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A remarkable event of tail reconnection at Saturn: UV auroral observations

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Abstract

We present high-resolution Cassini/UVIS (Ultraviolet Imaging Spectrograph) observations of Saturn's aurora during May 2013 (DOY 140-141). The observations reveal an enhanced auroral activity in the midnight-dawn quadrant in extended local time sector (02 to 05 LT), which rotates with an average velocity of ~45 of rigid corotation (region included in the rectangle in Figure 1).

The morphology of the feature is consistent with the auroral signatures of bursts of tail reconnection discussed in earlier theoretical and observational studies, however it bears several differences from previous solar wind driven events. One of them is that the open flux variations during this sequence demonstrate that the amount of open flux remains almost constant, which could be indicative of an internally driven reconnection process (Vasyliunas-type) operating on closed field lines.

The auroral observations also reveal multiple intensifications within the enhanced region suggesting an x-line in the tail, which extends from 02 to 05 LT. The localised enhancements evolve in arc and spot-like small scale features, which resemble vortices mainly in the beginning of the sequence. These auroral features could be related to enhanced plasma flows from reconnection which diverge into multiple narrow channels then spread azimuthally and radially. We suggest that the evolution of tail reconnection at Saturn may be pictured by an ensemble of numerous narrow current wedges or that inward transport initiated in the reconnection region could be explained by multiple localised flow burst events. The formation of vortical-like structures could then be related to field-aligned currents, building up in vortical flows in the tail. An alternative, but less plausible, scenario could be that the small scale auroral structures are related to viscous interactions involving small-scale reconnection.

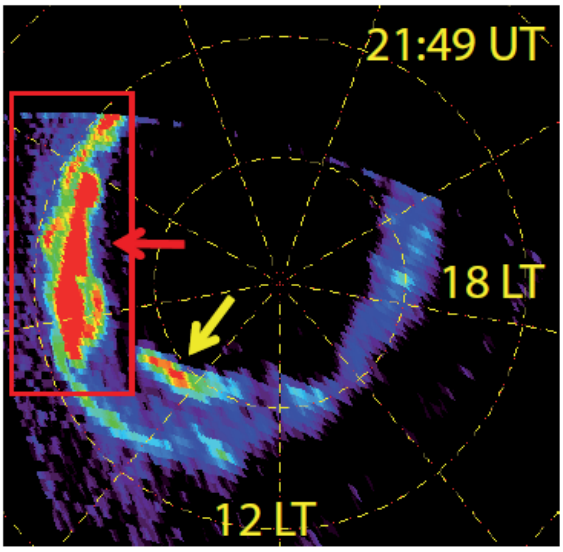

Figure 1: A polar projection of Saturn's northern aurora obtained with the FUV channel of UVIS onboard Cassini on DOY 141, 2013. Noon is to the bottom and dusk to the side. The red rectangle includes an auroral intensification in the dawn-midnight quadrant, possible related to tail reconnection.