Role of Pi 2 Pulsations in Substorm Process

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We have made a comparative study between Pi 2s observed at the CPMN stations and aurora UVI data obtained by the Polar satellite. It is found that Pi 2s occur just after brightenings at the auroral latitude. The one-to-one correspondence between the Pi 2s and the auroral brightening is much better than that between Pi 2s and substorm bay variations.

The high-latitude Pi 2s may be excited by a Ballooning instability in the inner magnetosphere around L= 9, and/or by abrupt formation of FACs caused by inhomogeneity in plasma pressure and the magnetic field intensity in the inner plasma sheet. The high-latitude Pi 2s are excited just as a manifestation of the magnetosphere-ionosphere coupling, while the substorm onset and the magnitude must be controlled by other mechanisms.

The Circum-pan Pacific Magnetometer Network (CPMN) has been constructed along the 210 magnetic meridian and the magnetic equator, then it is now possible to investigate global characteristics of Pi 2 pulsations. From the CPMN observations, we found that Pi 2 pulsations show dayside equatorial enhancement of wave amplitudes around 10 h LT (see Lee et al., 2000). Combining the observed phase delays of high-latitude Pi 2 pulsations on the ground and a numerical estimation of the Alfven transit time, the most probable source location of the Pi 2s was deduced to be located around 9 Re and 22.5 MLT on the equatorial plane in the magnetotail (Uozumi et al., 2001). At least 5 % of 119 multiple-onset Pi 2 events, which were observed at the CPMN stations in the midnight sector of 22:30-23:30 LT, are found to occur without magnetic bay (or with bay of smaller than 0.4 nT magnitude) at Guam.

In this paper, we have further made a comparative study between Pi 2 pulsations observed at the CPMN stations and aurora ultraviolet image (UVI) data obtained by the Polar satellite. It is found that Pi 2 events occur just after brightenings (particle precipitations) at the auroral latitude. The one-to-one correspondence between the Pi 2 pulsations and the auroral brightening is much better than that between Pi 2s and substorm bay variations.

Those observational facts indicate that Pi 2 pulsations at all latitudes are excited just after the auroral brightenings (caused by particle precipitations), which may generate an electric field variation in the nightside auroral ionosphere. The electric field variation can be transferred instantaneously to the dayside equatorial ionosphere, and produce the dayside equatorial Pi 2 enhancement on the ground. The high-latitude Pi 2 pulsations may be excited by a Ballooning instability in the inner magnetosphere around L= 9, and/or by abrupt formation of field-aligned currents (FACs) caused by inhomogeneity in plasma pressure and the magnetic field intensity in the inner plasma sheet (Iijima et al., 1993). The high-latitude Pi 2 pulsations are excited just as a manifestation of the magnetosphere-ionosphere coupling, while the substorm onset and the substorm magnitude, i.e. triggering and the amount of the explosive energy transfer from the magnetosphere into the auroral ionosphere, must be controlled by other mechanisms.