NORTHWARD IMF PLASMA SHEET ENTROPIES

JAY R. JOHNSON 1 and Simon Wing 2

1. Princeton University, Plasma Physics Laboratory, Princeton, NJ, USA
   e-mail: jrj@pppl.gov
2. Johns Hopkins University, Applied Physics Laboratory, Laurel, MD, USA
   e-mail: simon.wing@jhuapl.edu

The plasma sheet pressure, temperature, and density profiles inferred from DMSP observations are used to investigate northward IMF plasma sheet specific entropy, $s = p/\rho^{\gamma}$ or p/n^{γ} (for a single ion species) as well as for hot and cold populations separately. The hot ion population s profile suggests a duskward heat flux that is consistent with the curvature and gradient drift. In contrast, the s profile of the cold population is approximately conserved in the X direction but has a strong gradient toward the midnight meridian. The total entropy ($S= \int p^{1/\gamma}\, dl/B$) and s under various entry mechanisms are estimated for comparisons with observed values. The cold population s is higher than that of the magnetosheath, suggesting the entry process may heat the ions. Cusp reconnection by itself may not increase the magnetosheath ion s, but cusp reconnection with kinetic Alfvén waves (KAW) may provide the necessary heating. Localized reconnection in Kelvin-Helmholtz vortices may increase s if the plasma expands nonadiabatically into the large magnetospheric flux tube volume. KAWs may lead to diffusion and heating consistent with the observations. The cold population s increases by a factor of five from the flanks to the midnight meridian, which provides a constraint for transport mechanism(s) within the plasma sheet. We also discuss how spatial gradients of s in the plasma sheet could result from the temporal dependence of transport processes in the magnetopause boundary layer.

Entropy, Transport, Northward IMF

Jay R. Johnson, Princeton Plasma Physics Laboratory, Princeton University, PO Box 0451, Princeton, NJ 08543-0451, tel: 1-609-243-2603, fax: 1-609-243-2662, e-mail: jrj@pppl.gov