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Pitch angle distributions of electrons < 30 keV during dipolarization at Earth's tailside: Energy dependence of field-aligned anisotropy

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The phenomena of dipolarization had been often observed at Earth's tailside during geomagnetic activity. The pitch angle distributions (PADs) of electrons showed variations with this change in field configurations for decades via different satellite observations.[1]-[5] By exploring observed PADs of electrons at 42 dipolarization sites around 10 Earth radii near magnetic equator at tailside based on the THEMIS mission for the years of 2008 and 2009, we found that the number of observed events with cigar-type distributions (peaks at 0° and 180°) decreases sharply for electrons of energies below 1 keV after dipolarization, while for those above 1 keV to a few tens of keV, the observed number of cigar-type events increases after dipolarization and the number of isotropic events decreases.[6] Therefore, the above phenomena crossing the transit energy level around 1keV is further investigated.

To pursue this goal, quantification of PADs using field-aligned anisotropy (η) is adopted and more dipolarization events from 2010 and 2011 up to 62 sites are included. Figure 1 shows an example of observations of pitch angle distributions in cigar type (η > 1) most of the time at a dipolarization site from two different energy channels. A specific pattern on energy-dependence of variations in η of electrons from tens of eV to hundreds of eV or from hundreds of eV to thousands of eV is then found during dipolarization time based on measurements of the instrument ESA (ElectroStatic Analyzer) for < 30keV electrons, onboard of THEMIS Mission. More precisely speaking, in the beginning of dipolarization, the peak of η occurred at a lower energy level while this peak shifts to a higher energy level but with a smaller value when the dipolarization angle reaches maximum.[7]

We find that electrons observed at about two-thirds of these sites exhibit such a pattern and the associated energy levels is related with the ratio of bounce time to the dipolarization time. Furthermore, this pattern is found to hardly exist when the minimum AL index is less than -190 nT or the maximum of y-component of electric field (Ey) measured by the onboard instrument EFI (Electric Field Instrument) is higher than ~ 30 mV/m during the dipolarization time analyzed. We will review the observed pitch angle distributions and assess the mechanisms for the specific pattern of energy-dependence of η.

References

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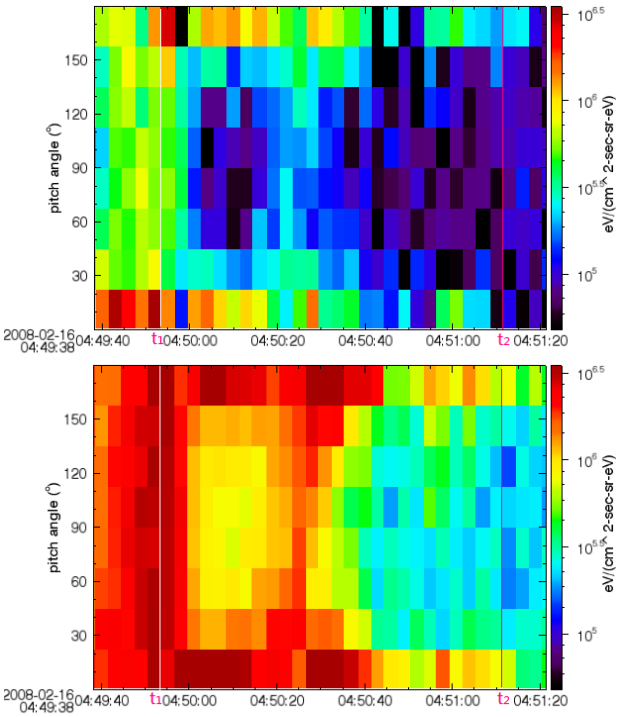

Figure 1. An example of observed pitch angle distribution of differential energy fluxes of electrons by THEMIS probe d on 2008/02/16 versus time (x-axis, in UT hh:mm:ss). **(Top)** 62 - 82 eV **(Bottom)** 187 - 247 eV. The begin time of dipolarization is denoted as t_1 and the time when the peak of dipolarization occurred is denoted as t_2.