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Ion and Neutral Sources and Sinks within Saturn's Inner Magnetosphere: Cassini Results

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We will present fluid parameters derived from Cassini Plasma Spectrometer (CAPS) observations of ions and electrons within Saturn's inner magnetosphere as presented in [1]. From these parameters one can estimate the ion total flux tube content, NL^2, for protons, H^+, and water group ions, W^+, as a function of radial distance or L shell. When we do this, the calculation shows NL^2 peaking at Dione's L shell, but that the estimated source for water molecules peaks near Enceladus' L shell $L \sim 4$, where most of the neutral oxygen and OH have been observed by Cassini [2] and HST [3, 4], respectively. The estimated source rate is $S_W \sim 10^{28}$ mol/s. In the vicinity of $L \sim 4$ possible sources are Enceladus, the E-ring and co-orbiting material. Our calculations show that the ion abundance for H^+ and W^+ are nearly identical for all L. If the mean ion mass for the W^+ ions is 17 amu, then this result would indicate that water clouds are the dominant source for the ion**s.** But, the details of the relative abundance of O^+, OH^+, H_2O^+ and H_3O^+ will need to be considered for a more definitive conclusion of this matter. Our calculations self-consistently solve for the ambipolar electric field and the ion distribution along the field lines. Pressure anisotropies from Voyager plasma observations are used [5]. We assumed the pressure anisotropies for electrons to be the same as protons. Future analysis of the CAPS data during later or-

bits with actuator motion should allow us to measure the pressure anisotropies of the ions and electrons. We will compare our results with RPWS electron densities. Our estimate of the neutral source term is based on a steady state calculation and estimated time scales for photoionization, electron impact ionization, charge exchange loss of neutrals, electron-ion recombination and radial transport of the plasma. In this model the primary sink for the neutral clouds at Enceladus is charge exchange, while the dominant loss of ions at Enceladus is via electron-ion recombination. All these issues will be discussed.

[1] Sittler et al., GRL, **32**, L14S07, 2005.

[2] Esposito et al., Science, **307**, 1251, 2005.

[3] Shemansky et al., Nature, **363**, 329, 1993.

[4] Richardson et al., J. Geophys. Res., **103**, 20245, 1998.

[5] Richardson and Sittler, J. Geophys. Res., **95**, 12019, 1990.