Influence of MHD Turbulence on Ion Kappa Distributions in the Earth's Plasma Sheet as a Function of Plasma β Parameter

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Abstract:

The possible influence of MHD turbulence on the energy distributions of ions in the Earth's plasma sheet was studied using data taken by the THEMIS satellites. Turbulence levels were traced using eddy diffusion coefficients (D), of which we measured one for each Geocentric Solar Magnetospheric (GSM) coordinates every 12 min. Ion fluxes between 1.75 and 210.5 keV during the same time windows that correspond to mainly suprathermal populations were fitted to Kappa distribution functions, which approximate a Maxwellian distribution when the κ-index (κ) is large. We found that the distribution of the eddy diffusion coefficients is bimodal, independently of both the eddy diffusion component and the plasma beta (β) parameter, which is defined as the ratio between plasma and magnetic pressures. The main peak corresponds to turbulent plasma flows with $D > 10^3$ $km^2 s^{-1}$. In such cases, the impact of turbulence on the κ index depends on the value of β and also on the direction of the turbulent transport. For eddy diffusion perpendicular to the neutral sheet, the values of κ decrease as Dzz increases for $\beta < 2$; while for higher values of β, κ increases with Dzz . For the other two directions, the values of κ decrease as D increases. This last tendency is stronger for β ≈ 1 but almost null for β ≈ 10. The secondary peak in the distribution of D values might represent quasi-laminar flows forming part of very large vortices, correct detection and description of which is beyond the scope of this study.

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FGM data. THEMIS satellite mission data used in this paper are available on the THEMIS mission website: http://themis.ssl.berkeley.edu/index.shtml.

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