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A statistical study of multiple ion band structures observed by 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', which shows existence of multiple O^+ components with discrete energies bouncing along the local magnetic field line, 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. In the fast and slow recovery phase, O^+ ions with different energy levels show a completely different contribution to the RC decay process. 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 multiple ion components observed during the main phase of the April 2001 storm resulted from direct O^+ supply from the ionosphere to the inner magnetosphere, and their possible role in the O^+ ion supply to the storm-time ring current is suggested.

In this study, we will investigate detailed characteristic of the multiple band structure of low-energy (less than 30keV) O^+ ions based on the statistical analysis of FAST data obtained in the year 2000, which corresponds to the solar maximum of the 23th solar cycle. The analyzed data include not only geomagnetically active times such as during magnetic storms but also quiet times. As the definition of the multiple ion band structure, we used the following criterion: In the ion energy spectrograms, there must be two or more than two bands at different energies for one ion species. Preliminary results with 2-month data show that (1) the multiple band structure of O^+ ions occurs mainly in the invariant magnetic latitude range from 60 to 67 degrees; (2) There are few events of the O^+ multiple band structure in the quiet times, except for some cases when there is large variation of the solar wind dynamic pressure; (3) In contrast with O^+ ions, the multiple band structures of H^+ ions are often found both in active and quiet times. These results suggest that the solar wind dynamic pressure plays an important role in the variation of O+ ions not only in storm times but also in quiet times.