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Cyclical reconnection in Saturn's magnetotail and the maintenance of ring current region asymmetry

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Field, plasma and energetic particle observations from Saturn's magnetosphere provide evidence of a rotating partial ring current located between the radial distance of 8 and 13 Rs. Khurana et al. (2009) showed that the rotating partial ring current has several profound effects on the structure of the magnetosphere. In the outer magnetosphere, the partial ring current imposes a sinusoidal variation of the magnetic field in the lobe region. The resulting asymmetric distribution of magnetic flux in Saturn's magnetosphere leads to an asymmetric lift of the magnetosphere by the solar wind which tilts the planet's current sheet even when the internal field is completely axisymmetric. The current sheet tilt generates out-of-phase periodicities in which the particle fluxes and the magnetic field strength are anti-correlated.

In this presentation, we explore ideas on how the ring current region anomalies can be generated and maintained in the magnetosphere. In particular, we focus on a model of self-generation of energetic particles' azimuthal asymmetry from periodic reconnection induced particle injections and bursty-bulk flows launched into inner magnetosphere from the neutral line.

Finally we discuss why the magnetosphere favors the azimuthal m = 1 mode over m = 0 (uniform ring current) and other higher order and non-integral modes. We show that for a given integrated energy density of particles , this mode produces the most stretched configuration in the reconnection region and thus the strongest feedback reaction from the magnetotail.