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The Variation of Ionospheric O^+ and H^+ Outflow during Sawtooth Oscillations

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Sawtooth events are repeated injections of energetic particles at geosynchronous orbit. Although studies have shown that 94% of sawtooth events occur during magnetic storm times, the main factor that causes a sawtooth event is unknown. Simulations have suggested that heavy ions like O^+ may play a role in driving the sawtooth mode by increasing the magnetotail pressure and causing the magnetic tail to stretch. O^+ ions located in the nightside auroral region have a direct access to the near-earth plasma-sheet. O^+ in the dayside cusp can reach to the midtail plasma-sheet when the convection velocity is sufficiently strong. Whether the dayside or nightside source is more important is not known.

We show results of a statistical study of the variation of the O+ and H+ outflow flux during sawtooth events for SIR and ICME sawtooth events. We perform a superposed epoch analysis of the ion outflow using the TEAMS (Time-of-Flight Energy Angle Mass Spectrograph) instrument on the FAST spacecraft. TEAMS measures the ion composition over the energy range of 1 eV e^{-1} to 12 keV e^{-1}. We have done major corrections and calibrations (producing 3D data set, anode calibration, mass classification, removing ram effect and incorporating dead time corrections) on TEAMS data and produced a data set for four data species (H^+, O^+, and He^+). From 1996 to 2007, we have data for 133 orbits of CME-driven and for 103 orbits of SIR-driven sawtooth events with an altitude above 1500 km. We found that:

- the averaged O^+ outflow flux is more intense in the cusp dayside than in the nightside, before and after onset time.
- Before onset, an intense averaged outflow flux in the dawnside of CME events is seen. This outflow decreases after onset time.
- In both CME-driven and SIR-driven, the averaged O^+ outflow increases after onset time, in the nightside, cusp dayside. This increase is greater on the nightside than in the cusp.

We will develop this study by performing a similar statistical study for H^+ outflow and finally will compare the H^+ result with the O^+ result.