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A diffusive equilibrium model for the plasma density in Saturn's inner magnetosphere

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Electron density measurements have been obtained by the Radio and Plasma Wave Science (RPWS) instrument for more than 50 Cassini passes through Saturn's inner magnetosphere between July 1, 2004 and September 1, 2007. Early density models were developed to describe the radial diffusion of the equatorial plasma [Persoon et al., *Geophys. Res. Lett.,* 32, L23105, 2005] and the distribution of the plasma along planetary magnetic field lines under the action of a strong centrifugal force [Persoon et al., *Geophys. Res. Lett.,* 33, L18106, 2006]. The early centrifugal potential model was derived from a simple analytical function which resulted in a linear fit to the density distribution and yielded a simple L-shell dependence of $L^{-4.1}$ for the equatorial density and an L-shell dependence of $L^{1.8}$ for the plasma scale height. However, this early centrifugal potential model had a limited latitudinal distribution and was able to resolve only one ion species in the plasma distribution. With recent density measurements acquired at higher latitudes, it is now possible to resolve two distinct plasma components, assumed to be water group ions (W+) and protons (H+). Equatorial ion densities and ion scale heights are determined from the comparison of the RPWS densities to a diffusive equilibrium model, derived from an analytical solution to the full force balance equation for a plasma distribution along Saturn's magnetic field lines, originally presented by Richardson and Sittler (*J. Geophys. Res., 95,* 12019, 1990) using the Voyager data. Density contour plots for the water group ions and the protons in Saturn's inner magnetosphere (L$<$10 R_S) will be presented.