A new interpretation of high-latitude Pi 2 observed at the MAGDAS/CPMN stations

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We report here a new interpretation of high-latitude Pi 2 observed at the MAGDAS/CPMN stations [*Uozumi et al.*, 2009: JGR in press]. *Olson* [1999: JGR] and *Yumoto and the CPMN Group* [2001: EPS] reviewed most of past Pi 2 studies and constructed phenomenological overview. *Olson* [1999] summarized that the Pi 2 signal is associated with the following two fundamental processes occurred at substorm expansion onset: (1) response of the high-latitude ionosphere to sudden generation of field-aligned currents in association with the disruption of cross-tail currents in the plasma sheet, (2) impulse response of the inner magnetosphere to the compressional waves that are generated at substorm onset. *Yumoto and the CPMN Group* [2001] summarized that the Pi 2 pulsation observed on the ground consisting five hydromagnetic wave components excited by the above two processes. *Olson* [1999] and *Yumoto and the CPMN Group* [2001] stated that the compressional pulse (fast magnetosonic wave) stimulate field line resonances and surface waves at the plasmapause, and also cavity wave in the inner magnetosphere. Most of low-latitude Pi 2s are recognized as cavity oscillation [e.g., *Yumoto*, 1990a: JGG; *Takahashi et al.*, 2003: JGR]. On the other hand, oscillations of substorm currents are detected across the nightside of the Earth at onset as the mid- and high-latitude portion of Pi 2. In other words, mid- and high-latitude Pi 2s have been understood as an oscillation of the field-aligned currents associated with substorm current wedge [e.g. *Lester et al.*, 1983: JGR; *Samson and Rostoker*, 1983: PSS]. We found that some of Pi 2 events, which were observed at high-latitude MAGDAS/CPMN stations, cannot be understood by the past interpretation of Pi 2 occurrence mechanisms reported in the above reviews and also other past studies [e.g. *Saka et al.*, 1997: JGR; *Kepko et al.*, 2001: JGR]. We propose a new interpretation for those Pi 2 events.

We analyzed Pi 2s, which were observed at MAGDAS/CPMN stations, and which had high-correlation between high- and low-latitude (correlation coefficient: |gamma|equal or greater than 0.75). We call those Pi 2s as high-correlation Pi 2 here. The MLT (magnetic local time) dependence of the delay-time (group delay) of the high-latitude Pi 2 was analyzed for each horizontal component (H and D) by using the timing of the low-latitude Pi 2 as a reference. This study has clarified firstly the timing relation between the high- and low-latitude Pi 2 taking into account the MLT dependence. We found the delay-time of the high-latitude H showed remarkable MLT dependence especially in the pre-midnight sector: That is, the pre-midnight sector the high-latitude H oscillation tends to delay from the low-latitude oscillation (less than ~100s). On the other hand, the delay time of the high-latitude D oscillation was not significant (~+/-10s) in the entire nighttime sector. We also examined the spatial distribution of high-correlation Pi 2 events relative to the center of auroral breakups. It was clarified that the high-correlation Pi 2 events tend to occur away from the center of auroral breakups by more than ~1.5 MLT. In conclusion, it can be interpreted that Pi 2 of the high-correlation high-latitude H with the delay-time within ~+/-100s are driven Alfvenic generated near the magnetic equatorial plane by a fast magnetosonic wave. This fast magnetosonic wave is considered to propagate from common driving source as that of low-latitude Pi 2. This driven Alfvenic type high-latitude Pi 2 has not been categorized into any of the previous interpretations of the high-latitude Pi 2 reviewed and constructed by *Olson* [1999] and *Yumoto and the CPMN Group* [2001], and also other past studies [e.g. *Saka et al.*, 1997: JGR; *Kepko et al.*, 2001: JGR].