Properties of energetic ion PSD during storm-time substorms observed by Van Allen Probes

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It is believed that ion injections from the magnetotail caused by substorms is one of the principal mechanisms that supply energetic ions to the magnetosphere ring current.However, it is not fully understood how deeply into the inner magnetosphere (i.e., inside the geostationary orbit) ions can penetrate.In this study, to characterize the supply of energetic ions to the ring current during a magnetic storm, we investigate the properties of energetic ion phase space densities (PSD) during storm-time substorms observed by the Van Allen Probes mission during magnetic storms that occurred in the period from April 23, 2013 to May 6, 2013.Using energetic ion (greater than 50 keV) and magnetic field data obtained by the RBSPICE and EMFISIS instruments onboard the Van Allen Probes, we examine the temporal variations of ion PSD spatial distributions in the L direction.

We obtained PSD and the first adiabatic invariant, mu, for ions with pitch angles of 70 to 110 degrees, as follows.First we calculated the ion energy perpendicular to the magnetic field from the total energy and pitch angle data, and then divided the perpendicular energy by the magnitude of the magnetic field.We also divided the ion differential flux by the perpendicular energy to derive PSD.Finally, we derived PSD for specific mu = 0.3, 0.5 and 1.0 keV/nT.This analysis provides the time variations of ion PSD with a certain mu value in the L distribution for each orbit of Van Allen Probes observations.

Preliminary results show that ions did penetrate directly down to L less than 5 at the time of substorms during the main phase of magnetic storms (which are relatively small, with the minimum Dst greater than -65 nT).Ions with smaller mu values (mu = 0.3 and 0.5 keV/nT) are found to penetrate more deeply than those with a larger mu values (mu = 1.0 keV/nT).The ion PSD distribution along L displays a sharp gradient at L ˜4.0 to 4.5 and L ˜3.0 to 3.5.In our presentation, we will also present differences between the PSD for protons and oxygen ions, and the dawn-dusk asymmetry of the L profiles.