

Energetic Neutral Atom Imaging at Saturn: Ring Current Structure and Dynamics, and Their Relationship to the Aurora

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Abstract

One of the primary Cassini mission objectives at Saturn is to characterize Saturn's aurora—its spatial morphology, associated particle energization, radio wave generation, and magnetospheric currents, relationship with solar wind pressure and magnetic field, and its large scale mapping to the magnetosphere. We demonstrate that under some magnetospheric conditions protons and oxygen ions are accelerated once per Saturn magnetosphere rotation, at a preferred local time between midnight and dawn. Although enhancements in energetic neutral atom (ENA) emission may in general occur at any local time and at any time in a Saturn rotation, those enhancements that exhibit a recurrence at a period very close to Saturn's rotation period usually recur in the same magnetospheric location. We suggest that these events result from current sheet acceleration in the 15 to 20 Rs range, probably associated with reconnection and plasmoid formation in Saturn's magnetotail. Simultaneous auroral observations by the Hubble Space Telescope (HST) and the Cassini Ultraviolet Imaging Spectrometer (UVIS) suggest a close correlation between these dynamical magnetospheric events and dawn-side transient auroral brightenings. We argue that the rotating azimuthal asymmetry of the ring current pressure revealed in the ENA images creates an associated rotating field aligned current system linking to the ionosphere and driving the correlated auroral processes. We also demonstrate that under some magnetospheric conditions for which protons and oxygen ions are accelerated once per Saturn magnetosphere rotation at a preferred local time

between midnight and dawn, simultaneous auroral observations by the Cassini UVIS instrument and by the HST reveal a close correlation between these dynamical magnetospheric events and dawn-side transient auroral brightenings. We will also discuss the interpretation of the ENA images how they may bear on different ion acceleration mechanisms in the outer (> 15 Rs) and inner (< 12 Rs) magnetosphere.

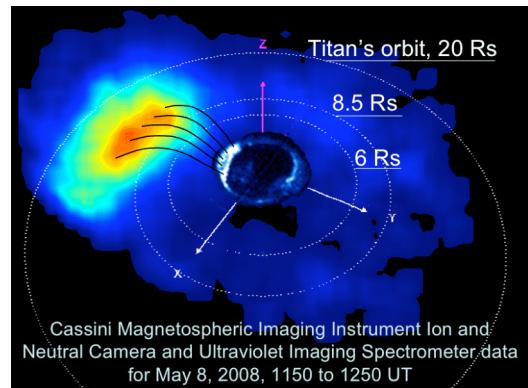


Figure 1: The emission of ENA from the ring current reveals the presence of an acceleration region in the equatorial plane that rotates in lock-step with the bright auroral ultra-violet emission. Field aligned currents presumably connect the ring current enhancement with the aurora. Mitchell et al. (2009) [1] suggest that the current generates electric fields parallel to the magnetic field, accelerates electrons into the atmosphere, and stimulates the UV emission.

References

[1] Mitchell et al., (2009), *P&SS*, in press.