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Proposed Model for Saturn's Auroral Response to the Solar Wind: Centrifugal Instability Model

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We present a model of Saturn's global auroral response to the solar wind as observed by Hubble Space Telescope (HST) and simultaneous upstream measurements of the solar wind taken by Cassini during the month of January 2004. These observations show a direct correlation between solar wind dynamic pressure and 1) auroral brightening toward dawn local time, 2) increase of rotational movement of auroral features up to 75 % of the corotation speed, 3) the movement of the auroral oval to higher latitudes and 4) increase in the intensity of Saturn Kilometric Radiation (SKR). Our model, referred to as centrifugal instability model and contrary to the reconnection model by *Cowley et al. [2005]*, provides a possible explanation for the above observations based on the fact that Saturn's magnetosphere is a fast rotator, thereby resulting in a different auroral response than the Earth. Since the torques on Saturn's outer magnetosphere are relatively low, its outer magnetosphere will tend to conserve angular momentum; when compressed on the dayside, the outer magnetosphere will tend to spin up to higher angular velocities; when it expands, the outer magnetosphere will tend to spin down, to lower angular velocities. This response occurs since Saturn's ionosphere is unable to enforce corotation. The outer boundary of the plasma sheet at L $\sim$ 15 is identified as the primary source location for the auroral precipitating particles. Enhanced wave activity, which can precipitate the auroral producing particles, may be present at this boundary. If radial transport is dominated by centrifugally driven flux tube interchange motions, when the magnetosphere spins up, outward transport will increase, and the precipitating particles will move radially outward (i.e., negative radial gradient in electron energy flux). This mechanism will cause the auroral oval to

move to higher latitudes as observed. Furthermore, the Kelvin-Helmholtz instability along the dawn flanks of the magnetosphere may contribute to the enhanced emission along the dawn meridian as observed by HST via enhanced wave activity and corresponding charged particle precipitation.

[1] Cowley et al., J. Geophys. Res., **110**, A02201, doi:10.1029/2004JA010796, 2005.