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A simple centrifugal potential model for the electron density in Saturn's inner magnetosphere

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In the sixteen months following orbit insertion, Cassini passed through the inner magnetosphere of Saturn nineteen times. The Radio and Plasma Wave Science (RPWS) instrument obtained near-continuous measurements of the upper hybrid resonance frequency for most of these orbits. Electron densities were derived from the upper hybrid frequency measurements over latitudes ranging from +14 degrees to -20 degrees and from 2 to 9 Saturn radii (R_S). The focus of this study is the plasma distribution in the inner magnetosphere over the L-shell range of $5 \leq L < 9$ where L is the equatorial radius of the magnetic field line in Saturn radii. Using a simple centrifugal potential model, we show that the equation $n_e = n_0$exp[-(1/3)(L^2/H^2)(1-cos$^6\lambda$)] provides a good fit to the measured electron densities, where n_0 is the density at the equator, λ is the latitude and H is the plasma scale height. The equatorial density is found to vary as L^{-4}, consistent with an earlier study of electron densities in Saturn's equatorial plane [Persoon et al., *Geophys. Res. Lett.*, 2005], and the scale height is found to vary as $L^{1.75}$.