

## Saturn's auroral morphology and field-aligned currents during a solar wind compression

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### Abstract

During the 2013 auroral observing campaign, instruments onboard Cassini and the Hubble Space Telescope observed Saturn's aurora while Cassini traversed the high latitude auroral field lines. Signatures of upward and downward field-aligned currents were detected on the nightside in the magnetic field and plasma measurements. The location of the upward current corresponded to the bright auroral arc seen in the auroral images, and the downward current region was located poleward of the upward current in an aurorally dark region. A solar wind compression region impacted Saturn's magnetosphere at the start of 2013-112 with the following sequence of effects: (1) intensification and extension to lower frequencies of the Saturn Kilometric Radiation; (2) intensification and spatial expansion of the auroral field-aligned current regions; (3) appearance of a localised, intense bulge in the dawnside aurora while the nightside aurora remained fainter and narrow; (4) latitudinal broadening and poleward contraction of the nightside aurora, where the poleward motion in this sector is opposite to that expected from a model of the auroral oval's usual oscillation. These observations are interpreted as the response to tail reconnection events, initially involving Vasyliunas-type reconnection of closed, mass-loaded magnetotail field lines, and then proceeding onto open lobe field lines, causing the contraction of the polar cap region.

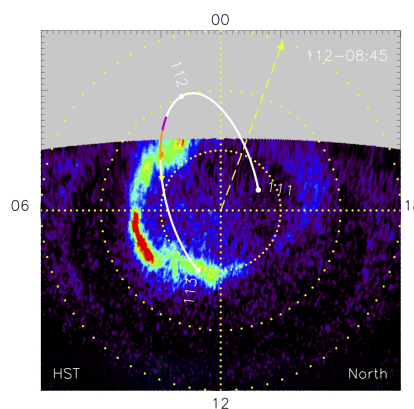


Figure 1: HST/ACS image of Saturn's northern UV aurora on 2013-112. Local noon is to the bottom and dawn to the left. The yellow grid marks circles of latitude at intervals of  $10^\circ$  and the noon-midnight and dawn-dusk meridians. The white line shows the ionospheric footprint of Cassini's trajectory on 2013-111 to 2013-113 mapped into the northern ionosphere. The yellow triangle on this line indicates the position of Cassini at the time this image was taken, while the purple and orange shaded regions show the location of the upward and downward field-aligned current regions, respectively, determined from the magnetic field data. The yellow dashed arrow indicates the direction in which the auroral oval is expected to be tilted at this time, according to a model of the oval oscillation based on magnetic field perturbations. The post-midnight auroral arc is located poleward of the upward field-aligned current detected earlier, indicating poleward contraction of the aurora, i.e. motion in the direction opposite to the expected tilt of the oval. The latitudinal broadening of the aurora also suggests increased electron precipitation resulting from tail reconnection.