Low-Latitude Pi 2 Pulsation as a Sensitive Indicator of Substorm Onset

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In order to find the best method to identify a substorm onset, merits and demerits of various techniques using the following data are intercompared with each other; i.e., all-sky movie, satellite auroral photograph, CNA data, VLF record, auroral electrojet index, normal-run magnetogram at high- and low-latitude stations, both plasma and magnetic field data obtained with satellites at various points in the magnetosphere, and magnetic pulsation data at various sites on the earth's surface. The reader may refer to the papers written by us since 1951 for the detailed description of many examples of the intercomparison.

Figure 1 shows only one of the many examples of the intercomparison among the all-sky photograph, the normal-run magnetograms in high- and low-latitudes. As shown in this figure a Pi 2 event commenced clearly at the low-latitude station, Onagawa ($\Phi=28^{\circ}.3$), *simultaneously* with the sudden brightening of the auroral arc at Inuvik ($\Phi=70^{\circ}.4$). It can be derived from this figure that in order to find the substorm onset the low-latitude Pi 2 is much better than both high- and low-latitude bay-disturbances.

Fig. 1

Fig. 2

Another example in Fig. 2 shows a case of very weak substorm in which a Pi 2 event commenced at the three night-side stations *simultaneously* with the sudden energization of the plasma in the distant tail and with the abrupt change in the plasma flow direction from the tailward to the earth-ward.

As shown in these examples onset of the low-latitude Pi 2 coincides with the onset of other substorm signatures. Moreover, the low-latitude Pi 2 has many merits that cannot be obtained from the other substorm signatures as far as the presently available methods of observation are concerned, namely, continuity of recording, wide view angle of the dark hemisphere, sharp onset in any local time, uselessness to combine multiple components to monitor, independence on weather condition, etc. Consequently, one of the most practical methods at the present stage of observations to identify the substorm onset is to monitor Pi 2's at three or four low-latitude stations that are properly separated in longitude.