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Estimating the current density in Saturn's equatorial current sheet

C.S. Arridge (1), K.K. Khurana (2) and M.K. Dougherty (1)

(1) Space and Atmospheric Physics, The Blackett Laboratory, Imperial College London, Prince Consort Road, London SW7 2AZ, United Kingdom, (2) Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90095, USA

The plasma sheet in the jovian magnetosphere passes over the spacecraft approximately twice every 10 hours due to the dipole tilt and the rapid rotation of the magnetosphere. This provides the opportunity to sample plasma sheet properties very quickly over a spacecraft orbit. Estimations of equatorial radial and azimuthal current density in the jovian and terrestrial magnetospheres use measurements near the magnetic equatorial plane to compute the current density across the sheet [Iijima et al., 1990; Khurana, 2001]. Such an approach is limited in the kronian magnetosphere because of the absence of a significant dipole tilt [Giampieri and Dougherty, 2004] which implies that the exploration of such current sheets is restricted by the spacecraft trajectory.

We assume that the plasma sheet consists of a planar equatorial current sheet which warps away from the magnetic equator, becoming parallel to the Saturn-Sun line, after a given hinging distance. Under this assumption we analyse Pioneer, Voyager, and Cassini magnetometer data with respect to this shape and use the field structure to infer the currents flowing in the sheet.

We compare the estimated current density with previous empirical estimations of the current density profile [Mauk et al. 1985], models of the current sheet [Connerney et al. 1983; Bunce and Cowley, 2003; Giampieri and Dougherty, 2004], and present a search for a significant local time asymmetry, as suggested by modelling studies [Giampieri and Dougherty, 2004].