MLT and IMF dependence of the SC amplitude

Atsuki Shinbori[1]; Takayuki Ono[2]; Masahide Iizima[3]; Atsushi Kumamoto[4]

[1] Geophys. Inst., Tohoku Univ.; [2] Department of Astronomy and Geophysics, Tohoku Univ.; [3] Geophysical Inst., Tohoku Univ.; [4] Tohoku Univ.

The dayside magnetopause current as well as the magnetic field intensity inside the magnetopause is enhanced due to the arrival of an interplanetary shock wave and discontinuity of solar wind to the earth's magnetosphere. Then, fast mode hydromagnetic (HM) waves propagate toward the earth passing through the magnetosphere, plasmasphere and ionosphere. On the ground, the signature of sudden commencement (SC) is recorded on the magnetogram which shows an abrupt increase of geomagnetic H-component within a few minutes. It is generally believed that the SC amplitude observed in low and middle latitudes tends to be larger in the dayside sector than in the nightside sector [e.g., Russell et al., 1994]. Moreover, the SC amplitude observed in the magnetosphere at 6.6Re also indicates a clear magnetic local time dependence [Kokubun, 1983]. In recent studies, several SC events which show that the amplitude is larger in the nightside sector than in the dayside sector have been reported [Russell et al., 1994; 1995; Clauer et al., 2001]. Russell et al. [1994] found that the SC amplitudes in the nightside sector are more enhanced, compared with that in the dayside sector in a case of the southward interplanetary magnetic field (IMF) Bz component. However, in these studies, statistical signature of local time dependence of the SC amplitude on the direction of the IMF Bz component.

In the present study, we analyzed 2803 SC events which have been identified in term of the SYM-H index within a period from 1989 to 2002 in order to clarify the dependence of the SC amplitude on magnetic local time and solar wind parameters. We picked up these SC events as a rapid increase of the SYM-H value with more than 5 nT within ten minutes in the SYM-H index data. For each SC event, the precise onset time, rise time, and amplitude were identified by referring the H-component geomagnetic variation from the rapid sampling records with the time resolution of 1 second obtained at Kakioka Magnetic Observatory. On the other hand, we used solar wind data obtained from the ACE satellite within the data analysis period from 1998 to 2001.

As a result, the SC amplitude normalized by the SYM-H value showed a clear dependence on magnetic local time. This signature gives two maximum and minimum values, respectively. The two maximum amplitudes appear in the dayside sector of 10-15 MLT and in the midnight sector of 22-02 MLT, respectively. The peak value of the SC amplitude in the midnight sector tends to be two or three times larger than that in the dayside sector. On the other hand, the two minimum amplitudes are located in the dawnside sector of 06-09 MLT and in the midnight sector of 15-18 MLT, respectively. The minimum value of the SC amplitude in the dawnside sector tends to be much smaller than that in the duskside sector. Moreover, for 888 SC events which occurred within a period from January 1, 1998 to April 30, 2001, we investigated the dependence of SC amplitude measured at Kakioka on IMF condition. As a result, the distribution of the normalized SC amplitude does not show a clear dependence on the amplitude and polarity of the IMF By component, but the SC amplitude tends to increase in the case of the southward direction of the IMF Bz component. In particular, for the SC events in the nightside sector of 20-04 MLT, the distribution of the SC amplitude shows a remarkable dependence on the polarity of the IMF Bz component.

Therefore, from these results, a possible mechanism which amplifies SC in the nightside sector is magnetic field disturbances which are produced by the enhanced Region-1 current associated with magnetic reconnection or positive bay of SC triggered substorm.