

## Saturn's secondary auroral ring

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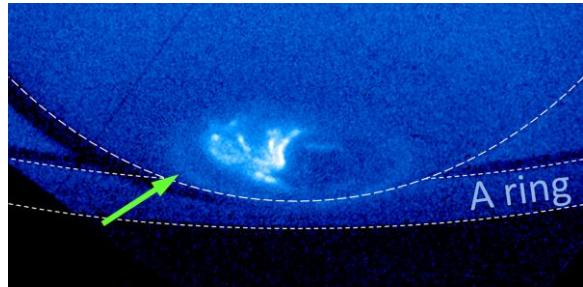
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### Abstract

In January 2004, Saturn's spin axis was strongly tilted away from Earth and revealed most of the southern polar cap region. We took advantage of this viewing geometry to observe very faint UV auroral emissions with the Hubble Space Telescope. Recent Cassini UVIS observations of Saturn's night side aurora appear to confirm the presence of this emission. In HST images, these auroral features appear near the planetary limb where they are amplified by limb brightening effect (Fig. 1). They form a distinct secondary ring of emission outside the main auroral ring, near the  $67^{\circ}$  S parallel. This outer auroral emission maps to a region of the equatorial plane between 4 and  $11 R_S$  [1]. We suggest that a population of suprathermal electrons observed by Cassini can provide more than the required energy flux without the need for field aligned acceleration. This auroral UV emission may also be associated with ENAs originating from the energetic protons and  $O^+$  of magnetosphere, and/or with a secondary infrared auroral oval.

### Observations

During January 2004, a total of 68 far-ultraviolet (FUV) images were collected with HST/STIS, spanning a 4-week period during which the Cassini spacecraft was approaching Saturn's magnetosphere and detected a series of solar wind perturbations propagating towards Saturn. This large number of images made it possible to draw a statistical picture of Saturn's southern auroral morphology. Among the different components of the auroral morphology, one is so faint that it can only be observed under very specific viewing geometries. This auroral feature, which Grodent et al. [2] named the "outer emission", appears as a permanent secondary arc equatorward of the main emission. It is revealed by limb brightening of the optically thin  $H_2$  auroral emission and therefore, can only be detected in the nightside sector.



**Figure 1:** Sum of two HST/STIS images of Saturn's southern hemisphere which were taken during an unusual event on Jan. 26, 2004 when the main ring of emission contracted and cleared the dusk and nightside sectors revealing an extended fainter, permanent band of emission at low latitude. The green arrow points to this faint secondary ring of auroral emission and the dashed lines show the planetary limb and Saturn's A-ring boundaries.

### Main Results

The outer auroral UV emission, or secondary auroral ring, in the southern hemisphere is a real feature revealed by limb brightening under particular viewing geometry. It is characterized by a limb brightening free brightness of  $\sim 1.7$  kR of  $H_2$  and an injected electron power of  $\sim 0.3$  mW m $^{-2}$ . Its position equatorward of the main emission (near  $67^{\circ}$  S) magnetically maps to distances in the equatorial plane from approximately 4 to  $11 R_S$ . In this region, Cassini observed a population of hot electrons which is able to provide more than the necessary energy flux without the need for field aligned acceleration. The outer emission may be directly or indirectly associated with ENAs originating from the energetic protons and  $O^+$  distributions in the same region. This UV emission might also be in accordance with a secondary IR oval [3] linked to sub-corotating magnetospheric plasma. Inspection of auroral images reconstructed from the Cassini ultraviolet Spectrograph scans of the auroral region provides additional constraints on this faint emission. A complete description of this study will soon be presented in [1].

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## References

- [1] Grodent, D., Radioti, A., Bonfond, B., Gérard, J.-C.: On the origin of Saturn's outer auroral emission, *J. Geophys. Res.*, accepted for publication, 2010.
- [2] Grodent, D., Gérard, J.-C., Cowley, S.W.H., Bunce, E.J., Clarke, J.T.: Variable morphology of Saturn's southern ultraviolet aurora, *J. Geophys. Res.*, 110, A07215, 2005
- [3] Stallard, T., Miller, S., Melin, H., Lystrup, M., Cowley, S.W.H., Bunce, E.J., Achileos, N., Dougherty, M.: Jovian-like aurorae on Saturn, *Nature*, 453, 1083, 2008.