Statistical properties of the multiple ion band structures observed by the FAST satellite

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During large magnetic storms, the appearance of characteristic distribution functions of O^+ ions named the multiple ion band structure (MIBS), which show multiple O^+/H^+ components with discrete energies, was reported based on the FAST Auroral Snapshot (FAST) satellite observations [*Seki et al.*, 2005]. It is observationally known that O^+ ions sometimes play a significant role in the ring current (RC) evolution and decay processes. O^+ ion contribution to the RC energy density becomes comparable to or larger than that from H^+ ions in some intense storms especially when the *Dst* index goes down below -200 nT. However, mechanisms of the drastic composition change of the storm-time ring current from H^+ to the ionosphere originating O^+ ions are far from understood. Based on the energy ratio of each band in the multiple ion band structures, *Seki et al.* [2005] concluded that the MIBS observed during the main phase of the April 2001 storm resulted from direct O^+ supply from the ionosphere to the inner magnetosphere, and suggested their contribution to the storm-time ring current.

In this study, data of low energy (less than 28 keV) H^+ and O^+ ions obtained by the FAST satellite were used to investigate the MIBS phenomena. Results showed MIBS distributions for H^+ and O^+ ions had different relationships with *AL* index, ILAT, and MLT, suggesting different formation mechanisms. O^+ MIBSs were observed during magnetically active periods around the equatorward boundary of the auroral oval, while H^+ MIBSs were observed during quiet times and at higher latitudes. O^+ MIBSs shift toward lower latitudes with decreasing *AL* index due to the expansion of the auroral oval during active periods. Both maximum and minimum MIBS energies decrease with decreasing ILAT. The observed statistical properties suggest that O^+ MIBSs supply O^+ ions from the ionosphere to the inner magnetosphere during magnetic storms and eventually to the storm time ring current.