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IR spectra of Saturn's ring spokes and multiple shines in the Saturn-rings system

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During the last Saturn equinox, in 2009 August, spokes on the Saturn's B ring have been observed for the first time spectroscopically, at visible and infrared wavelengths. Measurements were obtained by Cassini-VIMS (Visual and Infrared Mapping Spectrometer) instrument in the 0.35-5.1 micron range.
Spokes are either dark or bright features appearing on the B ring straddling the equinoxes, round to elongated in shape, lasting for minutes to hours, and moving partially pushed by Saturn's magnetic field. Previous spokes observations date back to the Voyager (1980 equinox,[1]), followed by a HST campaign (1995 equinox,[2]), and more recently Cassini-ISS images (2009 equinox,[3]). Theoretical models of spoke formation and evolution have been developed based on those observations, but there is not unanimous consensus on them. The most spread model considers the spoke as a cloud of very fine particles electrostatically levitating from the regolith of ring's boulders, and hovering on the ring plane while interacting with the ambient plasma until complete charge neutralization. The process triggering the grain charging is not yet clear (meteoroid bombardment, impacts of Saturn's lightnings electrons, etc.) but in any case a very small grain mass (high charge-to-mass ratio) is needed to allow electrostatic repulsion.
From the observational point of view, small grain sizes (0.3-0.5 micron) have been retrieved by modeling the spoke reflectance in the visible spectral range (both Voyager, HST, and Cassini were equipped with multispectral imaging cameras). However, a first VIMS spoke observation ([4]) inferred a more spread size distribution (0.3 to 2.5 microns) to explain the high spoke contrast measured in the infrared.
Here we will report about an analysis of two selected sets of spokes observed by VIMS. This selection aimed to include both high and low phase angle observations, and to take advantage from the highest spatial resolution data achieved in the infrared. We will highlight the importance of including illumination sources other than the Sun in the radiative transfer analysis, namely the Saturn-shine and the ring-shine. Their effect, more evident in the infrared range thanks to the deep water ice and methane bands, may bias the retrieval of spoke's micro-physics depending on the overall geometry of the scene. Possible debiasing and evaluation of consequences for visible retrievals will be illustrated.

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References - [1] Smith et al.,1981,Science,212,163. [2] McGhee et al.,2005,Icarus,173,508. [3] Mitchell et al.,2013,Icarus,225,446. [4] D'Aversa et al.,2010,Geoph.Res.Lett.,37,GL041427.