Low-energy ion observation in the outer radiation belt by FAST

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Previous observations have shown that the O+ ion population is an important contributor to the storm time ring current. Its abundance in terms of energy density increases with increasing geomagnetic activity. On the other hand, mechanisms of this dramatic composition change of the ring current are poorly understood. While enhanced polar outflows during geomagnetically active periods are considered to be responsible for the composition change, the link of the outflows and high energy ring current is not clear due to the lack of low-energy ion observations in the inner magnetosphere at L less than 6 Re. Penetration of radiation-belt electrons into instruments makes direct observations of low-energy ions difficult in the inner magnetosphere. A correction method to remove this background is also one of key elements needed for inner magnetospheric missions in the future.

The Electrostatic Analyzer (ESA) onboard the FAST satellite had been operated in the mid-latitude regions above ~45 degrees for the past 4 years and observed ions below 12 keV. Radiation belt contamination is quite uniform in energy. Utilizing this feature, we developed an automated method to subtract the radiation contamination from ESA data. The variation of radiation penetration during the April 11, 2001 magnetic storm are examined in detail. Comparing the estimated background with LANL energetic particle data, we discuss accuracy and issues of the background subtraction methods. The background counts rapidly decreased during the main phase and stayed low for ~1 day. The variation is similar to that of electron flux in energies of 315keV-1.5MeV at the geosynchronous orbit. The comparison with simultaneous ion composition measurements, which suffer no radiation contamination, we conclude that the background subtraction works reasonably well during the main phase. Corrected ion data show the existence of multiple energy-banded ion components in the inner magnetosphere intensified at ILAT=55-62 degrees during the main phase. Simultaneous ion composition data indicate that these ions mainly consist of O+. Their implication on the supply mechanisms of O+ ions in the storm-time ring current will be also discussed.