

## The Seasonal Variations of Saturn's Current Sheet Tilt

Krishan K. Khurana<sup>1</sup>, Michele K. Dougherty<sup>2</sup>, Christopher T. Russell<sup>1</sup>, <sup>1</sup>Institute of Geophysics and Planetary Physics and Dept. of Earth and Space Sciences, UCLA, Los Angeles, CA, 90095; <sup>2</sup>Imperial College, Department of Physics, London SW7 2AZ, UK. email: kkhurana@igpp.ucla.edu

### Abstract

The location of a planetary current sheet, where most of the magnetospheric plasma resides, is determined by the effects of centrifugal, solar wind and Lorentz forces on the plasma. It is well known that at any local time, Saturn's current sheet develops a static tilt from solar wind forcing which gives it a global shape of a shallow bowl [1]. However, less appreciated is the fact that the current sheet also develops a dynamic tilt which moves the current sheet up and down at any local time during a Saturnian day [2]. Khurana et al. (2009) suggested that the dynamic tilt results from the asymmetric lift of the magnetosphere in the presence of ring current asymmetries which rotate with the planet [3].

Khurana et al. (2009) examined Cassini data from the period of 2004-2006, when the solar elevation angle was  $> 14$  degrees. They showed that during this time, the dynamic tilt was  $> 10$  degrees. Saturn passed through its equinox during July 2009. The solar elevation angle during 2009 was between  $-3.4$  and  $2.2$  degrees. Using magnetic field observations from this period, we now show that the dynamic current sheet tilt was also extremely small ( $< 5$  degrees). We further show that the current sheet's dynamic tilt is governed largely by the solar elevation angle.

The variability of Saturn's current sheet's dynamic tilt has implications for the models of spin periodicity in Saturn's magnetosphere. Two types of models have been proposed to explain the spin periodicities in the magnetosphere. In the magnetospheric driven models, an inner magnetospheric vortex drives cyclical convection in the magnetosphere and creates periodicities in the observed field and plasma parameters. In the ionospheric driven models, a vortex in the ionosphere imposes magnetospheric periodicities including dynamic tilt in Saturn's current sheet. We show that the seasonal variations of Saturn's current sheet tilt is consistent with the magnetospheric driven models but cannot be explained by the ionospheric driven models.

### References

- [1] Arridge CS, Khurana KK, Russell CT, Southwood DJ, Achilleos N., Dougherty MK, Coates AJ, Leinweber HK, Warping of Saturn's magnetospheric and magnetotail current sheets, *J. Geophys. Res.*, 113, doi: 10.1029/2007JA012963, 2008.
- [2] Arridge C.S., Bertucci C., Jackman C.M., Dougherty, M.K., Khurana, K.K. and Russell, C.T., Large-scale dynamics of Saturn's magnetopause: Observations by Cassini, *J. Geophys. Res.*, 113, A11209, doi:10.1029/2008JA013265, 2008.
- [3] Khurana KK, Mitchell DG, Arridge CS, Dougherty MK, Russell CT, Paranicas C, Krupp N and Coates AJ, Sources of rotational signals in Saturn's magnetosphere, *J. Geophys. Res.*, 114, A02211, DOI: 10.1029/2008JA013312, 2009.