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Saturn's North and South aurora observed by Cassini camera in visible wavelengths.

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Abstract

We present 2009-2010 movies from the Cassini camera showing Saturn's aurora in both the northern and southern hemispheres.

The observations reveal reddish color of the aurora observed in filters spanning different wavelengths from 250 nm to 1000 nm. The prominent H-alpha line and the overall spectral shape agree with predicted spectra for Saturnian auroras [1]. Two 400+ frame movies, one in the northern hemisphere from October 5-9, 2009, and the other in the southern hemisphere from June 26, 2010, show the aurora varying dramatically with longitude and rotating together with Saturn.

The main longitudinal structure of the aurora can persist for ~3 days, as seen on the repeated views of the same longitudes several Saturn rotations later. Besides the steady main structure, aurora may brighten suddenly on the timescales on the order of 10 minutes. Near the limb the height of the auroral curtains above its base can be measured; this height can reach more than 1200 km.

The main auroral oval in the northern hemisphere appears near 75° latitude. The main auroral oval in the southern hemisphere appears near -72° latitude, with smaller instances of auroral activity near -75° and -77°.

The stability of the longitudinal structure of the aurora allow us to estimate its period of rotation to be 10.65 +/- 0.05 h, which is consistent to the SKR period detected by Cassini in 2009. These periods are also close to the rotation period of the lightning storms on Saturn. We will discuss those periodicities and their relation to Saturn's rotation.

1. Introduction

Before Cassini arrival, Saturnian aurora was observed in UV and infrared wavelengths, where the auroral light does not interfere with the daylight. Cassini camera was the first to observe the aurora in visible light. Such observations can only be taken at the night side of Saturn because of the aurora's extremely low signal brightness. Besides being the only visible observations of Saturn's aurora, the images and movies taken by the Cassini camera show the aurora at spatial resolution up to 30 km/pixel, and time resolution of few minutes.

2. Stability and variability

Cassini images of the northern polar region from October 2009 show auroral activity occurring at or near 75°N, though the exact latitude can vary with both time and longitude. The aurora can vary dramatically in brightness over time, brightening from a near quiescent state to a bright auroral arc over timescales as short as 10 minutes.

Besides sudden brightening, the overall auroral structure along the longitude remains remarkably stable on timescales of several days. The northern hemisphere images in 2009 were taken over several Saturn rotations, so it was possible to align the images by longitude over four distinct Saturn days, with the final rotation occurring seven Saturn days after the first (there are gaps in the time coverage). A pattern in the auroral activity can be seen, i.e. the same longitude that is active on one Saturn day is still active over several subsequent rotations of the planet. We matched the longitudes of auroral features observed on consecutive Saturn's rotations to obtain

a rotation rate for the 2009 norhern aurora of 10.65 +/- 0.05 h.

3. Reddish spectrum

Brightness measurements of multi-filter images of the southern hemisphere aurora in 2010 were used to construct a rough spectrum of the auroral emission shown in Fig. 1. The overall spectrum shows a red slope from ~250 to 1000 nm. The confident detection of bright aurora at the H-alpha filter (656nm) is consistent with the line emission obtained in a laboratory-simulated aurora [1].

4. Figures

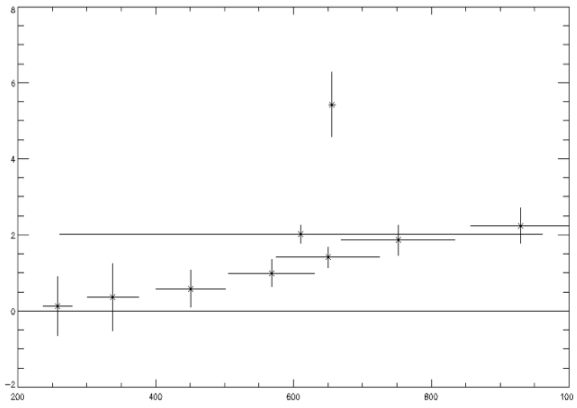

Figure 1: A plot of the brightness of the aurora in Rayleighs/nm (ordinate) at each filter versus the wavelength in nm (abscissa). Horizontal bars at each point show the filter bandwidth, while the vertical lines are RMS error bars

5. Discussion

Because of its high spatial and temporal resolution, movies of Saturn's visible aurora provide an independent measurement for the rotation rate of the aurora-related disturbances in the magnetosphere. This provides additional information about the controversial Saturn's internal rotation period. Other measurements of this period come from Saturn Kilometric Radiation and from the rotation of Saturn's clouds, the recent giant lighting storm in particular. We will compare and discuss the corresponding rotation rates and their possible relation to Saturn's internal rotation.

Acknowledgements

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References

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