Phase Relation of the Ionospheric Doppler Velocity with Magnetic Pi 2 Pulsations: FM-CW Radar and MAGDAS Observation

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At the onset of magnetospheric substorms, Pi 2 pulsations occur globally in the magnetosphere with a period range from 40 to 150 seconds [e.g. Saito, 1968]. Pi 2 has been studied with arrays of magnetometers on the ground and with in-situ observation by satellites [e.g., Yumoto et al., 2001]. However observations of Pi 2 pulsations in the ionosphere is limited.

In this study, we have focused on the phase relationship between 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).

During Sep., 2006 to Nov., 2007, we found about 100 Pi 2 events which (1) show high correlation coefficient between the Doppler Velocity (V) and magnetic H component (H), and (2) whose dominant frequency of V and H is the same in the local midnight sector (18-06 LT). The phase delay between V and H depends on LT and shows almost -90 degree in the local time sector of 21-06 LT. By assuming that the V is owing to the eastward pulsation electric field (Ey), the phase relation of -90 degree can be explained by the radial standing wave, i.e., cavity mode oscillation suggested by Takahashi et al. [JGR, 2001]. On the other hand, Pi 2 pulsations may arise from a different mechanism in other local time sectors.