

## **Rotation Rate of Saturn's Magnetosphere using CAPS Plasma Measurements**

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## Abstract

We present the present status of an investigation of the rotation rate of Saturn's magnetosphere using a 3D velocity moment technique being developed at Goddard which is similar to the 2D version used by Sittler et al. (2005) [1] for SOI and similar to that used by Thomsen et al. (2010). This technique allows one to nearly cover the full energy range of the CAPS IMS from  $1 \text{ V} \leq E/Q < 50 \text{ kV}$ . Since our technique maps the observations into a local inertial frame, it does work during roll manoeuvres. We have made comparisons with Wilson et al. (2008) [2] (2005-358 and 2005-284) who performs a bi-Maxwellian fit to the ion singles data and our results are nearly identical. We will also make comparisons with results by Thomsen et al. (2010) [3]. Our analysis uses ion composition data to weight the non-compositional data, referred to as singles data, to separate H<sup>+</sup>, H<sub>2</sub><sup>+</sup> and water group ions (W<sup>+</sup>) from each other. The ion data set is especially valuable for measuring flow velocities for protons, which are more difficult to derive using singles data within the inner magnetosphere, where the signal is dominated by heavy ions (i.e., proton peak merges with W<sup>+</sup> peak as low energy shoulder). Our technique uses a flux function, which is zero in the proper plasma flow frame, to estimate fluid parameter uncertainties. The comparisons investigate the experimental errors and potential for systematic errors in the analyses, including ours. The rolls provide the best data set when it comes to getting 4PI coverage of the plasma but are more susceptible to time aliasing effects. Since our analysis is a velocity moments technique it will work within the inner magnetosphere where pickup ions are important and velocity distributions are non-Maxwellian. So, we

will present results inside Enceladus' L shell and determine if mass loading is important. In the future we plan to make comparisons with magnetic field observations, use Saturn ionosphere conductivities as presently known and the field aligned currents necessary for the planet to enforce corotation of the rotating plasma.

## References

- [1] Sittler, E. C., Jr., et al., Preliminary results of Saturn's inner magnetosphere as observed by Cassini: Comparison with Voyager, *Geophys. Res. Lett.*, 32, L14S07, doi:10.1029/2005GL022653.
- [2] Wilson, R. J. et al., Cassini plasma spectrometer thermal ion measurements in Saturn's inner magnetosphere, *JGR*, vol. 113, A12218, doi:10.1029/2008JA013486.
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