CHARGE EXCHANGE ION LOSSES IN SATURN'S MAGNETOSPHERE. A. Sontag[1,2], G. Clark[2], P. Kollmann[2], [1] University of Pennsylvania, Philadelphia, PA, [2] Johns Hopkins University Applied Physics Laboratory, Laurel, MD.

Introduction: While various source and loss processes have been proposed for ions in Saturn's magnetosphere, it is not yet well understood what role they play in different regions. In this study, we use a physical model of charge exchange to predict how proton and water group ion intensity profiles evolve over time and compare the results to MIMI/CHEMS measurements collected during the Cassini mission. First, we divide the CHEMS data into inbound and outbound half-orbit segments and create intensity profiles for 3-220 keV H^+ and W^+ ions between 5 and 15 Saturn radii. Then, using the inbound half-orbits as initial conditions, we find qualitative similarities between measured and predicted outbound intensity profiles, suggesting that charge exchange drives this variability. The observed rate of charge exchange also presents information on the density of Saturn's neutral torus. In this presentation, we provide evidence for charge exchange's role as the dominant loss process and driver of observed variability for 3-220 keV protons and 10-50 keV water group ions between 5 and 15 R_S. We also suggest that data-model discrepancies in the higher energy water group ions may be an indication of a significant presence of ions with the water group mass that are multiply charged.

Acknowledgments: We are thankful to the institutions and personnel that made the Cassini mission and the MIMI instrument a success. We are also grateful to JHU/APL's Jon Vandegriff for assistance with data aggregation as well as Chris Paranicas and Todd Smith for their fruitful discussions. This work has been funded by NASA's Cassini Data Analysis Program under grant number: 80NSSC18K1234. The data presented here are available from the Planetary Plasma Interactions Node of NASA's Planetary Data System (https://pds-ppi.igpp.ucla.edu/).

References:

[1] Azari A. R. et al. (2018) *JGR, 123,* 4692-4711. [2] Cassidy T. A. et al. (2010) *Icarus, 209(2),* 696-703. [3] Carbary J. et al. (2018) Saturn in the 21st Century. [4] Chen Y. et al. (2010) *JGR, 115,* A10211. [5] Clark G. et al. (2014) *Planet. and Space Sci, 104,* 18-28. [6] Delamere P. A. et al. (2007) *Geophys. Res. Lett., 34*, L09105. [7] Dialynas K. et al. (2009) *JGR, 114,* A01212. [8] Dialynas K. et al. (2013) *JGR, 118,* 3027-3041. [9] Difabio R. D. (2012) (Doctoral dissertation). [10] Difabio R. D. et al. (2020) *JGR, 125.* [11] Dougherty M. K. et al. (2004) *The Cassini-Huygens Mission,* 331-383. [12] Fillius W. et al. (1980) *Science, 207*. [13] Fleshman B. L. et al. (2010) *Geophys. Res. Lett., 37,* L03202. [14] Fleshman B. L. et al. (2012) *JGR, 117,* E05007. [15] Gobet F. et al. (2001) *Phys. Rev. Lett., 86(17),* 3751. [16] Hodges R. R. and Tinsley B. A. (1981) *JGR, 86(A9),* 7649-7656. [17] Hood L. L. (1983) *JGR, 88(A2),* 808-818. [18] Horne R. B. et al. (2003) *JGR, 108(A1),* 1016. [19] Johnson R. E. and Strobel D. F. (1982) *JGR, 87(A12),* 10385-10393. [20] Jurac S. and Richardson J. D. (2005) *JGR, 110,* A09220. [21] Kennelly T. J. et al. (2013) *JGR, 118,* 832-838. [22] Kollmann P. (2012) (Doctoral dissertation). [23] Kollmann P. et al. (2015) *JGR, 120*. [24] Kollmann P. et al. (2018) *JGR, 123*. [25] Krimigis S. M. et al. (1981) *Science, 212,* 225-231. [26] Krimigis S. M. et al. (1982) *Science, 215,* 571-577. [27] Krimigis S. M. (2004) *The Cassini-Huygens Mission,* 233-329. [28] Krupp N. et al. (2018) Saturn in the 21st Century, 126-165. [29] Lagg A. et al. (2003) *Geophys. Res. Lett., 30,* 1556. [30] Lai H. R. et al. (2016) *JGR, 121,* 3050-3057. [31] Lejosne S. and Kollmann P. (2020) *SSR*. [32] Lindsay B. G. and Stebbings R. F. (2005) *JGR, 110,* A12213. [33] Lyons L. R. and Thorne R. M. (1972) *JGR, 77(28),* 5608-5616. [34] Mauk B. H. et al. (2005) *Geophys. Res. Lett., 32,* L14S05. [35] Melin H. et al. (2009) *Planet. and Space Sci., 57(14-15),* 1743-1753. [36] Morfill G. E. et al. (1993) *JGR, 98(A2),* 1435-1442. [37] Nénon Q. et al. (2018) *JGR, 123,* 3512-3532. [38] Paranicas C. et al. (2008) *Icarus, 197(2),* 519-525. [39] Paranicas C. et al. (2010) *JGR, 115,* A09214. [40] Paranicas C. et al. (2016) *Icarus, 264,* 342-351. [41] Perry M. E. et al. (2010) *JGR, 115,* A10206. [42] Persoon A. M. et al. (2009) *JGR, 114,* A04211. [43] Richardson J. D. et al. (1998) *JGR, 103(E9),* 20245-20255. [44] Richardson J. D. and Sittler E. C. (1990) *JGR, 95(A8),* 12019-12031. [45] Roussos E. (2014) *Planet. and Space Sci., 104,* 3-17. [46] Sánchez-Lavega A. (2005) *Science, 307(5713),* 1223-1224. [47] Saur J. et al. (2008) *Geophys. Res. Lett., 35,* L20105. [48] Sibeck D. G. et al. (1987) *JGR, 92(A12),* 13485-13497. [49] Smith H. T. et al. (2010) *JGR, 114,* A10252. [50] Southwood D. J. and Kivelson M. G. (1987) *Geophys. Res. Lett., 92(A1),* 109-116. [51] Teolis B. D. et al. (2017) *Astrobiology, 17(9),* 926-940. [52] Thomsen M. F. et al. (2012) *JGR, 117,* A09208. [53] Van Allen J. A. et al. (1980) *Science, 207,* 415-421. [54] Vandegriff J. et al. (2018) Cassini/MIMI Instrument Data User Guide.