Magnetic fluctuations embedded in dipolarization inside geosynchronous orbit and their possible role in selective accele

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Magnetic field dipolarization is a distinct phenomenon observed in the magnetosphere at substorm onset. According to previous studies, magnetic field dipolarization can be mostly seen at the geosynchronous altitude or farther down the tail (i.e., radial distance of $r>6.6 R_E$), and is accompanied by strong magnetic fluctuations. The characteristic time scale ($T_C$) of the magnetic fluctuations is reported to be a few seconds to a few tens of seconds, that is, $T_C=0.3-30$ s at $r=7-9 R_E$ by AMPTE/CCE [Lui et al., 1992; Ohtani et al., 1995], $T_C=8-28$ s at $r'=8 R_E$ by SCATHA [Ohtani et al., 1998], $T_C=5$ s at $X=-8$ to $-11 R_E$ by Geotail [Shiokawa et al., 2005], $T_C=10$ s at $X=-8.3 R_E$ by THEMIS [Lui et al., 2008], and $T_C=10-50$ s at $X=-17.5 R_E$ by Cluster [Huang et al., 2012]. These time scales are longer than local gyroperiods of $H^+$ by a factor of 2-20, and rather close to those of $He^+$ and $O^+$ ions. A recent study employing the MDS-1 satellite revealed that magnetic field dipolarization can be observed in the deep inner magnetosphere ($L=3.5-6.0$) and is accompanied by the magnetic fluctuations that have a period range between the local gyroperiods of $He^+$ and $O^+$ ions [Nose et al., 2010]. To our knowledge, there are few studies reporting $T_C$ just inside geosynchronous orbit ($L=5.0-6.6$).

In this study, we analyze magnetic fluctuations embedded in dipolarization events at the geosynchronous altitude, using the ETS (Engineering Test Satellite)-VIII satellite. From the period of 2010-2012, we select 6 dipolarization events that showed an increase of the northward magnetic field more than 60 nT. It is found that all of the events are accompanied by strong magnetic fluctuations with $T_C$ close to the local $O^+$ gyroperiods. We also study a dipolarization event in the inner magnetosphere ($L=4.9$) observed by the AMPTE/CCE satellite on December 10, 1987. This event is found with magnetic fluctuations that have a period range between the local gyroperiods of $He^+$ and $O^+$ ions. When the fluctuations appear, the $O^+$ flux is enhanced in the energy range of $<10$ keV.

These results suggest that magnetic fluctuations associated with dipolarization have generally $T_C$ close to the local gyroperiod of heavy ions, and may play an important role in selective acceleration of $O^+$ ions.