EPSC Abstracts,
Vol. 4, EPSC2009-338-1, 2009
European Planetary Science Congress,

Analysis of H^+ and H_2^+ Pickup ions in Titan's H and H_2 Corona

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It has been known for some time that measurement of pickup ions, born from neutral exospheres imbedded in moving plasmas, can be used to determine the composition and structure of the parent neutral exospheres [1]. Pickup ions have been observed at Titan by the Cassini Plasma Spectrometer (CAPS) and earlier by the Voyager 1 Plasma Science (PLS) instrument. The observed velocity distributions of these ions are used to determine properties of their neutral exospheric source gasses. This is accomplished by comparing observed ion spectra with phase space distributions obtained from a new general pickup ion model, which is an extension of a closed form solution to the Vlasov equation with an ion source [2]. In turn, the ion source is a three-dimensional exospheric density distribution, which can range from the classical Chamberlain type distribution to one with variable exobase temperatures, winds and nonthermal constituents. Neutral exosphere properties are inferred by adjusting such parameters to obtain the best fit between the resulting model pickup ion distributions and the observed ion spectra. This approach is applied to the H^+ and H_2^+ pickup ion exospheres born from Titan's neutral H and H_2 exospheres. The study is done in Titan's outer corona, beyond the region where the effects of the interaction of Saturn's rotating magnetosphere with Titan's atmosphere appear in the plasma.

[1] Hartle, R., Ogilvie, K. and Wu, C. (1973) *Planet. Space Sci.*, 21, 2181-2191.
[2] Hartle, R. and Sittler E. (2007) *J. Geophys. Res.*, 112, A07104, doi:10.1029/2006JA012157.