Pi 2-associated Ionosperic Doppler Velocity and Magnetic Pulsation at Mid-latitude MAGDAS Station

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At the onset of magnetospheric substorms, impulsive hydromagnetic oscillations occur globally in the magnetosphere with a period range from 40 to 150 seconds [e.g. Saito, 1968]. They are called Pi 2 magnetic pulsations. Pi 2 has been studied with arrays of magnetometers on the ground and with in-situ observation by satellites [cf. Yumoto et al., 2001]. However characteristics of Pi 2 electric pulsations in the ionosphere have not been clearly clarified yet.

In this study, we have focused on the relationship of the ionospheric Doppler velocity in the F-region detected by an FM-CW (Frequency Modulated Continuous Wave) radar and the magnetic Pi 2 pulsations observed by MAGDAS (the MAGnetic Data Acquisition System) [Yumoto and the MAGDAS Group, 2006 and 2007] at mid-latitude station PTK (Magnetic Latitude: 45.8 degree, Magnetic Longitude: 221.6 degree, L=2.05).

From our observations, we found 114 Pi 2 events observed by the FM-CW radar and MAGDAS simultaneously at local nighttime during a period from 23 September, 2006 to 4 November, 2006. In addition, we examined statistically the phase relation of 26 high-coherent Pi 2 events of Doppler Velocity (V) and magnetic H-component (H) with identical Pi 2 frequency. It is newly found that the phase relation of the Pi 2-associated V and H is almost constant, i.e., -90 or 270 degree in the local midnight sector of 21-03 LT. By assuming the Doppler velocity is caused by the eastward pulsation electric field, the phase relation can be explained by the radial standing wave, i.e., cavity mode oscillation suggested by Takahashi et al. [JGR, 2001]. In addition, this new finding indicates that the cavity mode resonance is maintained in the ionospheric F-region. While at the dusk side, the phase relation is not constant and its values do not gather near -90 or 270 degree. It seems the cavity mode retains only in the midnight region.