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# Spokes in the Saturn's B Ring: Distributions observed by Cassini-VIMS

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## Abstract

Spokes on the Saturn's B ring reappered again straddling the last saturnian equinox (2009, August). Here we report in-progress analysis of spokes in the Cassini/VIMS (*Visual and Infrared Mapping Spectrometer*) data. At this stage we will mainly focus on the distribution of spokes, discussing some observed peculiar features, like longitudinal asymmetry and regular patterns in spoke trains. Implications for spoke dynamics and/or formation models will be discussed.

## 1. Introduction

Spokes on Saturn's rings were first observed in Voyager data in 1981 ([1]). They appear as transient features, often radially elongated, and much more frequently in the morning ansa of the B ring. Their motion, clearly influenced by the corotating magnetic field, implied that spokes are electrically charged dust clouds electrostatically levitated over the ring boulders ([2]). Successive observational campaigns with the Hubble Space Telescope confirmed that spokes appear only close to Saturn's equinox, when the rings are illuminated nearly edge-on ([3]).
Regardless of the phenomena triggering the spokes formation, their observed seasonal behavior may be related to the effect of solar illumination on the density and charge of the plasma near the rings, generated by a balance between photodissociation by solar UV photons and fluxes of magnetospheric particles trapped in the Saturn's dipolar field. The ability of charged dust grains to rise above the ring surface may inversely depend on the photoelectron density in the ring ionosphere, making spoke formation possible only when and where the solar flux incident on the rings is low (i.e. near equinox and in the Saturn' shadow, see e.g. [4]).
Several models have been constructed to describe the dynamical behavior and the physical features of spokes, but a comprehensive theory is still missing. Also, the actual events triggering the spoke formation are poorly constrained and still under debate (meteoric bombardment vs. electron fuxes from lighting, see e.g. [5, 6]).

## 2. Spokes in the VIMS data

The ISS camera onboard Cassini spacecraft succeded in observing spokes on both sides of the B ring starting from late 2005 until the middle of 2010. The VIMS spectrometer began to observe spokes about 3 years after ISS, but its wider spectral range (spanning between 0.35 and 5.1 micron) allowed the first imaging of spokes at infrared wavelengths. Furthermore, the observed, high IR contrast of spokes suggested the presence of a consistent population of micron-sized grains therein ([8]).

Here, we report new VIMS spoke data analysis and the progress with ongoing statistical studies regarding the distribution of spokes in these data. Preliminary results were obtained using different observation sequences with full longitudinal coverage and fixed pointing to the morning ansa, at local times between 3.0 and 7.0. ). They show two main features of the longitudinal spokes' distribution. The first is a longitudinal asymmetry, which makes the spokes more likely to appear in the sector between about 230°and 350°of SystemIII longitudes (fig.1). The second is the appearence of trains of spokes characterised by well-defined, non-random and repeatable patterns of their angular distances (fig.2).

Longitudinal asymmetries in the distribution were already observed by Voyagers I and II ([9]), although the direct comparison of longitudes is affect by the different longitude systems used ([10]). Also Cassini/ISS data analysis seems to confirm some periodicity in the spoke longitudinal distribution, which is possibly correlated to the Saturn Kilometric Radiation period ([7]). On the contrary, regular patterns in spoke trains have

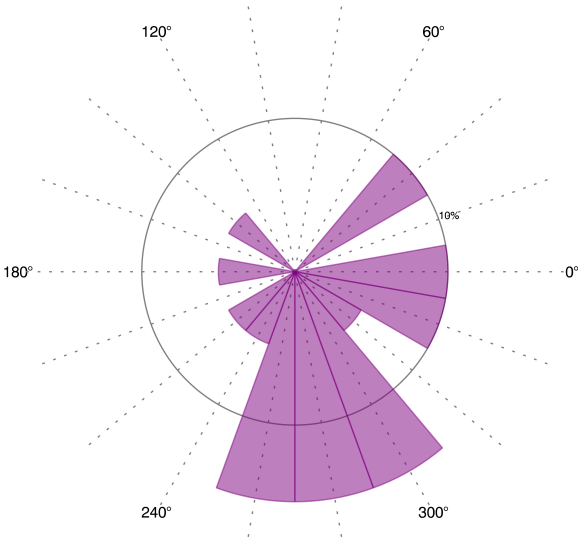


Figure 1: Polar hystogram of spoke longitudes in 20°bins. Spoke positions are obtained from three VIMS observing sequences using fixed-pointing on the morning ansa.

never been reported. If this phenomenon will be confirmed in a wider sample of spokes, some kind of correlation either among consecutive spokes or among the processes triggering their formation should exist, giving stronger constraints on spoke formation and/or dynamics models.

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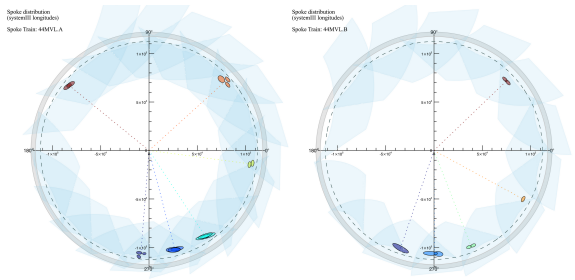

Figure 2: Examples of regular patterns of angular distances in two spoke trains. Light blue areas represent the spatial coverage of the data for each sequence.

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