside. An arc of the largest semicircle represents the magnetopause. The right panel of Fig. 9 shows the configuration of the geomagnetic field lines in the meridian plane of 12 MLT. For simplicity, the magnetosphere is represented by a box with straight field lines. We suppose that the oscillation was caused by a compressional wave which was launched at substorm onset. The compressional wave is thought to be trapped effectively in the local time region where the wave normal is perpendicular to the inner and outer boundaries (Takahashi *et al.*, 1995). Thus the wave trapped most effectively will be found in the meridian plane which includes substorm occurrence region, that is, around midnight. The compressional wave propagating to the dayside hemisphere could also establish cavity mode oscillation effectively around local noon. This idea led us to depict Fig. 9 with the outward initial displacement of the magnetic field lines which has the largest amplitude around local noon. We assume perturbations in the radial component in the magnetosphere map to the ground in the H-component without phase changes, because the cavity mode wave is due to fast mode waves which are not rotated by transmitting

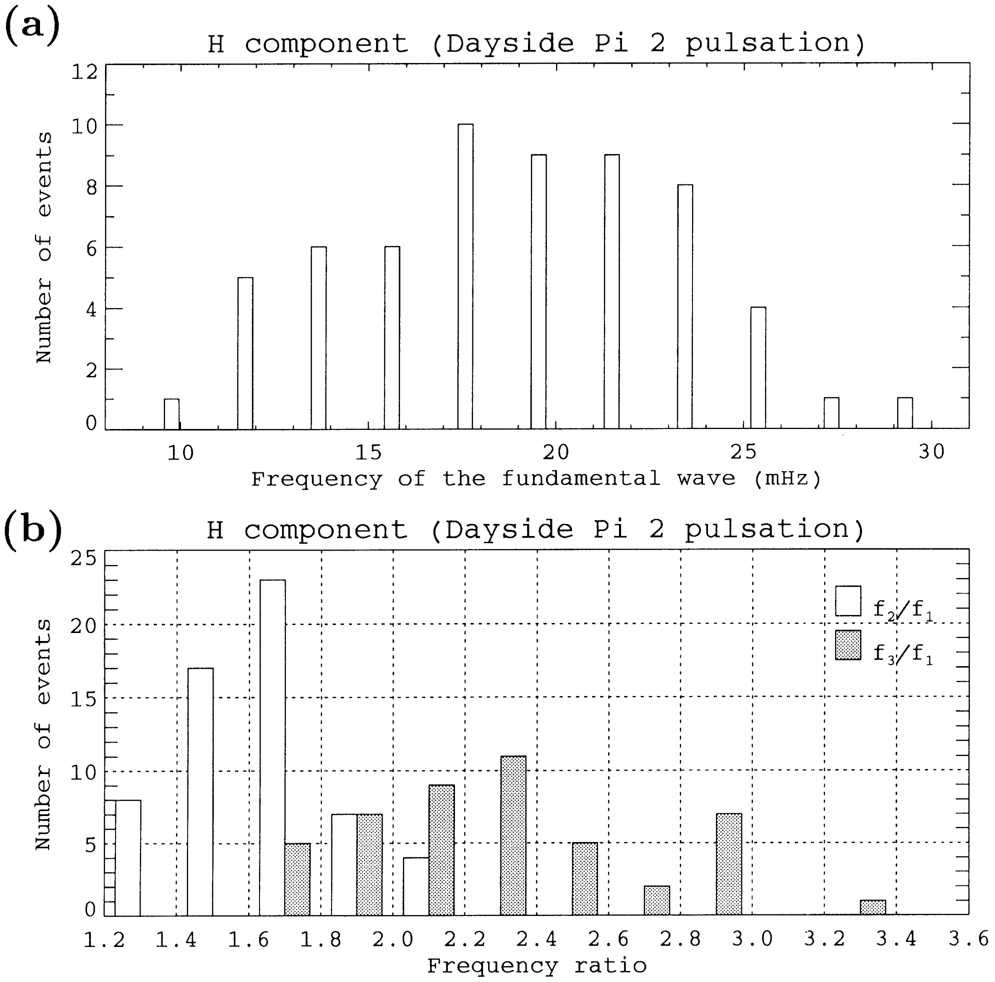

Fig. 8. (a) Number of dayside Pi 2 events as a function of frequency of the fundamental wave. (b) Number of dayside Pi 2 events as a function of frequency ratios of the higher harmonic waves to the fundamental wave. The number of events was counted in each bin of 0.2 of frequency ratio.

the ionosphere. (Hughes and Southwood, 1976; Nishida, 1978; Kivelson and Southwood, 1988). This assumption was also adopted by Takahashi *et al.* (1995) and Allan *et al.* (1996), which treated the cavity mode waves on the nightside. Therefore it is expected that the ground stations at both northern and southern hemispheres observe decreases of the H-component at the onset of dayside Pi 2 pulsations as shown in the right panel of Fig. 9, which is consistent with the observations of Fig. 4. We can expect that the amplitude of dayside Pi 2 pulsations in the H-component has a peak around local noon and minimum values at both dawn and dusk sides. This expectation is in accordance with the observational result shown in Fig. 6 and the previous observation by Lin *et al.* (1991) in which large-amplitude Pi 2 pulsations are more frequently observed during local noon (11–13 LT) and midnight (23–01 LT).

The magnetospheric cavity model can explain most of the statistical results of dayside Pi 2 pulsations derived from Mineyama observation, but a problem still remains in terms of polarization. The left panel of Fig. 9 indicates that oscillation in the H-component has the identical phase in all range of MLT on the dayside. The observation showed that the phase difference between H- and D-components changes from about $-180°$ around dawn side through about 0° at local noon to about 180° around dusk side (Fig. 5). Therefore the phase of dayside Pi 2 oscillation in the D-component is thought to depend on MLT, that is, the oscillation in the D-component is caused by westward propagating wave with azimuthal wave number (m) of 2. Previous studies obtained the similar results that the azimuthal wave number is small (typically $|m| < 3$) with westward propagation and the D-component $|m|$ is larger than the H-component $|m|$ (Li, 1994; Li *et al.*, 1998). However, we can not consider a coupled oscillation of the D-component with $m = 2$ and the H-component in which a phase does not depend on MLT in the dipole magnetic field. To solve this problem further observational and theoretical studies will be needed. Observations of ground stations which distribute longitudinally at low-latitude will give some clues to establish a more plausible cavity model which includes longitudinal phase structure. Simultaneous observations of ground stations and satellites on the dayside will be also useful.

3.2 Comparison with other excitation model

We proposed the magnetospheric cavity model for excitation mechanism of dayside Pi 2 pulsations, same as Yumoto (1990), Yumoto *et al.* (1990), and Sutcliffe and Yumoto

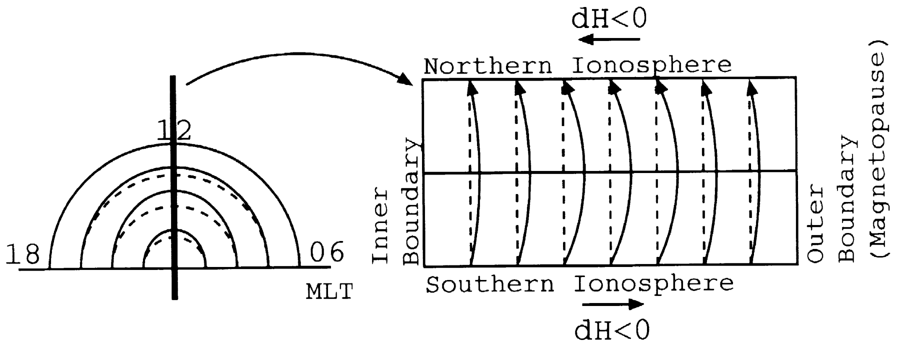

Fig. 9. A fundamental mode oscillation of magnetospheric cavity mode waves. The left panel illustrates displacement of geomagnetic field lines in the equatorial plane on the dayside. The right panel shows the configuration of the geomagnetic field lines in the meridian plane of 12 MLT.

(1991). However, some previous studies suggested that dayside Pi 2 pulsations are caused by the electric field penetration from the polar ionosphere (Sastry *et al.*, 1983; Shinohara *et al.*, 1997). This disagreement on excitation models are thought to stem from difference of the geomagnetic latitude of stations used in these studies. Data from low-latitude stations were analyzed by Yumoto (1990), Yumoto *et al.* (1990), Sutcliffe and Yumoto (1991), and the present study. Sastry *et al.* (1983) and Shinohara *et al.* (1997) focused on the equatorial enhancement of dayside Pi 2 amplitude which was observed at the geomagnetic equator ($|\text{GMLAT}| < \sim 1^\circ$). Therefore we think that the magnetospheric cavity model and the electric field penetration model are responsible for dayside Pi 2 pulsations in the low-latitude and in the geomagnetic equator, respectively.

4. Conclusions

Pi 2 pulsations observed at Mineyama observatory were studied statistically. We mainly concerned dayside Pi 2 pulsations. The followings are the main results.

1. Pi 2 pulsations occurred frequently near local midnight, but they were observed even on the dayside (06–18 MLT). The ratio of the number of Pi 2 pulsations on the dayside to that on the nightside was about 31%.

2. Pi 2 pulsations on the nightside have predominance of left-handed polarization, and the major axis of the wave ellipse which is located in the first (third) quadrant of the H-D plane before midnight and in the second (fourth) quadrant after midnight. The polarization of the dayside Pi 2 pulsations changed from right-handed before local noon to left-handed after local noon. Dayside Pi 2 pulsations have the phase difference between H- and D-components which is generally proportional to MLT.

3. Wave power of dayside Pi 2 pulsations in the H-component has a peak around local noon and dips on both dawn and dusk sides.

4. Frequency range of the fundamental wave is 9–30 mHz with dominant frequency of 17–24 mHz. The frequency ratios of the first three harmonics are $f_1 : f_2 : f_3 = 1 : (1.7 \pm 0.5) : (2.3 \pm 0.7)$.

We suggested that the magnetospheric cavity model plays an important role for excitation of dayside Pi 2 pulsations at low-latitude.

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